Sunday, 16-September-2012

16-Sep-12	14:00–19:00	Lobby

14:00 – 19:00 Registration Lobby

16-Sep-12	18:30–20:30	Ballroom

18:30 – 20:30 Welcome Reception Ballroom

Monday, 17-September-2012

08:45 – 08:55 Opening Remarks — J.Y. Tang

08:55 – 09:10 Welcome Address — J.Q. Wang

17-Sep-12	09:10–10:20	Ballroom

MOI1A — Invited Plenary - Session A

Chair: J.Q. Wang (IHEP)

MOI1A01 09:10 **LHC - challenges in handling beams exceeding 100 MJ**
R. Schmidt *(CERN)*

MOI1A02 09:45 **J-PARC Recovery Status**
K. Yamamoto *(JAEA/J-PARC)*

10:20 – 10:50 Coffee

17-Sep-12	10:50–12:35	Ballroom

MOI1B — Invited Plenary - Session B

Chair: W.-T. Weng (BNL)

MOI1B01 10:50 **High Intensity Issues at FAIR**
O.K. Kester *(GSI, IAP)*

MOI1B02 11:25 **Technological Challenges for High-Intensity Proton Rings**
Y. Yamazaki *(FRIB)*

MOI1B03 12:00 **Technical Challenges in Multi-MW Proton linacs**
V.A. Lebedev *(Fermilab)*

12:35 – 14:30 Lunch — *Restaurant »Solid Dining«*

17-Sep-12	14:30–16:15	Ballroom

MOI1C — Invited Plenary - Session C

Chair: W. Chou (Fermilab)

MOI1C01 14:30 **Intense-Beam Issues in CSNS and C-ADS Accelerators**
S. Fu *(IHEP), S.X. Fang, Z. Li, J. Peng, J.Y. Tang, S. Wang, F. Yan (IHEP)*

MOI1C02 15:05 **Challenges in Benchmarking of Simulation Codes against real High Intensity Accelerators**
I. Hofmann *(GSI)*

MOI1C03 15:40 **Beam Loss Mechanisms in High Intensity Facilities**
M.A. Plum *(ORNL)*

16:15 – 16:40 Coffee

16:40 – 18:00 Poster Session — Meeting Room 2

17-Sep-12	16:40–18:00	Meeting Room 2

MOP2 — Poster Session

MOP201 **Undulator Radiation inside a Dielectric Waveguide**
A. Kotanjyan *(YSU), A.A. Saharian (YSU)*

MOP203 **Bunch to Bunch Beam Loss Diagnostics with Diamond Detectors at the LHC**
M. Hempel *(BTU) T. Baer (University of Hamburg) S. Bart Pedersen, B. Dehning, E. Effinger, E. Griesmayer, A. Lechner, R. Schmidt (CERN) W. Lohmann (DESY)*

MOP204 **A Method to Measure the Incoherent Synchrotron Frequencies in Bunches**
O. Chorniy *(GSI), H. Reeg (GSI)*

MOP205 **Intense Heavy-Ion Bunches in Dual-Harmonic RF Systems**
M. Mehler *(GSI), O. Chorniy (GSI) O. Boine-Frankenheim (TEMF, TU Darmstadt) O.K. Kester (IAP)*

MOP206 **Numerical Calculation of Beam Coupling Impedances in the Frequency Domain for the SIS100 synchrotron for FAIR**
U. Niedermayer *(TEMF, TU Darmstadt), O. Boine-Frankenheim (TEMF, TU Darmstadt)*

MOP207 **Planning for Experimental Demonstration of Transverse Emittance Transfer at the GSI UNILAC Through Eigen-emittance Shaping**
C. Xiao *(IAP), O.K. Kester (IAP) L. Groening (GSI)*

MOP209 **High Intensity Proton FFAG Ring with Serpentine Acceleration for ADS**
E. Yamakawa *(Kyoto University, Research Reactor Institute), Y. Ishi, Y. Kuriyama, J.-B. Lagrange, Y. Mori, T. Uesugi (Kyoto University, Research Reactor Institute)*

MOP210 **Beam Stacking for High Intensity Pulsed Proton Beam with FFAG**
Y. Mori *(Kyoto University, Research Reactor Institute), Y. Ishi, Y. Kuriyama, T. Uesugi (Kyoto University, Research Reactor Institute)*

MOP211 **1-MW Beam Operation Scenario in the J-PARC RCS**
H. Hotchi *(JAEA/J-PARC)*

MOP212 **Preliminary Study of HOMs and the Associated Instabilities for C-ADS Linac**
P. Cheng *(IHEP), Z. Li (IHEP)*

MOP213 **Beam Losses due to the Foil Sacttering for CSNS/RCS**
M.Y. Huang *(IHEP), N. Wang, S. Wang, S.Y. Xu (IHEP)*

MOP214 **Test of Ferrite Rings for CSNS/RCS RF Cavities**
H. Shi *(IHEP), X. Li, W. Long, H. Sun, J.Y. Tang (IHEP)*

MOP215 **The Study on Measuring Beta Functions and Phase Advances in the CSNS/RCS**
Y.W. An *(IHEP), S. Wang (IHEP)*

MOP216 **The Design Study on the Longitudinal Beam Dynamics for CSNS/RCS**
N. Wang *(IHEP), M.Y. Huang, Y. Li, S. Wang, S.Y. Xu, Y.S. Yuan (IHEP)*

MOP217 **The MEBT2 Design for the C-ADS**
Z. Guo *(IHEP), H. Geng, Z. Li, J.Y. Tang (IHEP)*

MOP218 **Dynamics of Particles in a Tilted Solenoidal Focusing Channel**
H. Jiang *(IHEP), S. Fu (IHEP)*

MOP219 **Error Analysis and Correction Scheme in C-ADS Injector-I**
C. Meng *(IHEP), Z. Li,* ***C. Meng****, J.Y. Tang (IHEP)*

MOP220 **Compensation-rematch for Major Element Failures in the C-ADS Accelerator**
B. Sun *(IHEP), Z. Li, J.Y. Tang, F. Yan (IHEP)*

MOP221 **Physics Design of the C-ADS Main Linac with Two Different Injector Schemes**
F. Yan *(IHEP), Z. Li, C. Meng, J.Y. Tang (IHEP)*

MOP222 **Development of the Linac Design and Tracking Code PADSC**
Y.L. Zhao *(IHEP), S. Fu, Z. Li (IHEP)*

MOP223 **Radiation Safety System Design for PKUNIFTY Project**
J. Zhao *(PKU/IHIP)*

MOP224 **Physical Design of Quadrupole Magnet in the HEBT of C-ADS with Beam Distribution Transformation**
Y. Liu *(USTC) H.L. Luo, X.Q. Wang (USTC/NSRL)*

MOP225 **Physical Design of Superconducting Bending Magnet in the HEBT of C-ADS with Beam Distribution Transformation**
Y.Y. Lu *(USTC) H.L. Luo, X.Q. Wang (USTC/NSRL)*

MOP226 **Beam Optics Design of 1.5 GeV Transport Line in C-ADS with Beam Distribution Transformation**
H.L. Luo *(USTC/NSRL), X.Q. Wang (USTC/NSRL)*

MOP227 **The Concept Design and Research of the Hurling Magnet in the HEBT of C-ADS**
L. Yang *(USTC), H.J. Liu, Y.N. Zhu (USTC) H.L. Luo, X.Q. Wang (USTC/NSRL)*

MOP228 **The Study of Beam Distribution Transformation by Anti-symmetric Multipole Magnetic Field**
M. Jin *(USTC/NSRL), C.S. Li, L. Li, H.L. Luo, X.Q. Wang, Y. Zhang (USTC/NSRL)*

MOP229 **Design of the C-ADS Injector II MEBT1**
H. Jia *(IMP)*

MOP231 **Study of Non-equi-partitioning Lattice Setting and IBS Effects for J-parc Linac Upgrade**
Y. Liu *(IMP) M. Ikegami (JAEA/J-PARC)*

MOP232 **The Analysis of Stability Optimization for Superconducting Section of C-ADS Injector II**
S.H. Liu *(IMP), Y. He, C. Li, W.S. Wang, Z.J. Wang, X.B. Xu (IMP)*

MOP233 **Error and Tolerance Studies for Injector II of C-ADS**
W.S. Wang *(IMP)*

MOP234 **SSC Linac End-to-end Simulation and Error Analysis Based on the Beampath Code**
X.H. Zhang *(IMP)*

MOP235 **Medium Energy Beam Transport Design Update For ESS**
I. Bustinduy *(ESS Bilbao) B. Cheymol, M. Eshraqi (ESS) J. Stovall (CERN)*

MOP236 **Transverse Beam Profile Diagnostics at the European Spallation Source**
B. Cheymol *(ESS), C. Böhme, H. Hassanzadegan, A. Jansson, T.J. Shea, L. Tchelidze (ESS)*

MOP237 **Overview of the CERN LINAC4 Beam Diagnostic**
B. Cheymol *(ESS) B. Dehning, U. Raich, F. Roncarolo, L. Søby (CERN)*

MOP238 **Beam Position Monitor System of the ESS Linac**
H. Hassanzadegan *(ESS), A. Jansson (ESS) A.J. Johansson (Lund University)*

MOP239 **Batch-by-batch Longitudinal Emittance Blow-up in the LHC**
T. Mastoridis *(CERN), P. Baudrenghien, M. Jaussi, J.C. Molendijk (CERN)*

MOP240 **High Energy Tests of Advanced Materials for Beam Intercepting Devices at CERN HiRadMat Facility**
A. Bertarelli *(CERN), R.W. Assmann, E. Berthome, V. Boccone, F. Carra, F. Cerutti, A. Dallocchio, P. Francon, L. Gentini, M. Guinchard, N. Mariani, A. Masi, P. Moyret, S. Redaelli, S.D.M. dos Santos (CERN) L. Peroni, M. Scapin (Politecnico di Torino)*

MOP241 **An Experiment on Hydrodynamic Tunnelling of the SPS High Intensity Proton Beam at the HiRadMat Facility**
J. Blanco *(CERN), F. Burkart, N. Charitonidis, I. Efthymiopoulos, D. Grenier, C. Maglioni, R. Schmidt, C. Theis, D. Wollmann (CERN) E. Griesmayer (CIVIDEC Instrumentation) N.A. Tahir (GSI)*

MOP242 **Experimental Verification for a Collimator with In-Jaw Beam Position Monitors**
D. Wollmann *(CERN), O. Aberle, R.W. Assmann, A. Bertarelli, C.B. Boccard, R. Bruce, F. Burkart, E. Calvo, M. Cauchi, A. Dallocchio, D. Deboy, M. Gasior, O.R. Jones, V. Kain, L. Lari, A.A. Nosych, S. Redaelli, A. Rossi, G. Valentino (CERN)*

MOP243 **Experimental Results for Beam Halo at IHEP**
H.F. Ouyang *(IHEP), T. Huang, J. Li, J. Peng, T.G. Xu (IHEP)*

MOP244 **CERN High-Power Proton Synchrotron Design Study for LAGUNA-LBNO Neutrino Production**
R. Steerenberg *(CERN), M. Benedikt, I. Efthymiopoulos, F. Gerigk, Y. Papaphilippou (CERN)*

MOP245 **Quench Tests at the LHC with Collimation Losses at 3.5 Z TeV**
S. Redaelli *(CERN)*

MOP246 **A Tool Based on the BPM-interpolated Orbit for Speeding up LHC Collimator Alignment**
G. Valentino *(University of Malta, Information and Communication Technology), N.J. Sammut (University of Malta, Information and Communication Technology) R.W. Assmann, R. Bruce, G.J. Müller, S. Redaelli, B. Salvachua (CERN)*

Monday, 17-September-2012

MOP247 **Beam Stability and Tail Population at SPS Scrapers**
L.N. Drosdal *(CERN), K. Cornelis, B. Goddard, V. Kain, M. Meddahi, Ö. Mete, B. Mikulec, E. Veyrunes (CERN)*

MOP248 **Brightness Evolution for LHC Beams during the 2012 Run**
M. Kuhn *(Uni HH) G. Arduini, J.F. Comblin, A. Guerrero, V. Kain, B. Mikulec, F. Roncarolo, M. Schaumann, R. Steerenberg (CERN)*

MOP249 **Tune Spread Studies at Injection Energies for the CERN Proton Synchrotron Booster**
B. Mikulec *(CERN), V. Raginel, G. Rumolo, G. Sterbini (CERN)*

MOP250 **Colliding High Brightness Beams in the LHC**
T. Pieloni *(CERN), X. Buffat, R. Giachino, W. Herr, G. Papotti (CERN)*

MOP252 **Measurements of the LHC Longitudinal Resistive Impedance with Beam**
J. Esteban Muller *(CERN), T. Argyropoulos, T. Bohl, T. Mastoridis, N. Mounet, G. Papotti, E.N. Shaposhnikova, D. Valuch (CERN)*

MOP253 **Progress with Bunch-Shape Measurements at Cyclotrons and Beam Lines**
R. Dölling *(PSI)*

MOP254 **Design of the Photo Detachment Emittance Instrument for FETS**
C. Gabor *(STFC/RAL/ASTeC) G.E. Boorman, A. Bosco (Royal Holloway, University of London) A.P. Letchford (STFC/RAL) P. Savage (Imperial College of Science and Technology, Department of Physics)*

MOP255 **Acceleration in Vertical Orbit Excursion FFAGs with Edge Focussing**
S.J. Brooks *(STFC/RAL/ASTeC)*

MOP256 **High-Power Scaling FFAG Ring Studies**
D.J. Kelliher *(STFC/RAL/ASTeC), G.H. Rees (STFC/RAL/ASTeC)*

MOP257 **Space Charge Limits on the ISIS Synchrotron Including the Effects of Images**
B.G. Pine *(STFC/RAL/ISIS), C.M. Warsop (STFC/RAL/ISIS)*

MOP258 **Simulation of Intense Proton Beams in Novel Isochronous FFAG Designs**
S.L. Sheehy *(STFC/RAL/ASTeC) M. Berz, K. Makino, P. Snopok (MSU) C. Johnstone (Fermilab)*

MOP259 **Beam Dynamics Studies for a Proposed 800 MeV ISIS Upgrade Linac**
D.C. Plostinar *(STFC/RAL/ASTeC)*

MOP260 **Beam Halo Measurements Using Adaptive Masking Methods and Recent Halo Experiment**
H.D. Zhang *(UMD), B.L. Beaudoin, S. Bernal, R.B. Fiorito, R.A. Kishek, K. Řežaei (UMD)*

MOP261 **A Test Facility for MEIC ERL Circulator Ring Based Electron Cooler Design**
Y. Zhang *(JLAB)*

MOP262 **Observations of Space Charge Effects in the Spallation Neutron Source Accumulator Ring**
R.E. Potts *(ORNL RAD) S.M. Cousineau, J.A. Holmes (ORNL)*

08:45 – 09:00 Announcement Ballroom

18-Sep-12	09:00–10:20	Ballroom

TUO1A — Working Group-A

Chair: G. Franchetti (GSI)

TU01A01 09:00 **The High Intensity/High Brightness Upgrade Program at CERN: Status and Challenges**
S.S. Gilardoni *(CERN), G. Arduini, T. Argyropoulos, S. Aumon, H. Bartosik, E. Benedetto, N. Biancacci, T. Bohl, J. Borburgh, C. Carli, F. Caspers, H. Damerau, J. Esteban Muller, V. Forte, R. Garoby, M. Giovannozzi, B. Goddard, S. Hancock, K. Hanke, A. Huschauer, G. Iadarola, M. Meddahi, G. Métral, B. Mikulec, E. Métral, Y. Papaphilippou, G. Rumolo, B. Salvant, F. Schmidt, E.N. Shaposhnikova, R. Steerenberg, M. Taborelli, H. Timko, M. Vretenar, R. Wasef, C. Yin Vallgren, C. Zannini (CERN) G. Franchetti (GSI) M. Migliorati (University of Rome "La Sapienza") A.Y. Molodozhentsev (J-PARC, KEK & JAEA) S. Persichelli (Rome University La Sapienza) M.T.F. Pivi (SLAC) V.G. Vaccaro (Naples University Federico II, Mathematical, Physical and Natural Sciences Faculty)*

TU01A02 09:20 **Status of Collective Effects at GSI**
O. Boine-Frankenheim *(GSI)*

TU01A03 09:40 **Space Charge Effects in Isochronous FFAGs and Cyclotrons**
T. Planche *(TRIUMF, Canada's National Laboratory for Particle and Nuclear Physics), R.A. Baartman, Y.-N. Rao (TRIUMF, Canada's National Laboratory for Particle and Nuclear Physics)*

TU01A04 10:00 **Plasma Traps for Space Charge Studies: Status and Perspectives**
H. Okamoto *(HU/AdSM), H. Higaki, K. Ito (HU/AdSM) A. Mohri (Kyoto University, Graduate School of Human and Environmental Studies)*

10:20 – 10:50 Coffee

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08:45 – 09:00 Announcement Meeting Room 3

18-Sep-12	09:00–10:20	Meeting Room 3

TUO3A — Working Group-B&C

Chair: D. Raparia (BNL)

TU03A01 09:00 **Dynamical Aspects of Emittance Coupling in Intense Beams**
I. Hofmann *(GSI)* ***I. Hofmann***

TU03A02 09:20 **Status and Results of the UA9 Crystal Collimation Experiment at the CERN-SPS**
S. Montesano *(CERN), W. Scandale (CERN)*

TU03A03 09:40 **Equipartition, Reality or Swindle?**
J.-M. Lagniel *(GANIL)*

10:20 – 10:50 Coffee

Tuesday, 18-September-2012

18-Sep-12	10:50–12:30	Ballroom

TUO1B — Working Group-A&C
Chair: H.W. Zhao (IMP)

TU01B01 10:50 — **Beam Loss Due to Foil Scattering in the SNS Accumulator Ring**
J.A. Holmes *(ORNL), M.A. Plum (ORNL)*

TU01B02 11:10 — **Injection Design for Fermilab Project X**
D.E. Johnson *(Fermilab)*

TU01B03 11:30 — **Study of Intense Beam Injection and Extraction of Heavy Ion Synchrotron**
Y.J. Yuan *(IMP), W.P. Chai, J. Li, P. Li, R.S. Mao, J.W. Xia, J.C. Yang, X.D. Yang, H.W. Zhao (IMP)*

TU01B04 11:50 — **Beam Loss Control for the Fermilab Main Injector**
B.C. Brown *(Fermilab)*

TU01B05 12:10 — **The Design and Commissioning of the Accelerator System of the Rare Isotope Reaccelerator - ReA3 at Michigan State University**
X. Wu *(FRIB), B. Durickovic, M.J. Syphers, W. Wittmer (FRIB) A. Lapierre, D. Leitner, G. Perdikakis, J.A. Rodriguez, S. Schwarz (NSCL)*

12:30 – 14:00 Lunch — *Restaurant »Solid Dining«*

18-Sep-12	10:50–12:30	Meeting Room 3

TUO3B — Working Group-B
Chair: S. Fu (IHEP)

TU03B01 10:50 — **Beam Dynamics Design of ESS Warm Linac**
M. Comunian *(INFN/LNL)*

TU03B02 11:10 — **Beam Dynamics of the ESS Superconducting Linac**
M. Eshraqi *(ESS)*

TU03B03 11:30 — **Linac4 Beam Dynamics and Commissioning Strategy**
J.-B. Lallement *(CERN), G. Bellodi, A.M. Lombardi, P.A. Posocco (CERN)*

TU03B04 11:50 — **End to End Beam Dynamics and Design Optimization for CSNS Linac**
J. Peng *(IHEP), S. Fu, H.C. Liu, X. Yin (IHEP)*

TU03B05 12:10 — **Beam Dynamics of the 13 MeV/50 mA Proton Linac for the Compact Pulsed Hadron Source at Tsinghua University**
Q.Z. Xing *(TUB), C. Jiang, C.-X. Tang, H.Y. Zhang, S.X. Zheng (TUB) X.L. Guan (Tsinghua University) G.H. Li (NUCTECH)*

12:30 – 14:00 Lunch — *Restaurant »Solid Dining«*

18-Sep-12	14:00–16:30	Ballroom

TUO1C — Working Group-E

Chair: R. Doelling (PSI) & N. Hayashi (J-PARC)

TU01C01 14:00 **Recent Developments on High Intensity Beam Diagnostics at SNS.**
W. Blokland *(ORNL)*

TU01C02 14:20 **Online Monitoring System for the Waste Beam in the 3 GeV RCS of J-PARC**
P.K. Saha *(JAEA/J-PARC), H. Harada, S. Hatakeyama, N. Hayashi, H. Hotchi, K. Yamamoto, M. Yoshimoto (JAEA/J-PARC)*

TU01C03 14:40 **The Beam Diagnostics of CSNS**
T.G. Xu *(IHEP)*

15:00 – 15:30 Coffee

TU01C04 15:30 **Detection of 'Unidentified Falling Objects' at LHC**
E. Nebot Del Busto *(CERN), F.V. Day, B. Dehning, E.B. Holzer, A. Lechner, R. Schmidt, J. Wenninger, C. Zamantzas, M. Zerlauth, F. Zimmermann (CERN) T. Baer (University of Hamburg) M. Hempel (BTU)*

TU01C05 15:50 **Measurements and Interpretation of the Betatron Tune Spectra of High Intensity Bunched Beam in the SIS18**
R. Singh *(GSI), O. Boine-Frankenheim, O. Chorniy, P. Forck, W. Kaufmann, P. Kowina, K. Lang (GSI) T. Weiland (TEMF, TU Darmstadt)*

TU01C06 16:10 **Instrumentation Developments and Beam Studies for the Fermilab Proton Improvement Plan Linac Upgrade and New RFQ Front-End**
V.E. Scarpine *(Fermilab), D.S. Bollinger, K.L. Duel, N. Eddy, P.R. Karns, W. Pellico, C.-Y. Tan, R.E. Tomlin (Fermilab)*

16:40 – 18:00 WG-E Discussions R. Doelling (PSI) Ballroom

Tuesday, 18-September-2012

18-Sep-12	14:00–16:30	Meeting Room 3

TUO3C — Working Group-D

Chair: Y. Sato (KEK)

TU03C01 14:00 **Beam Losses at LHC and its Injector**
L. Ponce *(CERN)*

TU03C02 14:20 **FNAL Proton Source High Intensity Operations and Beam Loss Control**
F.G.G. Garcia *(Fermilab), W. Pellico (Fermilab)*

TU03C03 14:40 **Characterizing and Controlling Beam Losses at the LANSCE Facility**
L. Rybarcyk *(LANL)*

15:00 – 15:30 Coffee

TU03C04 15:30 **Beam Loss Mitigation in the Oak Ridge Spallation Neutron Source**
M.A. Plum *(ORNL)*

TU03C05 15:50 **Beam Commissioning Plan for CSNS Accelerators**
S. Wang *(IHEP), S. Fu, H.C. Liu, H.F. Ouyang, J. Peng, T.G. Xu (IHEP)*

TU03C06 16:10 **The Result of Beam Commissioning in J-PARC 3-GeV RCS**
H. Harada *(JAEA/J-PARC), N. Hayashi, H. Hotchi, M. Kinsho, P.K. Saha, Y. Shobuda, F. Tamura, K. Yamamoto, M. Yamamoto, M. Yoshimoto (JAEA/J-PARC) Y. Irie (KEK) S. Kato (Tohoku University, Graduate School of Science)*

