KURCHATOV SYNCHROTRON RADIATION SOURCE FACILITIES MODERNIZATION

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1. Kurchatov SR Center
2. The work of accelerator complex– SR sources
3. Modernization of systems
4. Improvement of electron beam parameters at Siberia-2
5. Installation of Insertion Devices at Siberia-2

1. Plan of Development of accelerator complex– SR sources

11 years of KCSR history

September 30, 2009
The order of president about organization of National Research Center in Kurchatov institute at KCSR base

April 18, 2007
Nano-technological program was approved

October 1, 1999
Kurchatov SR source opening

УКАЗ

ПРЕЗИДЕНТА РОССИЙСКОЙ ФЕДЕРАЦИИ

О дополнительных мерах по реализации пилотного проекта по созданию национального исследовательского центра «Курчатовский институт»

В целях научного обеспечения устойчивого технологического развития и модернизации приоритетных отраслей экономики постановляю:

1. Принять предложение Правительства Российской Федерации, Российской академии наук и Государственной корпорации по атомной энергии «Росатом» об участии в пилотном проекте по созданию национального исследовательского центра «Курчатовский институт» следующих организаций:

Учреждение Российской академии наук Петербургский институт ядерной физики имени Б.П.Константинова РАН;

федеральное государственное унитарное предприятие «Государственный научный центр Российской Федерации - Институт физики высоких энергий»;

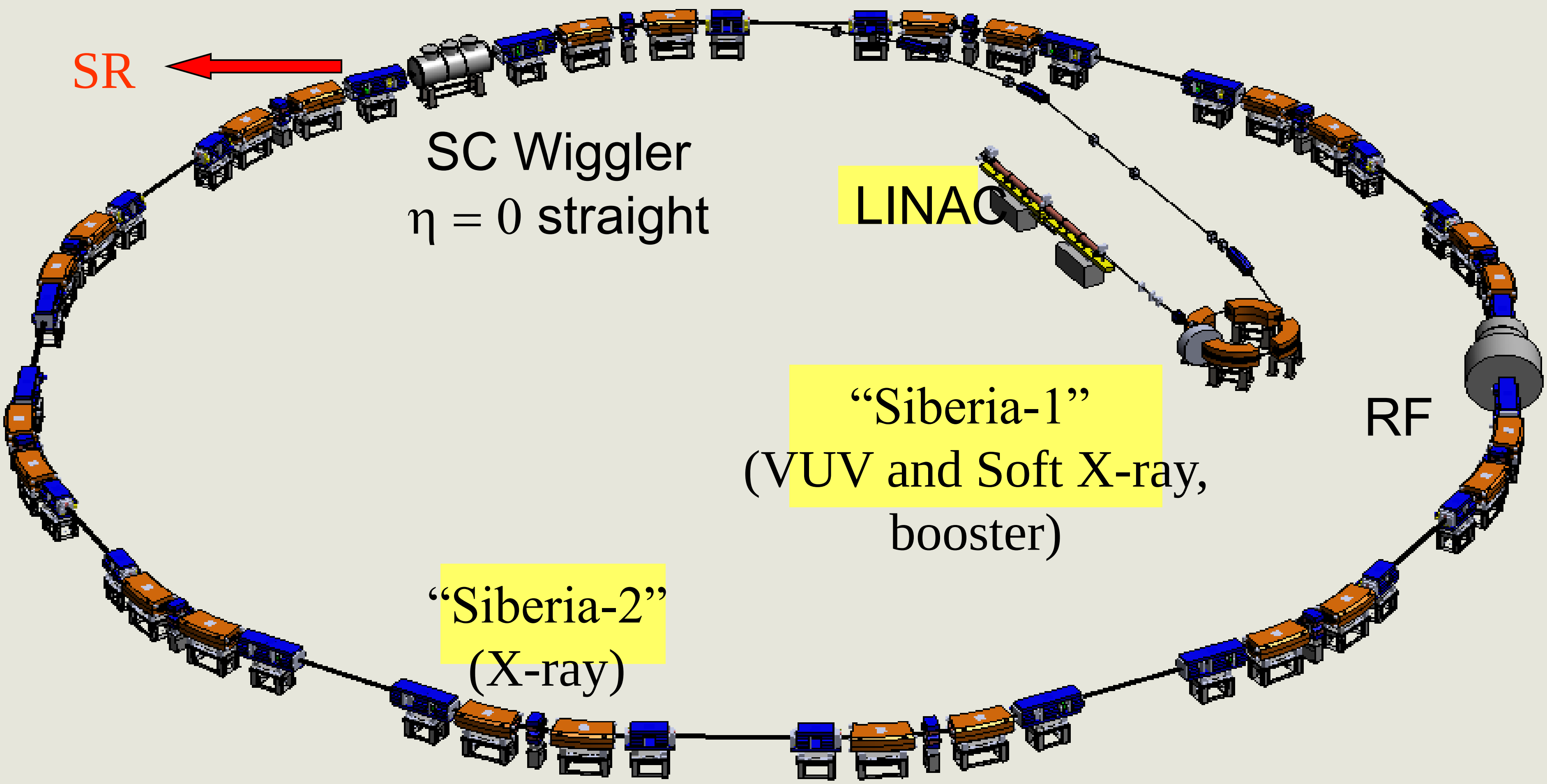
федеральное государственное унитарное предприятие «Государственный научный центр Российской Федерации - Институт Теоретической и Экспериментальной Физики».

2. Установить, что национальный исследовательский центр «Курчатовский институт» дополнительно к основным направлениям деятельности, определенным Указом Президента Российской Федерации от 28 апреля 2008 г. № 603 «О пилотном проекте по созданию национального исследовательского центра «Курчатовский институт», участвует от имени Российской Федерации в реализации соответствующих международных проектов на основании решений Президента Российской Федерации или Правительства Российской Федерации.

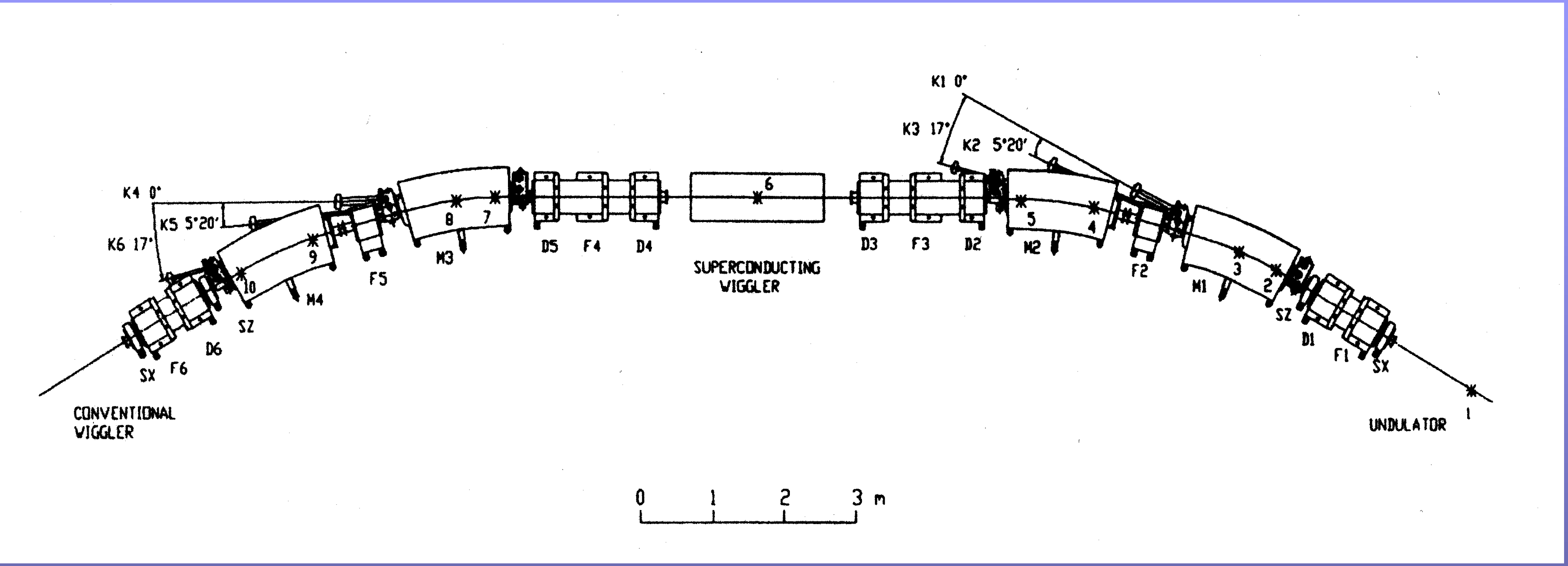
The law "About National Research Center "Kurchatov Institute"

Was approved by RF State Duma on July 16, 2010

KCSR accelerator facility layout



SR ejection scheme of Siberia-2



According to the project 39 SR channels are predicted (front ends):

24 - from BMs, $\lambda c = 1.75$ Å , $\Psi x = \pm 5$ mrad;

10 - from 2 superconducting wigglers, $\lambda c = (0.25\text{-}0.4)$ Å;

5 - from MPWs with low magnetic field, $\lambda_{fund} = (20 - 1.7)$ Å .

Linear Accelerator

Andreev`s structure – discs with radial supports and diaphragms with holes d=8.7 mm. Work on captured power, standing microwave of 2856MHz.

Electron gun: 40 kV, 4A, 18 ns

E = 80 МэВ, L = 6 m,

U=15 MeV/m, Rs=95 MHom/m,

Emittances < 10E-6 m-rad

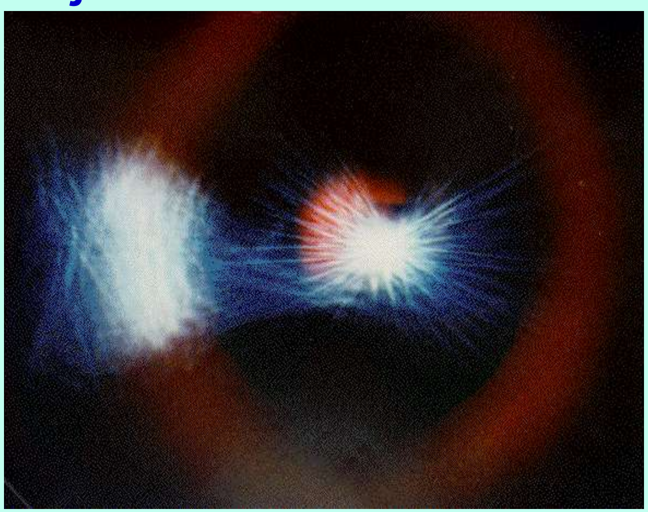
I = 0.2 A, ΔE/E = 0.005

T < 15 нс, F rep = 1 Гц

Control room

Small storage ring «SIBERIA-1»

First SR beam from BM,
1982, bld.140.
Injector - Linac «Jet»

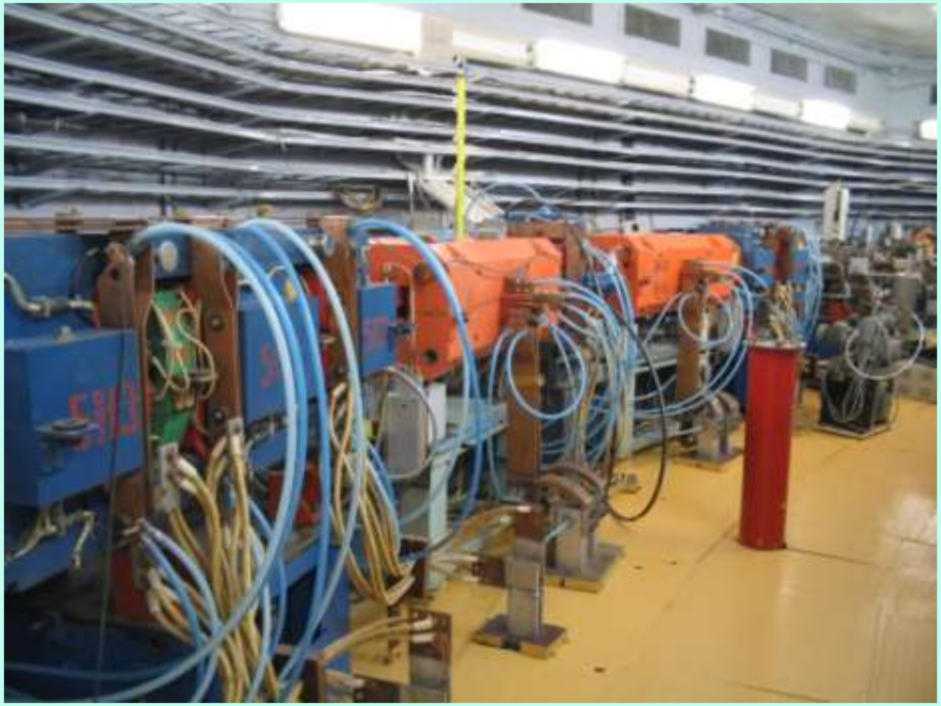


- **E = 0.45 GeV, I = 200 mA (340mA-max)**
- **Crit. Phot. En. - 0.21 keV (VUV, Soft X-ray)**
- **Diameter - 2.75 m**
- **Hor. emittance - $8.8\cdot10^{-7}$ m-rad**
- **Life time (100мА) – 1-1.5 hrs**
- **Stand. Bunch length - 30 cm**
- **SR pulse duration - 2.35 ns (FWHM)**
- **SR pulse frequency - 34.52 MHz**

Dedicated storage ring «SIBERIA-2»

SR Source in X-ray spectrum

- E = 2.5 GeV,
- I = 100-300 mA
- BMs critical energy – 7.2 keV
- Diameter - 40 m
- Hor. emittance - (76-98) nm-rad
- Life time (100 mA) – 10 ÷ 14 hrs
- Stand. bunch length – 1.84 cm
- 39 SR beam lines (project)

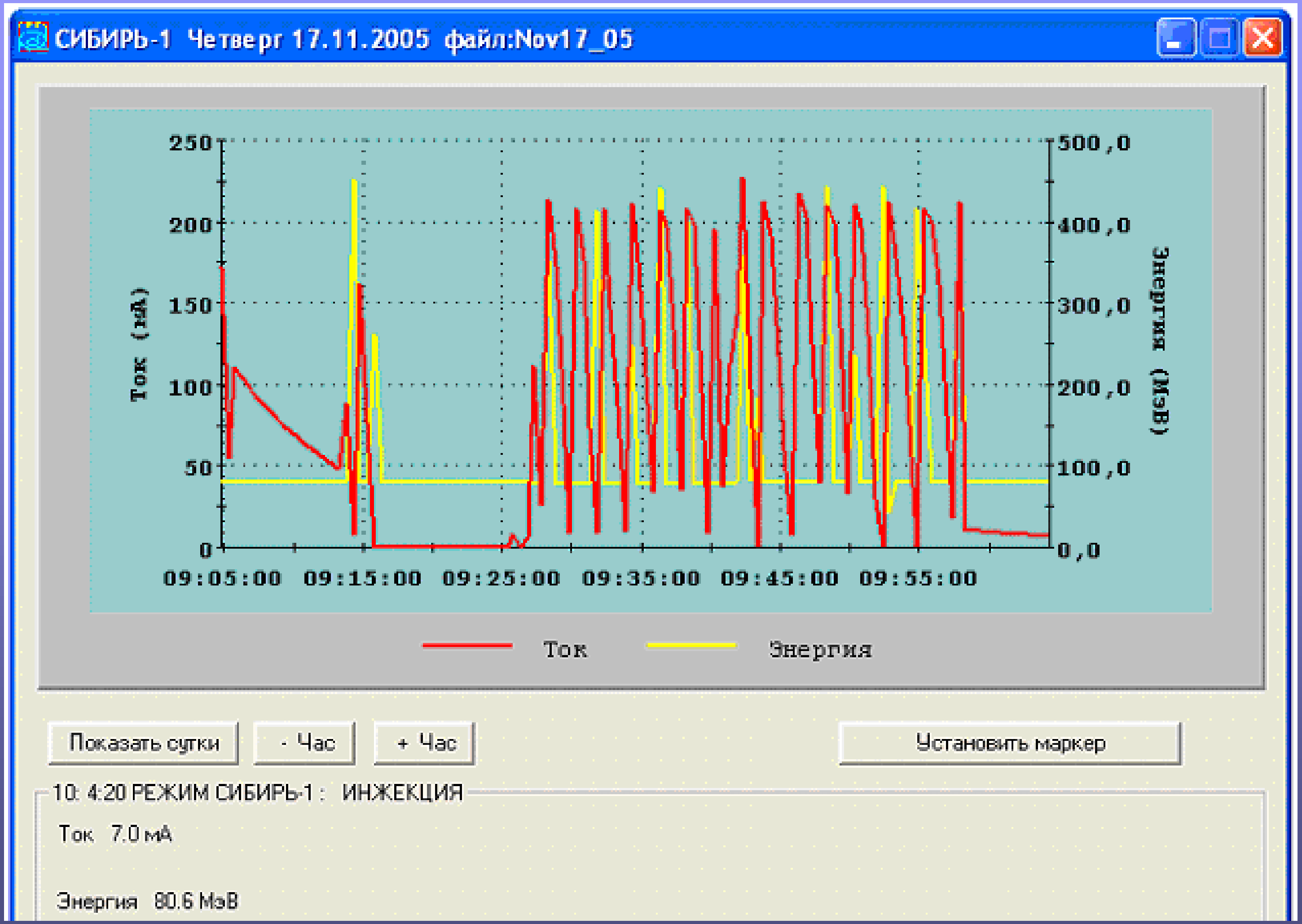


Parameters of KCSR accelerators

Linac	SIBERIA-1	SIBERIA-2
E = 80 MeV	E = 80÷450 MeV	E = 0.45÷2.5 GeV
I = 0.2 A	I = 0.2÷0.3 A (singlebunch)	I = 0.1÷0.3 A (multibunch)
L = 6 m	C = 8.68m	C = 124.13 m
DE/E = 0.005	B = 1.5 T	B = 1.7 T
$\varepsilon_0 \simeq 300$ nm·rad	$\varepsilon_{x0} \simeq 800$ nm·rad	$\varepsilon_{x0} \simeq 78 \div 100$ nm·rad
T = 18 ns	T_0 = 29 ns	T_0 = 414 ns
f_{rep} = 1 Hz	T_{rep} = 25 s	τ =10÷25 hrs
	λ_c=61 Å , BMs	λ_c=1.75 Å, BMs λ_c=0.40 Å, SCW
Forinjector	Booster, VUV and soft X-ray source	Dedicated SR source 0.1-2000Å [1]

2. The work of accelerator complex– SR sources

2. SIBERIA-1 WORK AS A BOOSTER



2. Siberia-2 work with SR beams

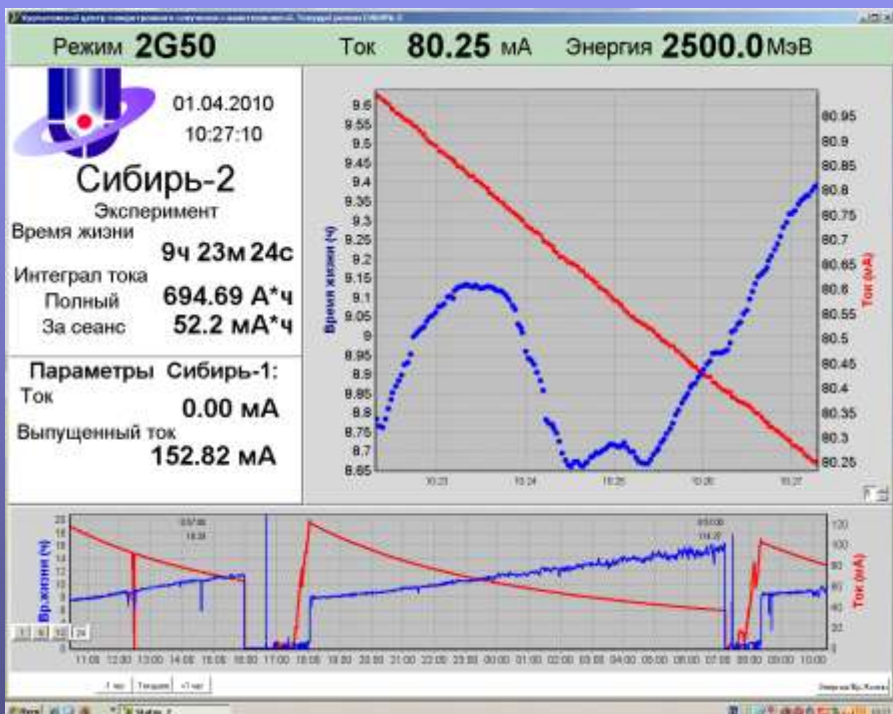
Now SR from BMs only:

Eph = 4 - 40 keV, Flux = $(2*10^{13}-10^{11})$ ph/s/0.1%BW.

