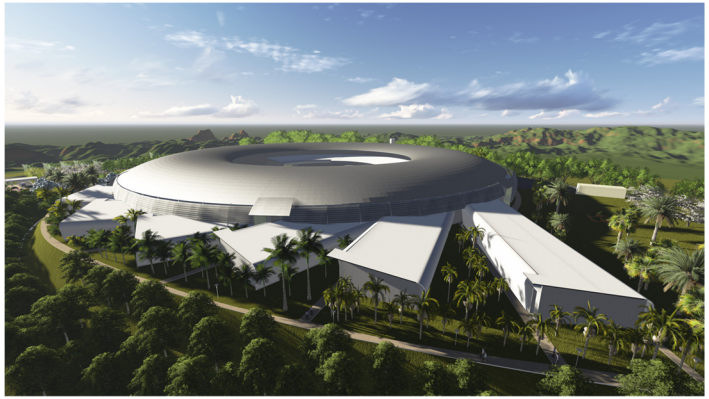


Sirius Status Report

On behalf of the Engineering Division

Regis Neuenschwander
Engineering Division Deputy Director
Brazilian Synchrotron Light Laboratory (www.lnls.br)

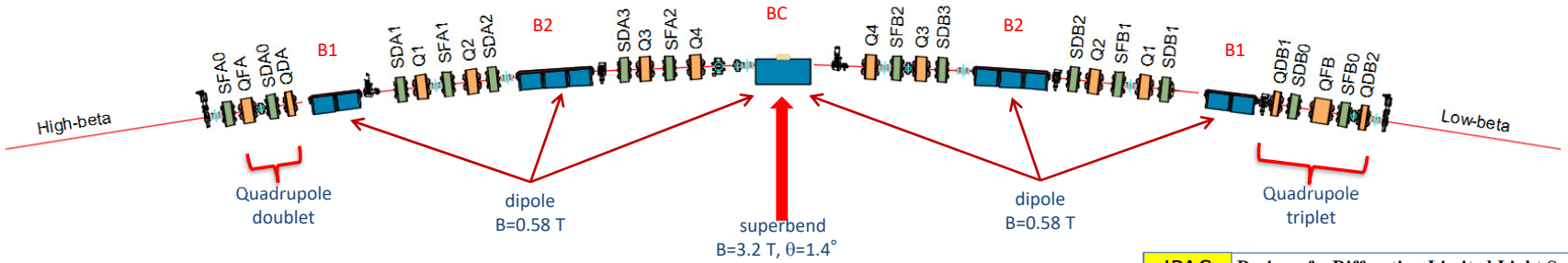
regis.terenzi@lnls.br

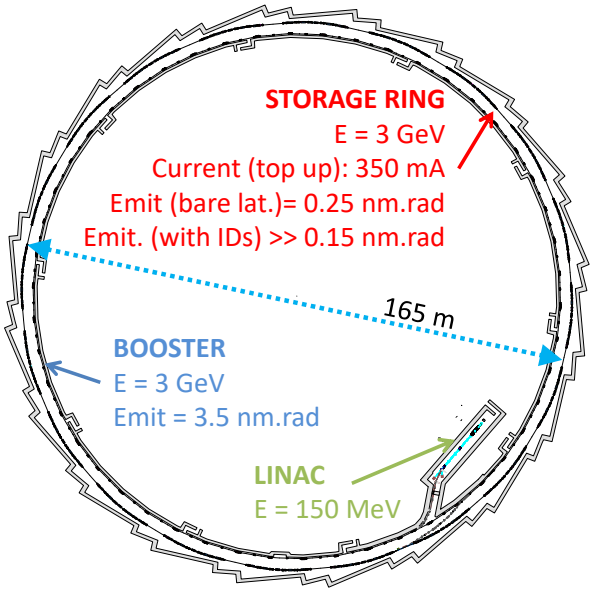
Content

Brazilian Synchrotron Light Laboratory

CNPEM Brazilian Center for Research in Energy and Materials

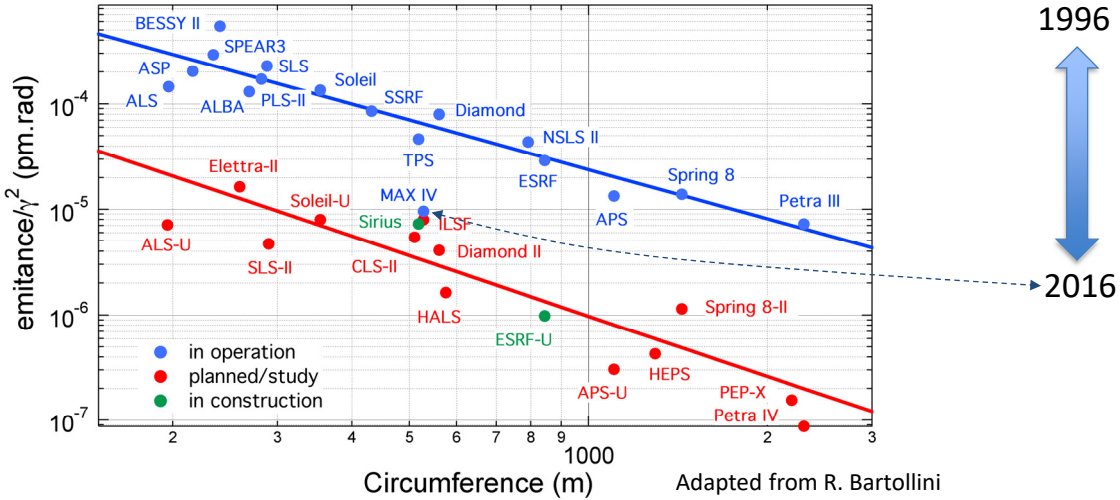
Introduction





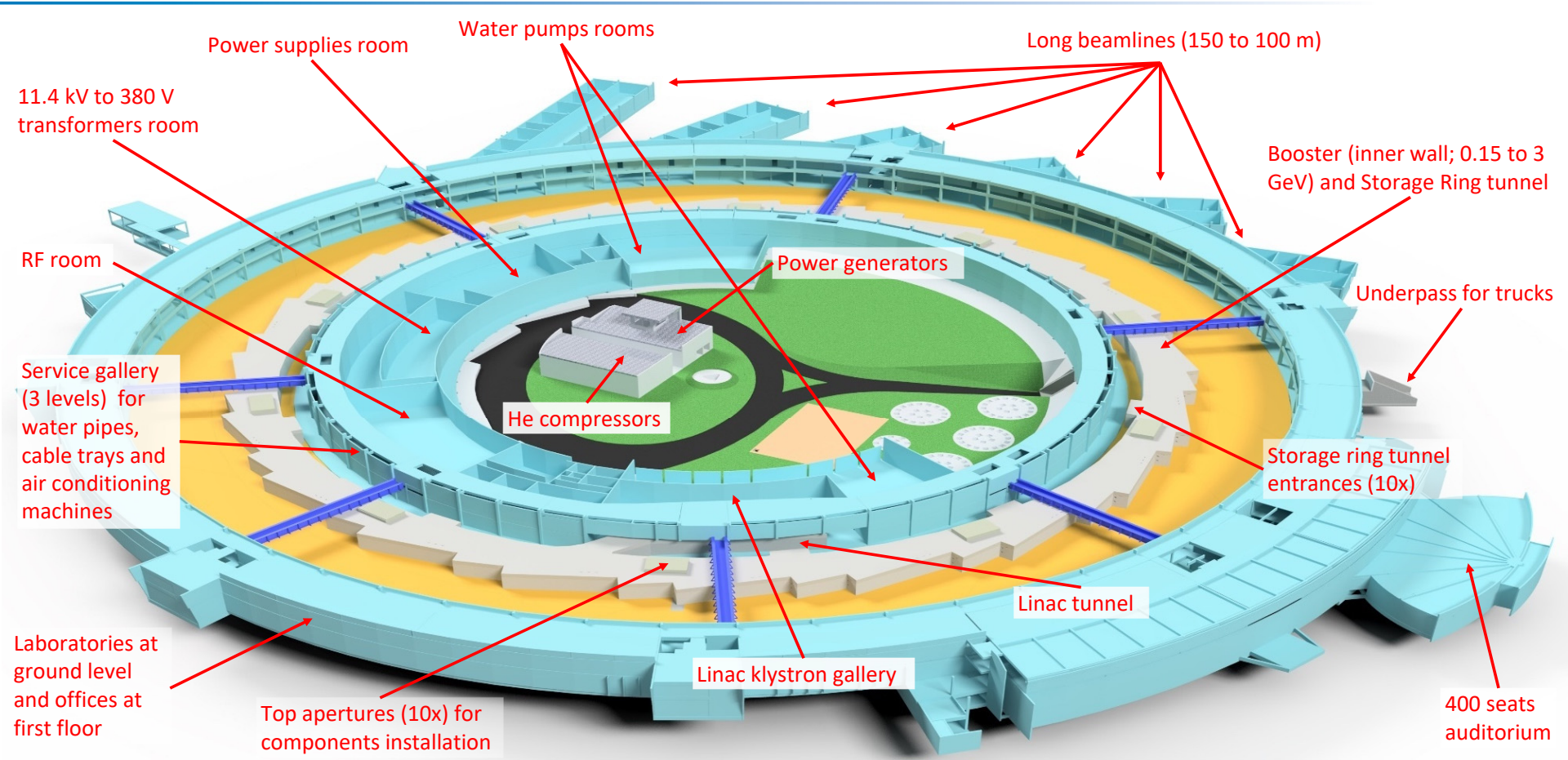
IPAC **Design of a Diffraction Limited Light Source (DIFL)**