16:40 – 18:00 WG-D Discussions R. Schmidt (CERN) Meeting Room 3

08:45 – 09:00 Announcement Ballroom

19-Sep-12	09:00–10:20	Ballroom

WEO1A — Working Group-A

Chair: E. Métral (CERN)

WEO1A01 09:00 **Impedance Studies of 2D Azimuthally Uniform Devices for low Energy Machines**
N. Biancacci *(CERN), E. Métral, B. Salvant (CERN) M. Migliorati, L. Palumbo (URLS) V.G. Vaccaro (Naples University Federico II and INFN)*

WEO1A02 09:20 **LHC Impedance Model: Experience with High Intensity Operation in the LHC**
B. Salvant *(CERN), O. Aberle, G. Arduini, R.W. Assmann, V. Baglin, M.J. Barnes, P. Baudrenghien, A. Bertarelli, C. Bracco, R. Bruce, F. Carra, F. Caspers, G. Cattenoz, S.D. Claudet, H.A. Day, J. Esteban Muller, M. Garlasché, L. Gentini, B. Goddard, A. Grudiev, B. Henrist, S. Jakobsen, G. Lanza, L. Lari, T. Mastoridis, N. Mounet, E. Métral, A.A. Nosych, J.L. Nougaret, A.M. Piguiet, S. Redaelli, F. Roncarolo, G. Rumolo, B. Salvachua, M. Sapinski, E.N. Shaposhnikova, L.J. Tavian, M.A. Timmins, J.A. Uythoven, A. Vidal, R. Wasef, D. Wollmann (CERN) S. Persichelli (Rome University La Sapienza)*

WEO1A03 09:40 **Resistive-wall Instability in the CSNS/RCS**
L. Huang *(IHEP), Y.D. Liu, S. Wang (IHEP)*

WEO1A04 10:00 **Review of Longitudinal Instabilities in the SPS and Beam Dynamics Issues with High Harmonic RF Systems in Accelerators**
E.N. Shaposhnikova *(CERN), T. Argyropoulos, T. Bohl, J. Esteban Muller, H. Timko (CERN)*

10:20 – 10:50 Coffee

Wednesday, 19-September-2012

08:45 – 09:00 Announcement Meeting Room 3

19-Sep-12	09:00–10:20	Meeting Room 3

WEO3A — Working Group-C

Chair: H.W. Zhao (IMP)

WEO3A01 09:00 **High Energy Electron Cooling**
V.B. Reva *(BINP SB RAS), M.I. Bryzgunov, V.M. Panasyuk, V.V. Parkhomchuk (BINP SB RAS)*

WEO3A02 09:20 **Beam Loss and Collimation in the ESS Linac**
R. Miyamoto *(ESS), H. Danared, M. Eshraqi, A. Ponton, L. Tchelidze (ESS) I. Bustinduy (ESS Bilbao) H.D. Thomsen (ISA)*

WEO3A03 09:40 **Extraction, Transport and Collimation of the PSI 1.3 MW Proton Beam**
D. Reggiani *(PSI)*

WEO3A04 10:00 **Current and Planned High Proton Flux Operations at the FNAL Booster**
F.G.G. Garcia *(Fermilab), W. Pellico (Fermilab)*

10:20 – 10:50 Coffee

19-Sep-12	10:50–12:30	Ballroom

WEO1B — Working Group-A

Chair: E. Métral (CERN)

WEO1B01 10:50 **Low Gamma Transition Optics for the SPS Simulation and Experimental Results for High Brightness Beams**
H. Bartosik *(CERN), G. Arduini, T. Argyropoulos, T. Bohl, K. Cornelis, J. Esteban Muller, W. Höfle, Y. Papaphilippou, G. Rumolo, B. Salvant, F. Schmidt, E.N. Shaposhnikova, H. Timko (CERN) A.Y. Molodozhentsev (KEK)*

WEO1B02 11:10 **Optics Design Optimization for IBS Dominated Beams**
F. Antoniou *(CERN), Y. Papaphilippou (CERN) M.T.F. Pivi (SLAC)*

WEO1B03 11:30 **Space Charge Suppression for Flat Beams**
A.V. Burov *(Fermilab) Y.S. Derbenev (JLAB)*

WEO1B04 11:50 **Scaling Properties of Resonance Crossing in Non-scaling FFAGs**
S.-Y. Lee *(Indiana University) K.Y. Ng (Fermilab)*

WEO1B05 12:10 **PTC-ORBIT Studies for the CERN LHC Injectors Upgrade Project**
A.Y. Molodozhentsev *(KEK) G. Arduini, H. Bartosik, E. Benedetto, C. Carli, M. Fitterer, V. Forte, S.S. Gilardoni, M. Martini, E. Métral, F. Schmidt, R. Wasef (CERN)*

12:30 – 14:00 Lunch *Restaurant »Solid Dining«*

19-Sep-12	10:50–12:30	Meeting Room 3

WEO3B — Working Group-B

Chair: P.A.P. Nghiem (CEA/DSM/IRFU)

WEO3B01 10:50 **FRIB Accelerator Beam Dynamics Design and Challenges**
Q. Zhao *(NSCL) A. Facco, F. Marti, E. Pozdeyev, M.J. Syphers, J. Wei, X. Wu, Y. Yamazaki, Y. Zhang (FRIB)*

WEO3B02 11:10 **Acceleration and Transport of Multi-Charges Ions through EBIS Pre-injector**
D. Raparia *(BNL)*

WEO3B03 11:30 **PXIE at FNAL**
N. Solyak *(Fermilab), S.D. Holmes, V.A. Lebedev, S. Nagaitsev, A.V. Shemyakin (Fermilab)*

WEO3B04 11:50 **RFQ Beam Dynamics Design for Large Science Facilities and Accelerator-Driven Systems**
C. Zhang *(IAP)*

WEO3B05 12:10 **Using Step-like Nonlinear Magnets for Beam Uniformization at IFMIF Target**
Z. Yang *(IHEP), J.Y. Tang (IHEP) N. Chauvin, P.A.P. Nghiem (CEA/DSM/IRFU)*

12:30 – 14:00 Lunch *Restaurant »Solid Dining«*

Wednesday, 19-September-2012

19-Sep-12	14:00–16:30	Ballroom
	WEO1C — Working Group-A	
	Chair: J.A. Holmes (ORNL)	

WEO1C01 14:00 — **Effect of Self-consistency on Periodic Resonance Crossing**
G. Franchetti *(GSI)*

WEO1C02 14:20 — **Simulation and Measurement of Half Integer Resonance in Coasting Beams in the ISIS Ring, with a Summary of Some Related High Intensity Effects.**
C.M. Warsop *(STFC/RAL/ISIS), D.J. Adams, B. Jones, S.J. Payne, B.G. Pine, H. V. Smith, R.E. Williamson (STFC/RAL/ISIS)*

WEO1C03 14:40 — **Longitudinal Beam Loss Studies of the CERN PS-to-SPS Transfer**
H. Timko *(CERN), T. Argyropoulos, T. Bohl, H. Damerau, J. Esteban Muller, S. Hancock, E.N. Shaposhnikova (CERN)*

15:00 – 15:30 Coffee

WEO1C04 15:30 — **Acceleration of High-Intensity Protons in the J-PARC Synchrotrons**
M. Yoshii *(KEK)*

WEO1C05 15:50 — **Longitudinal Space Charge Phenomena in an Intense Beam in a Ring**
R.A. Kishek *(UMD), B.L. Beaudoin, D.W. Feldman, I. Haber, T.W. Koeth, Y. Mo (UMD)*

WEO1C06 16:10 — **Measurement and Strong-Strong Simulations of Beam-Beam Effects in LHC**
S. Paret *(LBNL), J. Qiang (LBNL) R. Alemany-Fernandez, R. Calaga, R. Giachino, W. Herr, D. Jacquet, G. Papotti, T. Pieloni, L. Ponce, M. Schaumann (CERN) R. Miyamoto (ESS)*

18:00 Leaving for Banquet

18:30 Banquet — Restaurant »Grand Mansion«, Beijing

19-Sep-12	14:00–16:30	Meeting Room 3

WEO3C — Working Group-C

Chair: D. Li (LBNL) & N.V. Mokhov (FNAL)

WEO3C01 14:00 **Injection and Stripping Foil Studies for a 180 MeV Injection Upgrade at ISIS**
B. Jones *(STFC/RAL/ISIS), D.J. Adams, M.C. Hughes, S.J.S. Jago, B.G. Pine, H. V. Smith, C.M. Warsop, R.E. Williamson (STFC/RAL/ISIS)*

WEO3C02 14:20 **Collimation of Ion Beams**
I. Strašík *(GSI) O. Boine-Frankenheim (TEMF, TU Darmstadt)*

WEO3C03 14:40 **Beam Halo Dynamics and Control with Hollow Electron Beams**
G. Stancari *(Fermilab)*

15:00 – 15:30 Coffee

WEO3C04 15:30 **Long Baseline Neutrino Experiment (LBNE) Target Material Radiation Damage Studies Using Energetic Protons of the Brookhaven Linear Isotope Production (BLIP) Facility**
N. Simos *(BNL) P. Hurh, N.V. Mokhov (Fermilab)*

WEO3C05 15:50 **Radiation Effect Modeling at Intensity Frontier: Status and Uncertainties**
N.V. Mokhov *(Fermilab)*

WEO3C06 16:10 **Understanding Ion Induced Radiation Damage in Target Materials**
M. Tomut*, C. Trautmann (GSI)*

16:30 – 18:00	WG-C Discussions	N. Mokhov (FNAL)	Ballroom
18:00	Leaving for Banquet		
18:30	Banquet	Restaurant »Grand Mansion«, Beijing	

Thursday, 20-September-2012

08:45 – 09:00 Announcement — Ballroom

20-Sep-12	09:00–10:20	Ballroom

THO1A — Working Group-A

Chair: G. Franchetti (GSI)

TH01A01 09:00 — **Beam-Beam Effects in RHIC**
Y. Luo *(BNL), W. Fischer, C. Montag, S.M. White (BNL)*

TH01A02 09:20 — **Effects of Magnetic Field Tracking Errors and Space Charge on Beam Dynamics at CSNS/RCS**
S.Y. Xu *(IHEP), N. Wang, S. Wang (IHEP)*

TH01A03 09:40 — **Dual-Harmonic Acceleration Studies at CSNS RCS**
J.F. Chen *(IHEP), J.Y. Tang, X. Zhang (IHEP)*

TH01A04 10:00 — **High Intensity Longitudinal Dynamics Studies for an ISIS Injection Upgrade**
R.E. Williamson *(STFC/RAL/ISIS), C.M. Warsop (STFC/RAL/ISIS)*

10:20 – 10:50 Coffee

08:45 – 09:00 Announcement — Meeting Room 3

20-Sep-12	09:00–10:20	Meeting Room 3

THO3A — Working Group-B

Chair: I. Hofmann (GSI)

TH03A01 09:00 — **High Intensity Aspects of J-PARC Linac, Including Re-commissioning After Earthquake**
M. Ikegami *(KEK)*

TH03A02 09:20 — **Beam Dynamics of China ADS Linac**
Z. Li *(Private Address) P. Cheng, H. Geng, Z. Guo, C. Meng, B. Sun, J.Y. Tang, F. Yan (IHEP)*

TH03A03 09:40 — **Simulations and Measurements in High Intensity LEBT with Space Charge Compensation**
N. Chauvin *(CEA/IRFU) O. Delferrière, R. Gobin, P.A.P. Nghiem, D. Uriot (CEA/DSM/IRFU) R.D. Duperrier (ESS)*

TH03A04 10:00 — **Definition of the Beam Halo and its Consequences**
P.A.P. Nghiem *(CEA/DSM/IRFU), N. Chauvin, D. Uriot (CEA/DSM/IRFU) W. Simeoni (CEA/IRFU)*

10:20 – 10:50 Coffee

20-Sep-12	10:50–12:30	Ballroom

THO1B — Working Group-A

Chair: G. Franchetti (GSI)

THO1B01 10:50 **A Quest for a Superior Ion Beam for a High Luminosity Electron-Ion Collider**
Y. Zhang *(JLAB)*

THO1B02 11:10 **Test of Optical Stochastic Cooling in Fermilab**
V.A. Lebedev *(Fermilab)*

THO1B03 11:30 **Measurement of Optics Errors and Space Charge Effect**
K. Ohmi *(KEK), Y. Sato, J. Takano (KEK) S. Hatakeyama (JAEA/J-PARC)*

THO1B04 11:50 **Space Charge Effects in the NICA Collider Rings**
O.S. Kozlov *(JINR), S.A. Kostromin, I.N. Meshkov, A.O. Sidorin, A.V. Smirnov, G.V. Trubnikov (JINR) A.V. Eliseev (JINR/VBLHEP) T. Katayama (GSI)*

THO1B05 12:10 **Broad-band Transverse Feedback Against e-cloud or TMCI: Plan and Status**
C.H. Rivetta *(SLAC)*

12:30 – 14:00 Lunch — *Restaurant »Solid Dining«*

20-Sep-12	10:50–12:30	Meeting Room 3

THO3B — Working Group-C

Chair: D. Li (LBNL)

THO3B01 10:50 **Proton Beam Inter-Bunch Extinction and Extinction Monitoring for the Mu2e Experiment**
E. Prebys *(Fermilab)*

THO3B02 11:10 **SRF Technology Challenge and Development**
A. Facco *(INFN/LNL)*

THO3B03 11:30 **SRF Cavity Research for Project X**
R.D. Kephart *(Fermilab)*

THO3B04 11:50 **Beam Dynamics Studies of H^- Beam Chopping in a LEBT for Project X**
Q. Ji *(LBNL), D.P. Grote, A.R. Lambert, D. Li, T. Schenkel, J.W. Staples (LBNL)*

THO3B05 12:10 **Intense High Charge State Heavy Ion Beam Production for the Advanced Accelerators**
L.T. Sun *(IMP)*

12:30 – 14:00 Lunch — *Restaurant »Solid Dining«*

Thursday, 20-September-2012

20-Sep-12	14:00–16:30	Ballroom

THO1C — Working Group-D

Chair: M.A. Plum (LANL)

TH01C01 14:00 **High Intensity Operation and Controlling Beam Losses in a Cyclotron Based Accelerator**
M. Seidel *(PSI), J. Grillenberger, A.C. Mezger (PSI)*

TH01C02 14:20 **Beam Loss Control in the ISIS Accelerator Facility**
D.J. Adams *(STFC/RAL/ISIS), B. Jones, S.J. Payne, B.G. Pine, H. V. Smith, C.M. Warsop, R.E. Williamson (STFC/RAL/ISIS)*

TH01C03 14:40 **Collimation Experience at the LHC**
S. Redaelli *(CERN)*

TH01C04 15:30 **Performances and Future Plans of the LHC RF**
P. Baudrenghien *(CERN), T. Mastoridis (CERN)*

TH01C05 15:50 **Status and Beam Commissioning Plan of PEFP 100-MeV Proton Linac**
J.-H. Jang *(KAERI), S. Cha, Y.-S. Cho, D.I. Kim, H.S. Kim, H.-J. Kwon, Y.M. Li, B.-S. Park, J.Y. Ryu, K.T. Seol, Y.-G. Song, S.P. Yun (KAERI)*

TH01C06 16:10 **Recent Commissioning of High-Intensity Proton Beams in J-PARC Main Ring**
Y. Sato *(KEK), K. Hara, Y. Hashimoto, Y. Hori, S. Igarashi, K. Ishii, N. Kamikubota, T. Koseki, K. Niki, K. Ohmi, C. Ohmori, M. Okada, M. Shimamoto, M.J. Shirakata, T. Sugimoto, J. Takano, M. Tejima, T. Toyama, M. Uota, S. Yamada, N. Yamamoto (KEK) S. Hatakeyama, H. Hotchi, F. Tamura (JAEA/J-PARC) S. Nakamura, K. Satou (J-PARC, KEK & JAEA)*

20-Sep-12	16:50–18:00	Ballroom

THO1D — Working Group-A

Chair: J.A. Holmes (ORNL)

TH01D01 16:50 **Fully 3D Long-term Simulation of the Coupling Resonance Experiments at the CERN PS**
J. Qiang *(LBNL), R.D. Ryne (LBNL) G. Franchetti, I. Hofmann (GSI) E. Métral (CERN)*

17:10 – 18:00 WG-A Discussions J. Holmes (ORNL) Ballroom

20-Sep-12	14:00–16:30	Meeting Room 3

THO3C — Working Group-E

Chair: V.E. Scarpine (Fermilab) & N. Hayashi (J-PARC)

THO3C01 14:00 **Optical Transition Radiation for Non-relativistic Ion Beams**
B. Walasek-Höhne *(GSI), C.A. Andre, F. Becker, P. Forck, A. Reiter, M. Schwickert, R. Singh (GSI) A.H. Lumpkin (Fermilab)*

THO3C02 14:20 **Momentum Spread Determination of Linac Beams Using Incoherent Components of the Bunch Signals**
P. Kowina *(GSI), P. Forck, M. Schwickert (GSI) F. Caspers (CERN)*

THO3C03 14:40 **Beam Induced Fluorescence - Profile Monitoring for Targets and Transport**
F. Becker *(GSI), C.A. Andre, C. Dorn, P. Forck, R. Haseitl, B. Walasek-Höhne (GSI) T. Dandl, T. Heindl, A. Ulrich (TUM/Physik)*

THO3C04 15:30 **Longitudinal Beam Diagnosis with RF Chopper System**
T. Maruta *(JAEA/J-PARC) M. Ikegami (KEK)*

THO3C05 15:50 **Fiber Based BLM System R&D at CERN**
E.B. Holzer *(CERN), J.W. van Hoorne (CERN) S. Mallows (The University of Liverpool)*

THO3C06 16:10 **On-line Calibration Schemes for RF-based Beam Diagnostics**
P.-A. Duperrex *(PSI), U. Müller (PSI)*

16:50 – 18:00 WG-B Discussions D. Raparia (BNL) Meeting Room 3

Friday, 21-September-2012

08:45 – 09:00 Announcement — Ballroom

21-Sep-12	09:00–10:15	Ballroom
	FRO1A — Working group summaries	
	Chair: C. Zhang (IHEP)	

WG-A 09:00 — **Working Group Summary**
WG-A

WG-B 09:25 — **Working Group Summary**
WG-B

WG-C 09:50 — **Working Group Summary**
WG-C

10:15 – 10:45 Coffee

21-Sep-12	10:45–11:45	Ballroom
	FRO1B — Working group summaries & Closing	
	Chair: C. Zhang (IHEP)	

WG-D 10:45 — **Working Group Summary**
WG-D

WG-E 11:10 — **Working Group Summary**
WG-E

Close 11:35 — **Closing Remarks**
J.Y. Tang (IHEP)

11:45 – 13:30 Lunch — *Restaurant »Solid Dining«*

13:35 – 13:50 Transport to IHEP

14:00 – 16:00 IHEP Tour — IHEP

16:00 Departure from IHEP

Contents

17-Sep-12 09:10 – 10:20	Oral	Ballroom

MOI1A — Invited Plenary - Session A

Chair: J.Q. Wang (IHEP)

Plenary

MOI1A01 09:10 **LHC - challenges in handling beams exceeding 100 MJ** – ***R. Schmidt*** *(CERN)*

The Large Hadron Collider (LHC) at CERN operates at 4 TeV with high intensity beams, with bunch intensities exceeding the nominal value by several 10 %. The energy stored in each beams is beyond 130 MJ, less than a factor of three from the nominal value at 7 TeV. With these parameters, operation entered into a regime where various effects due to high intensity bunches are observed (instabilities, beam-beam effects, e-cloud effects). The highly efficient collimation system limits beam losses that threaten to quench superconducting magnets. The correct functioning of the machine protection systems is vital during the different operational phases, where already a small fraction of the stored energy is sufficient to damage accelerator equipment or experiments in case of uncontrolled beam loss. Safe operation in presence of such high intensity proton beams is guaranteed by the interplay of many different systems: beam dumping system, beam interlocks, beam instrumentation, equipment monitoring, collimators and absorbers. The experience gained with the key systems of LHC machine protection and collimation will be discussed.

MOI1A02 09:45 **J-PARC Recovery Status** – ***K. Yamamoto*** *(JAEA/J-PARC)*

J-PARC facilities were seriously damaged by the Great East Japan Earthquake in March 2011, but all facilities resumed a beam operation from December 2012. We report the operation status of J-PARC accelerators after the earthquake.

17-Sep-12 10:50 – 12:35	Oral	Ballroom

MOI1B — Invited Plenary - Session B

Chair: W.-T. Weng (BNL)

Plenary

MOI1B01 10:50 **High Intensity Issues at FAIR** – ***O.K. Kester*** *(GSI, IAP)*

The facility for antiproton and ion research - FAIR - will produce secondary beams of unprecedented intensities. In order to produce such intense secondary beams and to provide intense beams for the CBM and APPA collaboration, primary heavy ion beams of highest intensities will be required. The main driver accelerator of FAIR will be the SIS100 synchrotron. The GSI heavy ion accelerator facility will be the injector of ion beams for SIS100. In order to reach the final intensities above 10^{11} ions per cycle, the injector chain has to be modified accordingly and the SIS100 has to be tailored to the needs. Therefore an intensity upgrade program of the GSI accelerator facility has been started, which comprises improvements of ion sources, of the injector linacs and of the heavy ion synchrotron SIS18. In addition, high energy beam transport and the SIS100 need to have a dedicated design, in order to handle beam losses. The issues of the upgrade programme and of the SIS100 design will be addressed.

MOI1B02 11:25 **Technological Challenges for High-Intensity Proton Rings** – ***Y. Yamazaki*** *(FRIB)*

High-intensity, pulsed proton accelerators have been and will be requested by a wide variety of scientific fields and industrial and medical applications, for example, pulsed spallation neutron sources and neutrino sources. We will focus our discussion on the proton rings with a pulse length of a few μsec and a beam power of MW. These accelerators may be used for boosting injectors to higher-energy accelerators, like a neutrino factories. At first, we will discuss on the space-charge force which limit the stored charges in a ring together with the negative-ion injection scheme. The pulsed spallation neutron sources are classified into two schemes. One is the combination of a full-energy linac and an accumulation ring (AR) exemplified by SNS and LANSCE. The other is that of a low-energy linac and a Rapid-Cycle Synchrotron (RCS) exemplified by J-PARC RCS and ISIS. In general, pros and cons of accelerator schemes are dependent upon the technological development results. Pros and cons of AR versus RCS will be discussed on the basis of recent technological developments and beam experiment data together with the future perspectives for MW-class machines.

MOI1B03 12:00 **Technical Challenges in Multi-MW Proton linacs** – ***V.A. Lebedev*** *(Fermilab)*

The intensity frontier research is an important part of modern elementary particle physics. It uses proton beams to create secondary beams consisting of, but not necessary limited to, neutrinos, muons, kaons and neutrons. Deferent experiments require different time structure of proton beams but all of them require the beam power of about or exceeding 1 MW. In addition, powerful proton linacs can find an application in accelerator driven nuclear reactors and transmutation of radioactive waste. Recent advances in the superconducting RF technology make a multi-MW power level economically acceptable. This paper discusses main physics and technical limitations determining ultimate parameters of such accelerators, their structure and performance.