For users on a twenty-four hour basis:
9 shifts per week, shift-12hours;

For accelerator physics: 1-2 shifts per week

2. Siberia-2 work with SR beams

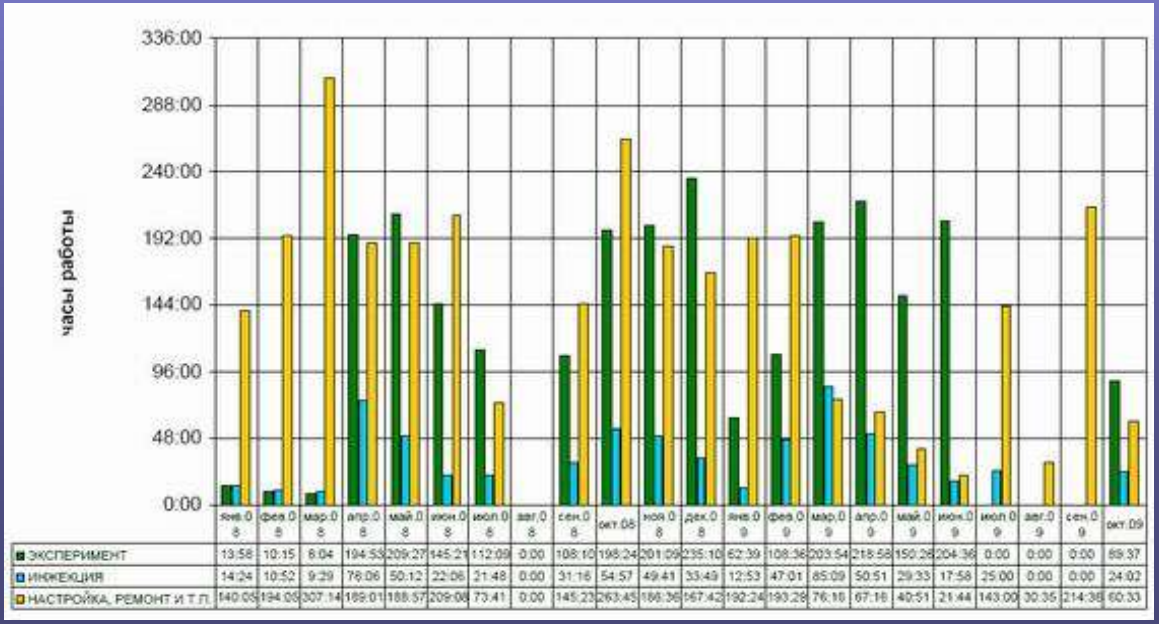


Work of KCSR with SR beams

Years	2005	2006	2007	2008	2009
Siberia-1: experiment, hrs	238	236	205	471	634
Integral, A-hrs	16.1	21.1	13.4	41.7	67.4
Siberia-2: experiment, hrs	1292	2035	1629	1437	1527
Integral, A-hrs	94.9	165.5	126.2	56.3	77.5

Work K CSR for users

per year

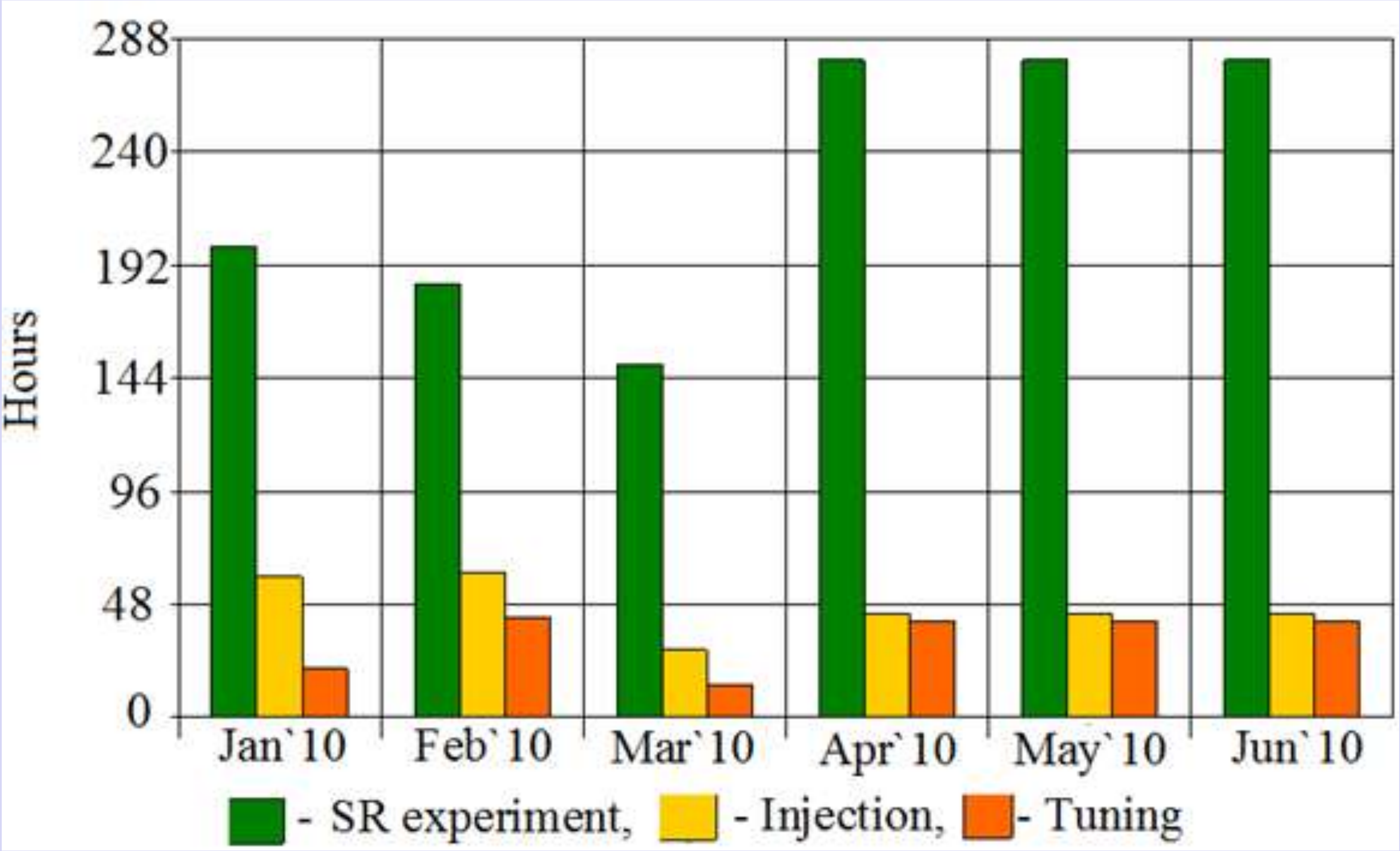


per month
in 2008-2009 г

Siberia-2 work in first one-half of 2010 year

Total operation time, hrs: min	**2265:53**
EXPERIMENT	
Duration, hrs: min	**1369:53**
% relative to total operation time	**60%**
Max. current, мA	**148.0**
Average current, мA	**37**
Total collected integral, A*hrs	**740.4**
Current integral per ¼ year, A*hrs	**76.2**
Number of energy ramping	**325**
Life time at 100 mA, hrs: min	**11:0**
Life time at 50 mA, hrs: min	**22:35**
INJECTION	
Duration, hrs: min	**282:14**
% relative to total operation time	**12%**
Max. current, мA	**171.1**
TUNING OF FACILITIES	
Duration, hrs: min	**198:26**
% relative to total operation time	**9%**

The Siberia-2 work in 2010



3. Modernization of accelerator complex systems

3.1 Power supplies *)
3.2 Septum Siberia-1
3.3 RF systems *) :
Generators, cavities, RF control

3.4 Automation control system (KCSR)
3.5 Feedback system and ns generators (plan 2011)

*) In collaboration with BINP SB RAS

3.1. Upgrade of magnetic system power supplies

(BINP and KCSR, 2005-2008)

Task:

Improving the electron and photon beam stability.

Upgrade:

-The new passive filters were installed in the power units of BMs and quads,

-The new electronics for the power supplies were made. The new electronics includes the active filters which guarantee both the long time current stability and the ripples not worse than $\pm 5\cdot 10^{-5}$ for quads, compared with $\pm 2\cdot 10^{-4}$ we had.

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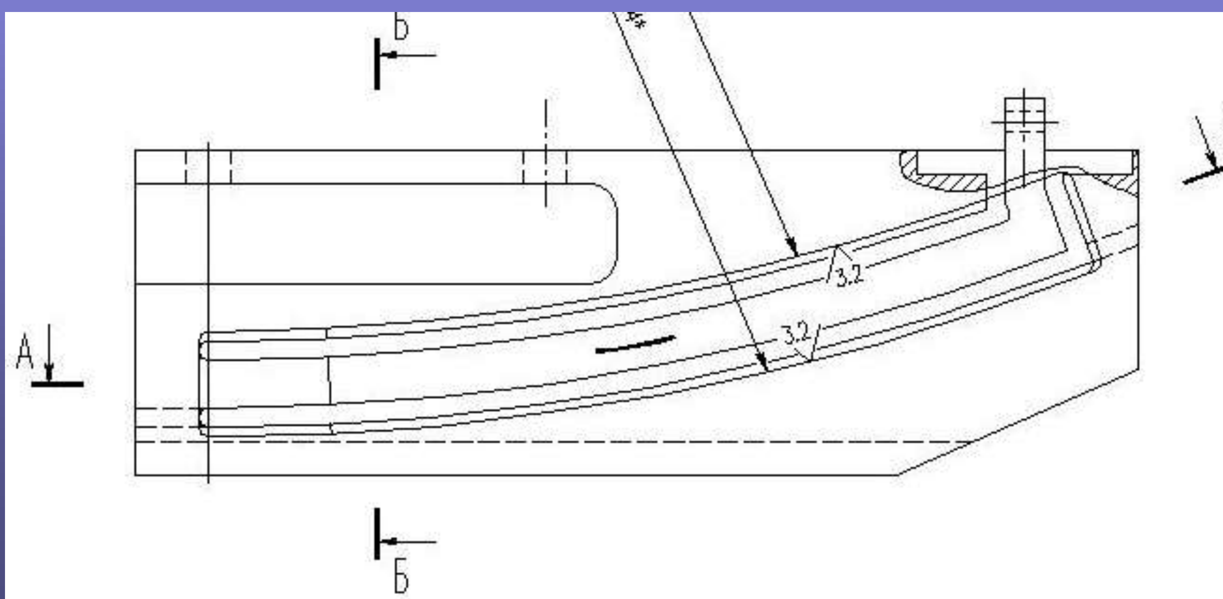
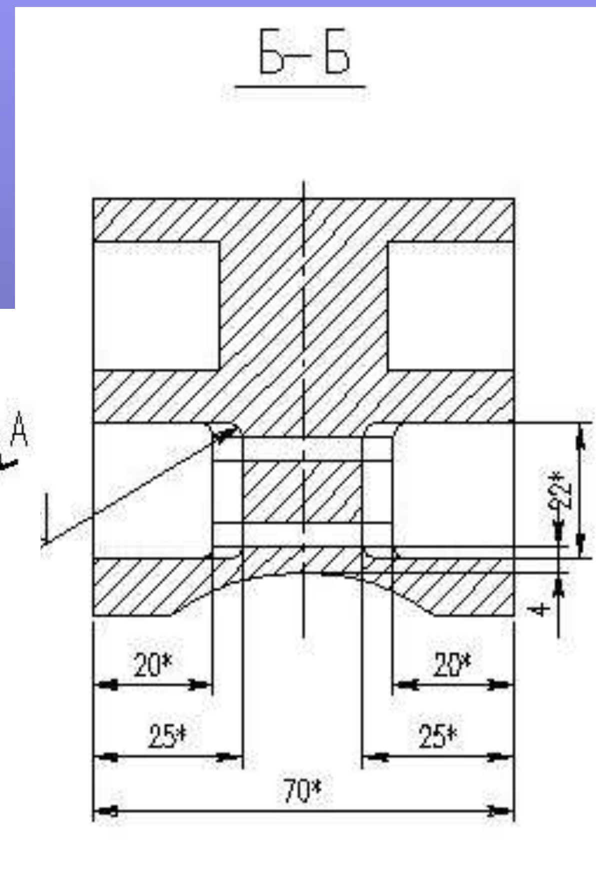
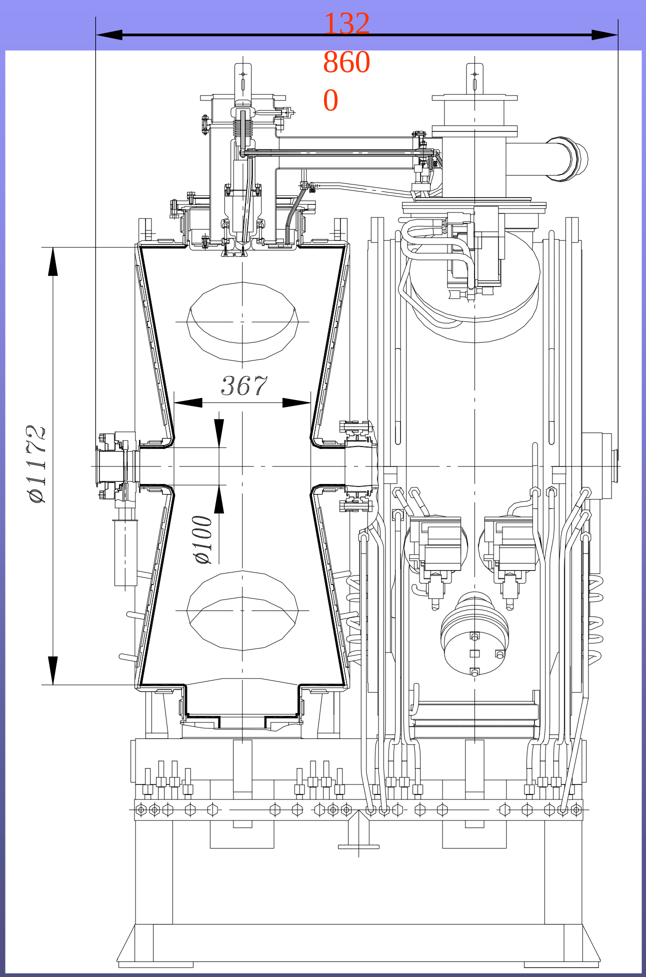
3.2 New output 30 kGs 100mks septum-magnet of Siberia -1 (KCSR-INP)

- Old septum has worked 8 years
- New septum has more homogeneous magnetic field distribution
- An increase in the coefficient of the release of electron beam from the Siberia-1 storage ring into the ETL-2 up to 70%





3.3. RF system of Siberia-2 upgrade (KCSR + BINP)



- **Reasons of modernization, 2007**:

1. Deterioration of the RF-equipment (a leak H_2O-in protective vacuum of cavity);
2. The work of SC wigglers increases the energy spread and demands much higher accelerating RF voltage: ≥2MV (for SR from BMs+2 SCWs of 7.5 T, 2.5 GeV).

3.3 RF system of Siberia-2 upgrade 2007-2009 (KCSR + BINP)

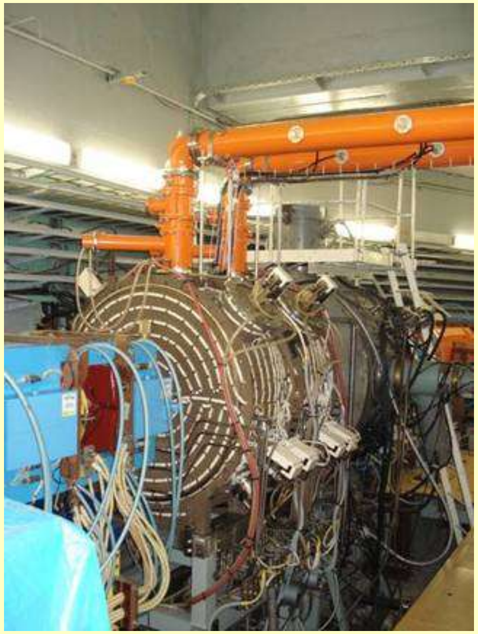


Figure 1.