D. Einfeld, J. Schaper, Fachhochschule Ostfriesland, Constantiaplatz 4, D-26723 Emden
M. Plesko, Institute Jozef Stefan, Jamova 39, P.O.B. 100, SLO-61111 Ljubljana



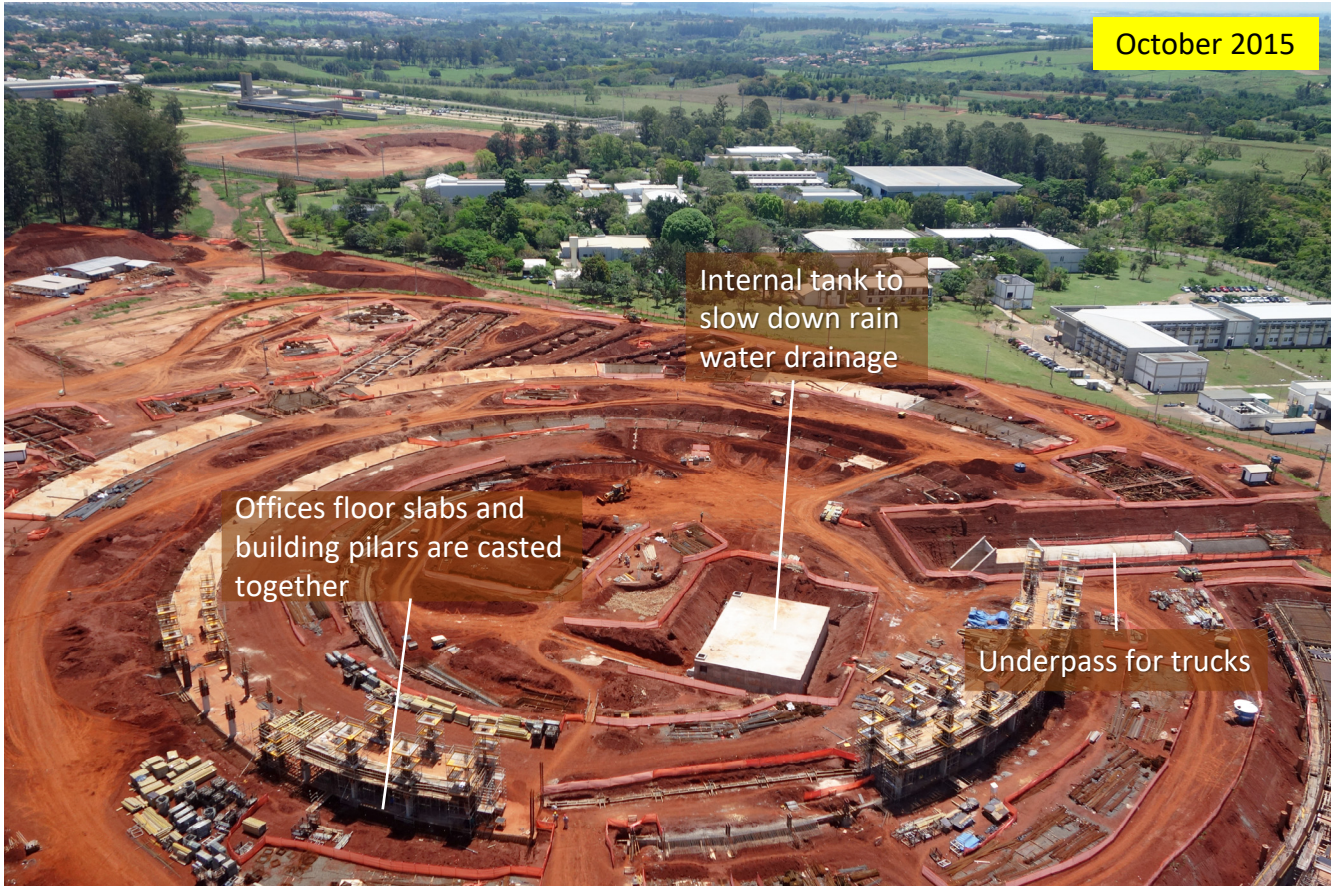
Adapted from R. Bartollini

Building

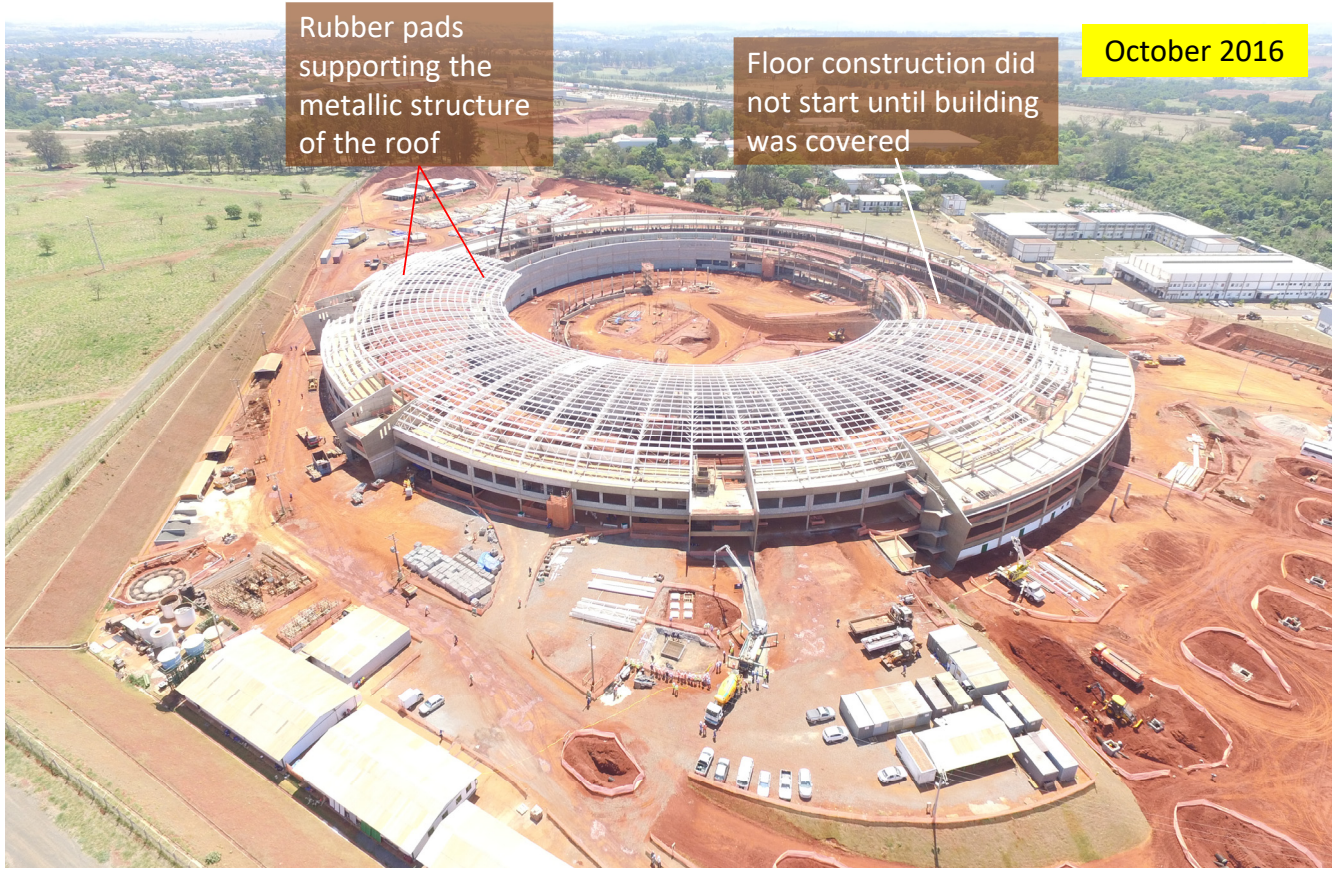

Water pumps rooms
Power supplies room
Long beamlines (150 to 100 m)
11.4 kV to 380 V transformers room
Booster (inner wall; 0.15 to 3 GeV) and Storage Ring tunnel
RF room
Power generators
Underpass for trucks