September 17

17-Sep-12 14:30 – 16:15	Oral	Ballroom

MOI1C — Invited Plenary - Session C

Chair: W. Chou (Fermilab)

Plenary

MOI1C01 14:30 **Intense-Beam Issues in CSNS and C-ADS Accelerators** – ***S. Fu*** *(IHEP), S.X. Fang, Z. Li, J. Peng, J.Y. Tang, S. Wang, F. Yan (IHEP)*

In 2011 construction of two intense-beam accelerators were launched for China Spallation Neutron Source (CSNS) project and China Accelerator Driven System (C-ADS) project. CSNS uses a pulsed accelerator with an H^- linac and a rapid cycling synchrotron, and C-ADS has a CW proton linac with superconducting cavities. In both cases, the beam power is high and beam loss control is a key issue in beam dynamics. Beam emittance growth and beam halo formation must be carefully studied in beam dynamics and well controlled in machine design. This paper will present a brief introduction to the physics design of the two intense-beam accelerators, especially on the issue of beam instability. In their linac design equapartitioning focusing scheme is adopted to avoid coupling instability. Some beam halo formation experimental results due to mismatching will be compared with simulations. Beam halo generation due to the quench of superconducting cavity and magnet is investigated in detail and compensation scheme is also proposed. Beam loss study for the error effects and orbit correction will be presented.

MOI1C02 15:05 **Challenges in Benchmarking of Simulation Codes against real High Intensity Accelerators** – ***I. Hofmann*** *(GSI)*

Benchmarking of simulation codes for linear or circular accelerators involves several levels of complexity, which will be revisited and discussed in this talk. As ultimate goal of benchmarking it is hoped that a predictive capacity and a practical control over emittance growth and/or beam loss can be obtained. We first give some examples of how simulation codes can be used to gain as much understanding of the underlying physics mechanisms as possible, which is an almost inevitable first step. With more and more experimental data from running high intensity accelerators having become available in recent years more questions need to be raised: Besides the proper physics, can we feed our codes with an accurate enough model of the real machine? What actually is the required accuracy, and does a specific accelerator have enough diagnostics to enable this accuracy? In the paper we explore these questions by discussing several examples of benchmarking efforts, their achievements as well as the limits and difficulties that have been encountered.

MOI1C03 15:40 **Beam Loss Mechanisms in High Intensity Facilities** – ***M.A. Plum*** *(ORNL)*

In the present operation of the Oak Ridge Spallation Neutron Source, 60 Hz, 825 μs H^-- beam pulses are accelerated to 910 MeV, and then compressed to less than a microsecond in the storage ring, to deliver 1 MW of beam power to the spallation target. The beam loss in the superconducting portion of the linac is higher than expected, and it has shown a surprising counter-intuitive correlation with quadrupole magnetic fields, with a loss minimum occurring when the quadrupoles are set to approximately half their design values. This behavior can now be explained by a recent set of experiments that show the beam loss is primarily due to intra-beam stripping. Beam halo is another important beam loss contributor, and collimation in the 2.5 MeV Medium Energy Beam Transport has proven to be an effective mitigation strategy. In this presentation, we will summarize these and other beam loss mechanisms that are important for 1 MW operations, and the methods used to mitigate the losses.

17-Sep-12 16:40 – 18:00	Poster	Meeting Room 2

MOP2 — Poster Session

Beam Dynamics in High-intensity Circular Machines

MOP201 **Undulator Radiation inside a Dielectric Waveguide** – ***A. Kotanjyan*** *(YSU), A.A. Saharian (YSU)*

We investigate the radiation from a charge moving along a helical trajectory around a dielectric cylinder immersed in a homogeneous medium. The radiation intensity in the exterior medium at large distances from the cylinder has been considered previously and here we are mainly concerned with the radiation propagating inside the cylinder. The expressions for the bound modes of the radiation field are derived in both interior and exterior regions. We investigate the relative contributions of the bound modes and the modes propagating at large distances from the cylinder to the total radiation intensity. Numerical examples are given for a dielectric cylinder in the vacuum. It is shown that the presence of the cylinder can lead to the considerable increase of the radiation intensity. The radiated energy inside the cylinder is redistributed among the cylinder modes and, as a result, the corresponding spectrum differs significantly from the homogeneous medium or free-space results. The radiation emitted on the waveguide modes propagates inside the cylinder and the waveguide serves as a natural collector for the radiation.

Beam Dynamics in High-intensity Linacs

MOP202 **Thermal effects in the transport of initially inhomogeneous beams** – ***R. Pakter*** *(IF-UFRGS), A. Endler, F.B. Rizzato, E.G. Souza (IF-UFRGS)*

We investigate the role of the temperature in the onset of singularities and the consequent breakdown of the fluid description in the transport of continuous, intense, inhomogeneous charged particle beams. In the cold beam limit, this system is shown to present wave breaking which is responsible for particle ejection from the beam core and formation of halo. Here, we develop a Lagrangian fluid model for the beam evolution that incorporates thermal effects using an adiabatic approximation. It is found that below a certain temperature threshold a different type of singularity that is responsible for the breakdown of the fluid description is present. Namely, a singular growth of the pressure gradient. As the threshold temperature is approached, however, the time for the occurrence of the singularity diverges and is found to be absent above it. In other words, the fluid model predicts the existence of a critical temperature that separates two different dynamical phases: a nonadiabatic transport at lower temperatures and a completely adiabatic evolution at higher temperatures. These findings are verified with the aid of self-consistent N-particle simulations.

MOP203 **Bunch to Bunch Beam Loss Diagnostics with Diamond Detectors at the LHC** – ***M. Hempel*** *(BTU) T. Baer (University of Hamburg) S. Bart Pedersen, B. Dehning, E. Effinger, E. Griesmayer, A. Lechner, R. Schmidt (CERN) W. Lohmann (DESY)*

A main challenge in the operation with high luminosity beams is managing beam losses that risk to quench magnets or even damage equipment. There are various sources of beam losses, such as losses related to injection, due to beam instabilities and UFOs (Unidentified Falling Objects). Mostly surprising in the first years of LHC operation was the observation of UFOs. They are believed to be dust particles with a typical size of 1-100 um, which lead to beam losses with a duration of about ten revolutions when they fall into the beam. 3600 BLMs (Beam Loss Monitors) are installed around the LHC ring, allowing to determinate the accurate location of UFOs. The time resolution of the BLMs is 40 μs (half a turn revolution). A measurement of the beam losses with a time resolution better than the bunch spacing of 50 ns is crucial to understand loss mechanisms. Diamond sensors are able to provide such diagnostics and perform particle counting with ns time resolution. In this paper, we present measurements of various types of beam losses (in particular UFOs) with diamond detectors. We also compare measurements of UFO induced beam losses around the LHC ring with results from MadX simulations.

MOP204 **A Method to Measure the Incoherent Synchrotron Frequencies in Bunches** – ***O. Chorniy*** *(GSI), H. Reeg (GSI)*

The method of measuring the incoherent synchrotron frequencies in a stationary bunch is presented. It can be shown that by measuring the local current at a fixed coordinate in RF bucket the corresponding incoherent synchrotron frequency can be obtained. Test calculations were done using simulation data where beam loading and space charge were included. The incoherent frequencies obtained with method are in a good agreement with theory. In real experiment, the incoherent frequencies were determined from bunch profiles recorded in the SIS18 with low intensity beam at injection energy. Bunch profiles were measured with a new Fast Current Transformer which has a relatively broad frequency range. The profiles were recorded using 8 bit resolution oscilloscope. The frequency spectra of local current fluctuation at different longitudinal positions were obtained numerically. The strongest lines in these spectra were at positions of theoretically expected incoherent frequencies. In this paper the method is described in details, the comparison of incoherent frequencies obtained from the simulation and measurement data with theoretical solutions is shown.

MOP205 **Intense Heavy-Ion Bunches in Dual-Harmonic RF Systems** – ***M. Mehler*** *(GSI), O. Chorniy (GSI) O. Boine-Frankenheim (TEMF, TU Darmstadt) O.K. Kester (IAP)*

For the synchrotron's SIS-18 and SIS-100 (FAIR) a dual-harmonic RF system with the harmonic numbers h1=2, h2=4 and h1=10, h2=20 respectively is planned. Such systems flatten the bunch form and increase the bunching factor Bf therefore reducing the transverse space charge force. For high currents cavity beam loading and potential-well distortion will deform the flattened bunch shape and lead to phase shifts. Optimized settings for the difference between the two RF phases and for the synchronous phase of the main RF harmonic are an option to reduce these effects. In this contribution we will analyse further aspects of the matched bunch distribution, possible instabilities of the obtained distribution will be discussed and results of machine experiments in SIS-18 will be presented.

MOP206 **Numerical Calculation of Beam Coupling Impedances in the Frequency Domain for the SIS100 synchrotron for FAIR** – ***U. Niedermayer*** *(TEMF, TU Darmstadt), O. Boine-Frankenheim (TEMF, TU Darmstadt)*

The transverse impedance of kicker magnets is considered to be one of the main beam instability sources in the projected SIS-100 at FAIR and also in the SPS at CERN. The longitudinal impedance can contribute to the heat load, which is especially a concern in the cold sections of SIS-100 and LHC. In the high frequency range, time domain codes are commercially available to calculate the impedance but they become inapplicable at medium and low frequencies. We present the ongoing work of developing a Finite Integration (FIT) solver in frequency domain which is based on the Parallel and Extensible Toolkit for Scientific computing (PETSc) framework in C++. The code is applied to an inductive insert used to compensate the longitudinal space charge impedance in low energy machines. Another application focuses on the impedance contribution of a ferrite kicker with inductively coupled pulse forming network (PFN) and frequency dependent complex material permeability. In future we plan to confirm our simulations with dedicated wire or coil bench measurements.

Accelerator System Design, Injection, Extraction, Beam-material Interaction

MOP207 **Planning for Experimental Demonstration of Transverse Emittance Transfer at the GSI UNILAC Through Eigen-emittance Shaping** – ***C. Xiao*** *(IAP), O.K. Kester (IAP) L. Groening (GSI)*

The minimum transverse emittances achievable in a beam line are determined by the two transverse eigen-emittances of the beam. For vanishing interplane correlations they are equal to the well-know rms-emittances. Eigen-emittances are constants of motion for all symplectic beam line elements, i.e. (even tilted) linear elements. To allow for rms-emittance transfer, the eigen-emittances must be changed by applying a non-symplectic action to the beam, preferably preserving the 4d-rms-emittance. This contribution will introduce the concept for eigen-emittance shaping and rms-emittance transfer at an ion linac. A path towards the experimental demonstration of the concept at the GSI UNILAC is presented.

MOP209 **High Intensity Proton FFAG Ring with Serpentine Acceleration for ADS** – ***E. Yamakawa*** *(Kyoto University, Research Reactor Institute), Y. Ishi, Y. Kuriyama, J.-B. Lagrange, Y. Mori, T. Uesugi (Kyoto University, Research Reactor Institute)*

In order to produce high intensity proton beam for ADS, a new type of fixed rf acceleration scheme, so-called serpentine acceleration, is examined in scaling FFAG. Longitudinal hamiltonian for scaling FFAG is first derived analytically. Then the features of serpentine acceleration in longitudinal phase space are studied. Ring design for ADS is finally shown.

Beam Dynamics in High-intensity Circular Machines

MOP210 **Beam Stacking for High Intensity Pulsed Proton Beam with FFAG** – ***Y. Mori*** *(Kyoto University, Research Reactor Institute), Y. Ishi, Y. Kuriyama, T. Uesugi (Kyoto University, Research Reactor Institute)*

Multi-beam stacking scheme to generate an intense short-pulsed proton beam with high repetition proton FFAG is presented.

Commissioning, Operations and Performance

MOP211 **1-MW Beam Operation Scenario in the J-PARC RCS** – ***H. Hotchi*** *(JAEA/J-PARC)*

The injection energy of the J-PARC RCS will be upgraded from 181 MeV to 400 MeV in the 2013 summer-autumn period. With this upgraded injection energy, we are to aim for 1 MW design output beam power. In this paper, we discuss beam dynamics issues for the 1 MW beam operation and their possible solutions.

Accelerator System Design, Injection, Extraction, Beam-material Interaction

MOP212 **Preliminary Study of HOMs and the Associated Instabilities for C-ADS Linac** – ***P. Cheng*** *(IHEP), Z. Li (IHEP)*

Superconducting cavities are employed in C-ADS linac to accelerate 10mA CW proton beams from 3.2 MeV to 1.5 GeV. High order modes in superconducting cavities are found by using the simulation tools CST and HFSS, then power dissipation caused by HOMs have been investigated, it is indicated that the Qext should not go beyond 10^7 in order to limit the additional heat load. Beam instabilities caused by high order modes in elliptical cavity sections are investigated using the code offered by Dr. Jean-Luc Biarrotte (CNRS, IPN Orsay, France). Beam errors, linac errors and high order modes frequency spread are investigated in detail. It shows that the monopole modes do not affect the proton beam critically and need no HOM couplers ($Q_{ext}=10^5$) if high order modes frequency spread is more than 100 kHz.

MOP213 **Beam Losses due to the Foil Sacttering for CSNS/RCS** – ***M.Y. Huang*** *(IHEP), N. Wang, S. Wang, S.Y. Xu (IHEP)*

For the Rapid Cycling Synchrotron of China Spallation Neutron Source (CSNS/RCS), the stripping foil scattering generate the beam halo and give rise to additional beam losses during the injection process. The interaction between the proton beam and the stripping foil were studied in detail. By using the codes ORBIT and FLUKA, the beam transportation and the stripping foil scattering during the injection process were simulated. Then, the beam losses due to the foil scattering were obtained.

MOP214 **Test of Ferrite Rings for CSNS/RCS RF Cavities** – ***H. Shi*** *(IHEP), X. Li, W. Long, H. Sun, J.Y. Tang (IHEP)*

The measurement of ferrite rings provides very important information for designing the RF cavities and the whole RF system of CSNS/RCS. A new two-ring ferrite test system for the CSNS/RCS ferrite-loaded cavities has been developed. The test system includes the test bench, 3 kW valve power amplifier, 3000 A bias current source and LLRF control system. The characteristics of the ferrite rings in low and high RF field with dc and ac bias current were tested respectively with this system. The dependence of RF frequency on bias current is given. With the increasing of the repetition rate of ac bias current, the obvious dynamic loss was observed, and the additional bias current is required to achieve resonance.

Beam Diagnostics and Instrumentation for High-intensity Beam

MOP215 **The Study on Measuring Beta Functions and Phase Advances in the CSNS/RCS** – ***Y.W. An*** *(IHEP), S. Wang (IHEP)*

As a key component of the China Spallation Neutron Source (CSNS) Project, the Rapid Cycling Synchrotron (RCS) will accumulate and accelerate the proton beams from 80 MeV to 1.6 GeV for extracting and striking the target with a repletion rate of 25 Hz. To check linear optics and locate the quadruple errors, beta function plays an important role in beam diagnostics of a particle accelerate system. The Independent Component Analysis (ICA) is a robust beam diagnosis method by decomposing the samples recorded by turn by turn BPMs (beam position monitors) into the independent components which represent the inherent motion of the beam. The beta functions and phase advances can be derived from the corresponding independent components. Because the linear part of the space charge gives a defocusing effect to the beam, beta function variation will be induced. We find that the ICA method can measure beta functions with a reasonable tolerance under the conditions of strong space charge effects.

Beam Dynamics in High-intensity Circular Machines

MOP216 **The Design Study on the Longitudinal Beam Dynamics for CSNS/RCS** – ***N. Wang*** *(IHEP), M.Y. Huang, Y. Li, S. Wang, S.Y. Xu, Y.S. Yuan (IHEP)*

Rapid Cycling Synchrotron (RCS) is the key part of China Spallation Neutron Source (CSNS) accelerators. The RCS accumulates and accelerates 80 MeV beam from linac to 1.6 GeV. The particle number is $1.56 \cdot 10^{13}$ for each pulse, with repetition rate of 25 Hz. In the RCS, longitudinal beam dynamics plays a crucial role in achieving high intensity beam with low beam loss. Longitudinal parameters are studied and optimized for efficient RF trapping of the beam in the longitudinal phase space. Beam performance is investigated by particle tracking simulations. Beam dynamic issues related to the high order mode induced by the RF generator are studied with a new developed code. Primary study on the adoption of dual harmonic cavity for higher beam power is also addressed.

Beam Dynamics in High-intensity Linacs

MOP217 **The MEBT2 Design for the C-ADS** – ***Z. Guo*** *(IHEP), H. Geng, Z. Li, J.Y. Tang (IHEP)*

The C-ADS linac is composed by two parallel injectors and a main linac, a section of Medium Energy Beam Line (MEBT2) is designed to guide and match beams from two injectors to the main linac. The two injectors are hot-spare for each other in order to satisfied the requirement of high availability and reliability. The beam in online operation mode will be directed to the main linac from one injector, while the beam in the offline mode with low repetition frequency from the other injector, will be directed to a beam dump through an auxiliary beam line. With a long drift distance and in the presence of space charge force for 10 mA 10 MeV proton beam, the debunching effect is very strong and it requires very strict control over beam losses and emittance growth. It is difficult to obtain satisfactory longitudinal matching without bunchers in the bending section. An analytical study using transfer matrix shows that with two bunchers of same voltage in the bending section the achromatism can be maintained if the effective voltage is inversely proportional to the distance between the two bunchers. It is also under consideration if and how a beam collimation can be implanted in MEBT2.

MOP218 **Dynamics of Particles in a Tilted Solenoidal Focusing Channel** – ***H. Jiang*** *(IHEP), S. Fu (IHEP)*

We use the paraxial ray approximation equations to investigate the dynamics of particles in a tilted solenoidal focusing channel; in this case, the particles' initial canonical angular momentum is nonzero. So we add the term of centrifugal potential to the dynamics equation of particles. And this centrifugal potential term is nonlinear, which will induce the emittance growth. We also consider the spherical aberration's effect on emittance growth and the linear part of the space-charge of a Kapchinskij-Vladimirskij distribution beam.

MOP219 **Error Analysis and Correction Scheme in C-ADS Injector-I** – ***C. Meng*** *(IHEP), Z. Li,* ***C. Meng****, J.Y. Tang (IHEP)*

C-ADS Injector-I is a 10 mA 10 MeV CW proton linac. It uses a 3.2MeV normal conducting 4-Vane RFQ and 12 superconducting single-Spoke cavities. According to the detailed sensitivity analysis of alignment and RF errors, the error tolerance of both static and dynamic ones for Injector-I are presented. The simulation results show that with the error tolerance there are beam losses, the residual orbit is too large which will produce significant emittance growth, so the correction is necessary for Injector-I. After detailed numerical studies, a correction scheme and monitor distributions are proposed. After correction the RMS residual orbit can be controlled within 0.4mm and RMS emittance growth can be controlled within 10%, but it still has 1.7×10^{-6} beam loss, which comes from the RF errors and low longitudinal acceptance. According to detailed analysis and simulations with 10^{8} macro particles, as a consequence, longitudinal emittance control and longitudinal distribution control as well as large longitudinal acceptance are the key to minimizing beam losses in low energy section. To minimize beam loss, a short period Injector-I lattice with larger longitudinal acceptance have been designed and performance very good error tolerance.

MOP220 **Compensation-rematch for Major Element Failures in the C-ADS Accelerator** – ***B. Sun*** *(IHEP), Z. Li, J.Y. Tang, F. Yan (IHEP)*

In order to achieve the required reliability and availability for the C-ADS accelerator, a fault tolerance design is pursued. The effects of cavity failure in different locations have been studied and the schemes of compensation by means of local compensation have been investigated. After one cavity failure, by adjusting the settings of the neighboring cavities and the focusing elements to make sure that the Twiss parameters and energy are approximately recovered to that of the nominal ones at the matching point. We find the normalized RMS emittance and emittances including

99.9% and 100% particles have no obvious growth after applying the compensation with the RMS rematching in each section of the main linac. However, the conclusions above are drawn from the simulation results with the TraceWin code, which doesn't consider the phase difference. A code based on Matlab is under developing. By applying the code on the cavity failure in the middle part of spoke021 section, a fully compensated scheme with good dynamics results is obtained. The space charge effect is still not implanted in the code, and further study and optimization of the code will be performed in the next step.

MOP221 **Physics Design of the C-ADS Main Linac with Two Different Injector Schemes** – ***F. Yan*** *(IHEP), Z. Li, C. Meng, J.Y. Tang (IHEP)*

Two design schemes for the main linac of C-ADS (China Accelerator Driven Subcritical system) are presented in this paper. They are corresponding to two different injector schemes. Injector-II scheme makes use of room-temperature RFQ and superconducting HWR cavities with the RF frequency of 162.5 MHz; Injector-I scheme makes use of higher-energy RFQ and superconducting spoke cavities with the RF frequency of 325 MHz. At the first choice, a relatively smaller longitudinal emittance is adopted for the RFQ designs with both the injector schemes to obtain more efficient acceleration. However, compared with the injector-I scheme, with the injector-II scheme, bunch current will be doubled in the main linac due to the half RF frequency in the injector-II. This means stronger space charge effects. Alternate design for the main linac with the injector-II scheme is to increase the longitudinal emittance by 50% so that the space charge effects will be alleviated. However, totally 30 cavities more and 36 m longer in the main linac have to be paid for this design scheme. The design considerations, the lattice designs, the simulation results including halo information are presented.

MOP222 **Development of the Linac Design and Tracking Code PADSC** – ***Y.L. Zhao*** *(IHEP), S. Fu, Z. Li (IHEP)*

The code PADSC (Proton-Accelerator-Design-and-Simulation-Code) is written for dynamic design and simulation of high intensity Linac. The tool used is C++ in Linux environment and the first accelerating structure is concerned on DTL. The length of every element of the DTL cell is got according to the field, synchrotron phase and transit time factor. The code repeats until the design velocity (geometry beta) agrees with the synchrotron velocity. The time interval 't' is the independent variable when tracking the beam. The beam tracking in external electromagnetic field use forth order explicit Runge-Kutta method (RK4). As for evaluating the space charge effect, both 2D and 3D methods are used. The 2D method treats the particles as charged elliptical rings centered in longitudinal axis. And the 3D one solves the problem with Poisson equation and FFT serves as the equation solver. The equipartitioning concept is carried out in the code.

Commissioning, Operations and Performance

MOP223 **Radiation Safety System Design for PKUNIFTY Project** – ***J. Zhao*** *(PKU/IHIP)*

PKUNIFTY (PeKing University Neutron Imaging FaciliTY) , which is based on a 2 MeV RFQ accelerator-driven compact neutron source with an expected fast-neutron yield of $3*10^{12}$ n/s via the deuteron-beryllium reaction, has been operating this year. A radiation safety system (accelerator safety interlock system) for PKUNIFTY that protects users from radiation hazards has been built and run since last year. Test results of hardware and software are presented.