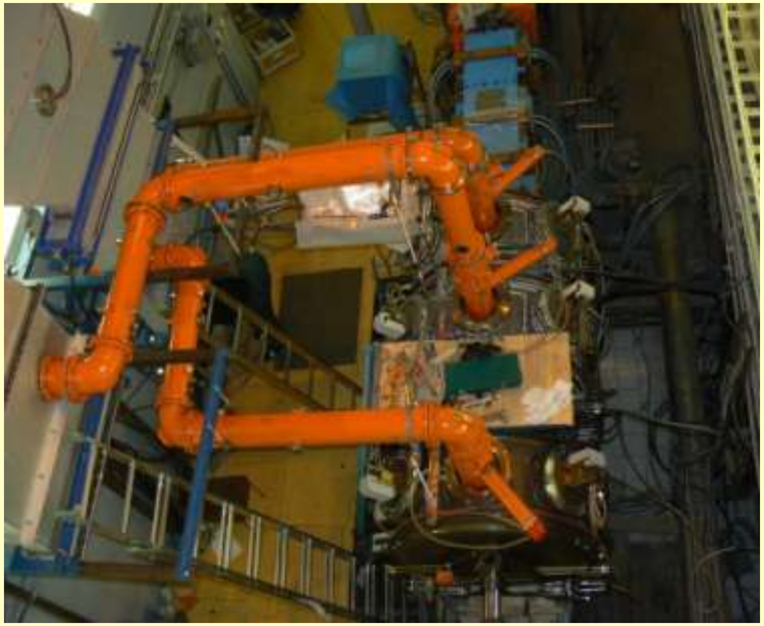


Figure 2.

•Fig.1. **(5.11- 28.12).2007.** Replacement 181 MHz cavity № 2 on 2 new cavities: New RF control electronics; 2 New feeders; New RF computer control for automation processes.

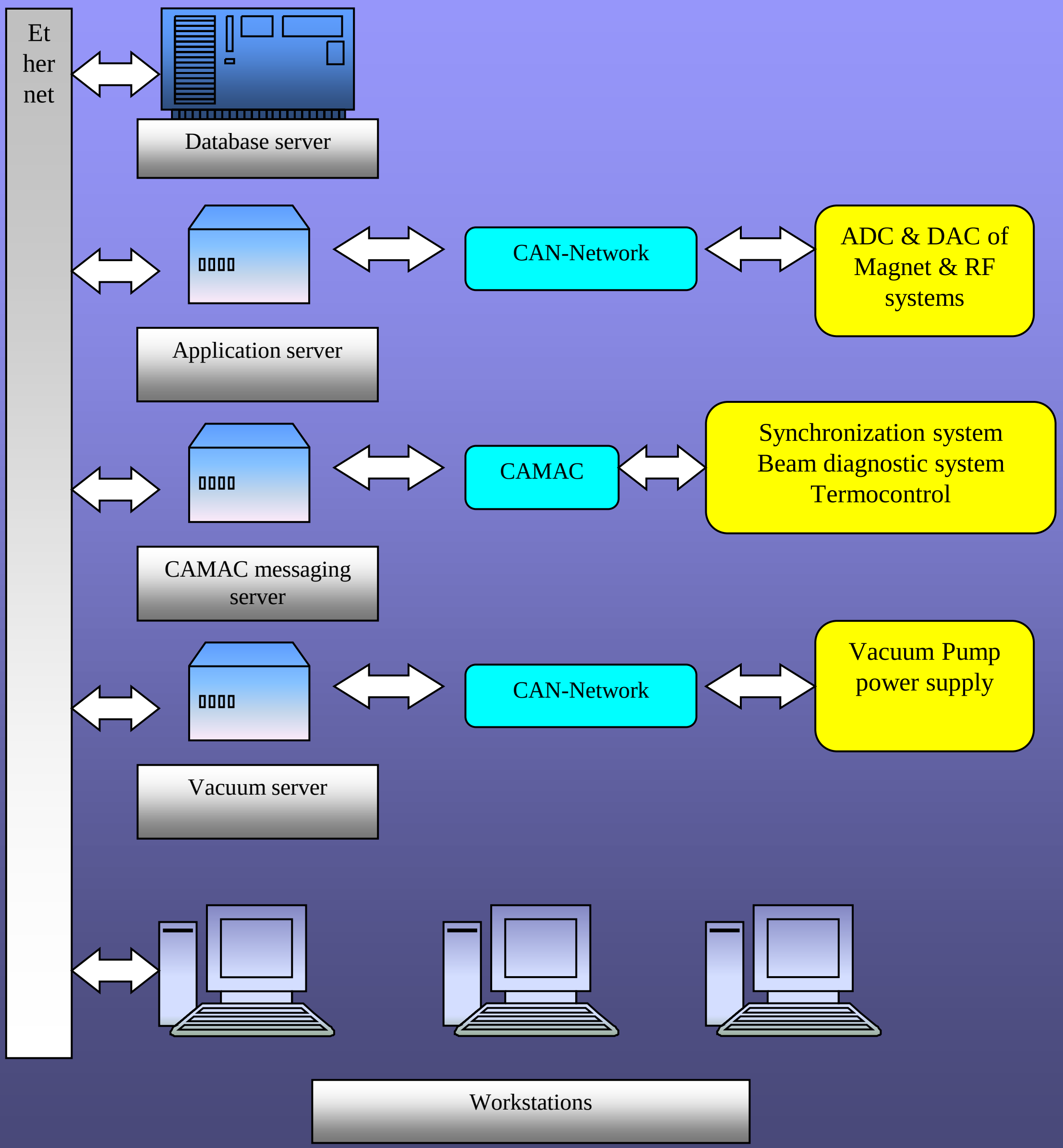
•Fig.2. **October 2009.** The installation 3-rd new 181 MHz cavity instead of old one.

•**Plan 2010:** Tuning the RF feeders and the waveguides at (n+1/8)l.

3.3 Parameters of Siberia-2 and its RF system after upgrade, 2010

Parameters of the Siberia-2 storage ring	**Energy of electrons**	E_{MAX}	**GeV**	**2.5**
	SR losses with BMs and wigglers	ΔE_{BMs} ΔE_{BM+WIG}	keV/ turn	681 1021
	Beam current	$I_{B\ MAX}$	A	0.29
	Total accelerating voltage	$2U_1+U_2$	kV	1500
First RF channel : 200 kW generator, two cavities (№1, №3)	Accelerating voltage	$2U_1$	kV	820
	Shunt impedance	$2ZT^2$	MOhm	8.6
	Power dissipated in the cavities	$2P_1$	kW	39
	Power transferred to the beam	$2P_{1b}$	kW	157
Second RF channel: 200 kW generator, one cavity (№2)	Accelerating voltage	U_1	kV	680
	Shunt impedance	ZT^2	MOhm	4.3
	Power dissipated in the cavity	P_2	kW	54
	Power transferred to the beam	P_{2b}	kW	139

3.4. NEW SYSTEM OPERATING CONTROL



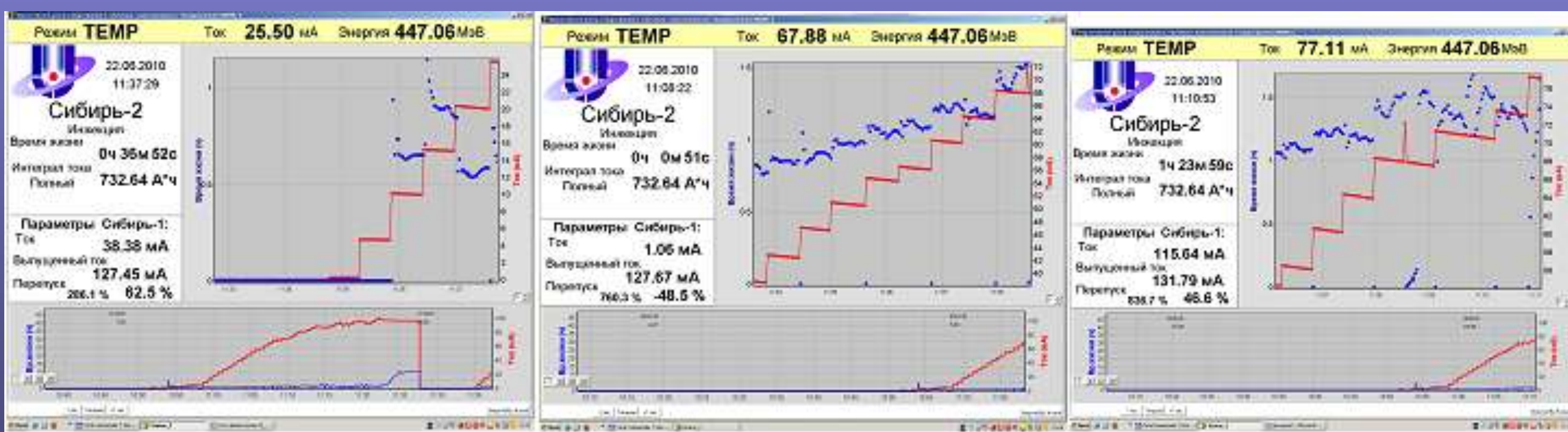
The network of operating terminals consists of workstations under control of MS Windows XP, combined in local network Ethernet.

Programs of management and diagnostics receive the information from a database server on the basis of MS SQL Server, where it arrives from the application server.

All executing modules, ADC and DAC are united in a CAN-network.

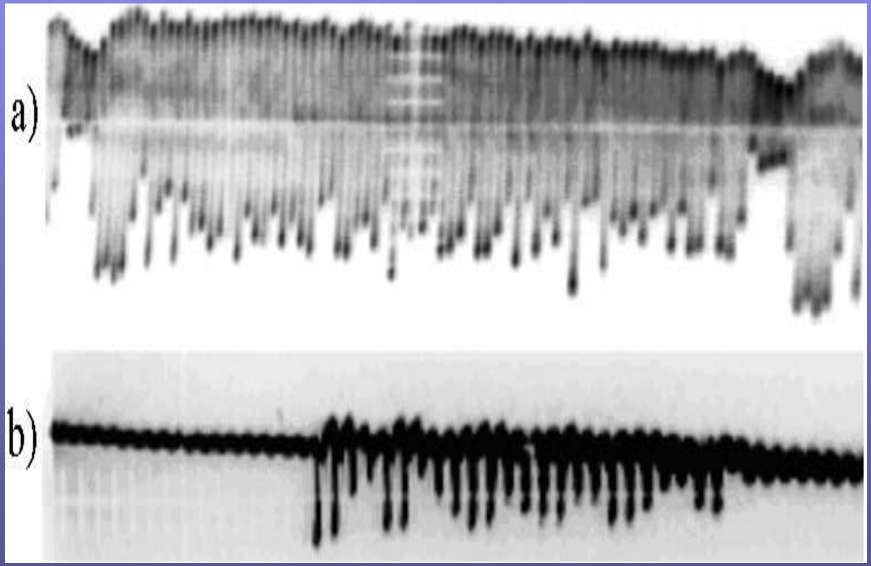
3.5 Injection into Siberia-2 (multibunch mode)

1. Lifetime grows from 0.5-0.6 hrs (in one bunch 4 - 5 мА) to 1.2 – 1.5 hrs when total current increases with a number of bunches at injection.
2. A saturation of lifetime is observed near 80 mA.
3. Higher RF voltage are required to dump the coherent synchrotron oscillation.

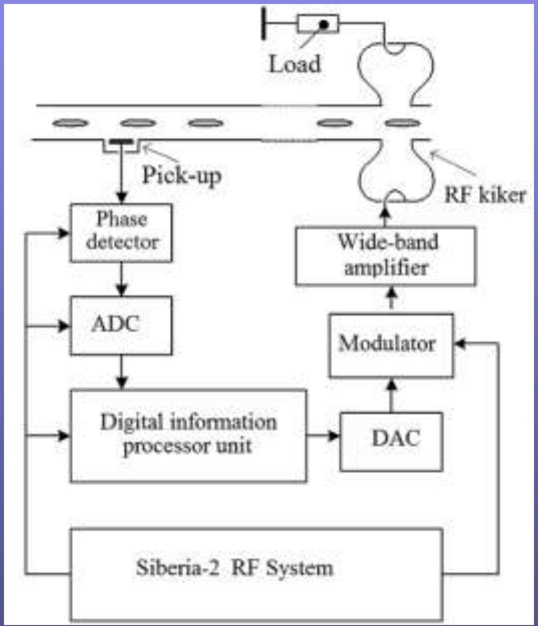


3.5 “Bunch-to-bunch longitudinal feedback” at Siberia-2 – plan 2011

- The synchrotron collective modes appear during injection at 450MeV and energy ramping leading to the losses of the beam part.
- The losses depend on the number of bunches and modulation of the longitudinal distribution of particles in bunches corresponds to the synchrotron mode number.



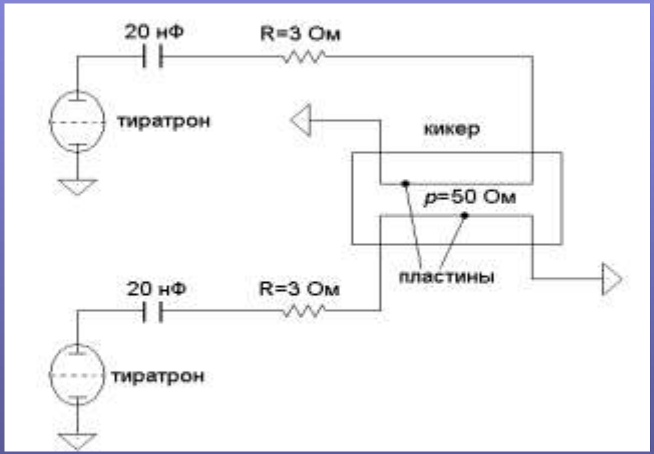
The modulation of bunches with different filling due to collective mode instability losses.

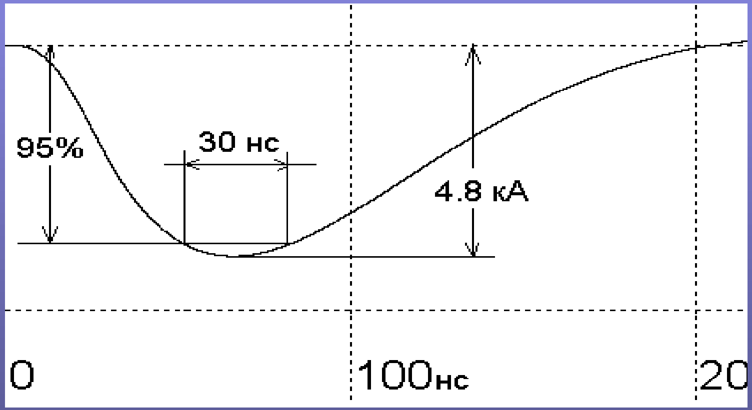


Bunch-to-bunch longitudinal feedback

3.5 New nanosecond generator (Siberia-2) based on the pseudo-spark thyratron “ТПИ1-10К/50”

- A base is the pseudo-spark thyratron with the cold cathode;
- Output parameters of ns generator:
- Nominal output current – 3 kA (parallel switched on inflector plates - 1.5 кА);
- Duration of semi-sin-like pulse – (100 – 200) нс;
- Jitter (temporal spread of key) – < 2 ns;
- Amplitude of anode voltage of the thyratron - 25-30 kV





Successfully tested with the electron beam at Siberia-2 in 2009.

- the high temporal stability of capture of electrons was reached – high efficiency injection (up to 70- 75%).
- The features : low voltage, absence of spark discharge and a work only with magnetic field between the kiker plates.
- The change for the existing high voltage inflector and preinflector nanosecond generators, which work on the electric spark dischargers.

4. IMPROVEMENT OF ELECTRON BEAM PARAMETERS AT SIBERIA-2

4.1. COD CORRECTION

4.2. VERTICAL EMITTANCE REDUCTION

4.3. STABILIZATION of the SR BEAM VERTICAL POSITION

4.4. DIAGNOSTICS *): Measurement of tunes, NMR

4.5 Increasing of electron life time at Siberia-2

*) In collaboration with BINP SB RAS

4.1. COD CORRECTION at SIBERIA-2

a) 24 BPM stations with ≤ 10 micron accuracy.

COD: $\sigma y < 0.10$ mm, $\sigma_x < 0.30$ mm.

b) To find COD at the 72 quads azimuths the method of the gradient changes is used with the correction coils existing on quadrupole lenses poles. The transverse distances between neighboring BPMs centers and quadrupole lenses axes are found and taken into account to improve COD control.

4.2. VERTICAL EMITTANCE REDUCTION at SIBERIA – 2

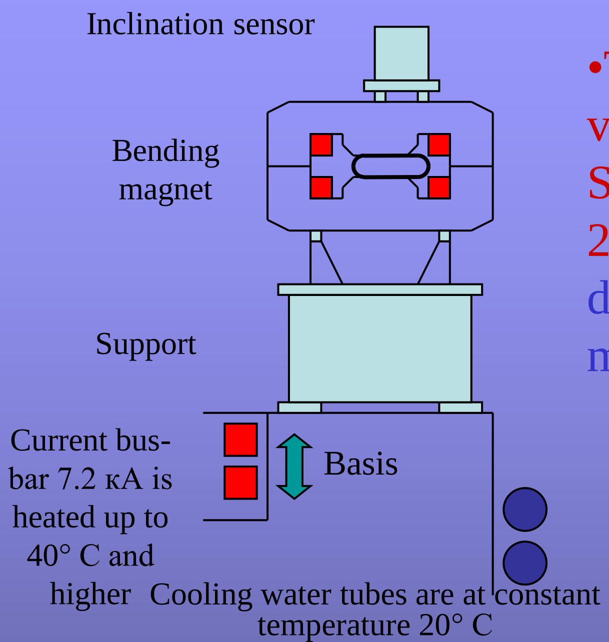
1. A correction of COD by using dipole correctors and a change of skew - quadrupoles connection scheme have allowed reducing a coupling factor of betatron oscillations essentially.

In fact, vertical emittance contribution arising due to betatron coupling can be reduced till 0.03 (0.01) % of the horizontal value.

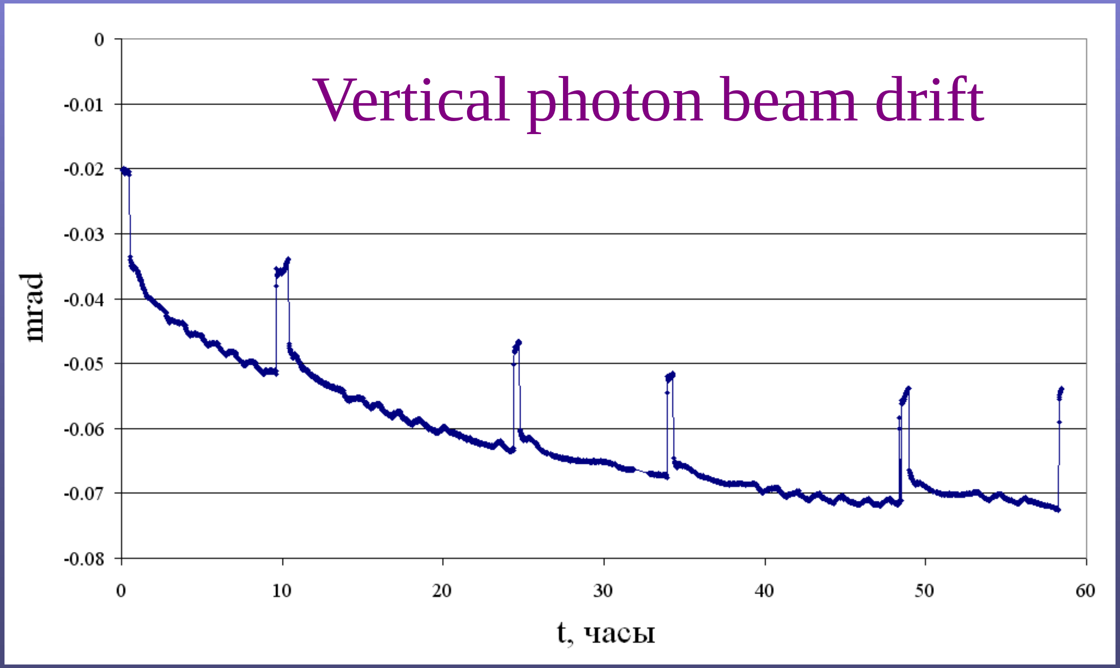
2. Correction of vertical dispersive function (arising due to errors in positions of lenses and COD of a vertical plane) has allowed reducing its value on the azimuths of pickups more than 3.5 times. It has resulted in appreciable reduction of the vertical size of an electron beam in BMs.