Service gallery (3 levels) for water pipes, cable trays and air conditioning machines
He compressors
Storage ring tunnel entrances (10x)
Linac tunnel
Laboratories at ground level and offices at first floor
Linac klystron gallery
Top apertures (10x) for components installation
400 seats auditorium

Building

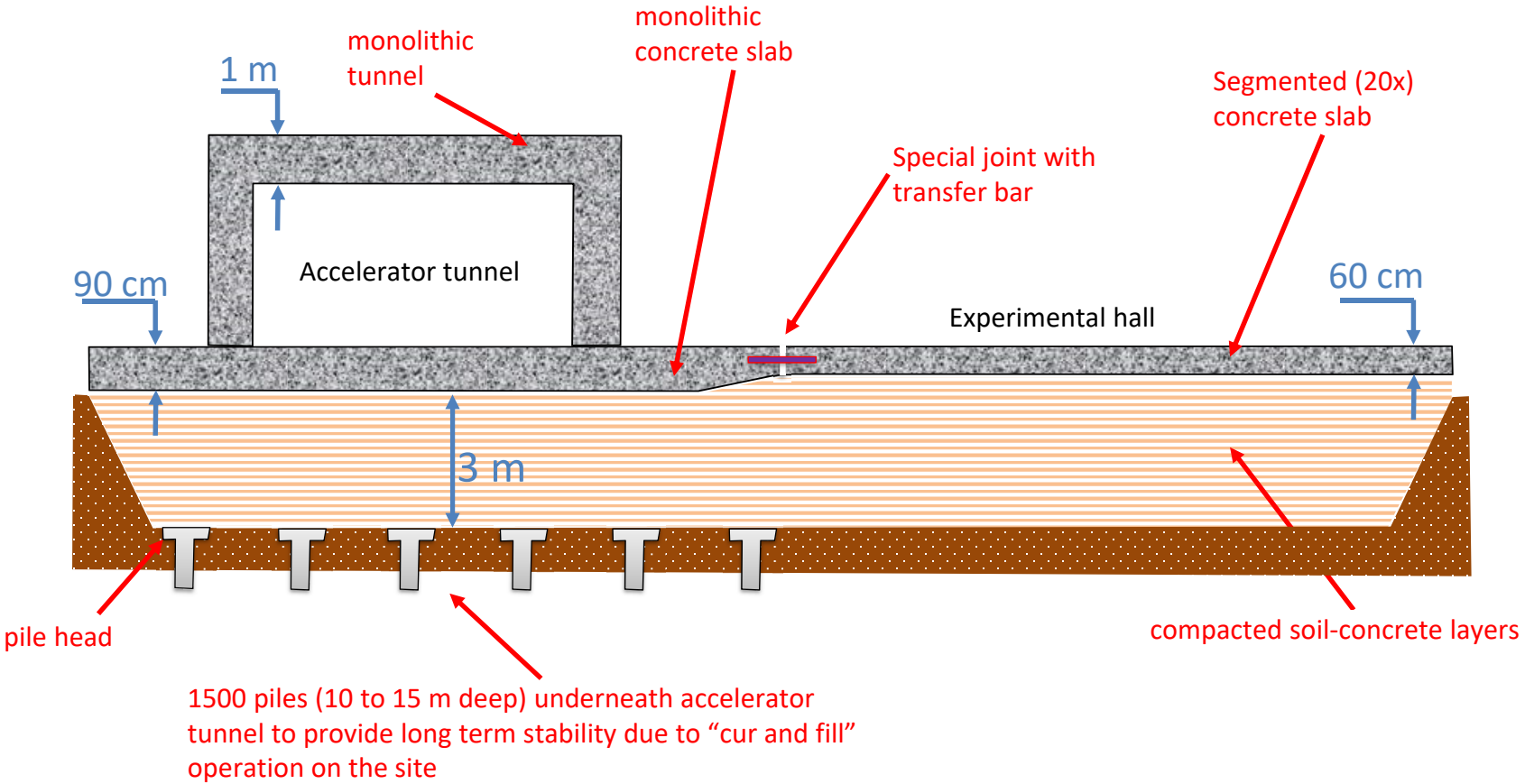
Building


October 2015
Internal tank to slow down rain water drainage
Offices floor slabs and building pilars are casted together
Underpass for trucks