Accelerator System Design, Injection, Extraction, Beam-material Interaction

MOP224 **Physical Design of Quadrupole Magnet in the HEBT of C-ADS with Beam Distribution Transformation** – ***Y. Liu*** *(USTC) H.L. Luo, X.Q. Wang (USTC/NSRL)*

Superconducting linear accelerator and transmutation reactor would be the main equipment of the C-ADS. The high energy beam transport is the critical equipment connected accelerator and transmutation reactor, and it's more than ten quadrupole magnets with different aperture. It's necessary to complete a design study of the geometric parameter and thermal physical of the quadrupole magnet. And to present this design study on this quadrupole magnet in this paper.

MOP225 **Physical Design of Superconducting Bending Magnet in the HEBT of C-ADS with Beam Distribution Transformation** – ***Y.Y. Lu*** *(USTC) H.L. Luo, X.Q. Wang (USTC/NSRL)*

In the high energy beam transport line (HEBT), it could be more than 1.5 T that bending beam orbit requires the high magnet field to be. Without superconducting magnet, it's hard to achieve such powerful magnet field in and will take up too large place . How to accomplish the physical design of a superconducting bending magnet with an effective aperture for erecting vacuum pipe is discussed in this paper.

MOP226 **Beam Optics Design of 1.5 GeV Transport Line in C-ADS with Beam Distribution Transformation** – ***H.L. Luo*** *(USTC/NSRL), X.Q. Wang (USTC/NSRL)*

The high energy beam transport line (HEBT) is a critical sub-system in C-ADS. It has the function of transporting the accelerated high power proton beam to the transmuter or beam dump with a beam footprint satisfying the special requirements. In this paper, two schemes on beam distribution transformation are listed. The first scheme is to adopt a novel hurling magnet with a two dimensional amplitude modulation (AM) of 1 kHz and scanning of more than 10 kHz at 360^{o} in transverse directions. The second scheme is to use the antisymmetry nonlinear magnetic field, which has a novel spatial pattern, to realize the expanded large beam footprints. The preliminary beam optics design of C-ADS HEBT optimized to minimize the beam loss on the vacuum chamber and the radiation damage caused by back-scattering neutrons will be reported.

MOP227 **The Concept Design and Research of the Hurling Magnet in the HEBT of C-ADS** – ***L. Yang*** *(USTC), H.J. Liu, Y.N. Zhu (USTC) H.L. Luo, X.Q. Wang (USTC/NSRL)*

The hurling magnet is a novel concept for achieving the uniform distribution of the accelerated high energy proton beam in the C-ADS. In this paper, the hurling magnet with a two dimensional amplitude modulation (AM) of 1 kHz and a scanning frequency of more than 10 kHz at 360^o in transverse directions, which is much higher than that for conventional wobbler magnets, is proposed. In the hurling magnet, the high power beam would be hurled by the force of the rotating dipole magnetic field into a spiral line, in which the uniform distribution of the beam is realized on the target. The design of the hurling magnet is presented by 3D magnetic field simulation code OPERA.

Beam Dynamics in High-intensity Linacs

MOP228 **The Study of Beam Distribution Transformation by Anti-symmetric Multipole Magnetic Field** – ***M. Jin*** *(USTC/NSRL), C.S. Li, L. Li, H.L. Luo, X.Q. Wang, Y. Zhang (USTC/NSRL)*

In order to prolong the lifetime of the proton beam window and the spallation target and to improve the utilization of the high power beam in C-ADS, a uniformly distributed round beam with little beam halo realized by static nonlinear magnets may be required. In this paper, the combinations of some anti-symmetric multipole magnetic field are considered to realize beam distribution transformation and the preliminary simulating tracking is presented. The design of static anti-symmetric multipole magnet by magnetic field simulation code OPERA is also reported.

MOP229 **Design of the C-ADS Injector II MEBT1** – ***H. Jia*** *(IMP)*

The MEBT1 of Chinese ADS Injector II is described. It transports a 2.1 MeV, 10 mA CW proton beam through a series of 7 quadruples and two buncher cavities from the RFQ to the superconducting DTL. For emittance preservation, a compact mechanical design is required. Details of the beam dynamics and mechanical design will be given.

MOP230 **An Untraditional RFQ Physical Design for HIAF** – ***C. Li*** *(IMP)*

The superconducting QWR cavity is proposed as the main accelerating structure after RFQ for HIAF (Heavy Ion Application Facility) Project. Because of the low longitudinal acceptance for the linac and loss control, a nontraditional RFQ physical design is chosen. With the help of multiharmonic buncher in the LEBT providing bunching effect,,The RFQ is designed with no bunching section but only accelerating section. The longitudinal emittance is found to be far lower in this method than ordinary RFQ design.

MOP231 **Study of Non-equi-partitioning Lattice Setting and IBS Effects for J-parc Linac Upgrade** – ***Y. Liu*** *(IMP) M. Ikegami (JAEA/J-PARC)*

For the coming upgrade of J-Parc, the peak power of linac will be greatly increased. This may open many interesting questions. For instance, for efficient acceleration from 19 0MeV to 400 MeV the annular coupled structure (ACS) was applied with frequency jump from 324 MHz to 972 MHz. Upstream part of J-PARC linac from the frequency jump is set with the equi-partitioning (EP) condition, which prevents from the coherent resonances. If EP condition is kept for the downstream part, due to the frequency jump, the transverse focusing should also 'jump' 3 times with shrink of envelop. The increased beam-density affects the interactions between particles, including the intra-beam stripping (IBS) effect in the H^- beam. The temperature ratio between transverse and longitudinal planes is used as a knob for studying the beam behavior for the cases away from equi-partitioning. The IBS effects, as well as strategies for setting downstream non-equi-partitioning lattice due to frequency jump are studied. The matching and beam evolution in the transition section from EP to non-EP (MEBT2) are also studied. The results help to reach an optimum with least risks from resonances and IBS effects and so on.

MOP232 **The Analysis of Stability Optimization for Superconducting Section of C-ADS Injector II** – ***S.H. Liu*** *(IMP), Y. He, C. Li, W.S. Wang, Z.J. Wang, X.B. Xu (IMP)*

Abstract: The general process of designing and tuning the lattice of a linac to produce certain desired properties is not straightforward. Often solutions are found through trial and error and it is not clear that the solutions are close to optimal. This is not only ritual, but it also cannot get an optimal result. In this paper, we adopt a scientific design of experiment which is the Orthogonal Array Designs specified in DAKOTA code combined with TRACK to find an optimal combination of component parameter and the range of stability in superconducting section of C-ADS. The analysis of stability optimization for superconducting section will be presented.

MOP233 **Error and Tolerance Studies for Injector II of C-ADS** – ***W.S. Wang*** *(IMP)*

The proposed Chinese Accelerator Driven System (C-ADS) driver linac is being designed by Chinese Academic Science (CAS). Injector II is designed and fabricated in Institute of Modern Physics (IMP). Injector II will accelerate 10 mA proton beams to 10 MeV. Because of the high final beam power (100 kW) specified for the linac operation, beam loss must be limited to 10^{-5} level to avoid radiation damage. Misalignment and RF error simulation for cavities and focusing elements after RFQ were performed and the correction schemes developed using the computing code TRACK. Error and tolerance studies for Injector II are presented.

MOP234 **SSC Linac End-to-end Simulation and Error Analysis Based on the Beampath Code** – ***X.H. Zhang*** *(IMP)*

A new linear accelerator called the SSC-Linac injector is under construction in the Heavy Ion Research Facility at Lanzhou (HIRFL). It consists of a electron cyclotron resonance ion source (ECRIS),a low energy beam transport (LEBT), a radio frequency quadrupole accelerator(RFQ), a medium energy beam transport (MEBT) and an interdigital H-mode drift tube linac (IH-DTL). Five dedicated tools have been involved in the design and simulation of the lattice. The trace3d code is employed for the LEBT and MEBT design, the PARMTEQ-M code is used for the beam dynamics along the RFQ, and the linrev code is adopted for the the IH-DTL design. The end-to-end simulation has been performed by the track code and the beampath code. Besides the beampath end-to-end simulation and optimization, the error analysis result is also shown in this paper.

MOP235 **Medium Energy Beam Transport Design Update For ESS** – ***I. Bustinduy*** *(ESS Bilbao) B. Cheymol, M. Eshraqi (ESS) J. Stovall (CERN)*

The major challenge of this part of the accelerator is to keep a high quality beam, with a pulse well defined in time, a low emittance and a minimized halo, so that the beam losses downstream the linac be limited and the overall ESS reliability be maximized. In order to minimize beam loss at high energy linac, and the consequent activation of components, a fast chopping scheme is presented for the medium energy beam transport section (MEBT). The considered versatile MEBT is being designed to achieve four main goals: First, to contain a fast chopper and its correspondent beam dump, that could serve in the commissioning as well as in the ramp up phases. Second, to serve as a halo scraping section by means of two adjustable blades. Third, to measure the beam phase and profile between the RFQ and the DTL, along with other beam monitors. And finally, to match the RFQ output beam characteristics to the DTL input both transversally and longitudinally. For this purpose a set of ten quadrupoles is used to match the beam characteristics transversally, combined with two 352.2 MHz buncher cavities, which are used to adjust the beam in order to fulfill the required longitudinal parameters.

MOP236 **Transverse Beam Profile Diagnostics at the European Spallation Source** – ***B. Cheymol*** *(ESS), C. Böhme, H. Hassanzadegan, A. Jansson, T.J. Shea, L. Tchelidze (ESS)*

The European Spallation Source (ESS), to be built in the south of Sweden, will use a 2.5 GeV superconducting linac to produce the worlds most powerful neutron source with a beam power of 5 MW. The beam power is a challenge for interceptive beam diagnostics like wire scanner, the thermal load on intercepting device implies to reduce the beam power in order to preserve the device integrity. For nominal operation, non-disturbing technics for profile measurements are planned, while for commissioning phase, accurate measurements and cross checking, wire scanners will be used. This paper describes the different options foreseen for non-disturbing profile measurements and describes the preliminary design of the wire scanner system in the normal conducing linac as well as in the superconducting linac.

MOP237 **Overview of the CERN LINAC4 Beam Diagnostic** – ***B. Cheymol*** *(ESS) B. Dehning, U. Raich, F. Roncarolo, L. Søby (CERN)*

The CERN LINAC4 will represent the first upgrade of the LHC injection chain, accelerating H^- ions from 45 keV to 160 MeV for charge-exchange injection into the PS Booster. Along the linac and in the transfer line to the PS booster, numbers of beam diagnostics will be installed in order to measure the beam position, the transverse and longitudinal profile as well as beam current and beam losses. These beam diagnostics have been designed in order to provide efficient operation of LINAC4, and ensure keeping the losses at a low level. In addition dedicated beam diagnostic has been designed for the commissioning phase, in particular transverse emittance, longitudinal bunch shape and chopping efficiency measurements. This paper gives an overview of the beam diagnostics design and their main features, and the plan for a future upgrade of the beam diagnostics, in particular the transverse beam profile and beam emittance measurement with a laser wire.

MOP238 **Beam Position Monitor System of the ESS Linac** – ***H. Hassanzadegan*** *(ESS), A. Jansson (ESS) A.J. Johansson (Lund University)*

The pulsed ESS linac will include about 100 BPMs, mostly with a European XFEL style button design, 6 BPMs with a special design for the Medium Energy Beam Transport, as well as 8 stripline BPMs foreseen for the Drift Tubes. The required accuracy and resolution of the position measurement are 100 μm (rms) and 20 μm (rms) respectively with the 50 mA 2.86 ms nominal pulse. In addition to the position measurement, the BPM system needs to measure the beam phase in the nominal pulse as well as several diagnostics pulse modes with a minimum duration and intensity of 5 μs and 5 mA respectively. After a study of the possible electronics platforms, MTCA.4 is now considered as the main prototyping platform for the high performance sub-systems at ESS. It is foreseen to prototype a Rear Transition Module for IQ-based RF signal measurements intended for both the BPM and LLRF systems. The requirements and specifications of the BPM system are presented and the plan for the continuation of the project is described in this paper.

Accelerator System Design, Injection, Extraction, Beam-material Interaction

MOP239 **Batch-by-batch Longitudinal Emittance Blow-up in the LHC** – ***T. Mastoridis*** *(CERN), P. Baudrenghien, M. Jaussi, J.C. Molendijk (CERN)*

The transverse bunch emittance in the LHC increases significantly at the injection energy of 450 GeV from the time of injection till the energy ramp due to Intra-Beam Scattering (IBS), resulting in lower luminosity in physics. Since IBS depends on the bunch charge density, it is possible to reduce the transverse emittance growth rates by selectively blowing up the longitudinal emittance of the incoming batch at each injection. The algorithms and techniques developed for batch-by-batch longitudinal emittance blowup at LHC injection are presented in this work. The longitudinal bunch length and transverse emittance are compared for fills with and without the batch-by-batch blowup. The resulting increase in luminosity is estimated.

MOP240 **High Energy Tests of Advanced Materials for Beam Intercepting Devices at CERN HiRadMat Facility** – ***A. Bertarelli*** *(CERN), R.W. Assmann, E. Berthome, V. Boccone, F. Carra, F. Cerutti, A. Dallocchio, P. Francon, L. Gentini, M. Guinchard, N. Mariani, A. Masi, P. Moyret, S. Redaelli, S.D.M. dos Santos (CERN) L. Peroni, M. Scapin (Politecnico di Torino)*

Predicting by simulations the consequences of LHC particle beams hitting Collimators and other Beam Intercepting Devices (BID) is a fundamental issue for machine protection: this can be done by resorting to highly non-linear numerical tools (Hydrocodes). In order to produce accurate results, these codes require reliable material models that, at the extreme conditions generated by a beam impact, are either imprecise or nonexistent. To validate relevant constitutive models or, when unavailable, derive new ones, a comprehensive experimental test foreseeing intense particle beam impacts on six different materials, either already used for present BID or under development for future applications, is being prepared at CERN HiRadMat facility. Tests will be run at medium and high intensity using the SPS proton beam (440 GeV). Material characterization will be carried out mostly in real time relying on embarked instrumentation (strain gauges, microphones, temperature and pressure sensors) and on remote acquisition devices (Laser Doppler Vibrometer and High-Speed Camera). Detailed post-mortem analyses are also foreseen after the cool down of the irradiated materials.

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MOP241 **An Experiment on Hydrodynamic Tunnelling of the SPS High Intensity Proton Beam at the HiRadMat Facility** – ***J. Blanco*** *(CERN), F. Burkart, N. Charitonidis, I. Efthymiopoulos, D. Grenier, C. Maglioni, R. Schmidt, C. Theis, D. Wollmann (CERN) E. Griesmayer (CIVIDEC Instrumentation) N.A. Tahir (GSI)*

The LHC will collide proton beams with an energy stored in each beam of 362 MJ. To predict damage for a catastrophic failure of the protections systems, simulation studies of the impact of an LHC beam on copper targets were performed. Firstly, the energy deposition of the first bunches in a target with FLUKA is calculated. The effect of the energy deposition on the target is then calculated with a hydrodynamic code, BIG2. The impact of only a few bunches leads to a change of target density. The calculations are done iteratively in several steps and show that such beam can tunnel up to 30-35 m into a target. Similar simulations for the SPS beam also predict hydrodynamic tunnelling. An experiment at the HiRadMat (High Radiation Materials) at CERN using the proton beam from the Super Proton Synchrotron (SPS) is performed to validate the simulations. The particle energy in the SPS beam is 440 GeV and has up to 288 bunches. Significant hydrodynamic tunnelling due to hydrodynamic effects are expected. First experiments are planned for July 2012. Simulation results, the experimental setup and the outcome of the tests will be reported at this workshop.

MOP242 **Experimental Verification for a Collimator with In-Jaw Beam Position Monitors** – ***D. Wollmann*** *(CERN), O. Aberle, R.W. Assmann, A. Bertarelli, C.B. Boccard, R. Bruce, F. Burkart, E. Calvo, M. Cauchi, A. Dallocchio, D. Deboy, M. Gasior, O.R. Jones, V. Kain, L. Lari, A.A. Nosych, S. Redaelli, A. Rossi, G. Valentino (CERN)*

At present the beam based alignment of the LHC collimators is performed by touching the beam halo with the two jaws of each device. This method requires dedicated fills at low intensities that are done infrequently because the procedure is time consuming. This limits the operational flexibility in particular in the case of changes of optics and orbit configuration in the experimental regions. The system performance relies on the machine reproducibility and regular loss maps to validate the settings. To overcome these limitations and to allow a continuous monitoring of the beam position at the collimators, a design with in-jaw beam position monitors was proposed and successfully tested with a mock-up collimator in the CERN SPS. Extensive beam experiments allowed to determine the achievable accuracy of the jaw alignment for single and multi-turn operation. In this paper the results of these experiments are discussed. The measured alignment accuracy is compared to the accuracies achieved with the present collimators in the LHC.

Beam Dynamics in High-intensity Linacs

MOP243 **Experimental Results for Beam Halo at IHEP** – ***H.F. Ouyang*** *(IHEP), T. Huang, J. Li, J. Peng, T.G. Xu (IHEP)*

Space-charge forces acting on mismatched beams have been identified as a major cause of beam halo. In this paper, we describe the beam halo experimental results in a FODO beam line at IHEP. With this beam transport line, experiments are firstly carried out to determine the main beam parameters at the exit of a RFQ with intense beams, and then measured beam profiles at different positions are compared with the multi-particle simulation profiles to study the formation of beam halo. The maximum measured amplitudes of the matched and mismatched beam profiles agreed well with simulations. Details of the experiment will be presented.

Accelerator System Design, Injection, Extraction, Beam-material Interaction

MOP244 **CERN High-Power Proton Synchrotron Design Study for LAGUNA-LBNO Neutrino Production** – ***R. Steerenberg*** *(CERN), M. Benedikt, I. Efthymiopoulos, F. Gerigk, Y. Papaphilippou (CERN)*

Within the framework of the LAGUNA-LBNO project, CERN has started design studies in view of producing neutrinos for future long base line neutrino experiments. These design studies foresee a staged approach in the increase of the primary proton beam power, used for the neutrino production. The first step consists of exploring the feasibility of a CERN SPS beam power upgrade from the existing 500 kW, presently available to CNGS, to 750 kW. This beam should then be transferred to a new to be built neutrino beam line that is dimensioned for a beam power of 2 MW. The 2 MW proton beam is to be provided at a subsequent stage by a 30 - 50 GeV High-Power Proton Synchrotron (HP-PS), which is a major part of the design studies. This paper will provide an overview of the project and then focus on the preliminary ideas for the HP-PS design study.

Commissioning, Operations and Performance

MOP245 **Quench Tests at the LHC with Collimation Losses at 3.5 Z TeV** – ***S. Redaelli*** *(CERN)*

The Large Hadron Collider (LHC) has been operating since 2010 at 3.5 TeV and 4.0 TeV without experiencing quenches induced by losses from circulating beams. This situation might change at 7 TeV where the reduced margins in the superconducting magnets. The critical locations are the dispersion suppressors (DSs) at either side of the cleaning and experimental insertions, where dispersive losses are maximum. It is therefore crucial to understand in detail the quench limits with beam loss distributions alike those occurring in standard operation. In order to address this aspect, quench tests were performed by inducing large beam losses on the primary collimators of the betatron cleaning insertion, for proton and lead ion beams of 3.5 Z TeV, to probe the quench limits of the DS magnets. Losses up to 500 kW were achieved without quenches. The measurement technique and the results obtained are presented, including observations of heat loads in the cryogenics system.

Beam Diagnostics and Instrumentation for High-intensity Beam

MOP246 **A Tool Based on the BPM-interpolated Orbit for Speeding up LHC Collimator Alignment** – ***G. Valentino*** *(University of Malta, Information and Communication Technology), N.J. Sammut (University of Malta, Information and Communication Technology) R.W. Assmann, R. Bruce, G.J. Müller, S. Redaelli, B. Salvachua (CERN)*

Beam-based alignment of the LHC collimators is required in order to measure the orbit center and beam size at the collimator locations. During an alignment campaign in March 2012, 80 collimators were aligned at injection energy (450 GeV) using automatic alignment algorithms in 7.5 hours, the fastest setup time achieved since the start of LHC operation in 2008. Reducing the alignment time even further would allow for more frequent alignments, providing more time for physics operation. The proposed tool makes use of the BPM-interpolated orbit to obtain an estimation of the beam centers at the collimators, which can be exploited to quickly move the collimator jaws from the initial parking positions to tighter settings before beam-based alignment commences.

Accelerator System Design, Injection, Extraction, Beam-material Interaction

MOP247 **Beam Stability and Tail Population at SPS Scrapers** – ***L.N. Drosdal*** *(CERN), K. Cornelis, B. Goddard, V. Kain, M. Meddahi, Ö. Mete, B. Mikulec, E. Veyrunes (CERN)*

Before injection into the LHC the beams are scraped in the SPS to remove the tails of the transverse particle distributions. Without scraping the tail population is large enough to create losses above the beam abort thresholds of the LHC beam loss monitor system when injecting. The scrapers are only effective if correctly set up. This paper shows the results of periodical scraper scans. The beam position and beam size at the scraper is changing with time. The scraper settings hence need to follow accordingly. The scans also give insight into the transverse tail population and could therefore provide useful beam quality diagnostics. The impact on new scraper designs and setting up strategy are discussed.

Beam Dynamics in High-intensity Circular Machines

MOP248 **Brightness Evolution for LHC Beams during the 2012 Run** – ***M. Kuhn*** *(Uni HH) G. Arduini, J.F. Comblin, A. Guerrero, V. Kain, B. Mikulec, F. Roncarolo, M. Schaumann, R. Steerenberg (CERN)*

One of the reasons for the remarkable achievements of the LHC is the excellent performance of the LHC injector chain. The evolution of the brightness in the injectors and at LHC collision in 2011 and 2012 is discussed. During certain run periods, the brightness from the beam provided by the injectors was lower than usual. Some of the issues have been identified so far and will be reported. The latest results on emittance blow-up investigations through the 2012 LHC cycle will also be presented and compared to the 2011 data. Possible implications for LHC upgrade scenarios will be mentioned.

MOP249 **Tune Spread Studies at Injection Energies for the CERN Proton Synchrotron Booster** – ***B. Mikulec*** *(CERN), V. Raginel, G. Rumolo, G. Sterbini (CERN)*

In the near future, a new H^- injector, Linac4, will replace the current proton injector of the CERN Proton Synchrotron Booster (PSB), Linac2. The new charge-exchange injection at 160 MeV will yield higher brightness beams compared to the conventional 50 MeV multi-turn injection of Linac2. To make full use of the higher injection energy, space-charge effects will need to be understood and mitigated to optimize the intensity versus transverse emittance reach. This includes an optimization of longitudinal acceptance and distribution with a two-harmonic rf system, careful selection of the working point to accommodate the large Laslett tune-shift of approximately -0.5 and compensation of resonances within their stopbands. This paper will present calculations of the tune spread, based on measurements of longitudinal parameters and transverse emittances, for energies up to 160 MeV, different bunch densities and varying beam intensities. It should provide valuable information on the expected tune spread after the connection of Linac4 with the PSB and input for the study of resonance compensation techniques.