By estimations, vertical emittance, arising due to presence of a vertical dispersion, makes about 1 % from horizontal one.

4.3. Stabilization of the SR beam vertical position



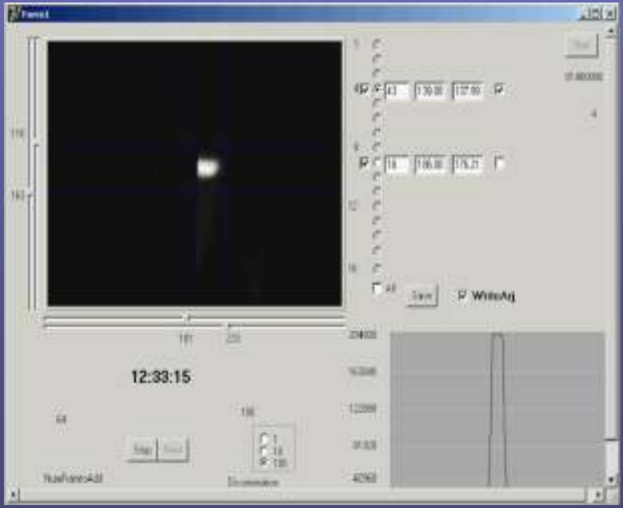
•The photon beams of Siberia-2 are slowly moving vertically during many hours (~70 hrs) at 2.5 GeV. Total SR beam shift during one-week operation was reaching 2-3 mm at a distance 15-20 m. The reason of the vertical drift of the photon beam is a not uniform heating of the magnetic elements basis and BMs inclination.



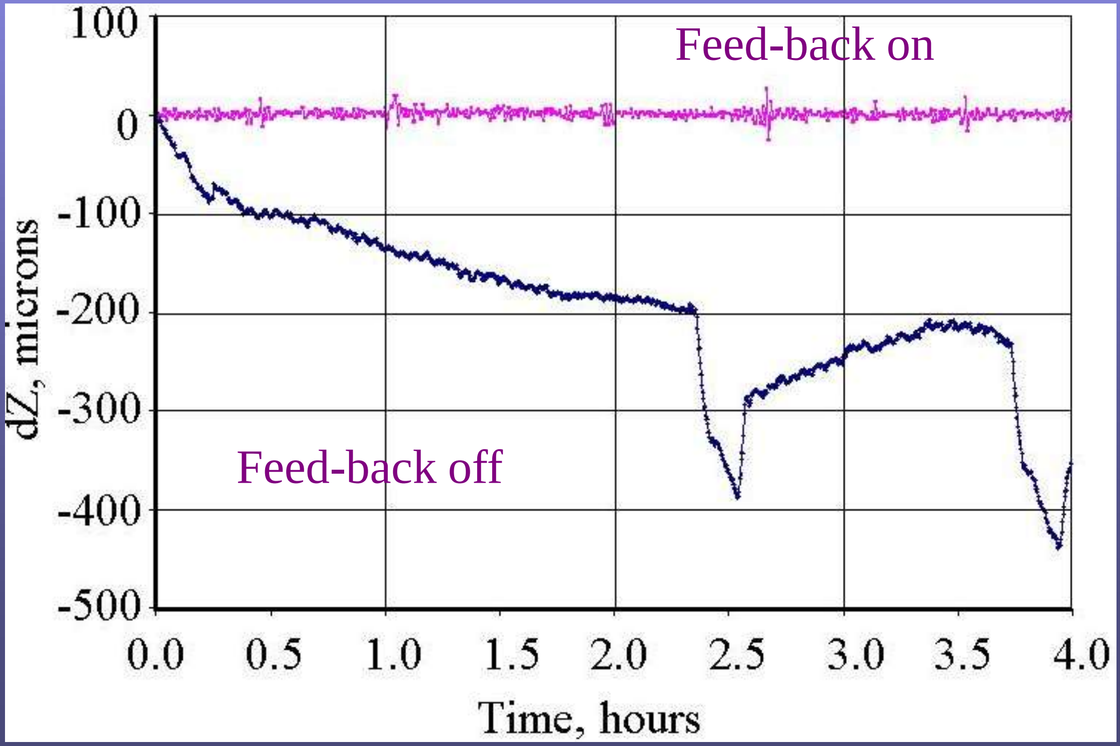
4.3. Stabilization of the SR beam vertical position

at SR stations with electro-optical feed-back system at 8 SR channels (electronics for 15 channels is ready) and dipole corrections of the storage ring

TV camera



SR beam drift is damped with an accuracy of
± 4-5 mkm
during work time



4.4. Diagnostics

a) A new electronics for betatron tunes measurement was run at Siberia - 1 and Siberia - 2 on January, 2009.

b) A new nuclear magnetic resonance (NMR) probe with auxiliary electronics and control code was installed in testing bending magnet of Siberia - 2 for accurate measuring the magnetic field.

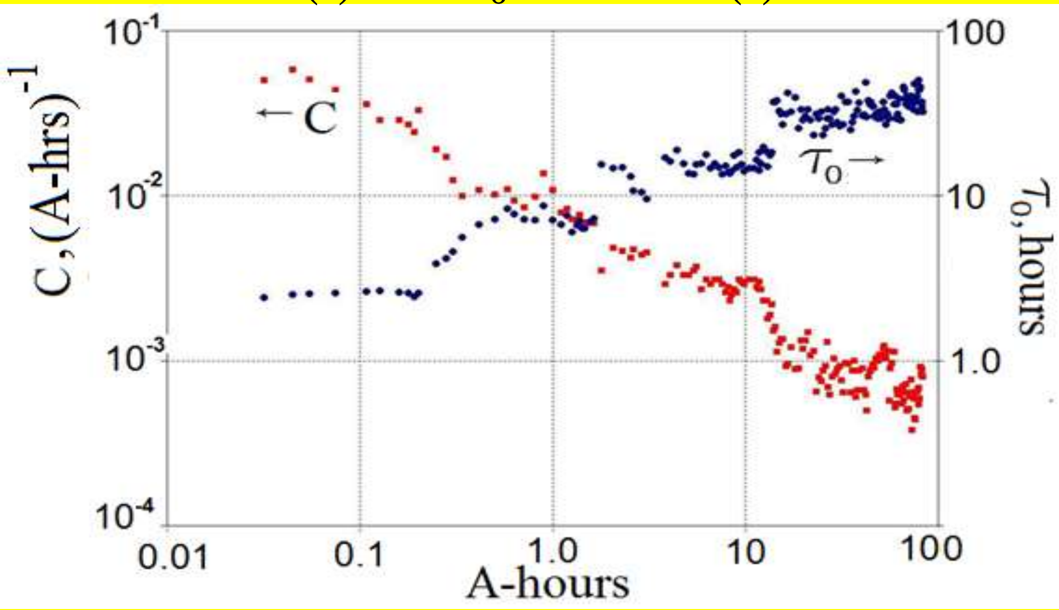
c) Electron energy stabilization in Siberia-2, NMR electronics serves as a part of feedback system.

4.5 Increasing of electron life time at Siberia-2

Injection 450 MeV: < 30 min with 3 - 4 mA in single-bunch mode - is mainly determined by Touschek effect in the presence of limiting the horizontal aperture.
The control of betatron oscillations coupling by two families of skew-quadrupoles.
An increase of lifetime was reached from 30% to 40% , thus reducing the loss of current during the ramping process from 5 - 6% to 1.5 - 2%.

2.5 GeV: > 15 hrs at a current of 100 mA, determined by the vacuum conditions.
Beam lifetime *τ(t)* at 2.5 GeV

$$\tau(t)^{-1} = \tau_0^{-1} + C \cdot I(t)$$



Note, that after closing the vacuum chamber, for the achievement of life time of 12 hours at the 100 мА electron current it was required to collect an integrated doze of 16 A*hrs, that is 10 times less, than it was required at the very beginning of SIBERIA-2 work with electron beam.

5. Installation of Insertion Devices at Siberia-2

First SC wiggler, installation on 25 December 2007

Superconducting wiggler in dispersion free straight section of SIBERIA-2.

MPSCW: NbTi coils

E=2.5 GeV, I=0.1-0.3 A

B= 3 - 7.5 T, Npoles=19+2

λ_{wig} = 164 mm

$E_{ph\ crit.}$ = 31.2 keV

Flux = (10^{14}-10^{12}) ph/s/0.1%BW

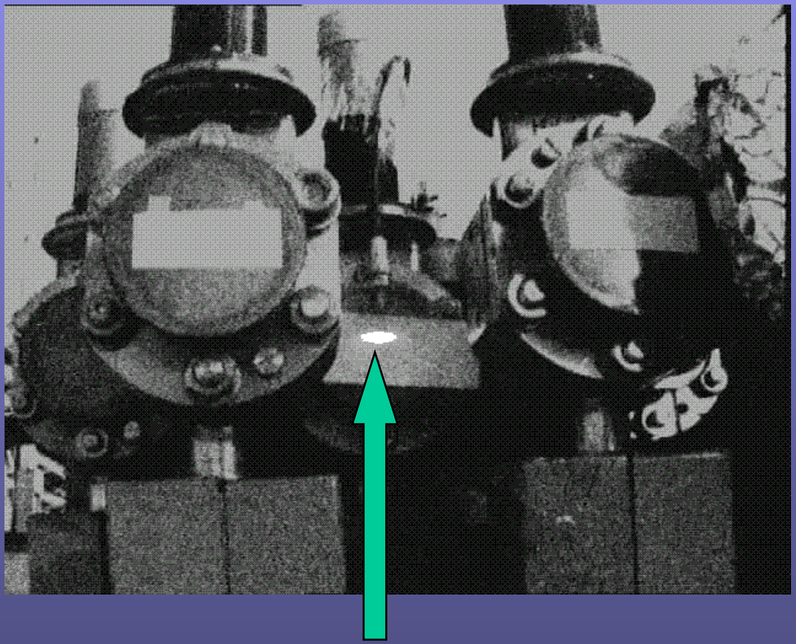
E_{ph} = 5 - 200 keV .

Θ_x max = ± 23.5 mrad

P_{tot} (100 mA) = 36.5 kW

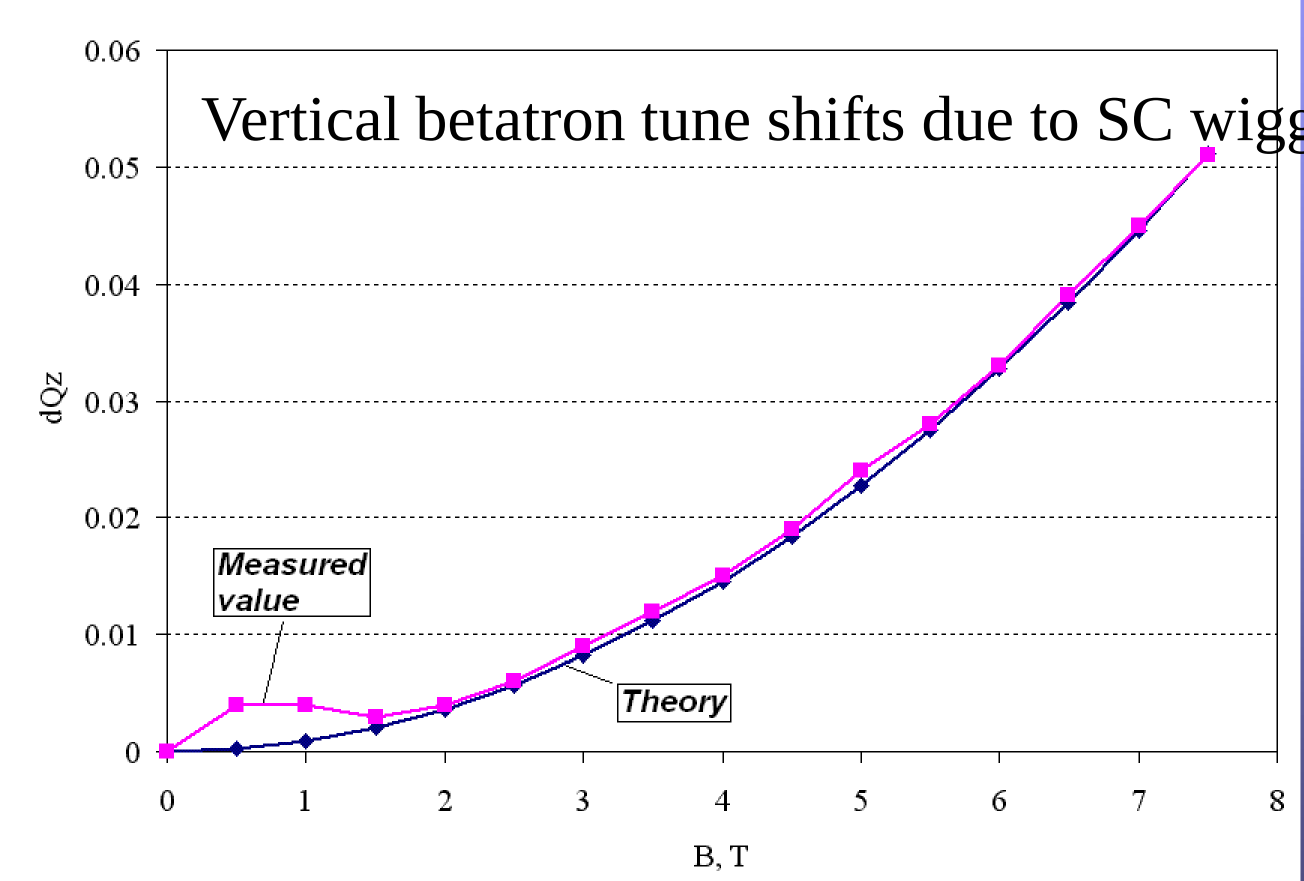
5. First radiation from superconducting wiggler
(7 June 2008)
B=3 T, Ee=2.5 GeV, Ie=25 мА

SR beam: λc=1A°, P=1.46 kW, Θmax=9.4 mrad



Radiation on luminescent screen

5. Commissioning of the SC Wiggler at **Bm = 7.5 T, E= 2.5 GeV,**
Ie = 0.85 mA,, U1rf = U2rf = 830 kV, lifetime = 20 hrs. (19.12.08)

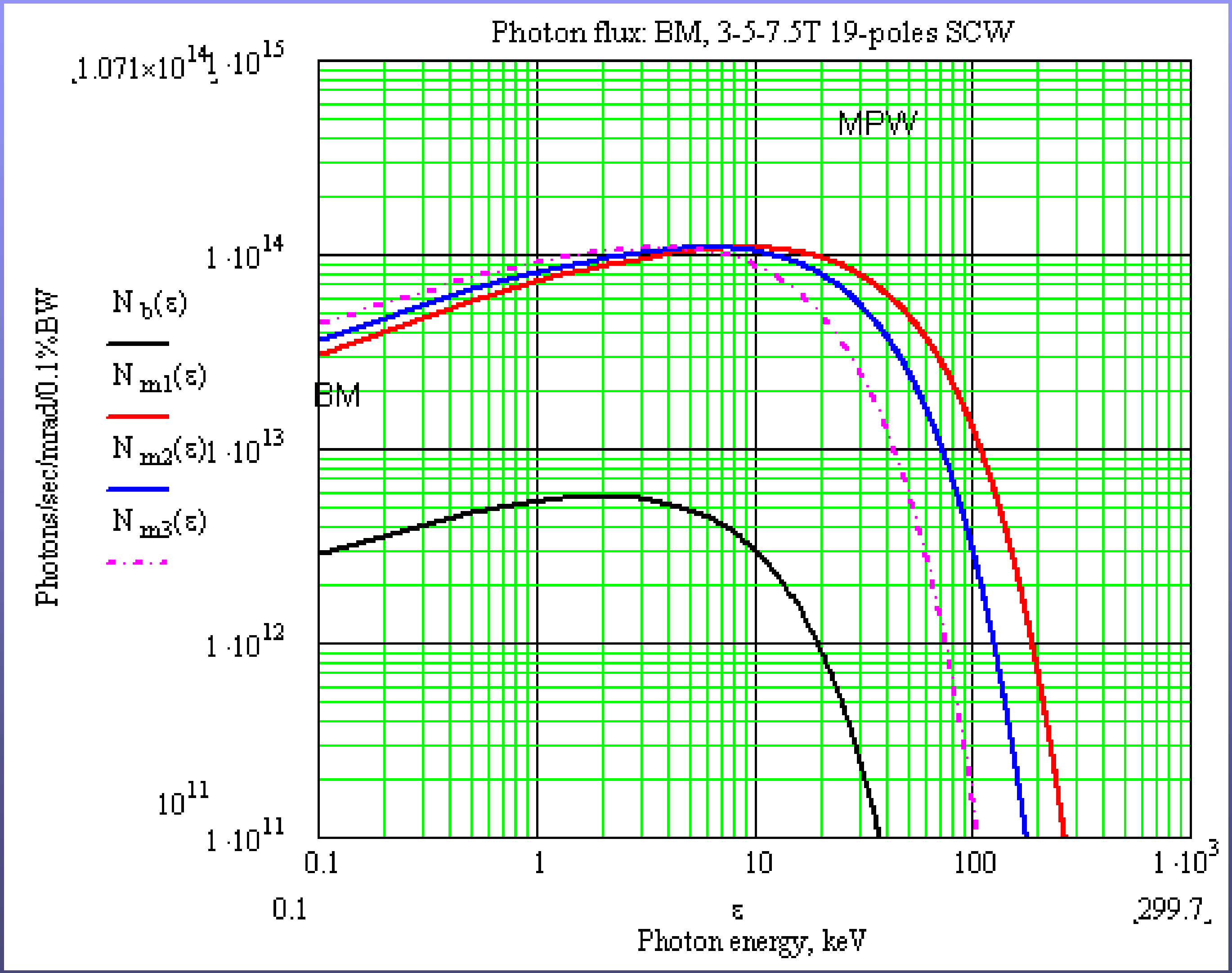


1. High accurate geodesy.
2. Codes for wiggler – storage ring SIBERIA-2 joint operation in different mode.
3. Understanding of large liquid He consumption. Now – 2 l/day…