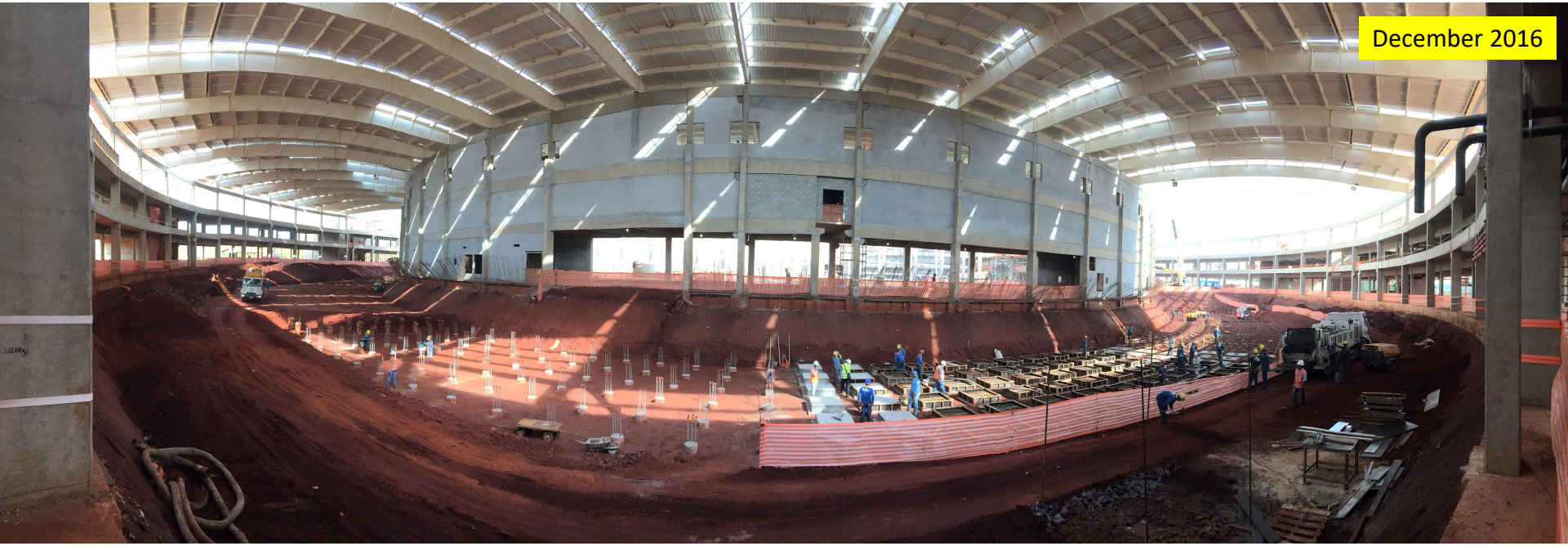
Building


Rubber pads supporting the metallic structure of the roof
Floor construction did not start until building was covered
October 2016

Building


monolithic tunnel
monolithic concrete slab
1 m
Segmented (20x) concrete slab
Special joint with transfer bar
Accelerator tunnel
90 cm
60 cm
Experimental hall
3 m
pile head
compacted soil-concrete layers
1500 piles (10 to 15 m deep) underneath accelerator tunnel to provide long term stability due to “cur and fill” operation on the site

Building



Building

Building

Building

Building

Storage ring and booster tunnel ready for components installation

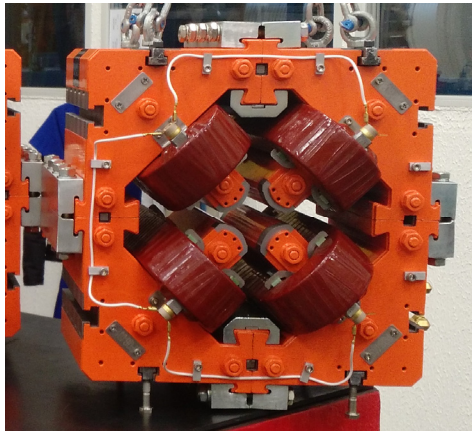
Accelerators subsystems: Linac

LINAC klystron room during installation

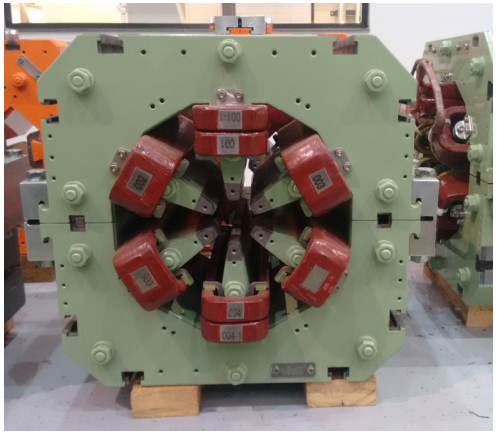
Accelerators subsystems: Linac

Turn-key 150 MeV LINAC bought from SINAP-Shanghai during installation

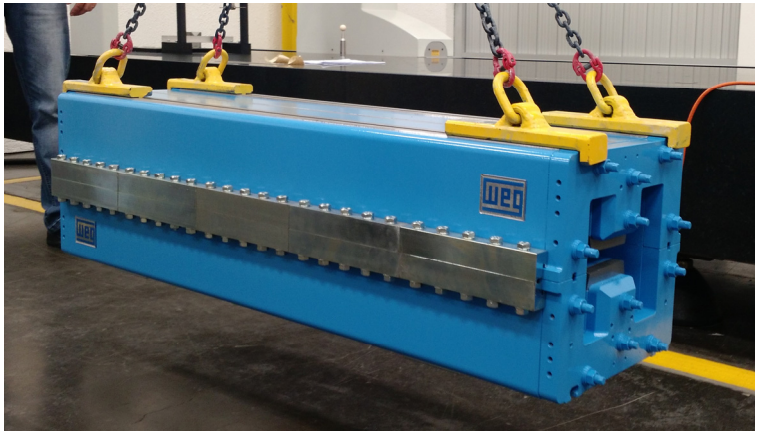
Accelerators subsystems: Magnets



Booster quadrupole
- 40 mm bore diameter
- 19 T/m maximum gradient
- 50 units focusing
- 25 units defocusing



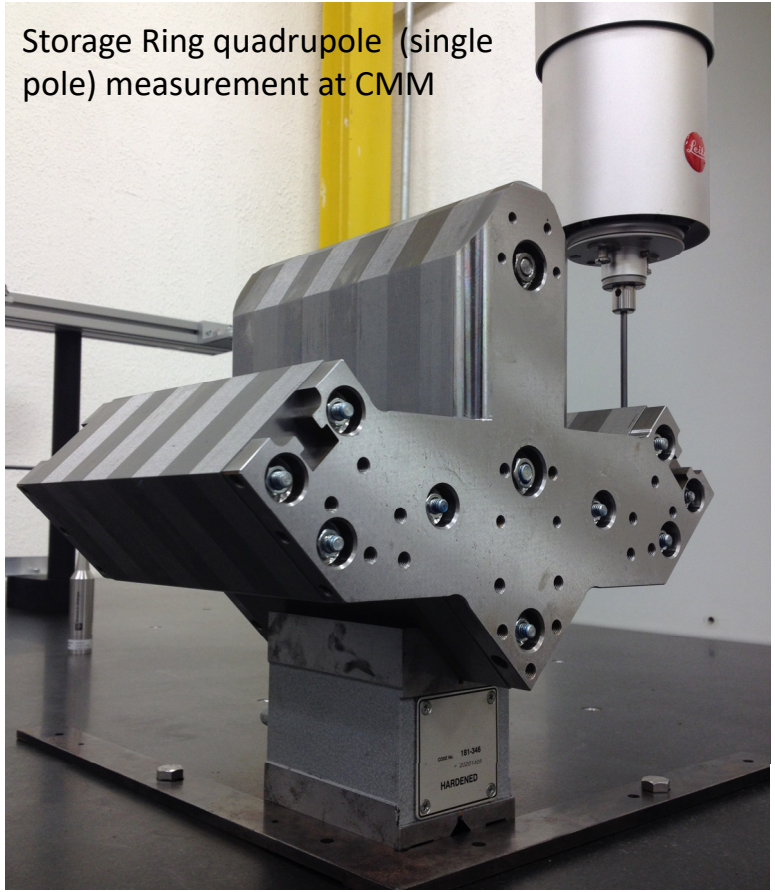
Booster sextupole
- 40 mm bore diameter
- 200 T/m2 maximum gradient
- 25 units focusing
- 10 units defocusing



Booster dipole (combined function)
- 28 mm gap and 1200 mm length
- Dipole hardedge field: 1.09 T
- Quadrupole gradient at extraction: 2.14 T/m
- Sextupole gradient at extraction: 22.3 T/m2
- 50 units