MOP250 **Colliding High Brightness Beams in the LHC** – ***T. Pieloni*** *(CERN), X. Buffat, R. Giachino, W. Herr, G. Papotti (CERN)*

The CERN-LHC is a high energy particle collider, where intense proton bunches are brought into collision. In order to achieve optimum performance, the bunches must have a high brightness, leading to strong and significant beam-beam effects. Experimental tests during the first two years of its operation have shown that beams with very high brightness can be collided head-on without detrimental effects on the beam dynamics. Such head-on collisions are therefore not expected to limit the LHC performance. Long range beam-beam interactions dominate the adverse effects on the dynamics but can profit from an increased beam brightness, in particular from small emittances. We summarize the experimental results and compare with the theoretical expectations. This allows to optimize the performance for future operation and a definition of promising upgrade scenarios.

MOP251 **An Analytical Derivation of the Transverse Impedance for a Step-out Transition** – ***C. Zannini*** *(CERN), G. Rumolo, B. Salvant, V.G. Vaccaro (CERN)*
Using the field matching technique, the transverse impedance of a step-out in a round cylindrical beam-pipe at arbitrary beam energy is obtained analytically. The beam-pipe sections have perfectly conducting pipe. The analytical results are benchmarked with reliable 3D Electro-Magnetic simulation code.

MOP252 **Measurements of the LHC Longitudinal Resistive Impedance with Beam** – ***J. Esteban Muller*** *(CERN), T. Argyropoulos, T. Bohl, T. Mastoridis, N. Mounet, G. Papotti, E.N. Shaposhnikova, D. Valuch (CERN)*
The resistive part of the longitudinal impedance contributes to the heat deposition on different elements in the LHC ring including the beam screens, where it has to be absorbed by the cryogenic system and can be a practical limitation for the maximum beam intensity. In this paper, we present the first measurements of the LHC longitudinal resistive impedance with beam, done through synchronous phase shift measurements during Machine Development sessions in 2012. Synchronous phase shift is measured for different bunch intensities and lengths using the high-precision LHC Beam Phase Module and then data are post-processed to further increase the accuracy. The dependence of the energy loss per particle on bunch length is then obtained and compared with the expected values found using the LHC impedance model and longitudinal bunch profiles measured by a wall current monitor.

Beam Diagnostics and Instrumentation for High-intensity Beam

MOP253 **Progress with Bunch-Shape Measurements at Cyclotrons and Beam Lines** – ***R. Dölling*** *(PSI)*
As proposed at HB2010, additional bunch-shape monitors have been installed at the last turns of the Injector 2 cyclotron and at several locations in the connecting beam line to the Ring cyclotron (@72 MeV), as well as behind the Ring cyclotron (@590 MeV). Now at each location, longitudinal-transversal 2D-density distributions of the bunched 2.2 mA proton beam, can be taken from four angles of view separated each by 45^{o}. The measurement setup, data evaluation and results are discussed.

MOP254 **Design of the Photo Detachment Emittance Instrument for FETS** – ***C. Gabor*** *(STFC/RAL/ASTeC) G.E. Boorman, A. Bosco (Royal Holloway, University of London) A.P. Letchford (STFC/RAL) P. Savage (Imperial College of Science and Technology, Department of Physics)*
Photo detachment is a possibility to diagnose non-destructively H^- ion beams. For emittance measurements, the produced neutrals are more suitable then the photo-detached electrons. Such a Photo-Detachment Emittance Measurement Instrument (PD-EMI) is planned for the Front End Test Stand (FETS) at Rutherford Appleton Laboratory (RAL/ UK).

FETS comprises a Penning ion source of 60 mA beam current with up to 2 ms pulse length at 50pps, a Low Energy Beam Transport (LEBT), a four-vane RFQ with 3 MeV and a Medium Energy Beam Transport (MEBT) with a chopper system. The PD-EMI will be integrated at the end of the MEBT to commission the RFQ which is currently under construction. The introduction gives an overview some results reached so far and explains the conceptual design. Beam simulations show how to implement this to the MEBT being under construction. The remaining paper concentrates then on the hardware which is the dipole magnet, the laser and optics. The design and and engineering of the magnet chamber needs special attention to both satisfy beam transportation and diagnostics purpose. First measurements about the laser and its parameters will be presented.

Beam Dynamics in High-intensity Circular Machines

MOP255 **Acceleration in Vertical Orbit Excursion FFAGs with Edge Focussing** – ***S.J. Brooks*** *(STFC/RAL/ASTeC)*

FFAGs with vertical orbit excursion (VFFAGs) provide a promising alternative design for rings with fixed-field superconducting magnets. They have a vertical magnetic field component that increases with height in the vertical aperture, yielding a skew quadrupole focussing structure. Edge focussing can provide an alternating gradient within each magnet, thus reducing the ring circumference. Like spiral scaling horizontal FFAGs (but not non-scaling ones) the machine has fixed tunes and no intrinsic limitation on momentum range. Rings to accelerate the 150mm.mrad geometric emittance beam from the ISIS proton synchrotron are investigated, in terms of both magnet field geometry and longitudinal behaviour during acceleration with space charge.

MOP256 **High-Power Scaling FFAG Ring Studies** – ***D.J. Kelliher*** *(STFC/RAL/ASTeC), G.H. Rees (STFC/RAL/ASTeC)*

High-power scaling FFAG rings have potential application in areas such as neutron spallation, muon production, and accelerator-driven systems. It is proposed to build a model of such a ring in order to study major issues such as space charge and injection. A 20 ’ 70 MeV radial DFD FFAG model incorporates long straights to facilitate H^- charge exchange injection. Bump magnets are used to move the injected beam away from the foil. The effect of the injection process on the beam emittance is considered. The tune depression and emittance blow up resulting from the effect of space charge is also calculated.

MOP257 **Space Charge Limits on the ISIS Synchrotron Including the Effects of Images** – ***B.G. Pine*** *(STFC/RAL/ISIS), C.M. Warsop (STFC/RAL/ISIS)*

The ISIS Synchrotron provides a pulsed, 50 Hz, 800 MeV proton beam for spallation neutron production. Each pulse from the synchrotron contains ~2.8×10^{13} ppp, and at this beam intensity space charge and image forces have a strong effect on transverse beam dynamics. In order to increase intensity in the current machine, and to prepare for possible upgrades running at a higher intensity, studies are under way aimed at understanding the most critical features of space charge and image induced beam loss. These studies are focused on direct space charge, working point optimisation, resonances and images. A 2D simulation code Set has been developed to improve understanding of transverse dynamics at ISIS, using a particle-in-cell algorithm to include space charge and image forces self-consistently. The ISIS Synchrotron has profiled vacuum vessels and RF shields which vary in parallel with the beam envelope, and have a unique influence on the beam dynamics. Set is specifically designed to include these image forces. Simulation results exploring the effect of the working point and images on transverse dynamics will be reported.

MOP258 **Simulation of Intense Proton Beams in Novel Isochronous FFAG Designs** – ***S.L. Sheehy*** *(STFC/RAL/ASTeC) M. Berz, K. Makino, P. Snopok (MSU) C. Johnstone (Fermilab)*

Recent developments in the design of non-scaling fixed field alternating gradient (FFAG) accelerators have been focused on achieving isochronous behavior with a small betatron tune excursion. These advances are particularly interesting for applications requiring CW beams, such as Accelerator Driven Systems for energy generation or waste transmutation. The latest advances in lattice design have resulted in a 330 MeV to 1 GeV lattice, isochronous to better than ± 1 percent. This paper reports on simulations of this new lattice design incorporating 3D space charge effects.

Beam Dynamics in High-intensity Linacs

MOP259 **Beam Dynamics Studies for a Proposed 800 MeV ISIS Upgrade Linac** – ***D.C. Plostinar*** *(STFC/RAL/ASTeC)*

Several schemes have been proposed to upgrade the ISIS Spallation Neutron Source at Rutherford Appleton Laboratory (RAL). One scenario is to develop a new 800 MeV, H^- linac and a ~3 GeV synchrotron, opening the possibility of achieving several MW of beam power. In this paper the overall beam dynamics design of the 800 MeV linac is presented.

Beam Dynamics in High-intensity Circular Machines

MOP260 **Beam Halo Measurements Using Adaptive Masking Methods and Recent Halo Experiment** – ***H.D. Zhang*** *(UMD), B.L. Beaudoin, S. Bernal, R.B. Fiorito, R.A. Kishek, K. Řežaei (UMD)*

Beam halo is a common phenomenon in particle beams, especially for modern, advanced accelerators where high beam intensities lead to strong space charge. Halo is generally understood as a population of particles that do, or will, reach large transverse radii relative to a more intense, centralized beam core. It is associated with emittance growth, beam quality degradation and particle loss. The particle-core model is commonly used to describe halo formation as the result of a parametric resonance due to envelope mismatch. Few experiments have been carried out to test this theory. Measurement of beam halo is particularly problematic for faint halos, where light from the intense core obscures the optical image of the halo. In this paper, we present a new diagnostic for high-dynamic range halo measurements based on adaptive masking of the beam core. We also present the design of an experiment to study halo formation from envelope mismatch for beams spanning a wide range of intensities on the University of Maryland Electron Ring (UMER).

MOP261 **A Test Facility for MEIC ERL Circulator Ring Based Electron Cooler Design** – ***Y. Zhang*** *(JLAB)*

An electron cooling facility which is capable to deliver a beam with energy up to 55 MeV and average current up to 1.5 A at a high bunch repetition rate up to 750 MHz is required for MEIC. The present cooler design concept is based on a magnetized photo-cathode SRF gun, an SRF ERL and a compact circulator ring. In this paper, we present a proposal of a test facility utilizing the JLab FEL ERL for a technology demonstration of this cooler design concept. Beam studies will be performed and supporting technologies will also be developed in this test facility

MOP262 **Observations of Space Charge Effects in the Spallation Neutron Source Accumulator Ring** – ***R.E. Potts*** *(ORNL RAD) S.M. Cousineau, J.A. Holmes (ORNL)*

The Spallation Neutron Source accumulator ring was designed to allow independent control of the transverse beam distribution in each plane. However, at high beam intensities, nonlinear space charge forces can strongly influence the final beam distribution and compromise our ability to independently control the transverse distributions. In this study we investigate the evolution of the beam at intensities up to 10^{14} ppp through both simulation and experiment. Specifically, we analyze the emittance and phase space evolution for beams with different aspect ratios and tune splits. We present observations of emittance exchange and the development of asymmetric beam distributions.

18-Sep-12 09:00 – 10:20	Oral	Ballroom

TUO1A — Working Group-A

Chair: G. Franchetti (GSI)

Beam Dynamics in High-intensity Circular Machines

TUO1A01 09:00 **The High Intensity/High Brightness Upgrade Program at CERN: Status and Challenges** – ***S.S. Gilardoni*** *(CERN), G. Arduini, T. Argyropoulos, S. Aumon, H. Bartosik, E. Benedetto, N. Biancacci, T. Bohl, J. Borburgh, C. Carli, F. Caspers, H. Damerau, J. Esteban Muller, V. Forte, R. Garoby, M. Giovannozzi, B. Goddard, S. Hancock, K. Hanke, A. Huschauer, G. Iadarola, M. Meddahi, G. Métral, B. Mikulec, E. Métral, Y. Papaphilippou, G. Rumolo, B. Salvant, F. Schmidt, E.N. Shaposhnikova, R. Steerenberg, M. Taborelli, H. Timko, M. Vretenar, R. Wasef, C. Yin Vallgren, C. Zannini (CERN) G. Franchetti (GSI) M. Migliorati (University of Rome "La Sapienza") A.Y. Molodozhentsev (J-PARC, KEK & JAEA) S. Persichelli (Rome University La Sapienza) M.T.F. Pivi (SLAC) V.G. Vaccaro (Naples University Federico II, Mathematical, Physical and Natural Sciences Faculty)*

The future beam brilliance and intensities required by the HL-LHC (High-Luminosity LHC) project and for possible new neutrino production beams triggered a deep revision of the LHC injector performances. The analysis, progressing in the framework of the LHC Injectors Upgrade (LIU) projects, outlined major limitations mainly related to collective effects - space charge in PSB and PS, electron cloud driven and TMCI instabilities in the SPS, longitudinal coupled bunch instabilities in the PS for example - but also to the existing hardware capability to cope with beam instabilities and losses. A summary of the observations and simulation studies carried out so far, as well as the future ones, will be presented. The solution proposed to overcome the different limitations and the plans for their implementation will be also briefly reviewed.

TUO1A02 09:20 **Status of Collective Effects at GSI** – ***O. Boine-Frankenheim*** *(GSI)*

A profound understanding and control of collective effects in ion beams will be necessary to reach the design intensity and quality in the existing SIS-18 synchrotron and in the projected SIS-100 for the FAIR project. Simulation and experimental studies of collective effects are therefore an integral part of the ongoing SIS-18 intensity upgrade and the SIS-100 design activities at GSI. In both rings collective effects are caused simultaneously by space charge, impedances and secondary particles. They occur in the longitudinal and transverse planes, in coasting beams as well as for different rf bucket forms. After a brief outline of the role of collective effects at GSI this contribution will focus on recent findings related to the interpretation of signals from intense bunches with space charge. The correct processing of these signals will be especially important for beam diagnostics and feedback control.

September 18

TUO1A03 09:40 **Space Charge Effects in Isochronous FFAGs and Cyclotrons** – ***T. Planche*** *(TRIUMF, Canada's National Laboratory for Particle and Nuclear Physics), R.A. Baartman, Y.-N. Rao (TRIUMF, Canada's National Laboratory for Particle and Nuclear Physics)*

Effects of space charge forces on the beam dynamics of isochronous rings will be discussed. Two different kinds of phenomena will be introduced through a brief review of the literature on the topic. The first one is a consequence of the very weak vertical focusing found in the low energy region of most cyclotrons. The space charge tune shift further reduces the vertical focusing, setting an upper limit on instantaneous current. The second one arises from the fact that longitudinal phase space is frozen in isochronous rings. This leads to effects of space charge forces which are very peculiar to isochronous machines. We will finally present the simulation tools being developed at TRIUMF to study these effects.

TUO1A04 10:00 **Plasma Traps for Space Charge Studies: Status and Perspectives** – ***H. Okamoto*** *(HU/AdSM), H. Higaki, K. Ito (HU/AdSM) A. Mohri (Kyoto University, Graduate School of Human and Environmental Studies)*

The beam physics group of Hiroshima University has developed non-neutral plasma traps dedicated solely to a wide range of beam dynamics studies. Those unique experimental tools approximately reproduce, in the laboratory frame, a many-body Coulomb system that is physically equivalent to a charged-particle beam observed in the center-of-mass frame. We have designed and constructed two different types of traps that employ either a radio-frequency electric quadrupole field or an axial magnetic field for transverse particle confinement. The former type is commonly referred to as "linear Paul trap" and the latter as "Penning trap". At present, three Paul traps and one Penning trap are operational while a new Penning trap for beam halo experiments is under construction. Each of these compact experimental facilities consists of a trap, many power supplies, a vacuum system, a computer control system, etc., and is called "S-POD (Simulator for Particle Orbit Dynamics)". S-POD is particularly useful for fundamental studies of high-intensity and high-brightness hadron beams. We here report on recent experimental outputs from S-POD and also briefly describe some future plans.

18-Sep-12 09:00 – 10:20	Oral	Meeting Room 3

TUO3A — Working Group-B&C

Chair: D. Raparia (BNL)

Beam Dynamics in High-intensity Linacs

TUO3A01 09:00 **Dynamical Aspects of Emittance Coupling in Intense Beams** – ***I. Hofmann*** *(GSI)* ***I. Hofmann***

In this paper we study in an idealized lattice model the dynamical behavior of non-equipartitioned beams and of approach to equipartition. It is shown that emittance transfer depends on times scales of tune change, but also the direction of crossing the stopbands of space charge resonances. This provides additional information to support the stability charts suggested previously as design tool for high current linacs.

Accelerator System Design, Injection, Extraction, Beam-material Interaction

TUO3A02 09:20 **Status and Results of the UA9 Crystal Collimation Experiment at the CERN-SPS** – ***S. Montesano*** *(CERN), W. Scandale (CERN)*

The UA9 experimental setup was installed in the CERN-SPS in 2009 to investigate the feasibility of the halo collimation assisted by bent crystals. Two-millimeter-long silicon crystals, with bending angles of about 150 microrad, are used as primary collimators instead than a standard amorphous target. Studies are performed with stored beams of protons and lead ions at 270 Z GeV. The loss profile is precisely measured in the area near to the crystal-collimator setup and in the downstream dispersion suppressor. A strong correlation of the losses in the two areas is observed and a steady reduction of dispersive losses is recorded at the onset of the channeling process. The loss map in the accelerator ring is is also reduced. These observations strongly support our expectation that the coherent deflection of the beam halo by a bent crystal should enhance the collimation efficiency in hadron colliders, such as LHC.

Beam Dynamics in High-intensity Linacs

TUO3A03 09:40 **Equipartition, Reality or Swindle?** – ***J.-M. Lagniel*** *(GANIL)*

By way of introduction to a general discussion on space-charge induced energy equipartition (EQP), the following questions will be tackled: Why the formula presently used to define EQP is wrong? Why energy exchanges can occur although the EQP rule is respected? Why safe tunings can be find although the EQP rule is not respected? Why EQP is a swindle for a large majority of our accelerated beams? Why LINAC designers nevertheless like to use the EQP rule?

18-Sep-12 10:50 – 12:30	Oral	Ballroom

TUO1B — Working Group-A&C

Chair: H.W. Zhao (IMP)

Beam Dynamics in High-intensity Circular Machines

TU01B01 10:50 **Beam Loss Due to Foil Scattering in the SNS Accumulator Ring** – ***J.A. Holmes*** *(ORNL), M.A. Plum (ORNL)*

The Spallation Neutron Source is now operating in production mode at about 1 MW of beam power on target, which corresponds to more than 10^{14} protons per pulse at 60 Hz with energies exceeding 900 MeV. Although overall beam losses in production tune are low, the highest losses in the entire machine occur in the region downstream of the ring injection stripper foil. In order to better understand the contribution of scattering from the primary stripper foil to losses in the SNS ring, we have carried out calculations using the ORBIT Code aimed at evaluating these losses. These calculations indicate that the probability of beam loss within one turn following a foil hit is ~$1.7 \cdot 10^{-8}$*T, where T is the foil thickness in g/cm^2, assuming a carbon foil. Thus, for a stripper foil of thickness T = 390 g/cm^2, the probability of loss within one turn of a foil hit is ~$6.7 \cdot 10^{-6}$. This paper describes the calculations used to arrive at this result, presents the distribution of these losses around the SNS ring, and compares the the calculated loss distribution with that observed experimentally.

Accelerator System Design, Injection, Extraction, Beam-material Interaction

TU01B02 11:10 **Injection Design for Fermilab Project X** – ***D.E. Johnson*** *(Fermilab)*

Fermilab is proposing a staged approach for Project X, a high power proton accelerator system. The first stage of this project will be to construct a 1 GeV CW H^- superconducting linear accelerator to inject into the existing 8 GeV Booster synchrotron ultimately providing in excess of 1 MW beam power for the Neutrino program out of the Main Injector. We will discuss the current project plans for injection into the Booster and related issues.

TU01B03 11:30 **Study of Intense Beam Injection and Extraction of Heavy Ion Synchrotron** – ***Y.J. Yuan*** *(IMP), W.P. Chai, J. Li, P. Li, R.S. Mao, J.W. Xia, J.C. Yang, X.D. Yang, H.W. Zhao (IMP)*

Experiments for physics research of RIB demands adequate particles stored and accelerated during limited experiment period. For Heavy Ion Research Facility at Lanzhou (HIRFL), the intensity of beam from injector cyclotrons is weak compared to Linac injectors, especially for heavy nuclei. The study to obtain intense heavy ion beam at HIRFL-CSRm synchrotron is presented here. The accelerated intense heavy ion beam is extracted by single turn extraction to hit the RIB production target or directly be transferred to HIRFL-CSRe experimental storage ring, or by 1/3 resonant slow extracted for external target experiments. The up to 10,000 s long period slow extraction is realized.

TU01B04 11:50 **Beam Loss Control for the Fermilab Main Injector** – ***B.C. Brown*** *(Fermilab)*

From 2005 through 2012,the Fermilab Main Injector provided intense 120 GeV protons to produce neutrino beams and antiprotons. Hardware improvements in conjunction with improved diagnostics allowed the system to reach operation at ~400 kW beam power. Losses were at or near injection energy where 95% beam transmission results in about 1.5 kW of beam loss. By minimizing and localizing loss, residual radiation levels fell while beam power was doubled. Lost beam was directed to either the collimation system or to the beam abort. Critical apertures were increased while improved instrumentation allowed optimal use of available apertures. We will summarize the impact of various loss control tools and the status and trends in residual radiation in the Main Injector.

TU01B05 12:10 **The Design and Commissioning of the Accelerator System of the Rare Isotope Reaccelerator - ReA3 at Michigan State University** – ***X. Wu*** *(FRIB), B. Durickovic, M.J. Syphers, W. Wittmer (FRIB) A. Lapierre, D. Leitner, G. Perdikakis, J.A. Rodriguez, S. Schwarz (NSCL)*

The National Superconducting Cyclotron Laboratory (NSCL) at Michigan State University (MSU) is currently constructing its new rare isotope reaccelerator facility: ReA3, which will provide unique low-energy rare isotope beams by stopping fast rare isotopes in gas stopping systems, boosting the charge state in an Electron Beam Ion Trap (EBIT) and reaccelerating them in a superconducting linac. The rare isotope beams will be producted intially by Coupled Cyclotron Facility (CCF) at NSCL and later by Facility for Rare Isotope Beams (FRIB), currently being designed and constructed at MSU. The accelerator system consists of a Low Energy Beam Transport (LEBT), a room temperature RFQ and a linac utilizing superconducting QWRs. An achromatic High Energy Beam Transport (HEBT) will deliver the reaccelerated beams to the mutiple target stations. Beams from ReA3 will range from 3 MeV/u for heavy nuclei such as uranium to about 6 MeV/u for ions with A<50. The commissioning of the EBIT, RFQ and two cryomodules of the linac is currently underway. The ReA3 accelerator system design and status of commissioning will be presented.

18-Sep-12 10:50 – 12:30	Oral	Meeting Room 3

TUO3B — Working Group-B

Chair: S. Fu (IHEP)

Beam Dynamics in High-intensity Linacs

TUO3B01 10:50 **Beam Dynamics Design of ESS Warm Linac** – ***M. Comunian*** *(INFN/LNL)*

In the present design of the European Spallation Source (ESS) accelerator, the Warm Linac will accelerate a pulsed proton beam of 50 mA peak current from source at 0.075 MeV up to 80 MeV. Such Linac is designed to operate at 352.2 MHz, with a duty cycle of 4% (3 ms pulse length, 14 Hz repetition period).In this paper the main design choices and the beam dynamics studies for the source up to the end of DTL are shown.

TUO3B02 11:10 **Beam Dynamics of the ESS Superconducting Linac** – ***M. Eshraqi*** *(ESS)*

The European Spallation Source, ESS, uses a linear accelerator to deliver the high intensity proton beam to the target station. The nominal beam power is 5 MW at an energy of 2.5 GeV. The superconducting part covers more than 95% of the energy gain and 90% of the length. The beam dynamics criteria applied to the design of the superconducting part of the linac including the frequency jump at a medium energy of 200 MeV as well as the beam dynamics performance of this structure are described in this paper.