5. Wiggler influence on general beam parameters in Siberia-2.

Parameters	Without wiggler	With one wiggler 7.5 T	With two wiggler 7.5 T
Energy	2.5 GeV	2.5 GeV	2.5 GeV
Horizontal emittance	98 nm·rad	64.7 nm·rad	48.4 nm·rad
Betatron tune shifts, $\Delta Q_{x,z}$	-	0; 0.05	0; 0.10
Radiation loss per turn	685 keV	1045 keV	1410 keV
Orbit compaction factor	0.01036	0.01036	0.01036
Energy dispersion, σ_E/E	0.000953	0.00142	0.00160
Damping times: τ_x, τ_z, τ_s	3.15, 3.02, 1.48 ms	2.05, 1.99, 0.98 ms	1.50, 1.47, 0.73 ms
RF-voltage amplitude	1.2 MV (current value)	1.61 MV (for the same energy acceptance)	2.0 MV (for the same energy acceptance)

5. SR Spectral Flux from 3-5-7.5 T SCW and 1.7 T BM. E=2.5 GeV, I=0.1A



5. Power density angle distribution of SR from 19-pole SC wiggler
E = 2.5 GeV, I = 0.1A, B = 7.5 T

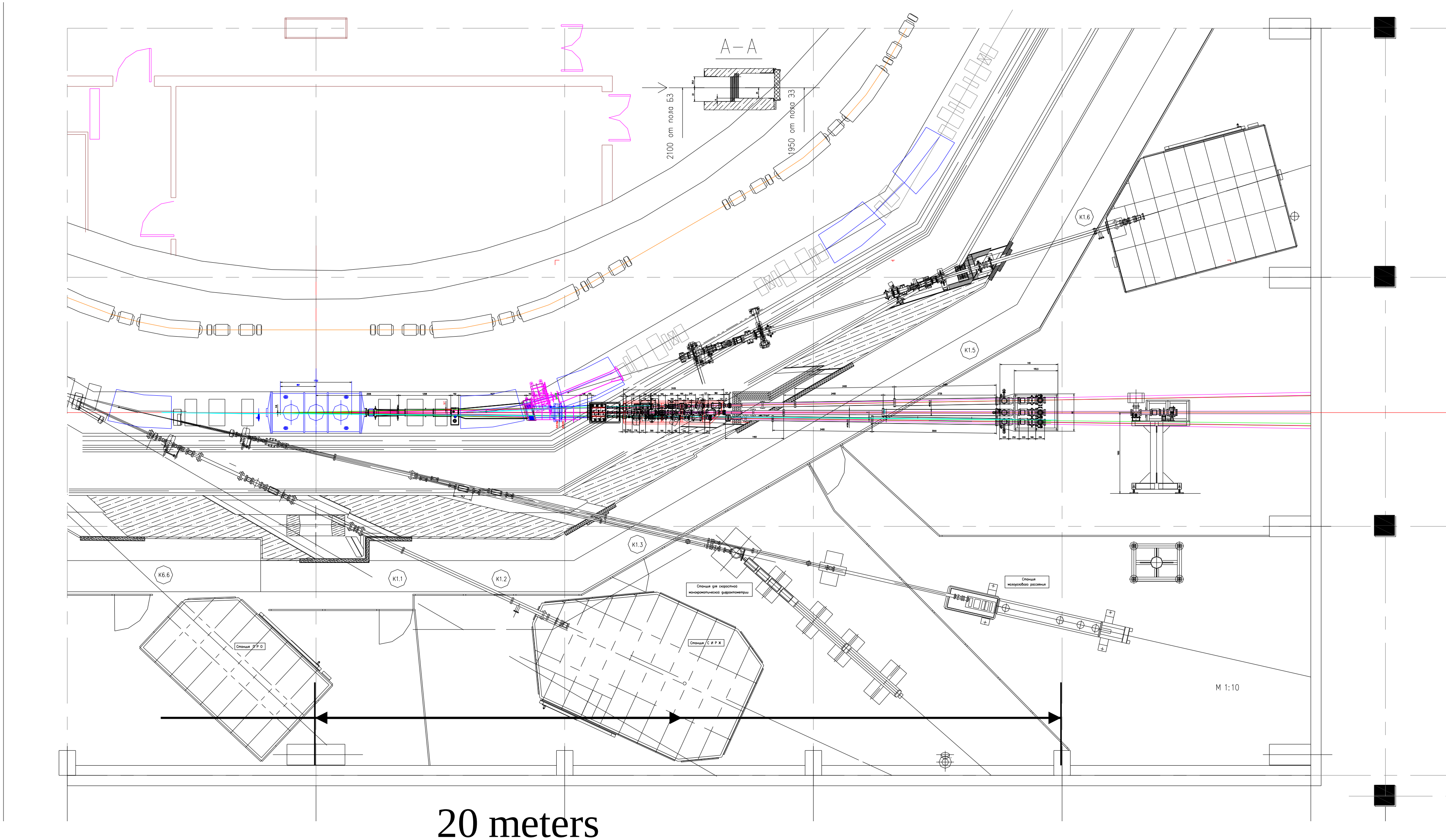
$$\frac{dP}{d\Theta}\left[\frac{W}{mrad}\right] = 4.22 \cdot E^3[GeV] \cdot B_m[T] \cdot I[A] \cdot \sqrt{1-(\Theta/\Theta_m)^2} \cdot N_{poles}$$

1. «XSA»:
(-17 ± 1) mrad,
λc = 0.58 Å,
P = 650 W/mrad

2. «Hard X-Ray»
(0 ± 1) mrad,
Up to 150 keV,
λc = 0.4 Å ,
P = 940 W/mrad,

3. «RS-MCD»:
(13.3 ± 1)mrad,
λc = 0.5 Å,
P = 760 W/mrad

5. Extraction of SR from SC wiggler into 3 photon lines



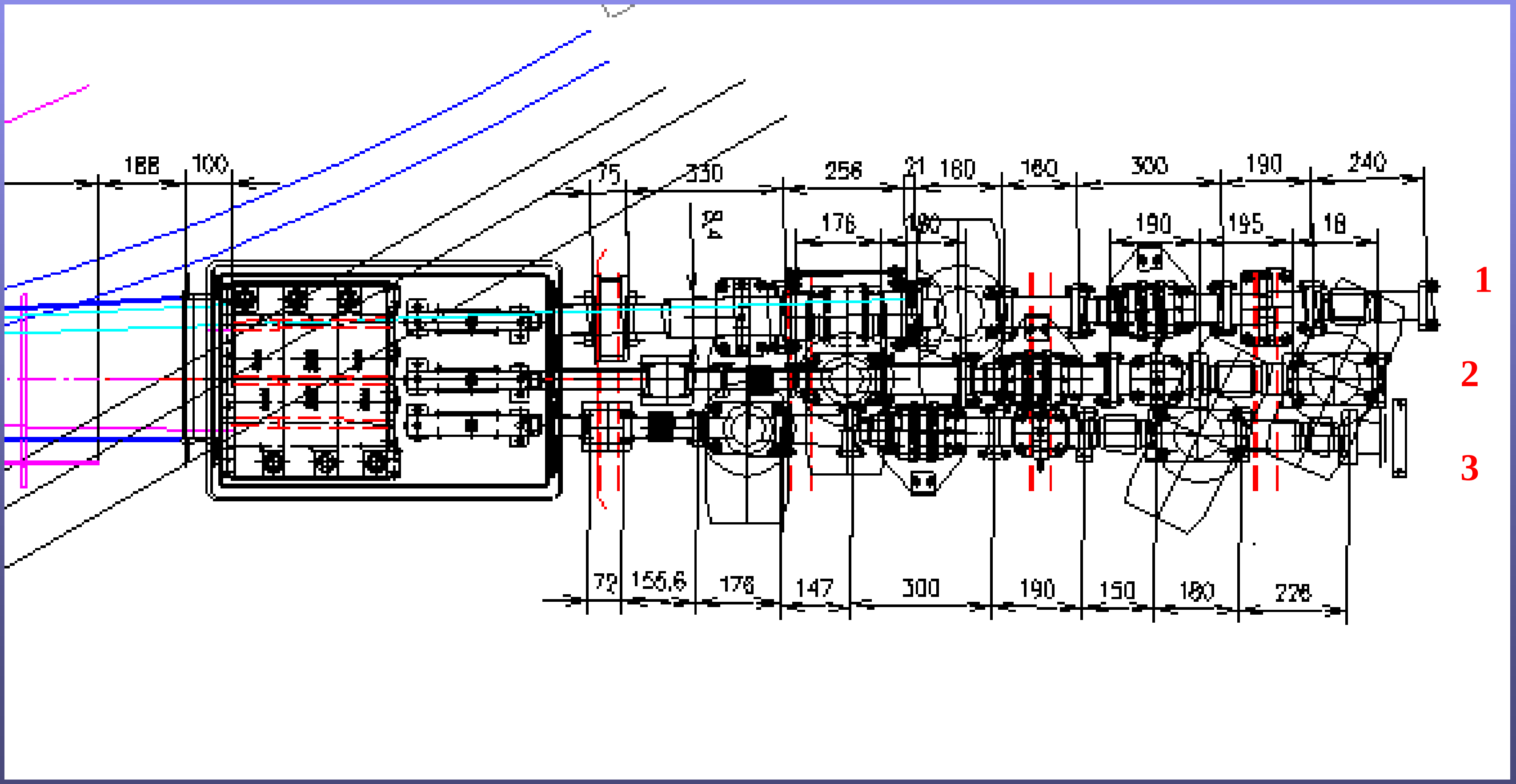
20 meters

SR Beam lines19-poles 7.5 T SCW:

1. RSA: (-17 ± 1) mrad;

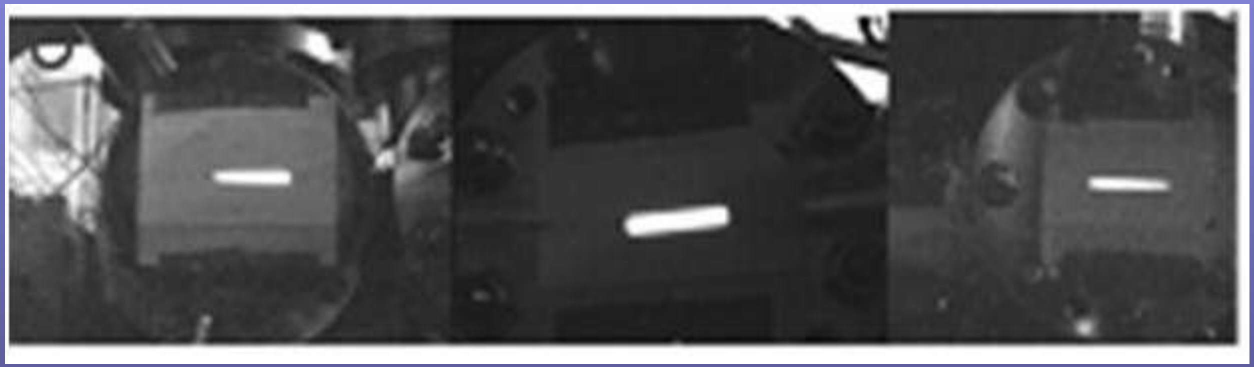
2. Extremale state: upto 150 keV, λc = 0.4 Å , P = 940 W/mrad, (0 ± 1) mrad;

3. RS-MCD: (13.3 ± 1)mrad



X-Ray beam from 7.5T SCW at output of three beam lines in the experimental hall of Siberia-2 (16.12.2009)

3 2 1



New experimental stations on 7.5T SCW

- Now there is a progress in the creation of next 3 new experimental station based on SR from 7.5 T SC wiggler:
- **EXAFS/XANES** and X-ray Magnetic Circular Dichroism (XMCD): Θ= (13.3 ± 1) mrad, λc = 0.5 Å, P = 760 W/mrad - K1.4.2;
- **Hard X-ray:** λc=0.4Å, P=940 W/mrad, Θ = (0 ± 1) mrad – K1.4.3;
- **RSA - X-Ray Structure Analysis-**: Θ =(-17 ± 1) mrad, λc=0.58 Å, P = 650 W/mrad – K1.4.4.
- Here the SR power data correspond to 100 mA current and 2.5 GeV energy of the electron.

5. Safety extraction of intense and power SR beam through the 3-ports

1. Upgrade of vacuum chamber between wiggler and front-end, installation additional SR absorbers;
2. The creation of high power density absorber of SR.
3. Installation of new 3 wiggler beam lines in tunnel of the ring and experimental hall.

New experimental station and SR beam lines from BMs **at Siberia-2**

- Under construction are 3 experimental stations and 3 SR beamlines from the 1.7T BMs:
- **“PES”** - Photoelectron Spectroscopy (PES, ARPES, NEXAFS) – beam line K6.5,
- **“PHASE”-** X-Ray precision optic-2 – beam line K2.3,
- **“NANOFAB-2”** – micro- and nano-electro-mechanical systems researches (MEMS and NEMS)- K2.6. These SR beamlines and experimental stations are producing with a firm “NT-MDT”, Zelenograd.

New SR beam line from BM at Siberia-1 (KCSR – NIIOFI)

- SR from 3[d] BM of Siberia-1 was conducted in VUV experimental hall after the completion of mechanical and vacuum works on the new beam line D3.2.

- First metrology experiments were made by NIIOFI and KCSR staff (beam sizes measurements).

6. Development of Kurchatov SR Center

6.1. Extension of KCSRNT with additional building was done – Organization NBIC-Center .

6.2. Technical upgrade of accelerator facilities for reaching the parameters of SR source of 2.5-3 generation (financial problem).

6.3. Equipping by new IDs and creation of new SR Stations

6.2. Technical upgrade of accelerator facilities (2008-?)

1. An elaboration of the magnetic optics of Siberia-2 ring with small emittances (ε_x~17-20 nm-rad, 2.5 GeV).

- More “brighter”optical structures permit to have ε_x = 4-6 nm-rad at 1.3 GeV, which corresponds to “the 3-d generation SR sources” parameters.
- New optical structure of Siberia-2 storage ring with small natural emittance leads to rather small Dynamic Apertures. Therefore the new injector with small phase volumes of electron beam is required.

2. New Injection system. Project of Booster Synchrotron at the energy 0.08(0.16)÷ 2.5 GeV implies a top up energy injection from BS and the small emittance of injected beam:

- to exclude the periodic store process of electrons at low energy in Siberia-2 ring, which a) breaks the use of SR beams and, b) leads to many troubles in a process of the electron energy ramping in storage ring when working with SCWs and other IDs;
  - to reach the effect of “continuous” lifetime of electron beam;
  - to work with much higher stability of the photon beams space position;
- to increase the reliability of SR source by new techniques, more stabilized power supplies;

6.2.1. Optics with 18 nm-rad horizontal emittance at 2.5 GeV

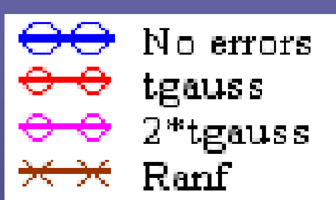
Calculations:

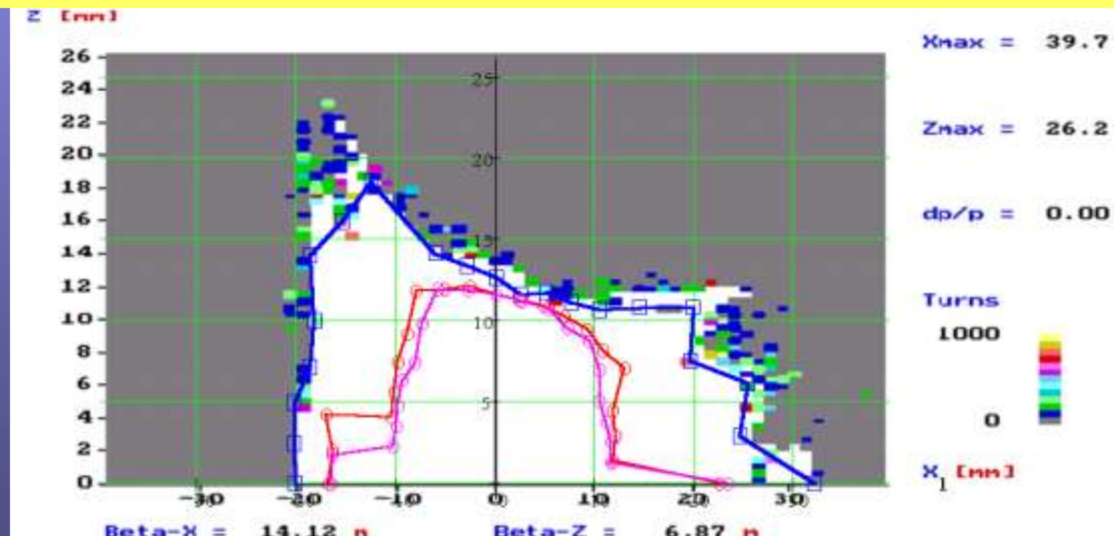
- non-zero dispersion in all sections of Siberia-2,
- betatron tunes ν_x=9.708, ν_y=5.623,
- chromaticities ζ_x=–21.4, ζ_y=–19.7,
- dynamical apertures (-19 mm < DA_x < 25mm, –12mm < DA_y < 12 mm).

N.B. It is possible a diffraction-limited radiation in vertical direction from the mini-undulator with rather short wavelength:

E≈1.33 GeV, εx = 4.8 nm-rad, εy = 0.048 nm-rad, λ_u = 7 mm, λ_{fund}=6Å.