All booster magnets ready to be installed

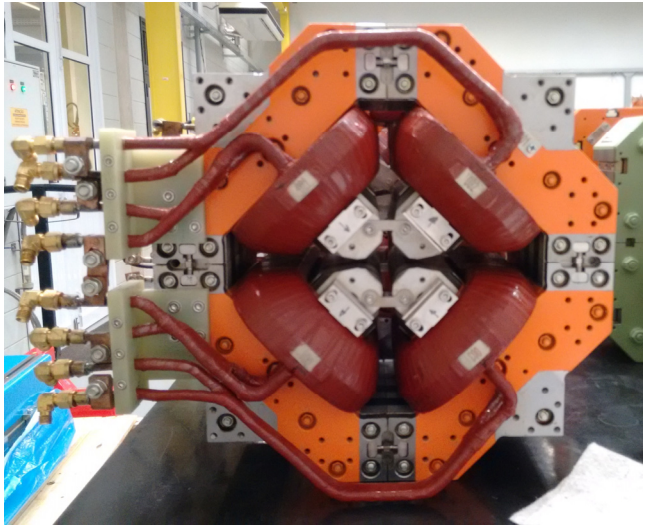
Accelerators subsystems: Magnets



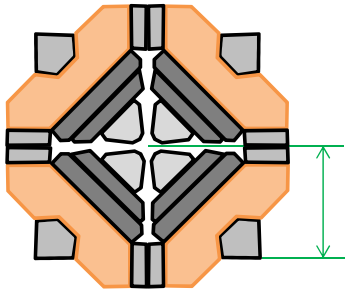
Storage Ring quadrupole (single pole) measurement at CMM

Storage Ring quadrupole

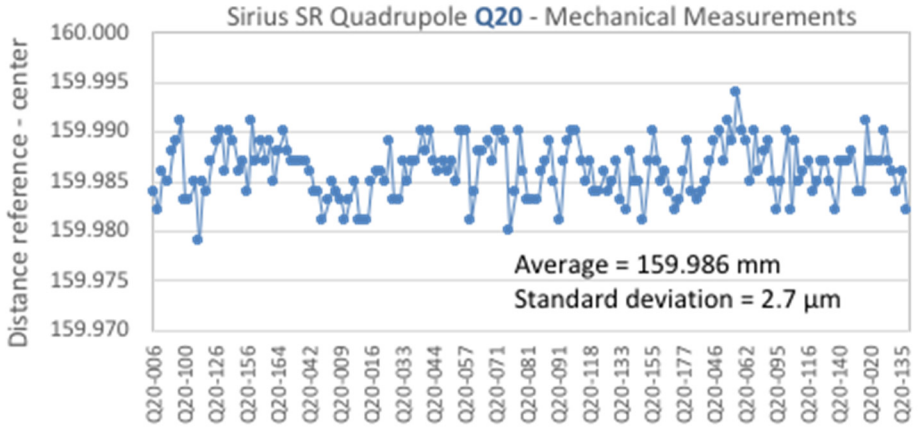
- 28 mm bore diameter
- 45.4 T/m maximum gradient
- High precision magnet reference achieved only by stacking laminations
- 270 units (14, 20 and 30 cm)
- All of them ready to be installed

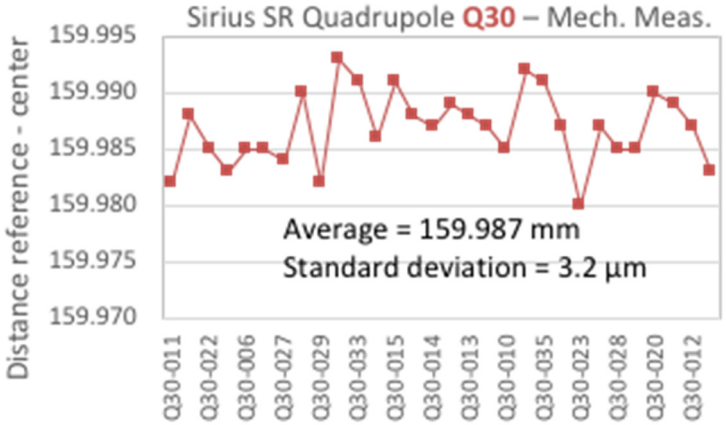


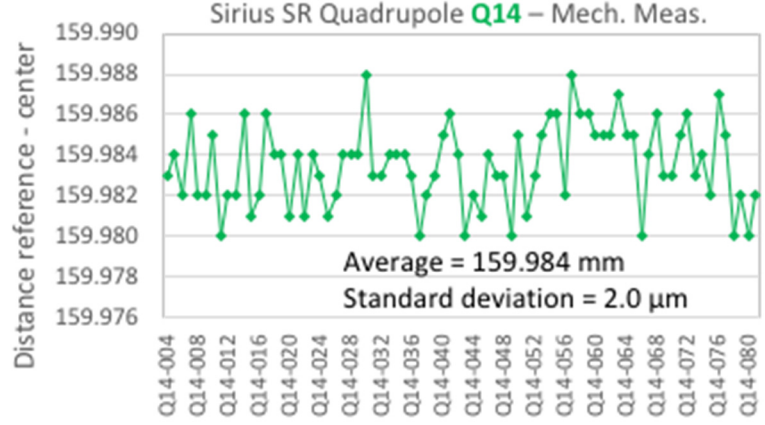
Accelerators subsystems: Magnets



Mechanical measurement of the geometric center done at a 3D measuring machine (CMM)