TUO3B03 11:30 **Linac4 Beam Dynamics and Commissioning Strategy** – ***J.-B. Lallement*** *(CERN), G. Bellodi, A.M. Lombardi, P.A. Posocco (CERN)*

Linac4 is a 160 MeV H^- ion linear accelerator, presently under construction, which will replace the 50 MeV Linac2 as injector of the CERN proton complex. Linac4 is a 90 m long normal-conducting Linac made of a 3 MeV Radio Frequency Quadrupole (RFQ) followed by a 50 MeV Drift Tube Linac (DTL), a 100 MeV Cell-Coupled Drift Tube Linac (CCDTL) and a Pi-Mode Structure (PIMS). Starting in 2013, five commissioning stages, interlaced with installation periods, are foreseen at the energies of 3, 12, 50, 100 and 160 MeV. In addition to the diagnostics permanently installed in the Linac, temporary measurement benches will be located at the end of each structure and will be used for beam commissioning. Comprehensive beam dynamics simulations were carried out through the Linac and the diagnostic benches to define a commissioning procedure, which is summarised in this paper. In particular, we will present a method for emittance reconstruction from profile measurements which keeps into account the effects of space charge and finite diagnostics resolution.

September 18

TUO3B04 11:50 **Beam Dynamics of the CSNS Linac** – ***J. Peng*** *(IHEP), S. Fu, H.C. Liu, X. Yin (IHEP)*

The China Spallation Neutron Source (CSNS) will use a linear accelerator delivering a 30 mA beam up to 80 MeV for injection into a rapid cycling synchrotron. Since each section of the linac was determined individually, a global optimization based on end-to-end simulation has refined some design choices, including the drift-tube linac (DTL) and medium energy beam transport (MEBT). The simulation results and reasons for adjustments are presented in this paper.

TUO3B05 12:10 **Beam Dynamics of the 13 MeV/50 mA Proton Linac for the Compact Pulsed Hadron Source at Tsinghua University** – ***Q.Z. Xing*** *(TUB), C. Jiang, C.-X. Tang, H.Y. Zhang, S.X. Zheng (TUB) X.L. Guan (Tsinghua University) G.H. Li (NUCTECH)*

We present the start-to-end simulation result on the high-current proton linac for the Compact Pulsed Hadron Source (CPHS) at Tsinghua University. The CPHS project is a university-based proton accelerator platform (13 MeV, 16 kW, peak current 50 mA, 0.5 ms pulse width at 50 Hz) for multidisciplinary neutron and proton applications. The 13 MeV proton linac contains the ECR ion source, LEBT, RFQ, DTL and HEBT. The function of the whole accelerator system is to produce the proton beam, accelerate it to 13 MeV, and deliver it to the target where one uniform round beam spot is obtained with the diameter of 5 cm.

18-Sep-12 14:00 – 16:30	Oral	Ballroom

TUO1C — Working Group-E

Chair: R. Dölling (PSI) & N. Hayashi (J-PARC)

Beam Diagnostics and Instrumentation for High-intensity Beam

TUO1C01 14:00 **Recent Developments on High Intensity Beam Diagnostics at SNS.** – ***W. Blokland*** *(ORNL)*

The Spallation Neutron Source Ring accumulates 0.6 μs long proton bunches of up to $1.6{\cdot}10^{14}$ protons with a typical peak current of over 50 A during a 1 ms cycle. To qualify the beam, we perform different transverse profile measurements that can be done at full intensity. The electron beam scanner performs a non-invasive measurement of the transverse and longitudinal profiles of the beam in the ring. Electrons passing over and through the proton beam are deflected and projected on a fluorescent screen. Analysis of the projection yields the transverse profile while multi transverse profiles offset in time yield the longitudinal profile. Progress made with this system will be discussed as well as temperature measurements of the stripping foil and other transverse measurements.

TUO1C02 14:20 **Online Monitoring System for the Waste Beam in the 3 GeV RCS of J-PARC** – ***P.K. Saha*** *(JAEA/J-PARC), H. Harada, S. Hatakeyama, N. Hayashi, H. Hotchi, K. Yamamoto, M. Yoshimoto (JAEA/J-PARC)*

We have established two independent methods for monitoring the waste beam of only about 0.4% in the 3 GeV Rapid Cycling Synchrotron of the Japan Proton Accelerator. Although using conventional monitor systems, the measurement technique made it possible for clearly measuring such a waste beam even with significantly low error. One of the method uses a current transformer to measure the waste beam as a whole, while the other one uses a multi-wire profile monitor for clearly measuring beam profiles of both un-stripped and partially stripped components of the waste beam. While the raw signal measured by a CT (current transformer) contains a large noise, an FFT (Fast Fourier Transformation) analysis made it possible to clearly identify the beam signal corresponding to the frequency of the intermediate pulse. The waste beam was measured to be (0.38±0.03)%. Being non destructive, the 1st method is efficiently operating for online monitoring of the waste beam during the RCS user operation so as to directly know the the stripper foil condition and would have great importance for higher power operation.

TUO1C03 14:40 **The Beam Diagnostics of CSNS** – ***T.G. Xu*** *(IHEP)*

CSNS project is in the construction stage. The overview of CSNS beam diagnostics is presented which includes linac, RCS and both transport beam line. also some predevelopment of CSNS beam diagnostics is presented.

TUO1C04 15:30 **Detection of 'Unidentified Falling Objects' at LHC** – ***E. Nebot Del Busto*** *(CERN), F.V. Day, B. Dehning, E.B. Holzer, A. Lechner, R. Schmidt, J. Wenninger, C. Zamantzas, M. Zerlauth, F. Zimmermann (CERN) T. Baer (University of Hamburg) M. Hempel (BTU)*

About 3600 Ionization Chambers are located around the LHC ring to detect beam losses that could damage the equipment or quench superconducting magnets. The BLMs integrate the losses in 12 different time intervals (from 40 μs to 83.8 s) allowing for different abort thresholds depending on the duration of the loss and the beam energy. The signals are also recorded in a database at 1 Hz for offline analysis. Since the 2010 run, a limiting factor in the machine availability occurred due to unforeseen sudden losses appearing around the ring on the ms time scale. Those were detected exclusively by the BLM system and they are the result of the interaction of macro-particles, of sizes estimated to be 1-100 microns, with the proton beams. In this document we describe the techniques employed to identify such events as well as the mitigations implemented in the BLM system to avoid unnecessary LHC downtime.

TUO1C05 15:50 **Measurements and Interpretation of the Betatron Tune Spectra of High Intensity Bunched Beam in the SIS18** – ***R. Singh*** *(GSI), O. Boine-Frankenheim, O. Chorniy, P. Forck, W. Kaufmann, P. Kowina, K. Lang (GSI) T. Weiland (TEMF, TU Darmstadt)*

The paper presents the status of the transverse tune measurements in the synchrotron SIS18 at GSI. Presently, there are two systems for tune measurements in operation in the SIS18, namely TOPOS (Tune, Orbit and POsition measurement System) and BBQ (Base Band tune measurement system). The first one is a digital system where the BPM signal is digitized and the bunch position is calculated numerically. The second system is an analog system, where the transverse bunch motion is detected using peak detector. Band limited noise and chirp excitations were used to excite the betatron oscillations. Measurements of the betatron tune spectra were done at injection energy at medium and high intensities. In the frequency spectra a number of peaks around the position of betatron tune were seen. The peaks can be attributed to different bunch head-tail modes which were observed in time domain. These modes were dependent on the beam intensity. In this paper we compare the tune spectra measured at high beam intensity with the theoretical model for the space charge affected head-tail modes.

TUO1C06 16:10 **Instrumentation Developments and Beam Studies for the Fermilab Proton Improvement Plan Linac Upgrade and New RFQ Front-End** –

V.E. Scarpine *(Fermilab), D.S. Bollinger, K.L. Duel, N. Eddy, P.R. Karns, W. Pellico, C.-Y. Tan, R.E. Tomlin (Fermilab)*

Fermilab is developing a Proton Improvement Plan (PIP) to increase throughput of it's the proton source. The plan addresses hardware modifications to increase repetition rate and improve beam loss while ensuring viable operation of the proton source through 2025. The first phase of the PIP will enable the Fermilab proton source to deliver $1.8 \cdot 10^{17}$ protons per hour by mid-2013. As part of this initial upgrade, Fermilab plans to install a new front-end consisting of dual H^- ion sources and a 201 MHz pulsed RFQ. This talk will present beam studies measurements of this new front-end as well as present new beam instrumentation upgrades for the Fermilab linac.

September 18

TUO3C — Working Group-D

Chair: Y. Sato (KEK)

Commissioning, Operations and Performance

TUO3C01 14:00 **Beam Losses at LHC and its Injector** – ***L. Ponce*** *(CERN)*

After two years of operation pushing the beam parameters (number of bunches, bunch peak intensity, emittances, β^*), we gained substantial experience on the different beam loss mechanisms observed in the LHC all along the beam cycle. Some of these mechanisms were expected like beam losses during injection process and from the collisions. Other mechanisms have been discovered with the higher intensities like beam losses due to UFOs and beam instabilities. Mitigations actions had to be put in place to allow efficient operation. This talk will address the different types of losses (operational beam losses, equipment failure and transient beam losses) as seen in the LHC and in the beam transfer from SPS to LHC.

TUO3C02 14:20 **FNAL Proton Source High Intensity Operations and Beam Loss Control** – ***F.G.G. Garcia*** *(Fermilab), W. Pellico (Fermilab)*

The Proton Source (PS) has been the workhorse of the Fermi National Accelerator Laboratory (FNAL) for over 40 years. During that time the United States High Energy Physics program has continued to change with increasing demands put on the PS. The past 10 years saw an increase of over 10 fold in required hourly flux for the PS and plans are now underway to have the capability to double the output with continued operations until at least 2025. To meet these goals, effort in area of beam loss control has been a major part of the upgrades. Beam collimation and absorption systems as well as diagnostics used to mitigate and control losses have been implemented. The recent implementation of new correctors for orbit and higher harmonic control has also been very beneficial. A summary of recent and planned modification to these PS systems will be discussed.

TUO3C03 14:40 **Characterizing and Controlling Beam Losses at the LANSCE Facility** – ***L. Rybarcyk*** *(LANL)*

The Los Alamos Neutron Science Center (LANSCE) currently provides 100-MeV H^+ and 800-MeV H^- beams to several user facilities that have distinct beam requirements, e.g. intensity, micropulse pattern, duty factor, etc.. Minimizing beam loss is critical to achieving good performance and reliable operation, but can be challenging in the context of simultaneous multi-beam delivery. This presentation will discuss various aspects related to the observation, characterization and minimization of beam loss associated with normal production beam operations.

TUO3C04 15:30 **Beam Loss Mitigation in the Oak Ridge Spallation Neutron Source** – ***M.A. Plum*** *(ORNL)*

The Oak Ridge Spallation Neutron Source (SNS) accelerator complex routinely delivers 1 MW of beam power to the spallation target. Due to this high beam power, understanding and minimizing the beam loss is an ongoing focus area of the accelerator physics program. In some areas of the accelerator facility the equipment parameters corresponding to the minimum loss are very different from the design parameters. In this presentation we will summarize the SNS beam loss measurements, the methods used to minimize the beam loss, and a compare the design vs. the loss-minimized equipment parameters.

TUO3C05 15:50 **Beam Commissioning Plan for CSNS Accelerators** – ***S. Wang*** *(IHEP), S. Fu, H.C. Liu, H.F. Ouyang, J. Peng, T.G. Xu (IHEP)*

The China Spallation Neutron Source (CSNS) is now under construction, and the beam commissioning of ion source will start from the end of 2013, and will last several years for whole accelerator. The commissioning plan for CSNS accelerators will be presented in the presentation, including the commissioning correlated parameters, the goal at different commissioning stages and some key commissioning procedures for each part of accelerators. The detailed schedule for commissioning will be also given.

TUO3C06 16:10 **The Result of Beam Commissioning in J-PARC 3-GeV RCS** – ***H. Harada*** *(JAEA/J-PARC), N. Hayashi, H. Hotchi, M. Kinsho, P.K. Saha, Y. Shobuda, F. Tamura, K. Yamamoto, M. Yamamoto, M. Yoshimoto (JAEA/J-PARC) Y. Irie (KEK) S. Kato (Tohoku University, Graduate School of Science)*

J-PARC 3-GeV RCS has started the beam commissioning since Oct. 2007. In the beam commissioning, the beam tuning for basic parameters and high-intensity operation has been continuously performed. This presentation will describe the results of the beam-loss reduction and minimization for high-intensity operation.

19-Sep-12 09:00 – 10:20	Oral	Ballroom

WEO1A — Working Group-A

Chair: E. Métral (CERN)

Beam Dynamics in High-intensity Circular Machines

WEO1A01 09:00 **Impedance Studies of 2D Azimuthally Uniform Devices for low Energy Machines** – ***N. Biancacci*** *(CERN), E. Métral, B. Salvant (CERN) M. Migliorati, L. Palumbo (URLS) V.G. Vaccaro (Naples University Federico II and INFN)*

In circular accelerators, the beam quality can be strongly affected by the self-induced electromagnetic fields excited by the beam in the passage through the elements of the accelerator. The beam coupling impedance quantifies this interaction and allows predicting the stability of the dynamics of high intensity, high brilliance beams. The coupling impedance can be evaluated with finite element methods or using analytical methods, such as Field Matching or Mode Matching. In this paper we present an application of the Mode Matching technique for an azimuthally uniform structure of finite length: a cylindrical cavity loaded with a toroidal slab of lossy dielectric, connected with cylindrical beam pipes. In order to take into account the finite length of the structure, with respect to the infinite length approximation, we decompose the fields in the cavity into a set of orthonormal modes. We obtain a complete set of equations using the magnetic field matching and the non-uniform convergence of the electric field on the cavity boundaries. We present benchmarks done with CST Particle Studio simulations and existing analytical formulas, pointing out the effect of finite length.

WEO1A02 09:20 **LHC Impedance Model: Experience with High Intensity Operation in the LHC** – ***B. Salvant*** *(CERN), O. Aberle, G. Arduini, R.W. Assmann, V. Baglin, M.J. Barnes, P. Baudrenghien, A. Bertarelli, C. Bracco, R. Bruce, F. Carra, F. Caspers, G. Cattenoz, S.D. Claudet, H.A. Day, J. Esteban Muller, M. Garlasché, L. Gentini, B. Goddard, A. Grudiev, B. Henrist, S. Jakobsen, G. Lanza, L. Lari, T. Mastoridis, N. Mounet, E. Métral, A.A. Nosych, J.L. Nougaret, A.M. Piguiet, S. Redaelli, F. Roncarolo, G. Rumolo, B. Salvachua, M. Sapinski, E.N. Shaposhnikova, L.J. Tavian, M.A. Timmins, J.A. Uythoven, A. Vidal, R. Wasef, D. Wollmann (CERN) S. Persichelli (Rome University La Sapienza)*

The CERN Large Hadron Collider (LHC) is now in luminosity production mode and has been pushing its performance in the past months by increasing the proton beam brightness, the collision energy and the machine availability. As a consequence, collective effects have started to become more and more visible and have effectively slowed down the performance increase of the machine. Among these collective effects, the interaction of brighter LHC bunches with the longitudinal and transverse impedance of the machine has been observed to generate beam induced heating and transverse instabilities since 2010. This contribution reviews the current LHC impedance model obtained from theory, simulations and bench measurements as well as a selection of measured effects with the LHC beam.

WEO1A03 09:40 **Resistive-wall Instability in the CSNS/RCS** – ***L. Huang*** *(IHEP), Y.D. Liu, S. Wang (IHEP)*
Rapid Cycling Synchrotron (RCS) of the China Spallation Neutron Source (CSNS) is a high intensity proton accelerator, with average beam power of 100kW. The collective effects caused by the coupling impedance may be the limit to beam power. The impedance estimation for components on beam line shows that the resistive wall impedance and its instability are more serious than any others. Based on the impedance budget, the instability is theoretically estimated. A simple resistive wall wake field model is used to simulate the bunch oscillation and obtain the growth rate. In this simulation model, the continuous resistive wall wake field is concentrated to one position in the ring and the long bunch is sliced into many micro-bunches. By tracking the dynamics of the macro-bunches, the transverse growth rates are obtained in 100kW and 200kW beam power, respectively. The simulation results are also confirmed the restriction to instability by natural chromaticity.

WEO1A04 10:00 **Review of Longitudinal Instabilities in the SPS and Beam Dynamics Issues with High Harmonic RF Systems in Accelerators** – ***E.N. Shaposhnikova*** *(CERN), T. Argyropoulos, T. Bohl, J. Esteban Muller, H. Timko (CERN)*
Even after a successful impedance reduction programme which eliminated the microwave instability in the SPS another longitudinal instability is still one of the main intensity limitations. It is observed during acceleration ramp for both single bunch and multibunch beams at intensities below the nominal LHC intensity. With the lower transition energy of the new SPS optics, under intensive studies now, the thresholds are increased. However, even in this case the operation of the 4th harmonic RF system is required for stability of the nominal beams. To cope with the higher intensity beams required for the future High Luminosity LHC an upgrade program for both RF systems is under way. The results of studies of the parameter space required for beam stability are presented and compared with operation modes of double RF systems in other accelerators.

19-Sep-12 09:00 – 10:20	Oral	Meeting Room 3

WEO3A — Working Group-C

Chair: H.W. Zhao (IMP)

Accelerator System Design, Injection, Extraction, Beam-material Interaction

WEO3A01 09:00 **High Energy Electron Cooling** – ***V.B. Reva*** *(BINP SB RAS), M.I. Bryzgunov, V.M. Panasyuk, V.V. Parkhomchuk (BINP SB RAS)*

The electron cooler of a 2 MeV for COSY storage ring FZJ is assembled in BINP. This paper describes the first experimental results from the electron cooler with electron beam and high voltage. The cooling section is designed on the classic scheme of low energy coolers like cooler CSRm, CSRe, LEIR that was produced in BINP before. The electron beam is transported inside the longitudinal magnetic field along whole trajectory from an electron gun to a collector. This optic scheme is stimulated by the wide range of the working energies 0.1(0.025)-2 MeV. The electrostatic accelerator consists of 34 individual unify section. Each section contains two HV power supply (±30 kV) and power supply of the magnetic coils. The electrical power to each section is provided by the cascade transformer. The cascade transformer is the set of the transformer connected in series with isolating winding.

WEO3A02 09:20 **Beam Loss and Collimation in the ESS Linac** – ***R. Miyamoto*** *(ESS), H. Danared, M. Eshraqi, A. Ponton, L. Tchelidze (ESS) I. Bustinduy (ESS Bilbao) H.D. Thomsen (ISA)*

The European Spallation Source (ESS), to be built in Lund, Sweden, is a spallation neutron source based on a 5 MW proton linac. A high power proton linac has a tight tolerance on beam losses to avoid activation of its components and it is ideal to study patterns of the beam loss and prepare beam loss mitigation schemes at the design stage. This paper presents simulations of the beam loss in the ESS linac as well as beam loss mitigation schemes using collimators in beam transport sections.

WEO3A03 09:40 **Extraction, Transport and Collimation of the PSI 1.3 MW Proton Beam** – ***D. Reggiani*** *(PSI)*

With an average operating beam power of 1.3 MW the PSI proton accelerator complex is currently leading the race towards the high intensity frontier of particle accelerators. This talk gives an overview of the extraction of the 590 MeV beam from the ring cyclotron and its low loss transport to the meson production targets M and E as well as to the SINQ spallation neutron source. Particular regard is given to the collimator system reshaping the beam which leaves the 40 mm thick graphite target E before reaching SINQ. Since 2011, up to 8 second long beam macro-pulses are regularly diverted to the new UCN spallation source by means of a fast kicker magnet. The switchover from the SINQ to the UCN beam line as well as the smooth beam transport up to the UCN spallation target constitute the subject of the last part of the talk.

WEO3A04 10:00 **Current and Planned High Proton Flux Operations at the FNAL Booster**

– ***F.G.G. Garcia*** *(Fermilab), W. Pellico (Fermilab)*

The Fermi Lab Proton Source has seen a dramatic increase in requested flux this past decade. An increase of over ten fold in hourly flux was necessary to meet the FNAL HEP experimental requirements. This next decade will be just as challenging as the lab's HEP planning will again require the Proton Source to double the hourly flux. The recent achievements were accomplished with major upgrades such a collimation system, new correctors and aperture improvements. To achieve the next level of proton delivery rates will require even more improvements. A five year Proton Improvement Plan (PIP) is currently underway with a goal to maintain 2012 activation levels while doubling the hourly flux. Tasks in the PIP to help reduce losses include an improved beam notching system, cogging, aperture improvement and beam emittances control and reduction. This talk will describe current conditions and plans to mitigate losses with the planned increase in proton throughput.

19-Sep-12 10:50 – 12:30	Oral	Ballroom

WEO1B — Working Group-A

Chair: E. Métral (CERN)

Beam Dynamics in High-intensity Circular Machines

WEO1B01 10:50 **Low Gamma Transition Optics for the SPS Simulation and Experimental Results for High Brightness Beams** – ***H. Bartosik*** *(CERN), G. Arduini, T. Argyropoulos, T. Bohl, K. Cornelis, J. Esteban Muller, W. Höfle, Y. Papaphilippou, G. Rumolo, B. Salvant, F. Schmidt, E.N. Shaposhnikova, H. Timko (CERN) A.Y. Molodozhentsev (KEK)*

The single bunch transverse mode coupling instability (TMCI) at injection is presently the major intensity limitation for LHC beams in the SPS. A new optics for the SPS with lower transition energy yields an almost 3-fold increase of the slip factor at injection energy and thus a significantly higher TMCI threshold, as demonstrated both in simulations and in experimental studies. It is observed furthermore that the low gamma transition optics yields better longitudinal stability during acceleration. In addition, simulations predict a higher threshold for the electron cloud driven single bunch instability, which is expected to become an important limitation for high intensity LHC beams with the nominal 25ns bunch spacing. This contribution gives a summary of the experimental and simulation studies, addressing also space charge effects and the achievable brightness with high intensity single bunch beams.

WEO1B02 11:10 **Optics Design Optimization for IBS Dominated Beams** – ***F. Antoniou*** *(CERN), Y. Papaphilippou (CERN) M.T.F. Pivi (SLAC)*

Intra-beam scattering is a small angle multiple Coulomb scattering effect, leading to emittance growth. It becomes important for high brightness beams in low emittance lepton rings, but also hadron synchrotrons and ring colliders. Several theoretical models have been developed over the years, however, when the IBS becomes predominant, the divergence between the models becomes important. In addition, the theoretical models are based on the consideration of Gaussian beams and uncoupled transverse motion. Recently, two multi-particle tracking codes have been developed, in order to enable the understanding of the IBS influence on the beam distribution and the inclusion of coupling. The comparison between theoretical models in different lattices and different regimes is discussed here and the benchmarking of the theoretical models with the tracking codes is presented. Finally, first measurement results are presented in low emittance rings and hadron synchrotrons.