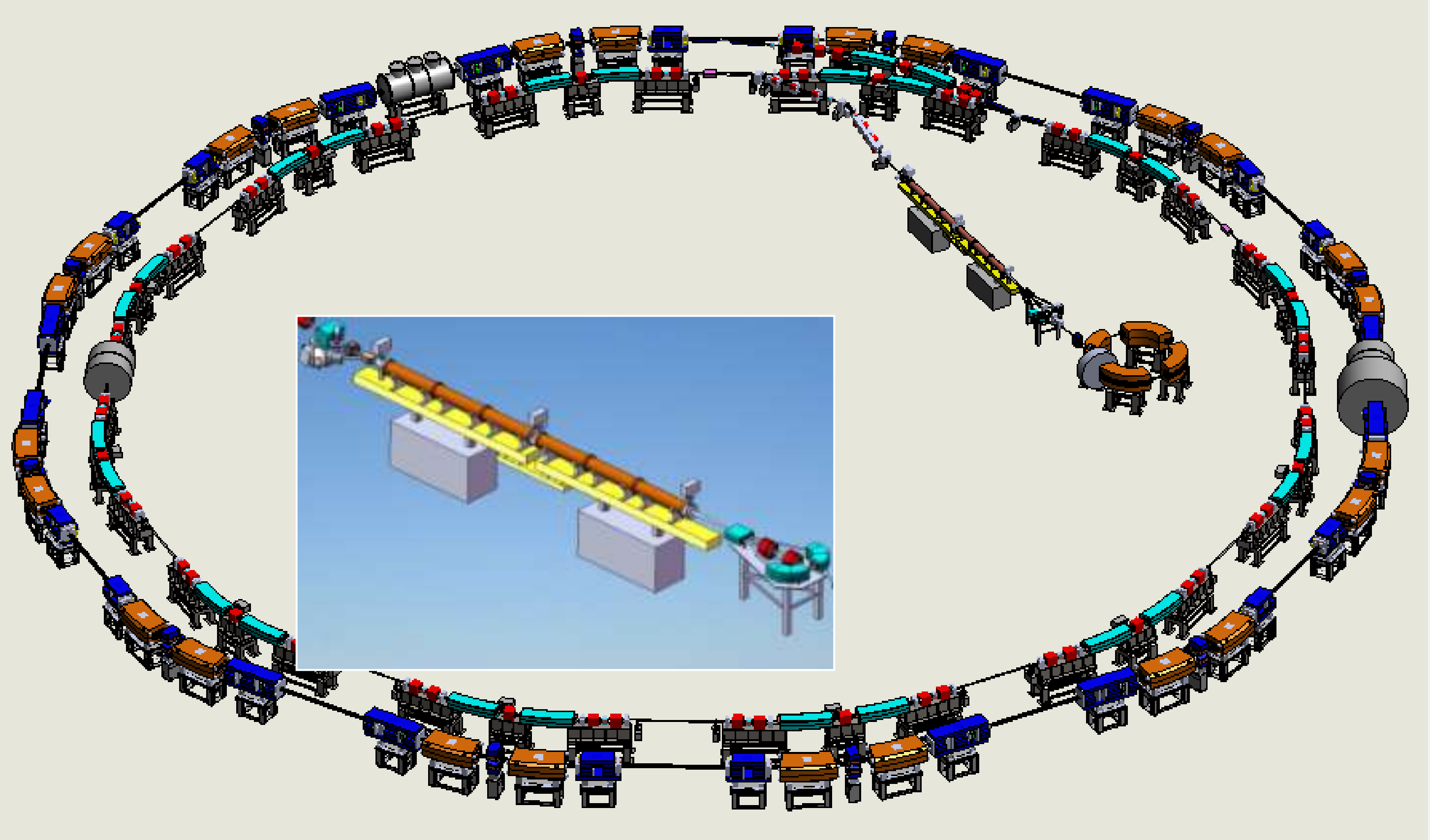
DA-18
MAD (1000)
Optick





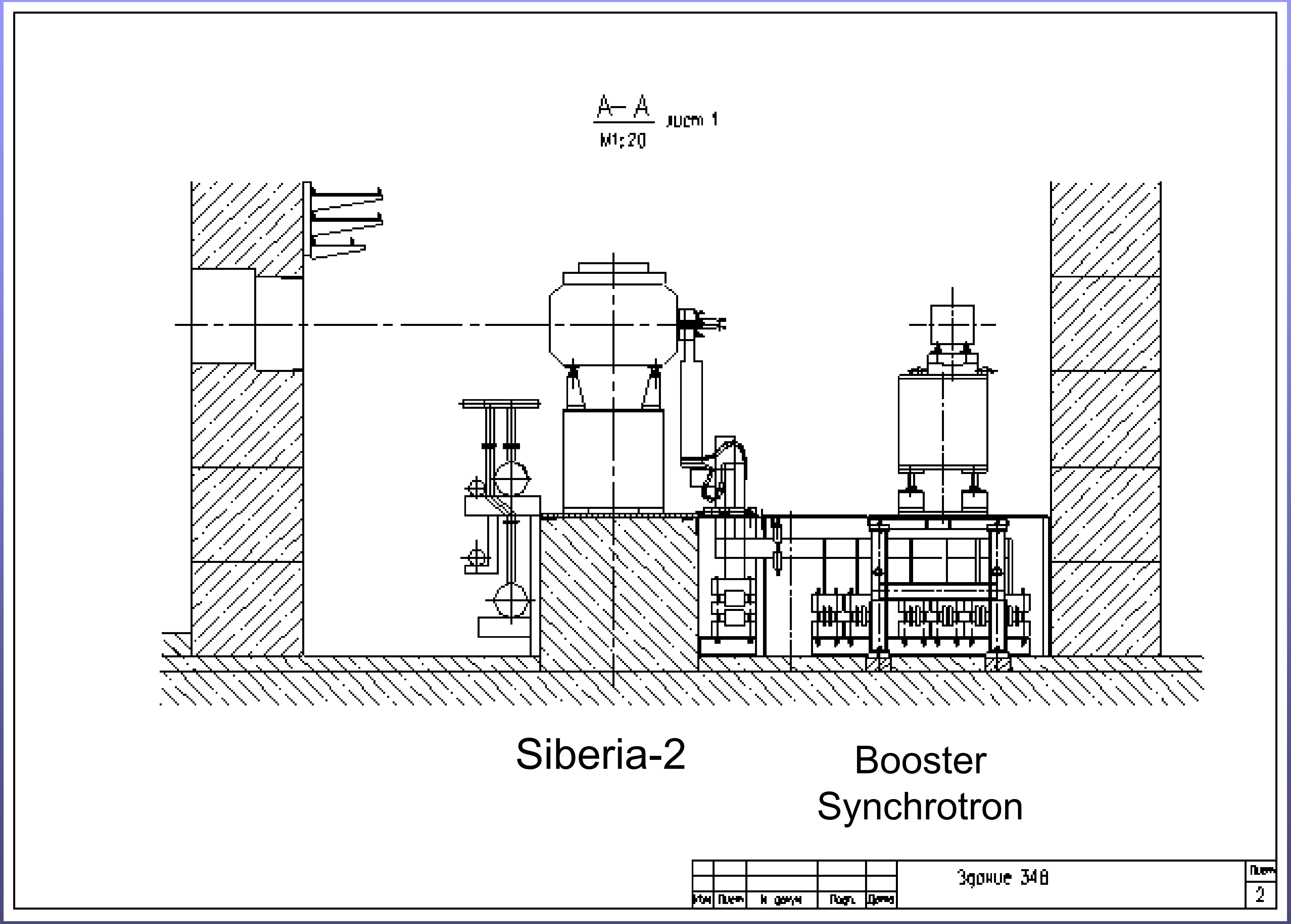
The “18 nm-rad” structure implies a modernization of the injection system and an optimization of the sextupole magnets positions on the ring.

6.2.2. PROJECT BS-1: Top-up energy injection scheme for dedicated SR source SIBERIA-2



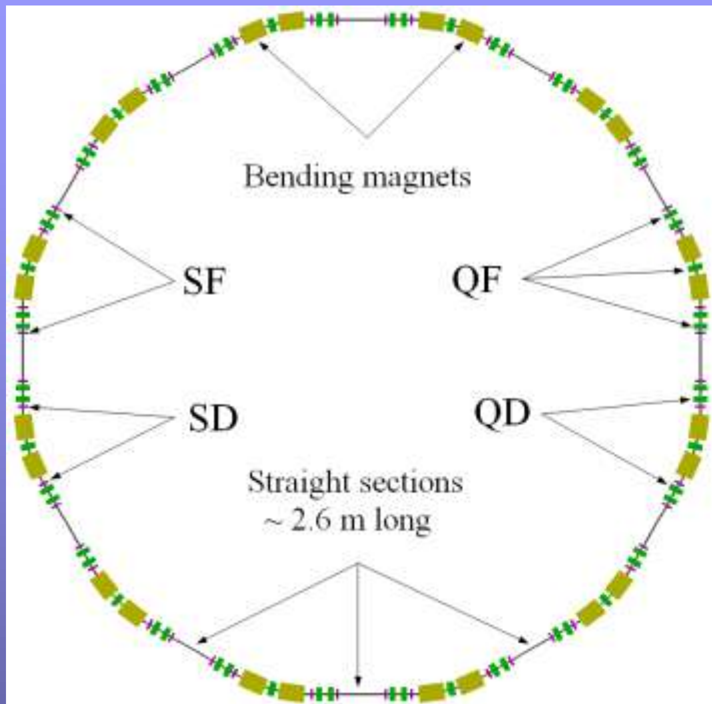
Injection in SIBERIA-2:
Linac 80 MeV - magnetic mirror - Linac-160 MeV,
Booster Synchrotron 160-2500 MeV,
Siberia-2 – 2500 MeV

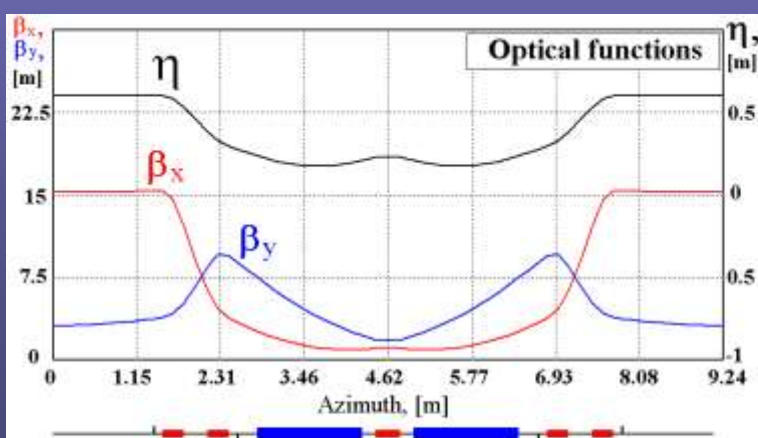
6.2.2. PROJECT BS-1: Cross-section of the shielding tunnel with Siberia-2 storage ring and 2.5 GeV BS



6.2.2. PROJECT BS-1: Structure of Booster Synchrotron

12 s-periods, 24 BMs, 60 Qs, 46 Ss, 12 straights 2.6m long

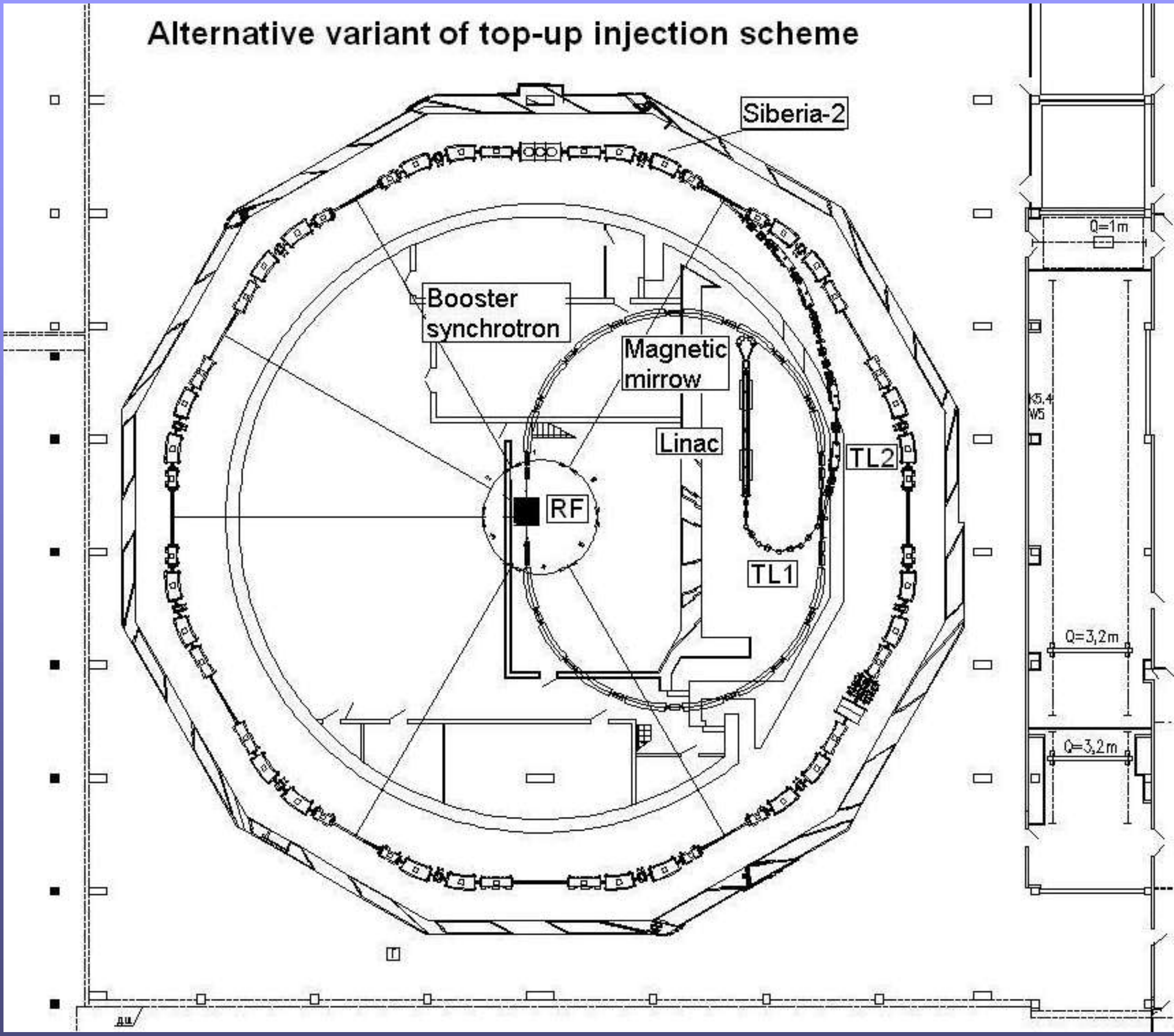




Injection energy	*80-160 MeV*
Extraction energy	*2.5 GeV*
Circumference	*110.9 m*
Cycling frequency	*1 Hz*
Emittance	*52.6 nm·rad*
Momentum compaction	*0.0107*
Betatron tunes: Q_x/Q_y	*6.83/4.57*
Chromaticity: x_x/x_y	*–14.12/–8.89*
R.m.s. energy spread	*9×10^{-4}*
Energy loss per turn	*622 keV*
Damping times: t_x, t_y, t_s	*3.08, 2.97, 1.46 ms*
Beam current	*20 mA*
RF frequency	*181.13 MHz*
Harmonic number	*268*
Synchrotron tune: Q_s	*0.092*

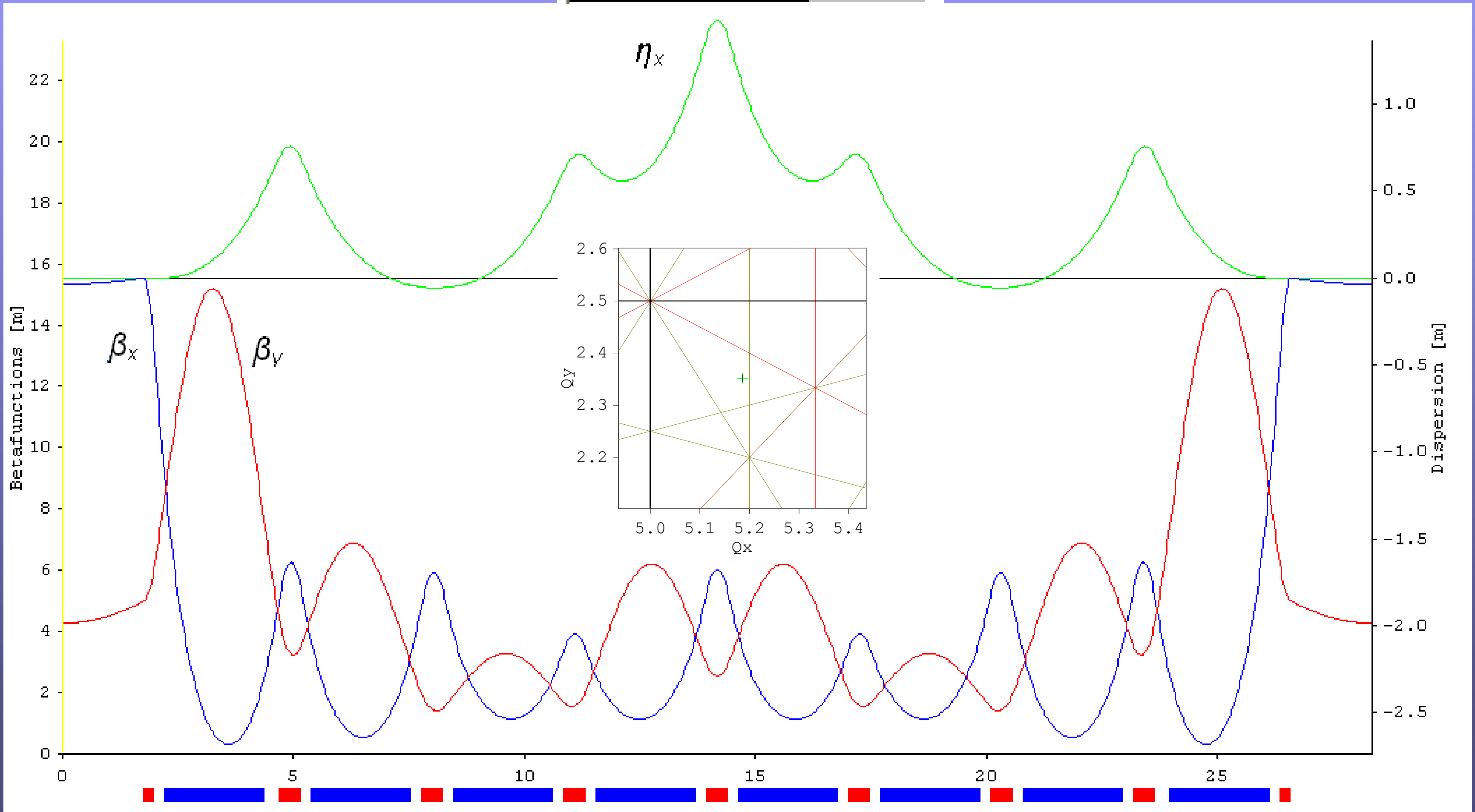
6.2.2. PROJECT BS-2 – Alternative Project

Periods		2
Length	[m]	56.707
TuneX		5.18583
TuneY		2.35161
ChromX		-8.849
ChromY		-4.451
Alpha	[xE-3]	32.241
Jx		2.56422
Energy	[GeV]	2.500
EmitXo	[nm rd]	90.142
dE/turn	[keV]	621.9
Espread	[xE-3]	1.946
TauX	[ms]	0.593
TauY	[ms]	1.521
TauE	[ms]	3.490
Location		START
Position	m	0.000
BetaX	m	15.342
AlphaX		0.0000
BetaY	m	4.277
AlphaY		0.0000
Disp.	m	0.0001