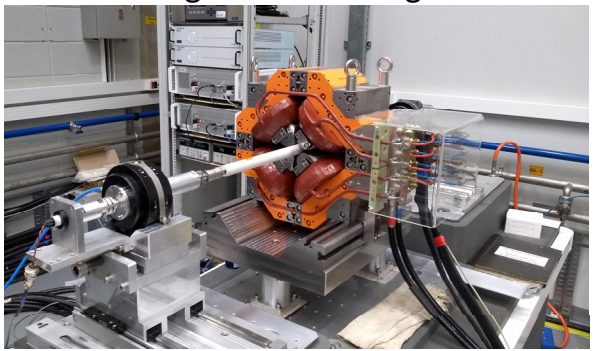


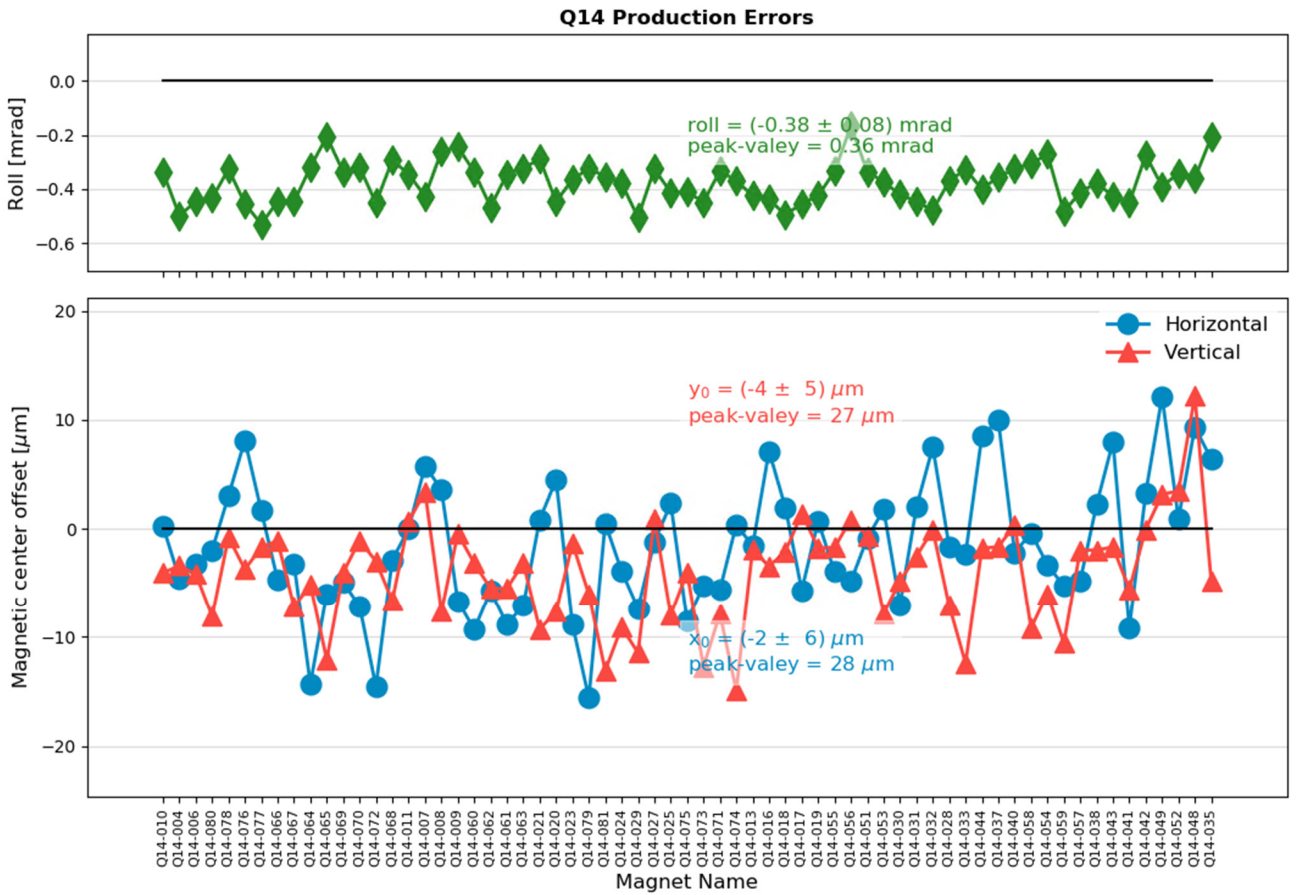


Accelerators subsystems: Magnets

Magnetic field roll and center offset measured at the rotating coil bench

LNLS rotating coil measuring bench

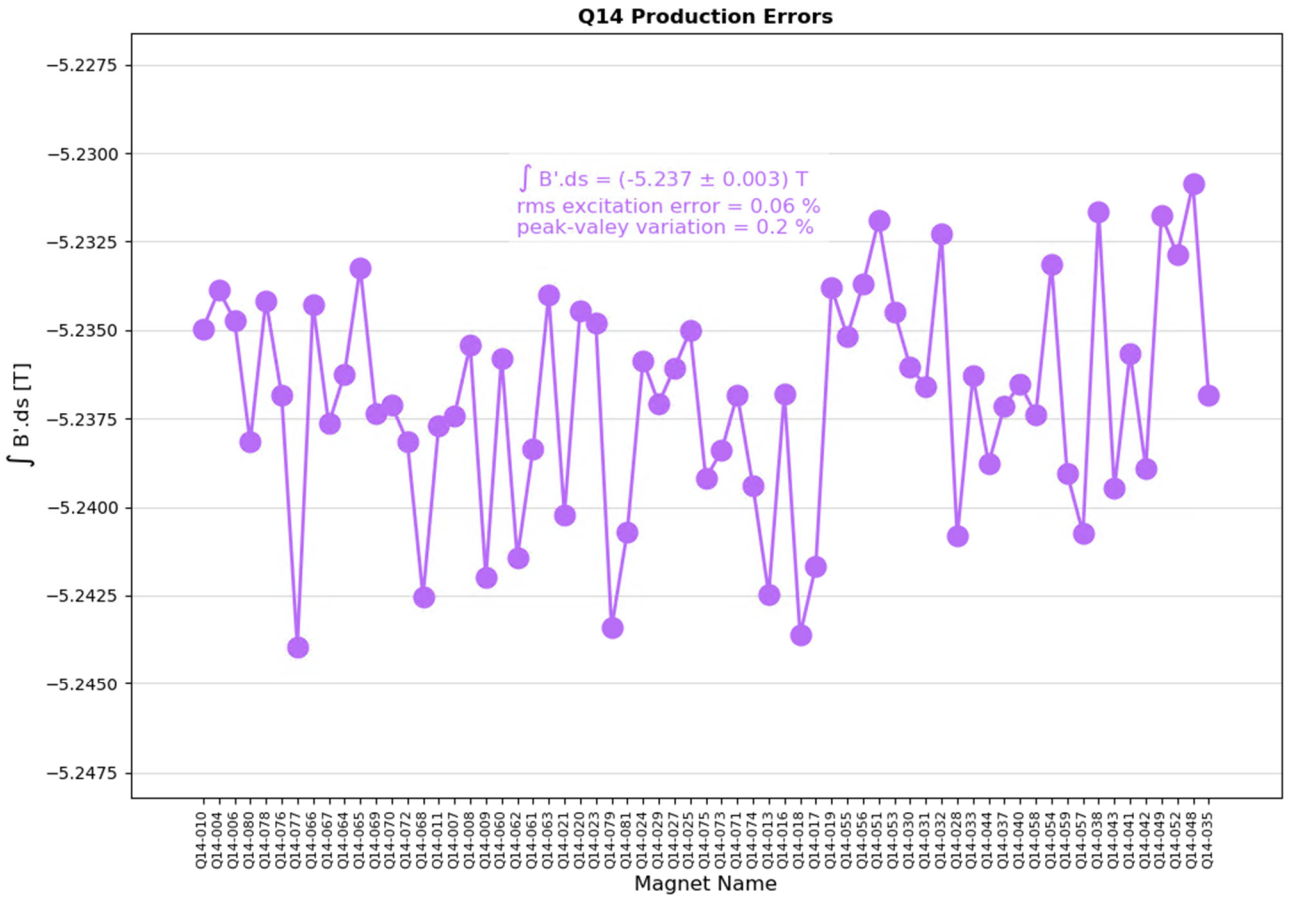




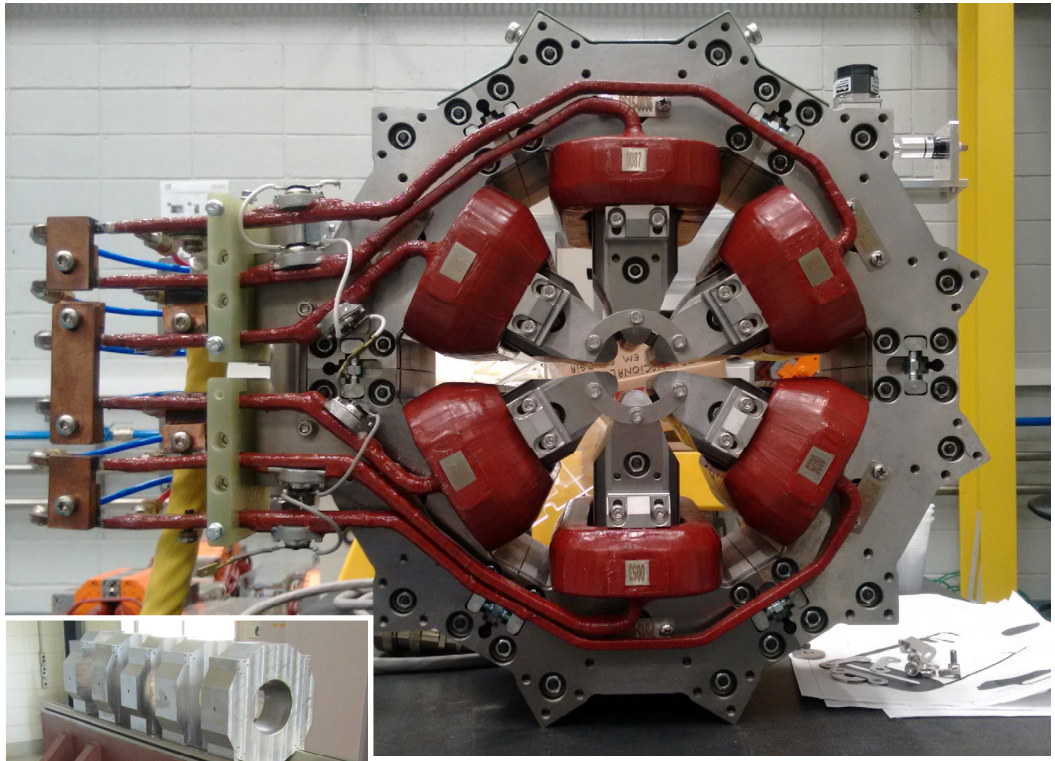
Accelerators subsystems: Magnets

Integrated magnetic field measured with rotating coil

Use of calibration sheets of 0.6 mm instead of standard 0.5 mm thick ones for length fine tuning