WEO1B03 11:30 **Space Charge Suppression for Flat Beams** – ***A.V. Burov*** *(Fermilab) Y.S. Derbenev (JLAB)*

Benefits and problems for operation with flat beams are discussed.

WEO1B04 11:50 **Scaling Properties of Resonance Crossing in Non-scaling FFAGs** – ***S.-Y. Lee*** *(Indiana University) K.Y. Ng (Fermilab)*

The effects of resonances on high power hadron accelerators are explored. These resonances include systematic space-charge resonances, third-order resonance, and other weak random resonances that are often present in FFAG and other RCS accelerators. The distortion of invariant torus during resonance crossing is used to set limit on emittance growth or fraction of particle trapped. The critical resonance strength in the ring lattice is determined from a simple scaling law derived as a function of the tune-ramp rate and initial emittance. Such scaling law can be useful in the evaluation of the performance in high power accelerators.

WEO1B05 12:10 **PTC-ORBIT Studies for the CERN LHC Injectors Upgrade Project** – ***A.Y. Molodozhentsev*** *(KEK) G. Arduini, H. Bartosik, E. Benedetto, C. Carli, M. Fitterer, V. Forte, S.S. Gilardoni, M. Martini, E. Métral, F. Schmidt, R. Wasef (CERN)*

The future improvement of the beam brilliance and intensities required in the frame of the LIU (LHC Injectors Upgrade) project to reach the demands of the HL-LHC (High-Luminosity LHC) project triggered a comprehensive study of the combined effects of the space charge and the machine resonances for the CERN synchrotrons, which are the injector chain for LHC. In frame of this report we will summarize new features of the PTC-ORBIT code which allow the beam dynamics modeling in the LHC injectors taking into account the time variation of the machine parameters during the injection process. The measurements, obtained during recent MD companies, and simulations for the low-energy high-intensity beams, will be discussed.

19-Sep-12 10:50 – 12:30	Oral	Meeting Room 3

WEO3B — Working Group-B

Chair: P.A.P. Nghiem (CEA/DSM/IRFU)

Beam Dynamics in High-intensity Linacs

WEO3B01 10:50 **FRIB Accelerator Beam Dynamics Design and Challenges** – ***Q. Zhao*** *(NSCL) A. Facco, F. Marti, E. Pozdeyev, M.J. Syphers, J. Wei, X. Wu, Y. Yamazaki, Y. Zhang (FRIB)*

The Facility for Rare Isotope Beams (FRIB) will be a new national user facility for nuclear science. This cw, high power, superconducting (SC), heavy ion driver linac consists of a frontend to provide various highly charged ions at 0.5 MeV/u, three SC acceleration segments connected by two 180^{o} bending systems to achieve an output beam energy of ≥200 MeV/u for all varieties of stable ions, and a beam delivery system to transport multi-charge-state beams to a fragmentation target at beam power of up to 400 kW. The linac utilizes four types of low-beta resonators with one frequency transition from 80.5 to 322 MHz after Segment 1, where ion charge state(s) is boosted through a stripper at ≤20 MeV/u. The beam dynamics design challenges include simultaneous acceleration of multi-charge-state beams to meet beam-on-target requirements, efficient acceleration of high intensity, low energy heavy ion beams, limitation of uncontrolled beam loss to <1 W/m, accommodation of multiple charge stripping scenarios, etc. We present the recent optimizations on linac lattice, the results of end-to-end beam simulations with machine errors, and the simulation of beam tuning and fault conditions.

WEO3B02 11:10 **Acceleration and Transport of Multi-Charges Ions through EBIS Pre-injector** – ***D. Raparia*** *(BNL)*

A new heavy ion pre-injector at Brookhaven National Laboratory consist of an electron Beam Ion Source (EBIS), RFQ and IH Linac and a short transport line. This pre-injector provide any ion Helium to Uranium at energy of 2 MeV/u for Relativistic Heavy Ion Collider (RHIC) and the NASA Space Radiation Laboratory (NSRL). EBIS produces multiple charge states of an ion of interested. These charge states are accelerated through RFQ (300 keV/u) and IH Linac (2 MeV/u) and transported to booster. Charge desecration occurs just before the injection into the booster. This paper discusses implication of acceleration and transports of multiple charge state ions.

September 19

WE03B03 11:30 **PXIE at FNAL** – ***N. Solyak*** *(Fermilab), S.D. Holmes, V.A. Lebedev, S. Nagaitsev, A.V. Shemyakin (Fermilab)*

PXIE is the integrated systems test for the Project X frontend. It is expected to accelerate 1-2 mA CW beam up to 30 MeV. The major goal of the project is a validation of the Project X concept and elimination of technical risks. It is expected to be constructed in the period of 2012-2016. In presentation the conceptual design of the experimental test facility, lattice and beam dynamics studies will be discussed in details.

WE03B04 11:50 **RFQ Beam Dynamics Design for Large Science Facilities and Accelerator-Driven Systems** – ***C. Zhang*** *(IAP)*

Serving as the front-end structure for large science facilities and accelerator-driven systems, the Radio-Frequency Quadrupole (RFQ) accelerator needs to reach low beam losses, good beam quality, high reliability, and cost savings such design goals typically at high beam intensities. To address the challenges for realizing such modern RFQs, a new beam dynamics design technique characterized by a reasonable and efficient bunching process with balanced space-charge effects has been developed as an alternative to the classic Four-Section Procedure originally proposed by Los Alamos National Laboratory. For a better comparison between the two methods, some real projects will be presented as examples.

WE03B05 12:10 **Using Step-like Nonlinear Magnets for Beam Uniformization at IFMIF Target** – ***Z. Yang*** *(IHEP), J.Y. Tang (IHEP) N. Chauvin, P.A.P. Nghiem (CEA/DSM/IRFU)*

Uniform beam distribution and minimum beam halo on target are often required in high intensity beam applications to prolong the target lifetime, ease cooling and obtain better irradiation effect. In this report, step-like nonlinear magnets instead of standard multipole magnets have been studied for the application at IFMIF. Although the preliminary results are still below the very critical requirement of spot uniformity at the IFMIF target, they are quite permissive. The method demonstrates significant advantages over the conventional combination of octupole and duodecapole on very low beam loss, better uniformity and very low cost. Further studies are needed to fully meet the IFMIF specifications.

19-Sep-12 14:00 – 16:30	Oral	Ballroom

WEO1C — Working Group-A

Chair: J.A. Holmes (ORNL)

Beam Dynamics in High-intensity Circular Machines

WEO1C01 14:00 **Effect of Self-consistency on Periodic Resonance Crossing** – ***G. Franchetti*** *(GSI)*

In high intensity bunched beams resonance crossing gives rise to emittance growth and beam loss. Both these effects build up after many synchrotron oscillations. Up to now long term modeling have relied on frozen models neglecting the physics of self-consistency. We address here this issue and present the state of the art of simulations also applied to the SIS100.

WEO1C02 14:20 **Simulation and Measurement of Half Integer Resonance in Coasting Beams in the ISIS Ring, with a Summary of Some Related High Intensity Effects.** – ***C.M. Warsop*** *(STFC/RAL/ISIS), D.J. Adams, B. Jones, S.J. Payne, B.G. Pine, H. V. Smith, R.E. Williamson (STFC/RAL/ISIS)*

ISIS is the spallation neutron source at the Rutherford Appleton Laboratory in the UK. Operation centres on a high intensity proton synchrotron, accelerating $3{\cdot}10^{13}$ ppp from 70-800 MeV, at a repetition rate of 50 Hz. Present studies are looking at key aspects of high intensity behaviour with a view to increasing operational intensity, identifying optimal upgrade routes and understanding loss mechanisms. Of particular interest is the space charge limit imposed by half integer resonance: we present results from coasting beam experiments with the ISIS ring in storage ring mode, along with detailed 3D (ORBIT) simulations to help interpret observations. The methods for experimentally approaching resonance, and the implications on beam behaviour, measurement and interpretation are discussed. In addition, results from simpler 2D simulations and analytical models are used to help interpret expected beam loss and halo evolution. Plans and challenges for the measurement and understanding of this important beam loss mechanism are summarised, as are some closely related areas of high intensity work on ISIS.

WEO1C03 14:40 **Longitudinal Beam Loss Studies of the CERN PS-to-SPS Transfer** – ***H. Timko*** *(CERN), T. Argyropoulos, T. Bohl, H. Damerau, J. Esteban Muller, S. Hancock, E.N. Shaposhnikova (CERN)*

Bunch-to-bucket transfer between the Proton Synchrotron (PS) and the Super Proton Synchrotron (SPS) is required before beams can enter the Large Hadron Collider. The overall beam loss at this transfer is currently around 5-10 %, and is increased for higher intensities or larger longitudinal emittances. Previous attempts to reduce the losses with additional RF voltage from spare cavities in the PS were unsuccessful. In this paper, we modelled the complete PS flat-top bunch splitting and rotation manipulations, PS-to-SPS transfer, SPS flat bottom and acceleration ramp using end-to-end simulations. Starting from the measured bunch distributions, the simulations provide an accurate insight into the problem and allow direct benchmarking with experiments. As a result, it was understood and confirmed by measurements that shorter bunches do not necessarily lead to better transmission. The particle distribution in longitudinal phase space at PS extraction should be optimised instead. A significant loss reduction of up to 50 % is expected from simulations; experimental studies are on-going to verify these theoretical findings.

WEO1C04 15:30 **Acceleration of High-Intensity Protons in the J-PARC Synchrotrons** – ***M. Yoshii*** *(KEK)*

The J-PARC consisting of the 181 MeV Linac, the 3GeV rapid cycling synchrotron (RCS) and the 50 GeV main synchrotron (MR), is the first high intensity proton synchrotron facility to use the high field gradient magnetic alloy (MA) loaded accelerating cavity. MA is a low-Q material. However, because of the high permeability and the high saturation magnetic flux density, the MA cores are the only materials to realize the required gradient. The MA loaded cavity can be considered as a stable passive load. No tuning control is necessary. 11 RF systems are installed in the RCS, and 8 RF systems in the MR. In addition, the RCS RF systems are operated in a dual harmonic mode to perform the acceleration and the longitudinal manipulation of the high intensity beam in the RCS available space. Beam loading compensation is an important issue. The feedforward method using the RF beam signals from the wall current monitor has been established. The J-PARC synchrotrons realize stable, reproducible and clean acceleration of high intensity protons. A transition-free lattice and a precise digital timing system asynchronous to the AC-line are the distinctive features, which enable this achievement.

WEO1C05 15:50 **Longitudinal Space Charge Phenomena in an Intense Beam in a Ring** – ***R.A. Kishek*** *(UMD), B.L. Beaudoin, D.W. Feldman, I. Haber, T.W. Koeth, Y. Mo (UMD)*

The University of Maryland Electron Ring (UMER) uses nonrelativistic, high-current electron beams to access the intense space charge dynamics applicable to hadron beams. The UMER beam parameters correspond to space charge incoherent tune shifts, at injection, in the range of 1-5.5 integers. Longitudinal induction focusing is used to counteract the space charge force at the edges of a long rectangular bunch, confining the beam for 100s of turns. We report on two recent findings: (1) The formation and propagation of solitons from large amplitude longitudinal perturbations, observed experimentally and reproduced in WARP simulations. (2) The evolution of a longitudinal multi-streaming instability when the space-charge force is allowed to lengthen the bunch ends. The expanding bunch ends fill the ring, interpenetrate, and wrap repeatedly, forming multiple streams at any one location, each with its unique velocity. The resulting multi-stream instability is investigated over a wide range of beam currents and initial pulse lengths, and experimental observations are in good agreement with WARP simulations and an analytical theory that successfully predicts the onset of the instability.

WEO1C06 16:10 **Measurement and Strong-Strong Simulations of Beam-Beam Effects in LHC** – ***S. Paret*** *(LBNL), J. Qiang (LBNL) R. Alemany-Fernandez, R. Calaga, R. Giachino, W. Herr, D. Jacquet, G. Papotti, T. Pieloni, L. Ponce, M. Schaumann (CERN) R. Miyamoto (ESS)*

Beam-beam effects play an important role for the beam dynamics in LHC. Due to the high beam quality, beam-beam parameters exceeding the nominal value multiple times have been achieved. These effects will still be more important for the High Luminosity LHC. Dedicated experiments have been carried out to investigate these effects in LHC targeting both at effects due to colliding bunches long-range interactions. Computer simulations provide additional insights into the beam dynamics under experimental conditions taking advantage of a full control of the beam parameters and of the fact that they can be run independently of the accelerator. Various experimental setups have been simulated with the code BeamBeam3D, employing a strong-strong collision model. In this talk, results of these simulations are compared to experimental observations.

19-Sep-12 14:00 – 16:30	Oral	Meeting Room 3

WEO3C — Working Group-C

Chair: D. Li (LBNL) & N.V. Mokhov (FNAL)

Accelerator System Design, Injection, Extraction, Beam-material Interaction

WEO3C01 14:00 **Injection and Stripping Foil Studies for a 180 MeV Injection Upgrade at ISIS** – ***B. Jones*** *(STFC/RAL/ISIS), D.J. Adams, M.C. Hughes, S.J.S. Jago, B.G. Pine, H. V. Smith, C.M. Warsop, R.E. Williamson (STFC/RAL/ISIS)*

ISIS is the pulsed neutron and muon source, at the Rutherford Appleton Laboratory in the UK. A mean beam power of 0.2 MW, $3{\cdot}10^{13}$ protons per pulse, is delivered to target via a 70 MeV H– linac and an 800 MeV proton synchrotron at 50 Hz. Current upgrade studies at ISIS are focussed on a new 180 MeV injector which could increase intensity in the ring toward the 0.5 MW regime. This paper summarises studies of the injection process and designs for a new injection system. Benchmarked longitudinal and transverse beam dynamics simulations are used to optimise injection at 180 MeV. Detailed particle tracking through magnetic models of the injection region including stripping foil interactions are presented.

WEO3C02 14:20 **Collimation of Ion Beams** – ***I. Strašík*** *(GSI) O. Boine-Frankenheim (TEMF, TU Darmstadt)*

The SIS 100 synchrotron as part of the FAIR project at GSI will accelerate various beam species from proton to uranium. An important issue is to minimize uncontrolled beam losses using a collimation system. An application of the two-stage collimation concept, well established for proton accelerators, is considered for the fully-stripped ion beams. The two-stage system consists of a primary collimator (a scattering foil) and secondary collimators (bulky absorbers). The main tasks of this study are:

- to specify beam optics of the system,
- to calculate dependence of the scattering angle in the foil on the projectile species,
- to investigate importance of the inelastic nuclear interaction in the foil and
- to calculate dependence of the collimation efficiency on the projectile species.

A concept for the collimation of partially-stripped ions is based on the stripping of remaining electrons and deflecting using a beam optical element towards a dump location. Residual activation and radiation damage issues of collimator materials are also being studied at GSI. Experimental results from irradiation of carbon-based materials by heavy ions are presented.

WEO3C03 14:40 **Beam Halo Dynamics and Control with Hollow Electron Beams** – ***G. Stancari*** *(Fermilab)*

Experimental measurements of beam halo population and diffusion dynamics with collimator scans are reviewed. The concept of halo control with a hollow electron beam collimator, its demonstration at the Tevatron, and its possible applications at the LHC are discussed.

WEO3C04 15:30 **Long Baseline Neutrino Experiment (LBNE) Target Material Radiation Damage Studies Using Energetic Protons of the Brookhaven Linear Isotope Production (BLIP) Facility** – ***N. Simos*** *(BNL) P. Hurh, N.V. Mokhov (Fermilab)*

One of the future multi-MW accelerators is the LBNE Experiment where Fermilab plans to produce a beam of neutrinos with a 2.3 MW proton beam as part of a suite of experiments associated with ProjectX. Specifically, the LBNE Neutrino Beam Facility aims for a 2^{+} MW, 60-120 GeV pulsed,high intensity proton beam produced in the ProjectX accelerator intercepted by a low Z solid target to facilitate the production of low energy neutrinos. The multi-MW level LBNE proton beam will be characterized by intensities of the order of $1.6 \cdot 10^{+14}$ p/pulse, σ_{radius} of 1.5-3.5 mm and a 9.8 μs pulse length. These parameters are expected to push many target materials to their limit thus making the target design very challenging. Recent experience from operating high intensity beams on targets have indicated that several critical design issues exist namely thermal shock,heat removal, radiation damage,radiation accelerated corrosion effects,and residual radiation within the target envelope. A series of experimental studies on radiation damage and thermal shock response conducted at BNL and focusing on low-Z materials have unraveled potential issues regarding the damageability from energetic particle beams which may differ significantly from thermal reactor experience. Irradiation damage results for low-Z materials associated with the LBNE and other high power experiments will be presented.

WEO3C05 15:50 **Radiation Effect Modeling at Intensity Frontier: Status and Uncertainties** – ***N.V. Mokhov*** *(Fermilab)*

The next generation of accelerators for Mega-Watt proton, electron and heavy-ion beams, such as Project X, ESS and FAIR projects, puts unprecedented requirements on the predictive power and accuracy of the codes used to simulate particle interactions with accelerator components and targets. Status of the codes used by the community is described in the following categories: particle and nuclide production, electromagnetic interactions, instantaneous, transient and accumulated energy deposition effects, radiation damage and radiation shielding. Uncertainties in the code predictions are estimated in each of these categories. The needs for further code developments and for experimental data are identified.

WEO3C06 16:10 **Understanding Ion Induced Radiation Damage in Target Materials** – ***M. Tomut****, C. Trautmann (GSI)*

Successful operation of next generations of radioactive beam facilities depends on the target survival in conditions of intense radiation field and thermo-mechanical solicitations induced by the driving ion beam. Material property degradation due to ion- beam induced damage will limit target lifetime, either by affecting target performance or, by reducing the material resilience. Similar problems are faced by beam protection elements at LHC. Understanding the mechanism of radiation damage induced by ion beam in these materials provides valuable knowledge for lifetime prediction and for the efforts to mitigate performance degradation. On their way through the target material, energetic heavy ions induce a trail of ionizations and excitations, resulting in formation of ion tracks consisting of complex defect structures. We give a review on the ion-induced damage creation in high power target materials, on the structural and thermo-mechanical property degradation and on their recovery in high temperature irradiation experiments.

20-Sep-12 09:00 – 10:20	Oral	Ballroom

THO1A — Working Group-A

Chair: G. Franchetti (GSI)

Beam Dynamics in High-intensity Circular Machines

THO1A01 09:00 **Beam-Beam Effects in RHIC** – ***Y. Luo*** *(BNL), W. Fischer, C. Montag, S.M. White (BNL)*

In this article we will review the beam-beam effects in the Relativistic Heavy Ion Collider (RHIC). We will cover the experimental observations, beam-beam simulation techniques and results, and head-on beam-beam compensation with electron lenses. The next luminosity goal in the RHIC polarized proton operation is to double the luminosity with a higher proton bunch intensity. After the upgrade, the beam-beam parameter will reach 0.03. Head-on beam-beam compensation is aimed to reduce the beam-beam tune spread and non-linear beam-beam resonance driving terms.

THO1A02 09:20 **Effects of Magnetic Field Tracking Errors and Space Charge on Beam Dynamics at CSNS/RCS** – ***S.Y. Xu*** *(IHEP), N. Wang, S. Wang (IHEP)*

The China Spallation Neutron Source (CSNS) is an accelerator-based facility. It operates at 25 Hz repetition rate with an design beam power of 100 kW. CSNS consists of a 1.6-GeV Rapid Cycling Synchrotron (RCS) and a 80-MeV linac. The lattice of the CSNS/RCS is triplet based four-fold structure. The preferred working points of CSNS/RCS are (4.86, 4.78) which can avoid the major low-order structure resonances. But because of the chromatic tune shift, space-charge incoherent tune shift and the tune shift caused by magnetic field tracking errors between the quadrupoles and the dipoles, some structure resonances are unavoidable. The chromaticity, space charge effects and magnetic field tracking errors can also induce beta function distortion, and influence the transverse acceptance and the collimation efficiency of the collimation system. In this paper we show results of space-charge simulations introducing magnetic field tracking errors and discuss the combined effects of chromaticity, magnetic field tracking errors and space charge on the beam dynamics for CSNS/RCS.

TH01A03 09:40 **Dual-Harmonic Acceleration Studies at CSNS RCS** – ***J.F. Chen*** *(IHEP), J.Y. Tang, X. Zhang (IHEP)*

Dual harmonic acceleration is proposed to alleviate the space charge effects in the RCS (Rapid Cycling Synchrotron) at the upgrading stages of the CSNS (China Spallation Neutron Source). Different dual harmonic acceleration schemes have been studied by using a self-made parameter calculation code - RAMADH and the simulation code - ORBIT. Both complete and partial coverage of the dual harmonic RF system along the acceleration have been considered. The injection by combining beam chopping and off-momentum is used in the macro-particle tracking simulations by ORBIT. In addition, a new idea that unlocks the RF frequency and the magnetic field in the injection period is found very useful in obtaining a good longitudinal painting.

TH01A04 10:00 **High Intensity Longitudinal Dynamics Studies for an ISIS Injection Upgrade** – ***R.E. Williamson*** *(STFC/RAL/ISIS), C.M. Warsop (STFC/RAL/ISIS)*

ISIS is the world's most productive pulsed neutron and muon source, at the Rutherford Appleton Laboratory in the UK. Operation is centred on a loss-limited 50 Hz proton synchrotron which accelerates $3{\cdot}10^{13}$ protons per pulse from 70 MeV to 800 MeV, delivering a mean beam power of 0.2 MW. Recent upgrade studies at ISIS have centred on a new 180 MeV linac for injection into the existing ring offering the possibility of beam powers in the 0.5 MW regime through reduction in space charge and optimized injection. A central and critical aspect of such an upgrade is the longitudinal dynamics including beam stability, associated RF parameters, space charge levels and stringent requirements on beam loss. This paper outlines possible longitudinal injection schemes for the injection upgrade meeting key design requirements such as minimising halo, bunching factor and satisfying the Keil-Schnell-Boussard (KSB) stability criterion throughout acceleration. Details of simulation models including calculation of KSB are given together with associated assumptions. Latest results from studies to understand and confirm stability limits on ISIS via simulation and experiment are presented.

THO3A — Working Group-B

Chair: I. Hofmann (GSI)

Beam Dynamics in High-intensity Linacs

THO3A01 09:00 **High Intensity Aspects of J-PARC Linac, Including Re-commissioning After Earthquake** – ***M. Ikegami*** *(KEK)*

We had a massive earthquake in March 2011, which forced us to shutdown J-PARC accelerators for nearly nine months due to its resultant damages. After significant restoration effort, we resumed the beam operation of J-PARC linac in December 2011 and user operation in January 2012. Subsequently, we restored the same beam power as just before the earthquake in March 2012. In the course of the beam commissioning after the earthquake, we have experienced beam losses which were not observed before the earthquake. We discuss the experimentally observed beam losses and its comparison with particle simulations.