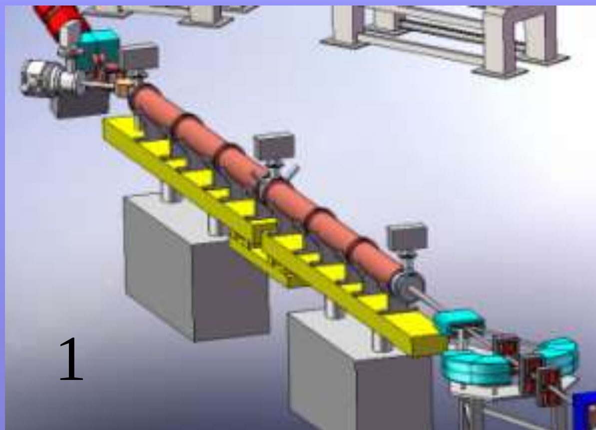


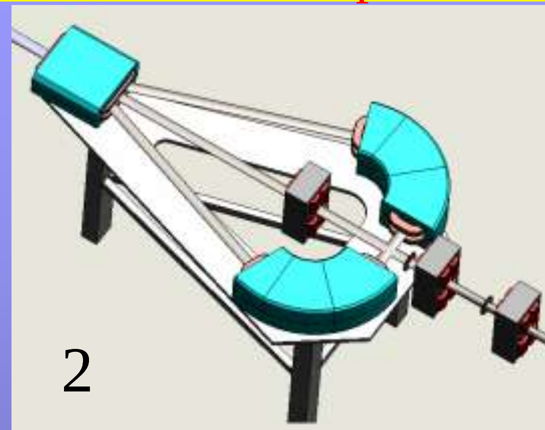
6.2.2. PROJECT BS-2. AMPLITUDE FUNCTIONS of BS-2

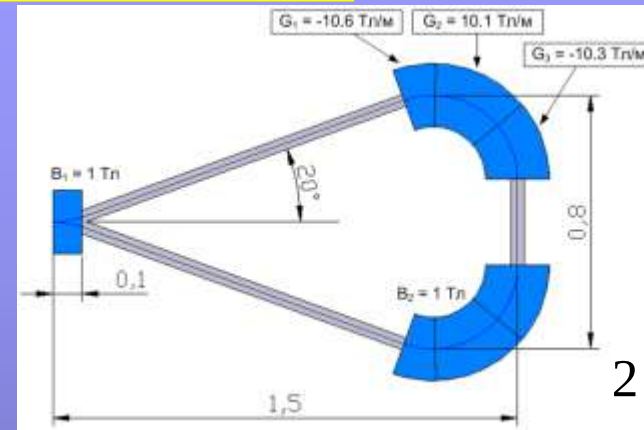
TuneX	5.18583
TuneY	2.35161
ChromX	-8.849
ChromY	-4.451

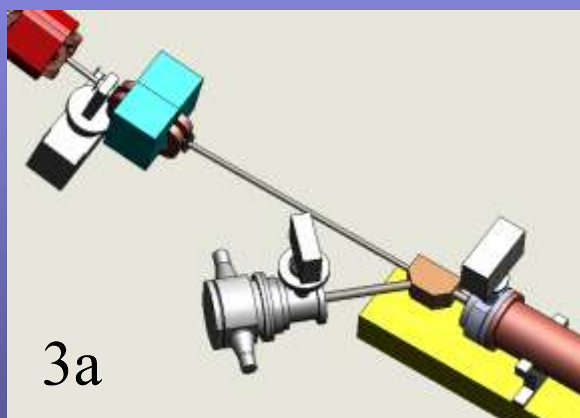


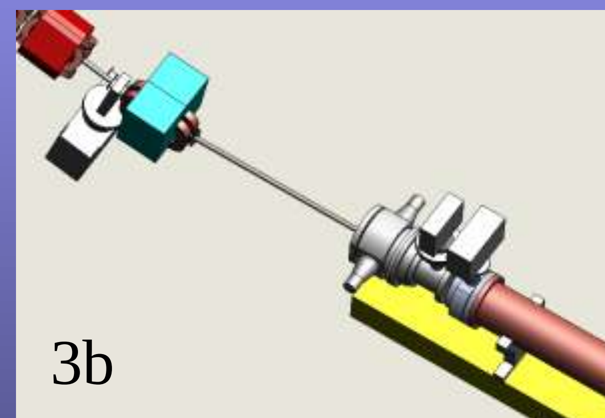
6.2.2. Linear Accelerator Energy Doubling from 80 MeV up to 160 MeV









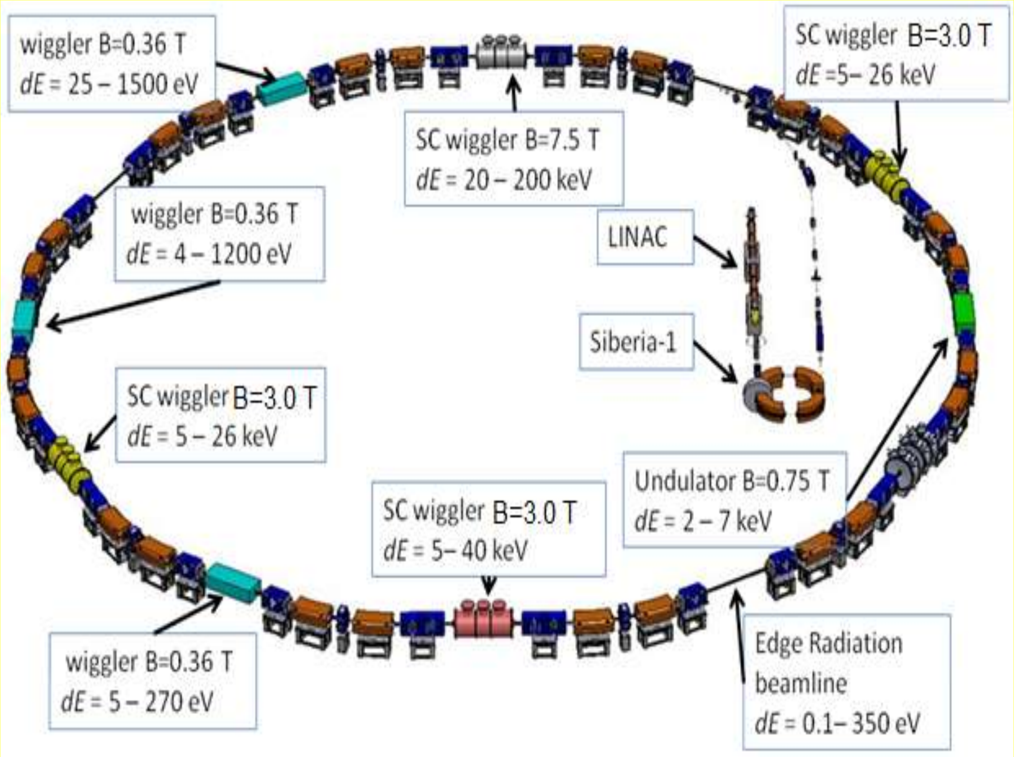


1 – 80 MeV Linac operating at standing wave;
2 – Isochronous achromatic magnetic mirror on 80 MeV;
3a –40keV electron gun with spherical cathode;
3b – 40keV electron gun with hollow cathode.

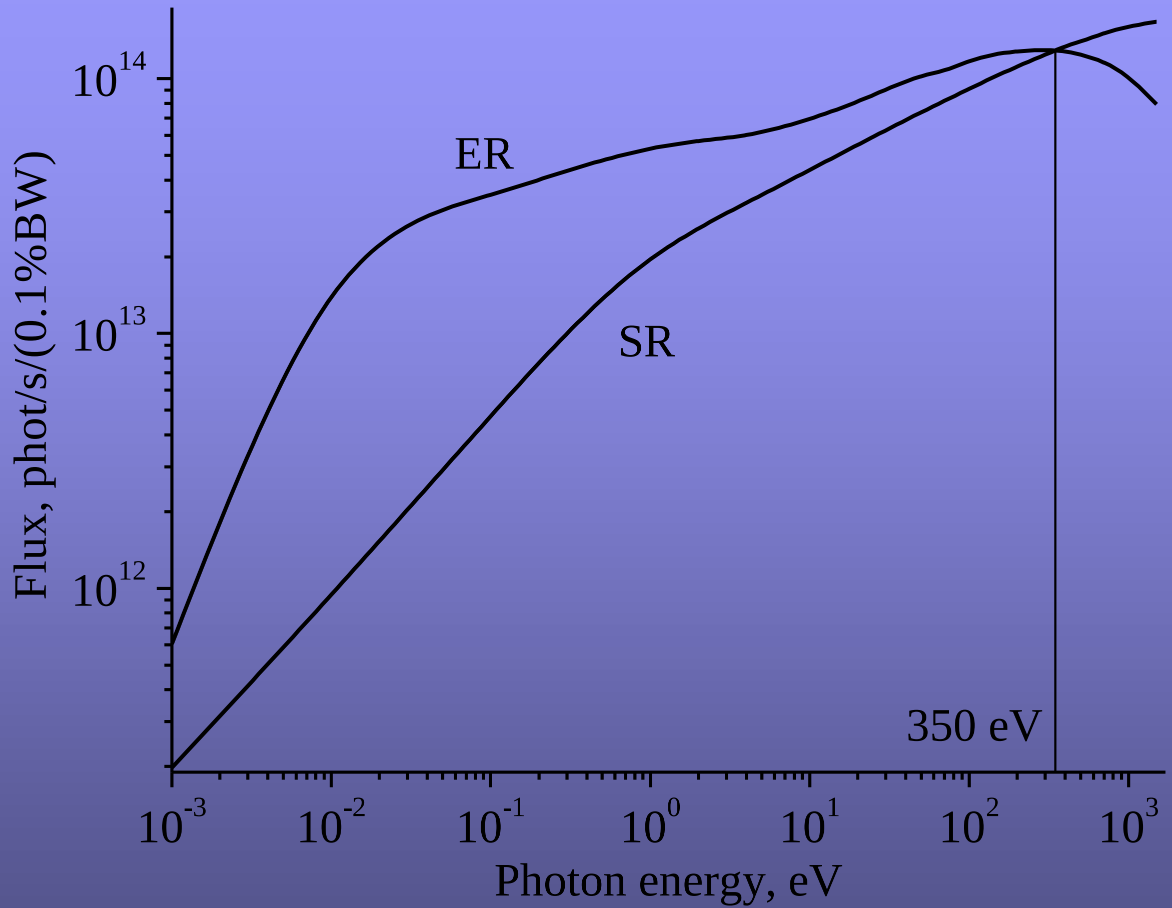
6.3. Insertion devices – specialized SR source

6.3 Main parameters of planed insertion devices and Plan of IDs location at Siberia-2

IDs	Bmax T	λu, mm	Np	Eph	SR station, planed
1 SCW	7.5	164	10	4-200 keV	RSA, RS-MCD, Hard X-Ray
3 SCW	3.0	44	35	5-40 keV	Belok-1, Belok-2, Lengmuir-2, Standing X-Ray
3 NCW	0.36	80	51	5.5-270eV	PES microscop, PES-SH Resol., Spectro-Lumi, VUV, MR
Mini-U	0.75	7	300	2-7 keV	1.3 GeV: X-Ray holography
IR ER	-	-	-	0.1-350eV	IR, VUV, Soft-X-Ray



6.3. Edge radiation on Siberia-2



ER and SR fluxes

into 10x10 mrad2 solid angle

6.1. Enlargement of experimental hall of KCSR **was done**

August 2009

Mars 2008

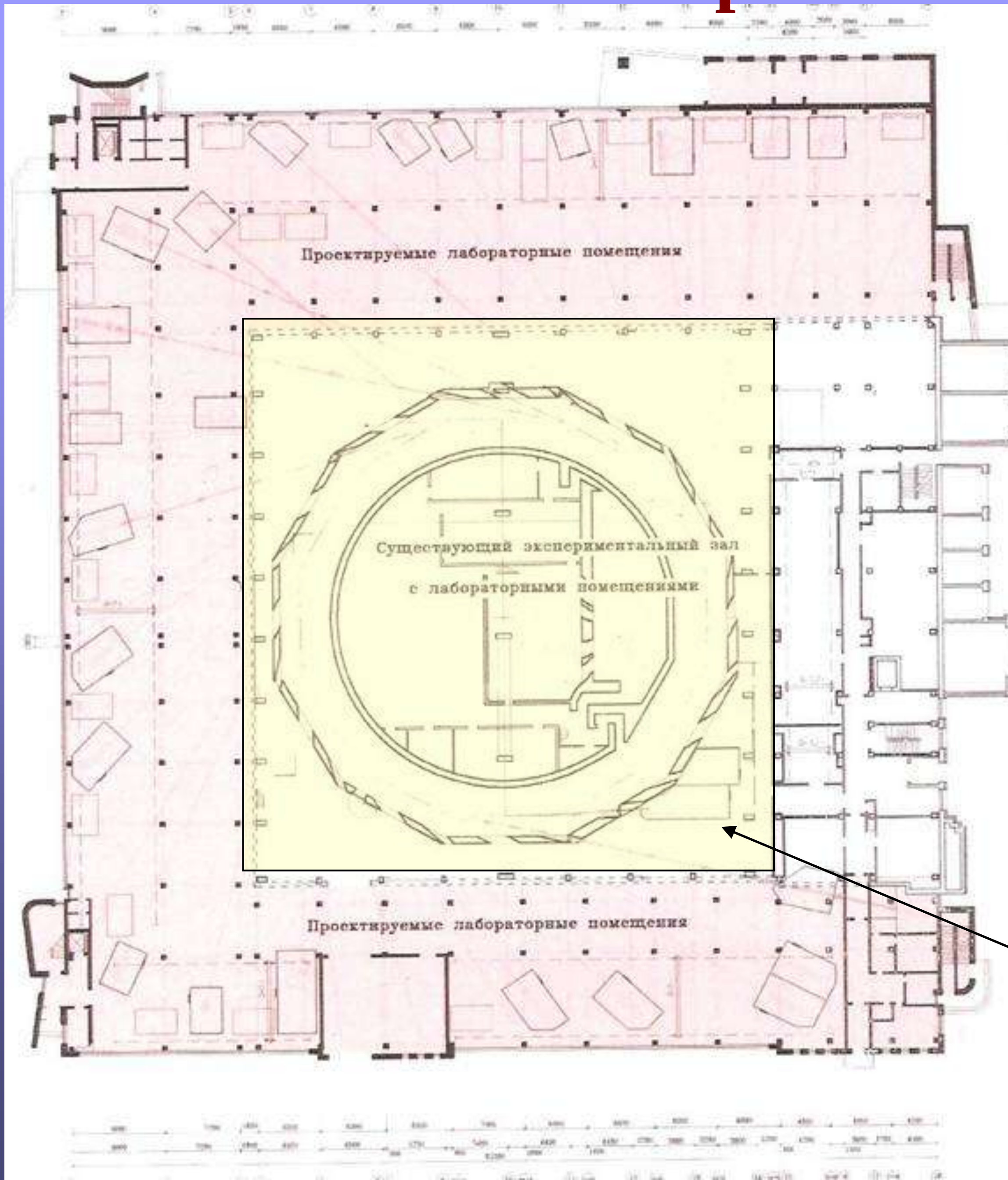
August 2007

6.1. Additional building , reconstruction of existing building, essential increasing of the useful surfaces for SR beam lines and experimental stations.

2007-2009

	Before reconstruction	After reconstruction
Experimental hall area, m²	***950***	***4 850***
Office area, m²	***512***	***4 643***
Total surface, m²	***6 026***	***16 756***

New experimental area

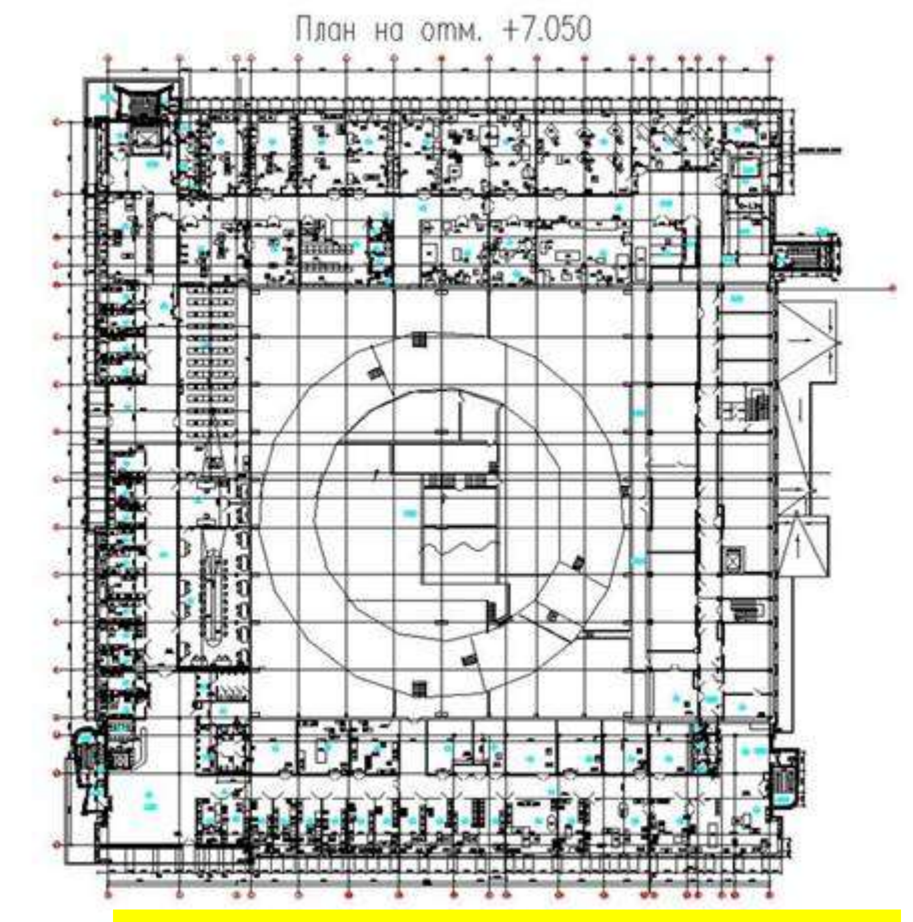


S = 4 850 кв.м.