Accelerators subsystems: Magnets



It's ugly, but compatible with the girder

Storage Ring sextupole

- Multifunctional: sextupole, H or V slow corrector or skew quadrupole
- 28 mm bore diameter
- 2402 T/m2 maximum gradient
- High precision magnet reference achieved only by stacking laminations
- 280 units (15 cm each)
- 84 produced so far
- Final delivery June 2018

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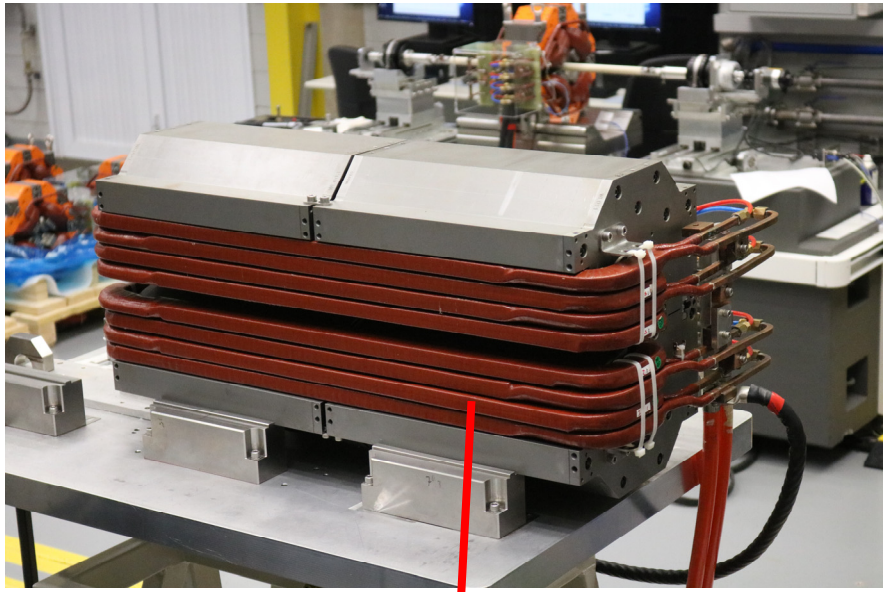
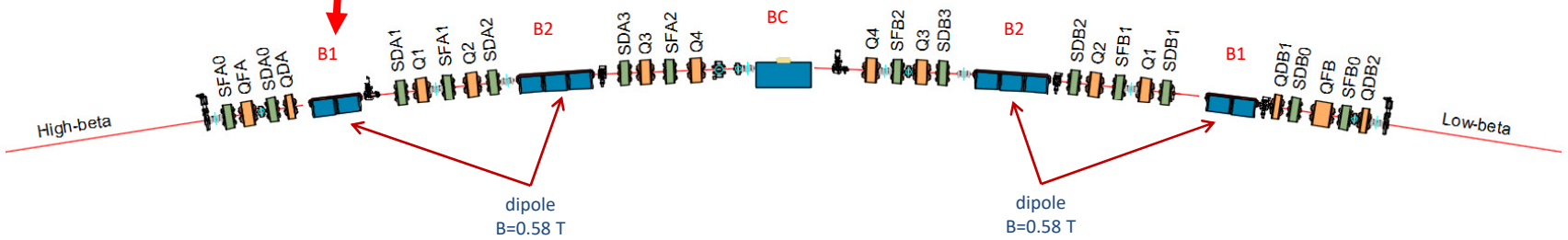
Accelerators subsystems: Magnets

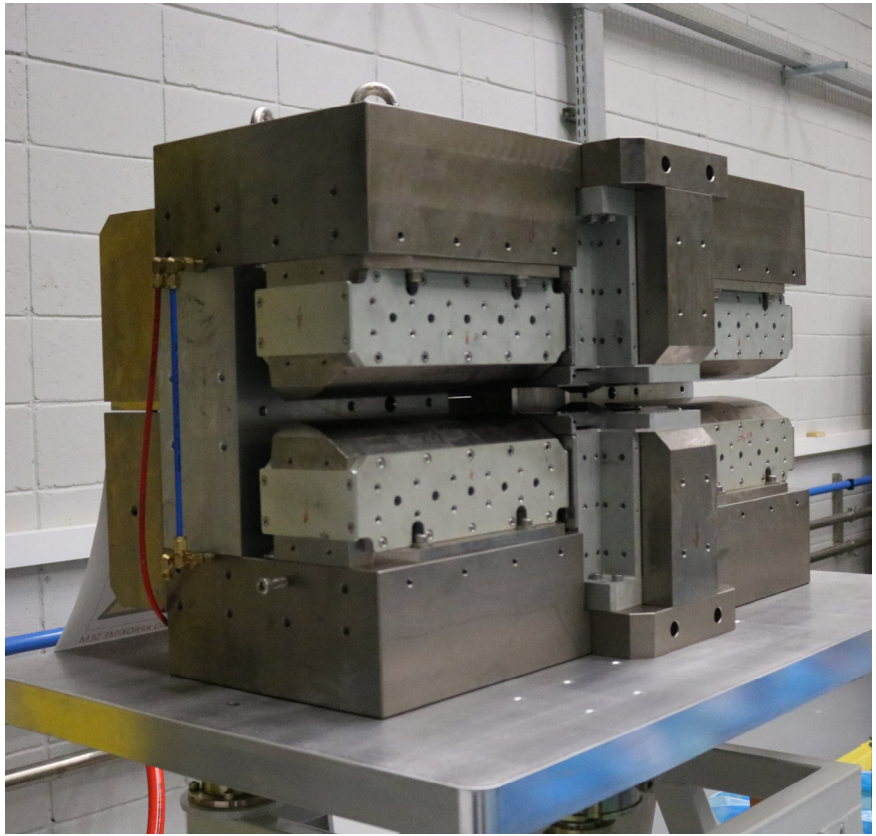


Storage ring low field dipoles

- Made using 2 or 3 straight blocks
- Hardedge field: 0.58 T
- Hardedge quadrupole gradient: 7.8 T/m
- High precision magnet reference achieved only by stacking laminations
- 40 units with 2 blocks
- 40 units with 3 blocks
- Final delivery next July

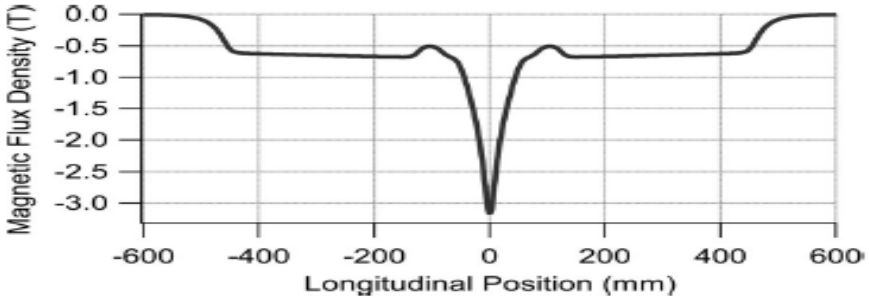


Accelerators subsystems: Magnets

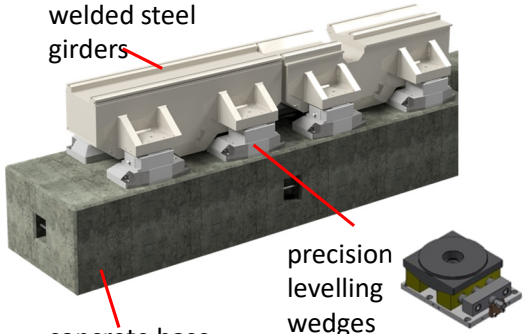


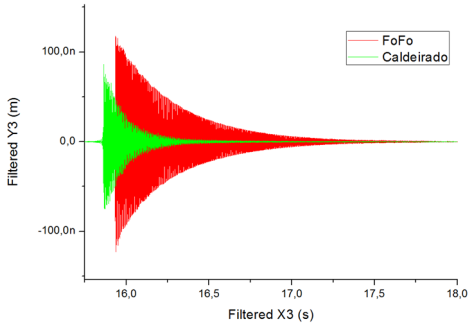
Storage Ring Superbend

- Magnetic Material : NdFeB
- Remanent Field: 1.36T
- High Field Central Pole Piece: Iron-Cobalt
- Maximum Field: 3.18 T
- 20 units
- Adjustable gap on the back for integrated field fine tuning
- Cooling plates bellow PM blocks for thermal stabilization
- Horizontal adjustment of the pole pieces for magnetic field correction
- Adjustment for quadrupolar integrated component on both sides of central peak field
- Assembled at LNLS. Final delivery next August