THO3A02 09:20 **Beam Dynamics of China ADS Linac** – ***Z. Li*** *(Private Address) P. Cheng, H. Geng, Z. Guo, C. Meng, B. Sun, J.Y. Tang, F. Yan (IHEP)*

An ADS study program is approved by Chinese Academy of Sciences at 2011, which aims to design and built an ADS demonstration facility with the capability of more than 1000 MW thermal power within the following 25 years. The 15 MW driver accelerator will be designed and constructed by the Institute of High Energy Physics (IHEP) and Institute of Modern Physics (IMP) of China Academy of Sciences. This linac is characterized by the 1.5 GeV energy, 10 mA current and CW operation. It is composed by two parallel 10 MeV injectors and a main linac integrated with fault tolerance design. The superconducting acceleration structures are employed except the RFQ. The general considerations and the beam dynamics design of the driver accelerator will be presented.

THO3A03 09:40 **Simulations and Measurements in High Intensity LEBT with Space Charge Compensation** – ***N. Chauvin*** *(CEA/IRFU) O. Delferrière, R. Gobin, P.A.P. Nghiem, D. Uriot (CEA/DSM/IRFU) R.D. Duperrier (ESS)*

Over the last years, the interest of the international scientific community for high power accelerators in the megawatt range has been increasing. One of the major challenges is to extract and transport the beam while minimizing the emittance growth in the Low Energy Beam Transport line (LEBT). Consequently, it is crucial to perform precise simulations and cautious design of LEBT. In particular, the beam dynamics calculations have to take into account not only the space charge effects but also the space charge compensation of the beam induced by ionization of the residual gas. The code SOLMAXP has been developed in CEA-Saclay to perform self-consistent calculations taking into account space charge compensation. Extensive beam dynamics simulations have been done with this code to design the IFMIF LEBT (Deuteron beam of 125 mA at 100 keV, cw). The commissioning of the IFMIF injector started a few months ago and emmittance measurements of H^+ and D^+ beams have been done. The first experimental results will be presented and compared to simulation.

THO3A04 10:00 **Definition of the Beam Halo and its Consequences** – ***P.A.P. Nghiem*** *(CEA/DSM/IRFU), N. Chauvin, D. Uriot (CEA/DSM/IRFU) W. Simeoni (CEA/IRFU)*

In high-intensity accelerators, much attention is paid to the beam halo: formation, growth interaction with the beam core, etc. Indeed, beam losses, a critical issue for those high-power accelerators, directly depend on the beam halo behaviour. But in the presence of very strong space-charge forces, the beam distribution takes very different shapes along the accelerator, often very far from any regular distributions, with very varied halo extensions. The difficulty is then to find a general definition of the halo capable of describing any distribution type. This paper proposes a definition of the beam halo, studies its consequences and compares it to the most usual ones.

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THO1B — Working Group-A
Chair: G. Franchetti (GSI)

Beam Dynamics in High-intensity Circular Machines

THO1B01 10:50 **A Quest for a Superior Ion Beam for a High Luminosity Electron-Ion Collider** – ***Y. Zhang*** *(JLAB)*
The high luminosity goal of MEIC, the envisioned medium energy ring-ring electron-ion collider at Jefferson Lab, is achieved through the implementation of a design concept based on high bunch repetition rate colliding beams with a crab crossing. Recently at Jefferson Lab, an ion injector and storage ring complex has been designed for delivering a required ion beam of superior qualities characterized by ultra short bunch length and ultra small emittance. Such ion beams are possible due to advantages of the high bunch repetition rate, ultra small bunch charges, and multi-staged beam cooling. This paper will present highlights of the design of this ion complex and the scheme of ion beam formation. We then present the staged beam cooling scheme followed by a discussion on its critical role in the ion beam formation process. We further will present the design concept of a medium energy electron cooler for the ion collider ring utilizing two advanced accelerator technologies, namely, ERL and circulator ring. Lastly we will present a recent proposal of a test facility based on the JLab FEL driver ERL for a technology demonstration of this medium energy ERL circulator cooler concept.

THO1B02 11:10 **Test of Optical Stochastic Cooling in Fermilab** – ***V.A. Lebedev*** *(Fermilab)*
A new 150 MeV electron storage ring is planned to be build in Fermilab. The construction of new machine pursues two goals a test of highly non-linear integrable optics and a test of optical stochastic cooling (OSC). This paper discusses details of OSC arrangements and choice of major parameters of the cooling scheme. At the first step the cooling will be achieved without optical amplifier. It should introduce the damping rates of about 1 order of magnitudes higher than the cooling rates due to synchrotron radiation. Similar scheme looks as a promising technique for the LHC luminosity upgrade. Its details are also discussed.

THO1B03 11:30 **Measurement of Optics Errors and Space Charge Effect** – ***K. Ohmi*** *(KEK), Y. Sato, J. Takano (KEK) S. Hatakeyama (JAEA/J-PARC)*
Beta function and x-y coupling are measured using turn-by-turn monitor system in J-PARC MR. Errors of the optics parameters induce to undesirable resonances due to lattice nonlinear magnets and space charge force. We estimate the resonance strength and the degradation of emittance growth and beam loss.

TH01B04 11:50 **Space Charge Effects in the NICA Collider Rings** – ***O.S. Kozlov*** *(JINR), S.A. Kostromin, I.N. Meshkov, A.O. Sidorin, A.V. Smirnov, G.V. Trubnikov (JINR) A.V. Eliseev (JINR/VBLHEP) T. Katayama (GSI)*

Accelerator complex NICA, developed at JINR, will provide an ion-ion (Au^{79+}) collisions at energies of 1-4.5 GeV/u, as well as experiments on collisions of polarized proton-proton and deuteron-deuteron beams. The calculations of the optical properties of superconducting collider rings have been aimed to create appropriate conditions for the collisions of beams and obtaining the required luminosity parameters in the working range of energies. The collider characteristics and the beam dynamics have been worked out mainly for ion-ion mode of the complex. The main effects limiting luminosity are the space charge dominating at the range of 1-3 GeV/u and the intrabeam scattering dominating for 3-4.5 GeV/u beams. Application of both electron and stochastic cooling methods is essential feature of the project. That allows us to suppress these effects in the corresponding energy ranges.

TH01B05 12:10 **Broad-band Transverse Feedback Against e-cloud or TMCI: Plan and Status** – ***C.H. Rivetta*** *(SLAC)*

The feedback control of intra-bunch instabilities driven by electron-clouds or strong head-tail coupling (Transverse mode coupled instabilities, TMCI) requires bandwidth sufficient to sense the vertical position and apply multiple corrections within a nanosecond-scale bunch. These requirements impose challenges and limits in the design and implementation of the feedback system. To develop the feedback control prototype, different research areas have been pursed to model and identify the bunch dynamics, design the feedback control and implement the Giga-Hertz bandwidth hardware. This paper presents those R&D lines and reports on the progress as it stands today. It presents preliminary results of feedback systems stabilizing the transverse intra-bunch motion, based on macro-particle simulation codes (CMAD / HeadTail) and measurement results of the beam motion when it is driven by particular excitation signals.

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THO3B — Working Group-C
Chair: D. Li (LBNL)

Accelerator System Design, Injection, Extraction, Beam-material Interaction

THO3B01 10:50 **Proton Beam Inter-Bunch Extinction and Extinction Monitoring for the Mu2e Experiment** – ***E. Prebys*** *(Fermilab)*

The goal of the Mu2e experiment at Fermilab will be the search for the conversion of a muon into an electron in the field of a nucleus, with a precision roughly four orders of magnitude better than the current limit. The experiment requires a beam consisting of short (~200 ns FW) bunches of protons are separated by roughly 1.5 microseconds. Because the most significant backgrounds are prompt with respect to the arrival of the protons, out of time beam must be suppressed at a level of at least 10^{-10} relative to in time beam. The removal of out of time beam is known as "extinction". This talk will discuss the likely sources of out of time beam and the steps we plan to take to remove it. In addition, the plan for monitoring the extinction level will be presented.

THO3B02 11:10 **SRF Technology Challenge and Development** – ***A. Facco*** *(INFN/LNL)*

SRF technology in particle accelerators is in continuous evolution, providing a large variety of high gradient- low loss resonators with large apertures, suitable for many different beam current and energy regimes. Recent development was aiming not only at highest gradient and Q but also at improving field quality, reliability and cost reduction for large production. The SRF R&D effort, once concentrated mostly in the high energy electron machines, is increasingly focused to heavy ion linacs, energy recovery linacs and also to cavities for special applications. A concise overview of the present state of the art will be given.

THO3B03 11:30 **SRF Cavity Research for Project X** – ***R.D. Kephart*** *(Fermilab)*

Project X is a new SRF linac based multi-MW class proton source proposed for construction at Fermilab. It consists of a 3 MW, 1 mA CW H^- SRF linac that feeds an intensity frontier Physics program and a 3-8 GeV pulsed linac that accelerates ~5% of the output of the CW linac to 8 GeV for injection into the Fermilab Main Injector synchrotron resulting in an additional 2 MW of beam power at 60-120 GeV in support of a world class long baseline neutrino program. The project has chosen operating frequencies that are sub-harmonics of 1.3 GHz and is developing 6 separate cavity designs for acceleration of H^- particles with various velocities. An R&D program is in progress to develop these cavities; the associated cryomodules; and the required fabrication and test infrastructure. A status and progress report on this R&D program will be presented.

TH03B04 11:50 **Beam Dynamics Studies of H^- Beam Chopping in a LEBT for Project X** – ***Q. Ji*** *(LBNL), D.P. Grote, A.R. Lambert, D. Li, T. Schenkel, J.W. Staples (LBNL)*

Project X is proposed as a high intensity proton facility at Fermilab to support a world-leading program in neutrino and flavor physics over the next several decades. The front-end consists of an H^- ion source, low-energy beam transport (LEBT), and 162.5 MHz CW Radio-Frequency-Quadrupole (RFQ) accelerator. The LEBT design, currently under study at LBNL, would comprise two solenoids, a dipole magnet and a chopper. The LEBT chopper is designed to achieve 1 MHz beam chopping of a partially neutralized 30 keV, 5 mA H^- beam. Preliminary simulation studies show that chopping the beam before the second solenoid is more efficient in terms of chopper bias voltages. However, the space charge neutralization will be lost along the beam after the chopper and through the second solenoid. A beam dynamics study, using WARP 3D (a Particle-in-cell simulation code), has been carried out to investigate both the time-dependence of the partial neutralization in the segment after the chopper, as well as the beam stability and emittance growth. Benchmark experiments are ongoing and simulation and experimental results will be presented in this Workshop.

TH03B05 12:10 **Intense High Charge State Heavy Ion Beam Production for the Advanced Accelerators** – ***L.T. Sun*** *(IMP)*

Modern advanced heavy ion beam accelerators have strong needs for either dc or pulsed intense high charge state heavy ion beams, such as dc beams for FRIB project, SPIRAL2 project, HIRFL/IMP facility, RIBF/RIKEN facility ect, and pulsed beams for RHIC, LHC, FAIR project. After decades' development, only several typical ion sources have found their applications in these accelerators, i.e. ECR ion source, EBIS and LIS or Laser Ion Source. This paper will give a general review of the advantages and limitations of the three types of ion sources. The latest development and performance for the three types of ion sources will be presented.

20-Sep-12 14:00 – 16:30	Oral	Ballroom

THO1C — Working Group-D

Chair: M.A. Plum (LANL)

Commissioning, Operations and Performance

THO1C01 14:00 **High Intensity Operation and Controlling Beam Losses in a Cyclotron Based Accelerator** – ***M. Seidel*** *(PSI), J. Grillenberger, A.C. Mezger (PSI)*

This presentation discusses aspects of high intensity operation in PSI's cyclotron based proton accelerator (HIPA). Major beam loss mechanisms and tuning methods to minimize losses are presented. Concept and optimization of low loss beam extraction from a cyclotron are described. Collimators are used to localize beam losses and activation. Activation levels of accelerator components are shown. An overview on instrumentation for loss monitoring and prevention of failure situations is given. Other relevant aspects include the beam trip statistics and grid to beam power conversion efficiency.

THO1C02 14:20 **Beam Loss Control in the ISIS Accelerator Facility** – ***D.J. Adams*** *(STFC/RAL/ISIS), B. Jones, S.J. Payne, B.G. Pine, H. V. Smith, C.M. Warsop, R.E. Williamson (STFC/RAL/ISIS)*

The ISIS spallation neutron and muon source has been in operation since 1984. The accelerator complex consists of an H^- ion source, RFQ, 70 MeV linac, 800 MeV proton synchrotron and associated beam lines. The facility currently delivers ~$2.8\cdot10^{13}$ protons per pulse at 50 Hz, splitting the pulses 40/10 between two neutron target stations. High intensity performance and operation are dominated by the need to control beam loss, which is key to sustainable machine operation and hands on maintenance. Beam loss measurement systems on ISIS are described, along with typical operational levels. The dominant beam loss in the facility occurs in the synchrotron due to high intensity effects during the H^- injection and longitudinal trapping processes. These losses are localised in a single superperiod using a beam collector system. Emittance growth during acceleration also drives extraction and beam transport loss at 800 MeV. Measurements, simulation and correction systems for these processes are discussed, as are the implications for further intensity upgrades.

TH01C03 14:40 **Collimation Experience at the LHC** – ***S. Redaelli*** *(CERN)*

The collimation system of the Large Hadron Collider (LHC) consists of 100 movable collimators that are used in all machine phases, from injection to collisions. A multi-stage cleaning protects the machine against regular and abnormal betatron and momentum beam losses. The system has also a crucial role in the passive machine protection and in the luminosity performance in terms of β^* reach, limited by triplet magnet aperture constraints. The system provided record cleaning inefficiencies in cold magnets below a few 0.0001 and enabled ooperating at β^* of 60 cm with total stored energies up to 130 MJ at 4 TeV. The collimation experience at the LHC and the achieved system performance are reviewed.

TH01C04 15:30 **Performances and Future Plans of the LHC RF** – ***P. Baudrenghien*** *(CERN), T. Mastoridis (CERN)*

The ramp-up of the LHC operation has been exceptionally fast: from the first acceleration of a single bunch at nominal intensity (1.1· E11 p) to 3.5 TeV/c on May 2010, to the accumulation of 11 fb-1 integrated luminosity two years later (June 2012). On the RF side this was made possible by a few key design choices and several developments, that allow reliable LHC operation with 0.35 A DC beam at 4 TeV/c (1380 bunches at 50 ns spacing, $1.5 \cdot 10^{11}$ p per bunch). This paper reviews the RF design and presents its performance. Plans are also outlined that would allow operation with 25 ns bunch spacing (doubling the beam current) and even increased bunch intensity with the target of above 1A DC current per beam, without big modification to the existing RF power system.

TH01C05 15:50 **Status and Beam Commissioning Plan of PEFP 100-MeV Proton Linac** – ***J.-H. Jang*** *(KAERI), S. Cha, Y.-S. Cho, D.I. Kim, H.S. Kim, H.-J. Kwon, Y.M. Li, B.-S. Park, J.Y. Ryu, K.T. Seol, Y.-G. Song, S.P. Yun (KAERI)*

The proton engineering frontier project (PEFP) is developing a 100 MeV proton linac which consists of a 50 keV injector, a 3 MeV RFQ (radio frequency quadrupole), and a 100 MeV DTL (drift tube linac). The installation of the linac was finished on March this year. The other elements including the high power RF components will be installed after completing the other part of the accelerator building. The beam commissioning is scheduled at the end of this year. This work summarized the status of the PEFP linac development and the beam commissioning plan.

THO1C06 16:10 **Recent Commissioning of High-Intensity Proton Beams in J-PARC Main Ring** – ***Y. Sato*** *(KEK), K. Hara, Y. Hashimoto, Y. Hori, S. Igarashi, K. Ishii, N. Kamikubota, T. Koseki, K. Niki, K. Ohmi, C. Ohmori, M. Okada, M. Shimamoto, M.J. Shirakata, T. Sugimoto, J. Takano, M. Tejima, T. Toyama, M. Uota, S. Yamada, N. Yamamoto (KEK) S. Hatakeyama, H. Hotchi, F. Tamura (JAEA/J-PARC) S. Nakamura, K. Satou (J-PARC, KEK & JAEA)*

J-PARC main ring (MR) provides high power proton beams of 200 kW to the neutrino experiment. Beam losses were well managed within capacity of collimation system. Since this beam power was achieved by shortening the repetition rate, following tunings had been applied in order to reduce the beam losses, such as improvement of tune flatness, chromaticity correction, upgrades of injection kickers, dynamic bunch-by-bunch feed-back to suppress transverse oscillation, beam loading compensation using feed-forward technique, and balancing the collimators of MR and the injection beam transport line. The dynamic bunch-by-bunch feed-back was effective to reduce the beam losses to one-tenth during injection and beginning of acceleration. With the beam loading compensation, impedance seen by the beam was significantly reduced, longitudinal oscillations were damped, and the beam power was increased over 5% without increasing the beam losses. Monitors were upgraded to find time structure and location of the beam losses, even in first several turns after each injection. In this presentation these commissioning procedures and beam dynamics simulations are shown, and our upgrade plan is discussed.

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THO3C — Working Group-E

Chair: V.E. Scarpine (Fermilab) & N. Hayashi (J-PARC)

Beam Diagnostics and Instrumentation for High-intensity Beam

THO3C01 14:00 **Optical Transition Radiation for Non-relativistic Ion Beams** – ***B. Walasek-Höhne*** *(GSI), C.A. Andre, F. Becker, P. Forck, A. Reiter, M. Schwickert, R. Singh (GSI) A.H. Lumpkin (Fermilab)*

In this contribution, recent results of Optical Transition Radiation (OTR) measurements with a non-relativistic heavy-ion beam will be presented. This feasibility study was prompted by previous measurements and the theoretical estimation of expected signal strengths for the GSI linear accelerator UNILAC. For this experiment, an 11.4 MeV/u Uranium beam was chosen to investigate OTR signal from several target materials and to evaluate the working regime for the used experimental setup. The OTR light was either observed directly with an Image Intensified CCD camera (ICCD) or indirectly via a spectrometer for wavelength resolved data. A moveable stripping foil allowed measurements with two different ion charge states. The theoretical q2 dependency of the OTR process predicts a six-fold increase in light yield which was confirmed experimentally. Obtained OTR beam profiles were compered to SEM-Grid data. Moreover, ICCD gating feature, as well as the emitted light spectrum ruled out contribution of any background sources with longer emission time constant e.g. blackbody radiation.

THO3C02 14:20 **Momentum Spread Determination of Linac Beams Using Incoherent Components of the Bunch Signals** – ***P. Kowina*** *(GSI), P. Forck, M. Schwickert (GSI) F. Caspers (CERN)*

Measurements of the momentum spread of the beam particles are of great importance when optimizing linac settings for high current operation with controlled longitudinal phase space occupation. A new method of momentum spread determination was tested at the GSI heavy ion linear accelerator UNILAC. The method is based on an analysis of incoherent components of the bunch signal. A significant enhancement of the signal-to-noise ratio was achieved by means of a resonant pick-up of pill-box shape. Spectra were analyzed on the 36th harmonics of the linac rf-frequency, i.e. at 1.3 GHz. Thus, the contribution of coherent components in the frequency spectrum of the bunched beam, e.g. due to common mode, was significantly damped. Fast digital processing and gating synchronized to the bunch train allowed for a drastic reduction of the measurement time and, additionally, suppressed noise signals in the frequency spectrum. This contribution describes the measurement setup and discusses first results obtained with heavy ion beams.

THO3C03 14:40 **Beam Induced Fluorescence - Profile Monitoring for Targets and Transport** – ***F. Becker*** *(GSI), C.A. Andre, C. Dorn, P. Forck, R. Haseitl, B. Walasek-Höhne (GSI) T. Dandl, T. Heindl, A. Ulrich (TUM/Physik)*

Online profile diagnostic is preferred to monitor intense hadron beams at the Facility of Antiproton and Ion Research (FAIR). One instrument for beam profile measurement is the gas based Beam Induced Fluorescence (BIF)-monitor. It relies on the optical fluorescence of residual gas, excited by beam particles. In front of production targets for radioactive ion beams or in plasma physics applications, vacuum constraints are less restrictive and allow for sufficient fluorescence photons, even at minimum ionizing energy. Imaging spectroscopy in nitrogen and rare gases at 10^{-3} to 30 mbar indicates a usable dynamic range from UHV to atmospheric pressure. Issues as radiation damage and radiation induced background will be discussed, as well as technical aspects like dedicated shielding, image transport and radiation tolerant components.

THO3C04 15:30 **Longitudinal Beam Diagnosis with RF Chopper System** – ***T. Maruta*** *(JAEA/J-PARC) M. Ikegami (KEK)*

J-PARC linac has a chopper system between RFQ and DTL, which utilizes an RF deflector cavity instead of a usual slow wave kicker. Taking advantage of this unique feature of the chopper system, we have experimentally measured the longitudinal full width of phase direction at the chopper cavity. In this presentation, I would like to discuss the measurement technique and measurement results.

THO3C05 15:50 **Fiber Based BLM System R&D at CERN** – ***E.B. Holzer*** *(CERN), J.W. van Hoorne (CERN) S. Mallows (The University of Liverpool)*

The application of a beam loss measurement (BLM) system based on Cherenkov light generated in optical fibers to a linear accelerator with long bunch trains is currently under investigation at CERN. In the context of the Compact Linear Collider (CLIC) study, the machine protection role of the BLM system consists of its input to the 'next cycle permit'. In between two cycles it is determined whether it is safe to commit the machine for the next cycle. A model for light production and propagation has been developed and validated with beam measurements. Monte Carlo simulations of loss scenarios established the suitability in terms of sensitivity and dynamic range. Test set-ups of a Cherenkov fiber BLM system were installed at the CLIC Test Facility, CTF3. Model predictions and measurements will be presented: of the achievable longitudinal position resolution of the system, considering that the bunch trains and the optical fiber length are comparable in size; and of the possibility to distinguish between losses from the drive beam decelerator and the main linac, which run in parallel.

TH03C06 **16:10** **On-line Calibration Schemes for RF-based Beam Diagnostics** – ***P.-A. Duperrex*** *(PSI), U. Müller (PSI)*

RF-based beam diagnostics such as BPMs and beam current monitors rely on precise RF signal measurements. Temperature drifts and differences in the overall measurement chain gain make such measurements very challenging and calibration validity over time is an issue. Over some years, on-line calibration schemes for BPMs and current monitors have been developed. These innovative schemes are based on the use of a pilot signal at a frequency offset from the measurement frequency. Results, advantages and disadvantages of such schemes are discussed.

20-Sep-12 16:50 – 18:00	Oral	Ballroom

THO1D — Working Group-A

Chair: J.A. Holmes (ORNL)

Beam Dynamics in High-intensity Circular Machines

THO1D01 16:50 **Fully 3D Long-term Simulation of the Coupling Resonance Experiments at the CERN PS** – ***J. Qiang*** *(LBNL), R.D. Ryne (LBNL) G. Franchetti, I. Hofmann (GSI) E. Métral (CERN)*

Space-charge driven nonlinear coupling resonance can have significant impact in high intensity linac and ring operation. Such a resonance causes emittance exchange between different degrees of freedom and may result in potential particle loss from the direction with smaller aperture size. In this paper, we will report on numerical simulation studies of the resonance crossing phenomena using a previous experiment at the CERN PS including detailed three-dimensional space-charge effects and machine nonlinearity.

Boldface papercodes indicate primary authors

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