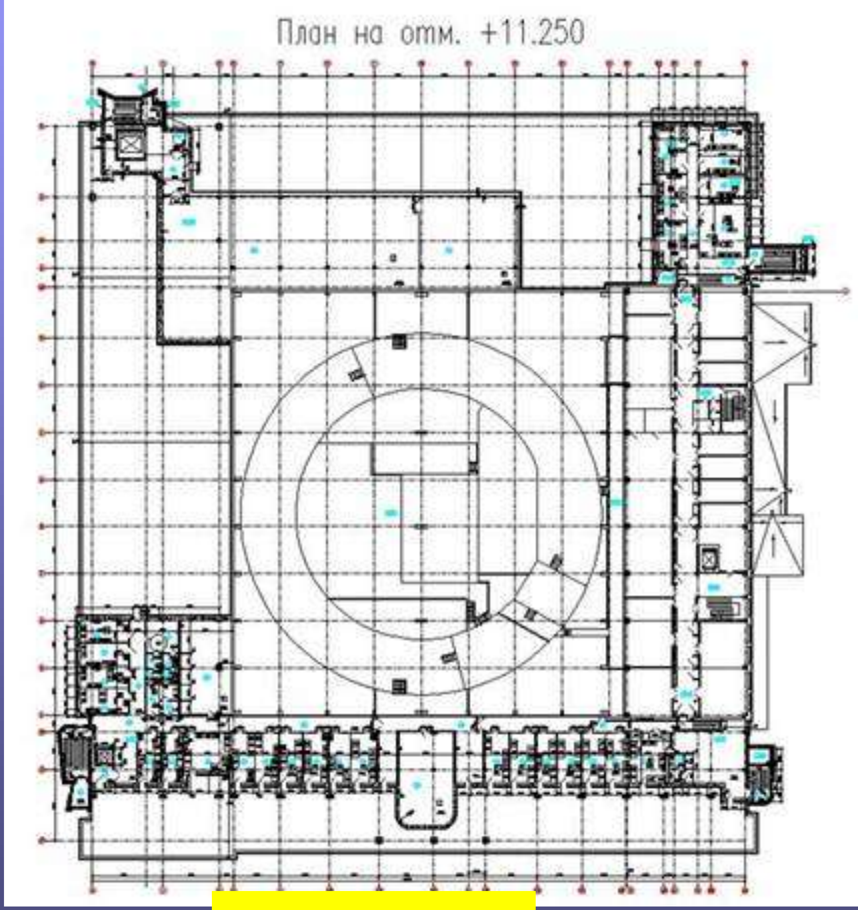
S = 950 кв.м.

Old hall

New area for staff and users *S=16 000 м2.*



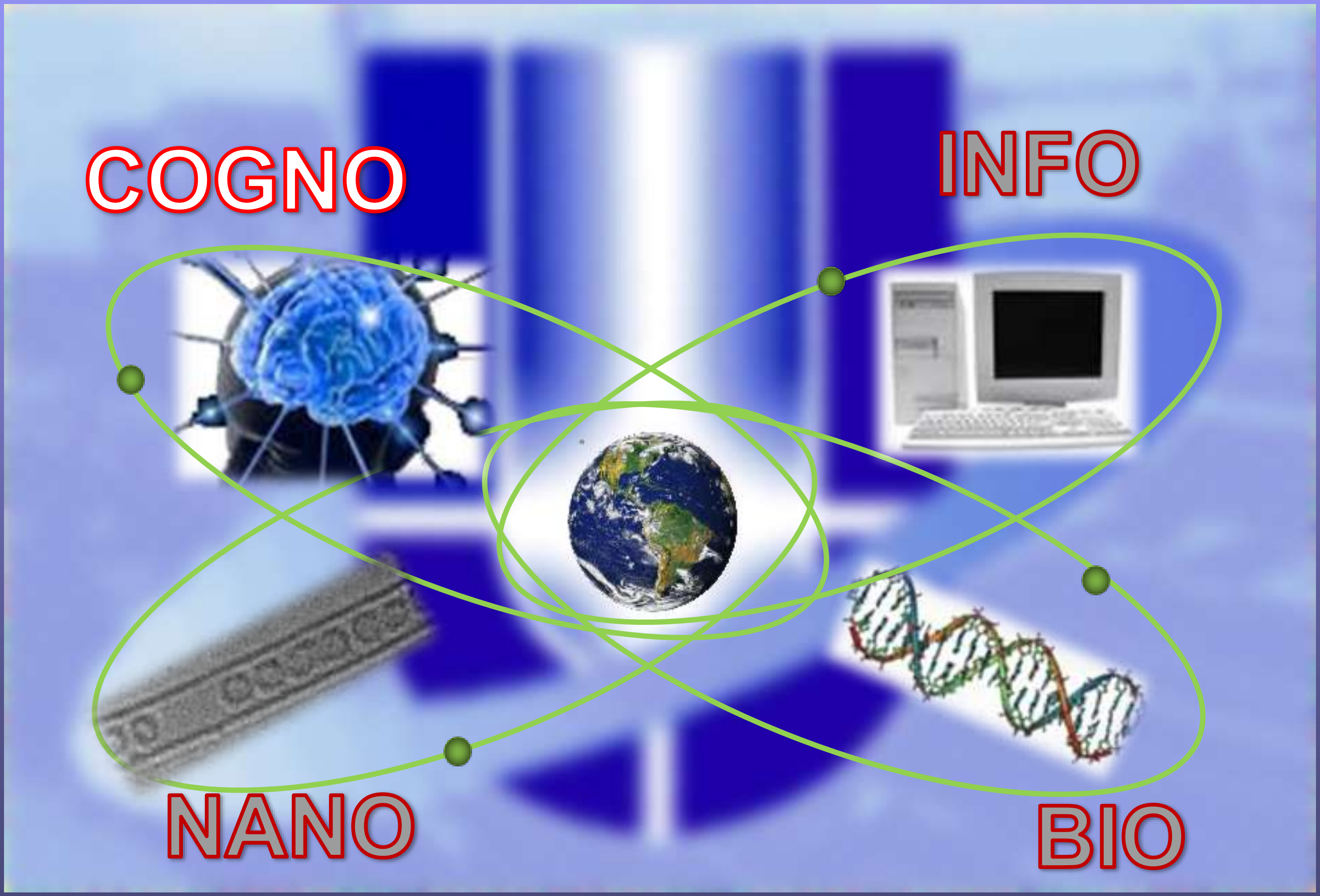
2-d floor,
Offices, laboratories, conference-hall



3-d floor ,
User`s rooms

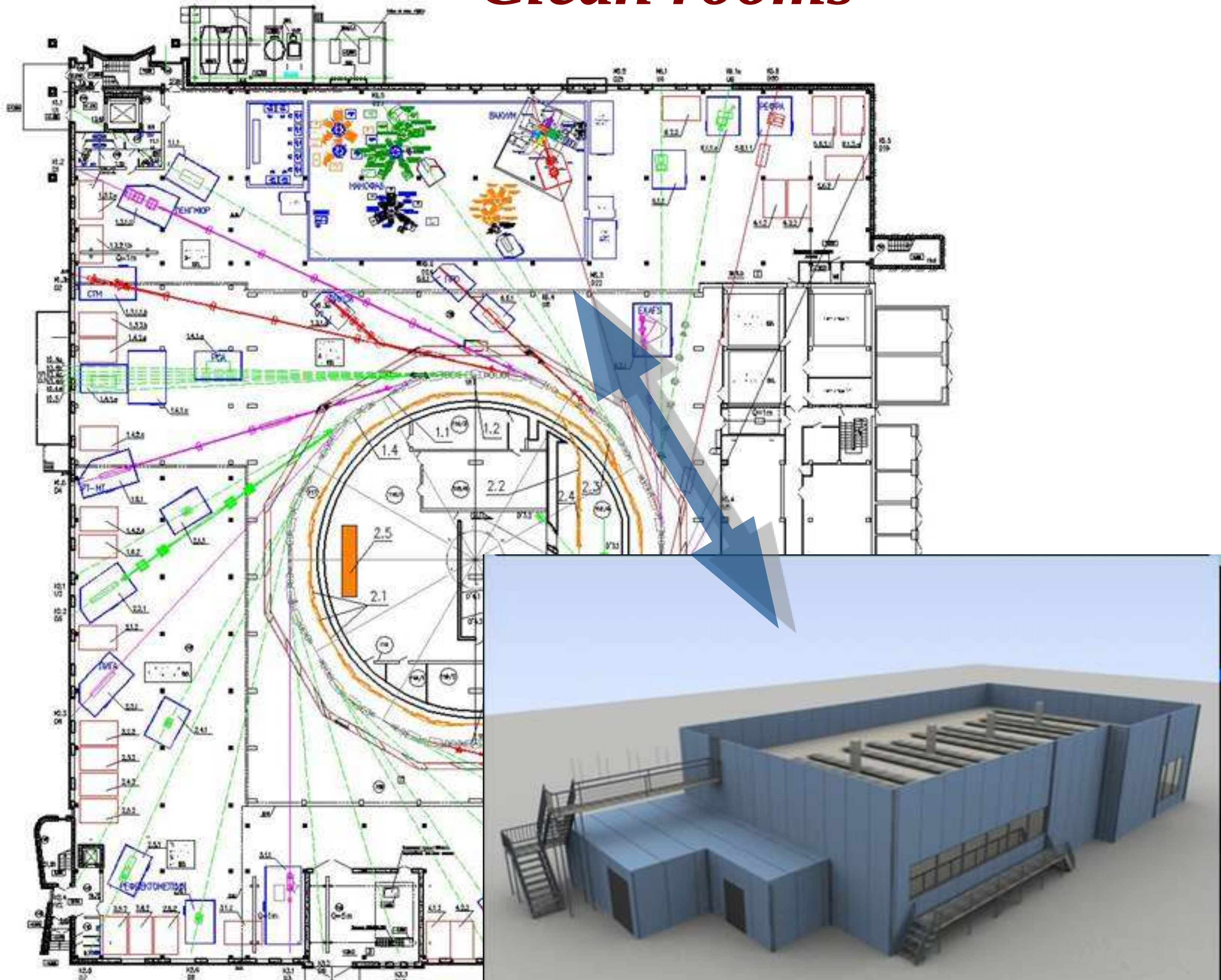
•*Combination* of modern *technologies*, (microelectronics,…) *with "constructions"* principles of *living nature* (bioobjects)

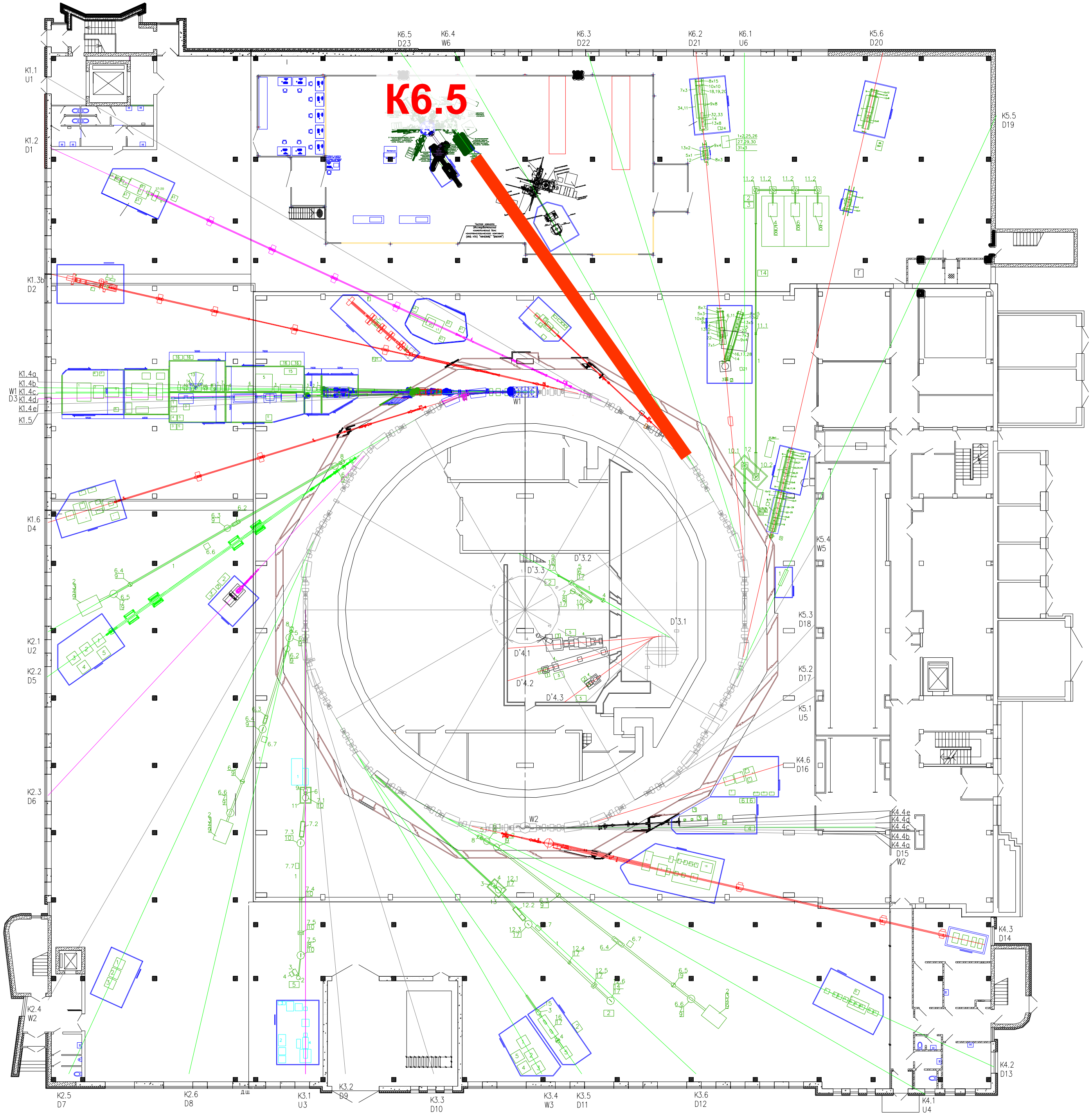
•Development of *Hybrid materials*



Clean experimental zones

Clean rooms




K6.5
K6.5 D23
K6.4 W6
K6.3 D22
K6.2 D21
K6.1 U6
K5.6 D20
K5.5 D19
K1.1 U1
K1.2 D1
K1.3b D2
K1.4a
K1.4b
W1 K1.4c
D3 K1.4d
K1.4e
K1.5
W1
K1.6 D4
K2.1 U2
K2.2 D5
K2.3 D6
K2.4 W2
K2.5 D7
K2.6 D8
K3.1 U3
K3.2 D9
K3.3 D10
K3.4 W3
K3.5 D11
K3.6 D12
K4.1 U4
K4.2 D13
K4.3 D14
K4.4e
K4.4d
K4.4c
K4.4b
K4.4a
D15
W2
W2
K4.6 D16
K5.1 U5
K5.2 D17
K5.3 D18
K5.4 W5
D'3.2
D'3.3
D'3.1
D'4.1
D'4.2
D'4.3

Рентгеновские станции (Накопитель «Сибирь-2»)

Станция	Полное название станции
Рентгеновское кино	Станция для скоростной малоугловой дифрактометрии
СТМ	Станция малоуглового рассеяния
Ленгмюр	Станция исследования биоорганических пленок на поверхности жидкости
Медиана	Станция комплексных исследований по медицинской диагностике
Белок	Станция белковой кристаллографии
РКФМ	Станция рентгеновской кристаллографии и физического материаловедения
РЕФРА	Станция рентгеновской рефракционной оптики
EXAFS	Флуоресцентный EXAFS спектрометр
ЛИГА	Станция глубокой рентгеновской литографии
ПРО	Станция прецизионной рентгеновской оптики

ВУФ станции (Накопитель «Сибирь-1»)

Станция	Полное название станции
ФЭС	Станция фотоэлектронной спектроскопии
СПЕКТР	Станция спектроскопии конденсированного состояния
ЛОКУС	Станция люминесцентных и оптических исследований

Основные научные направления

- **Нанодиагностика и материаловедение** (атомная структура, макромолекулярная структура, нанопленки, гетероструктуры, сверхрешетки, нанокластеры, мелкодисперсные среды, квантовые точки, радиационные дефекты, углеродные наноструктуры, нанокомпозиты и пр.)
- **Нанотехнологии** (молекулярно-лучевая эпитаксия, техника Ленгмюра-Блоджетт и пр.)
- **Биотехнологии** (белковая кристаллография, биоорганические пленки на поверхности жидкости и пр.)
- **Микросистемная техника** (ЛИГА – технология)
- **Фундаментальные исследования** (материалы при сверхвысоких давлениях, «космические» кристаллы, рентгеновская оптика и пр.)
- **Живые системы и ядерная медицина** (новые методы медицинской диагностики, надмолекулярная структура биологических тканей и жидкостей и пр.).
- **Двойные технологии** (неразрушающий контроль ответственных изделий, судебная экспертиза и пр.)
- **Метрологическое обеспечение нанотехнологий** (спектрорадиометрия, метрология слоистых структур и пр.)

Перечень организаций – пользователей КЦСИиНТ

Москва и МО:

- Институт кристаллографии РАН.
- Московский государственный университет.
- МВТУ им. Баумана, Москва.
- ОИЯИ, г.Дубна.
- МФТИ, г. Долгопрудный.
- МИФИ, г. Москва.
- Институт стали и сплавов, Москва.
- Институт элементоорганических соединений РАН, Москва.
- Институт теоретической и экспериментальной биофизики РАН, Пущино.
- Институт общей и неорганической химии РАН, Москва;
- Институт Биофизики Клетки РАН
- Российский онкологический научный центр им. Н.Н. Блохина
- НИИ Пульмонологии
- Институт Общей и Неорганической Химии РАН.
- Научный центр волоконной оптики РАН, Москва
- ГУП МосНПО "Радон", Москва;
- Государственный научно-исследовательский институт редких металлов, Москва.
- Ассоциация "Аспект".
- Институт судебной экспертизы.
- Научно-исследовательского центра по изучению свойств поверхности и вакуума, Москва.
- НТ-МДТ, г. Зеленоград.
- ФИАН, г. Москва.
- ВНИИОФИ, г. Москва
- НИИ Биомедицинской Химии РАМН им. В. Н. Ореховича
- ВНИИНМ им. Бочвара, Москва.
- ВИАМ, г. Москва

Северо-западный регион:

- Санкт-Петербургский государственный университет.
- Физико-технический институт им.Иоффе, Санкт-Петербург.
- Петербургский Институт Ядерной Физики, г. Гатчина
- ЗАО «Научное и технологическое оборудование», Санкт-Петербург.

Южный регион:

- Южный федеральный университет, г. Ростов-на Дону,
- Таганрогский радиотехнический университет, г. Таганрог.
- НИИ физики, г. Ростов-на Дону.

Сибирь

- Институт Ядерной Физики СО РАН
- Институт катализа СО РАН, Новосибирск;
- Институт Неорганической Химии СО РАН

Зарубежье:

- Европейский центр СИ (ESRF), Франция
- Институт прикладных физических проблем им. А.Н. Севченко, Минск

III Высшие курсы для молодых ученых, аспирантов и студентов старших курсов стран СНГ по современным методам исследования наносистем и материалов "Синхротронные и нейтронные исследования наносистем (СИН-нано-2010)".

5 -17 июля 2010г

Thank you for your attention