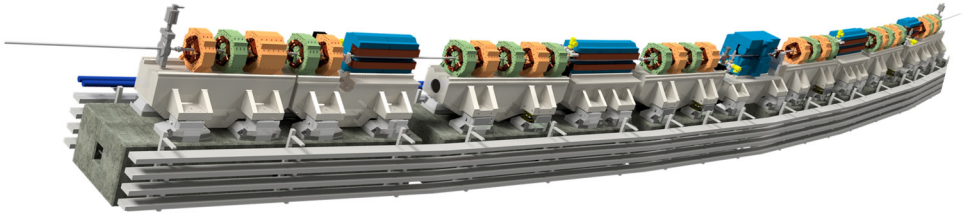
Accelerators subsystems: Girders

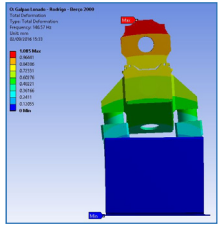


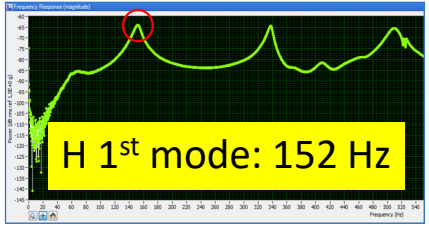


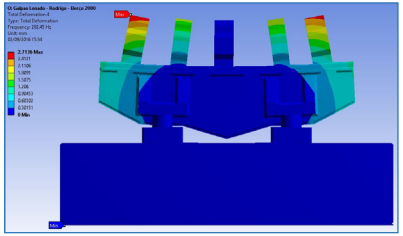
- Higher dumping ratio for welded girder compared with the casted one (0.23% x 0.15%)
- Higher resonance frequency (511 Hz x 260 Hz)

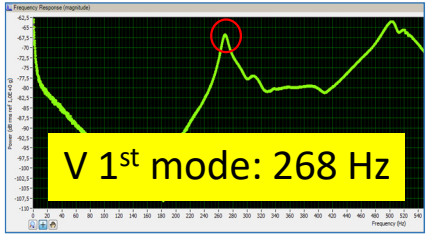
- The magnets are positioned on the girder by reference surface (no adjustments)
- High precision machined girder reference (12 µm flatness)







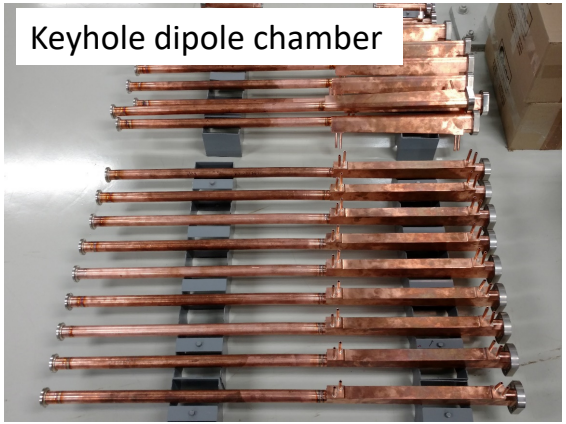




Accelerators subsystems: Vacuum System

Dipole chamber

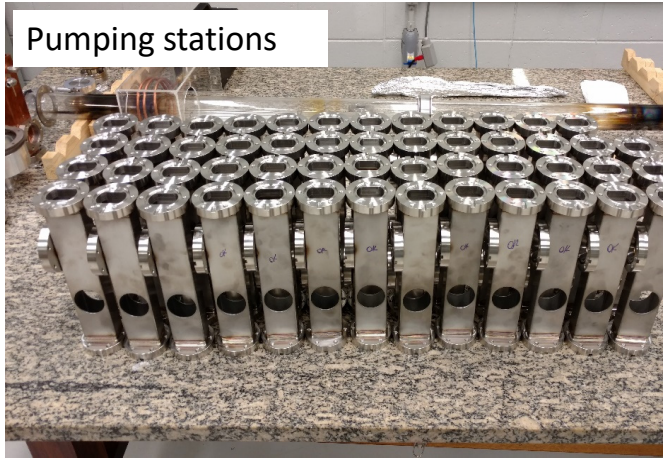
Keyhole dipole chamber



RF shielded bellows

Chamber with SS sector

Pumping stations



0.4 mm thick 220° C heating tape

- Around 85% of the vacuum components are ready to be installed
- Stainless steel components produced at a nearby company
- Copper components produced at LNLS
- NEG coating done at LNLS

Accelerators subsystems: NEG coating infrastructure

Vacuum chambers during cleaning procedures

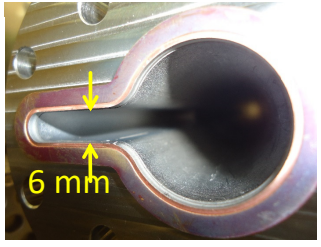
Vacuum chambers being installed at the cartridge

CERN
License & Training

Some numbers:

- 730 hour of NEG runs accumulated up to now
- 30 hour/week operation
- Some special chambers needs 2 NEG runs for complete coating
- 430 m of chambers already coated (67%)
- 110 units of “Tees” and “4-way cross” already coated (100%)

Dipole chamber w/ narrow gap for photon extraction



Cartridge being installed in the special oven

Accelerators subsystems: Power Supplies

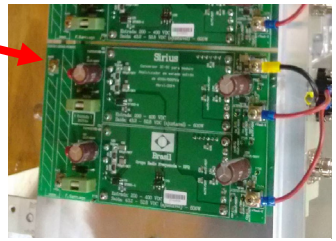



MODEL	DESCRIPTION	APPLICATION	QT.	RATED CURRENT [A]	RATED VOLTAGE [V]	RATED POWER [kW]	RMS ripple at 3kHz (ppm)	12h stability (ppm)	SUPPLIER	Final Delivery
FBP	Low current 4-Q	Steering magnets, trim coils, skew quadrupoles	740	10	5	0.05	20	100	WEG	Ago 18
FAP	DC high current 1-Q	Storage ring dipoles, quadrupoles and sextupoles; transfer lines quadrupoles and dipoles	45	150 to 700	50 to 450	1.5 to 180	20	20	LNLS	Jul 18
FAC	AC high current 4-Q	Booster dipoles, quadrupoles and sextupoles	6	30 to 1100	50 to 800	1.5 to 333	30	50	LNLS	Jun 18

Accelerators subsystems: RF

- Amplifier modules based on BLF578 transistor supplied by BBF (China) under license of Soleil
- Booster RF tower operational, being used for the Petra 5 cavity commissioning
- 2 storage ring towers being assembled for NCC (Petra 7) operation at the end of this year.
- Superconducting cavity ordered from Research Instruments (RI), to be delivered in 2020.

50 Kw RF tower for the booster

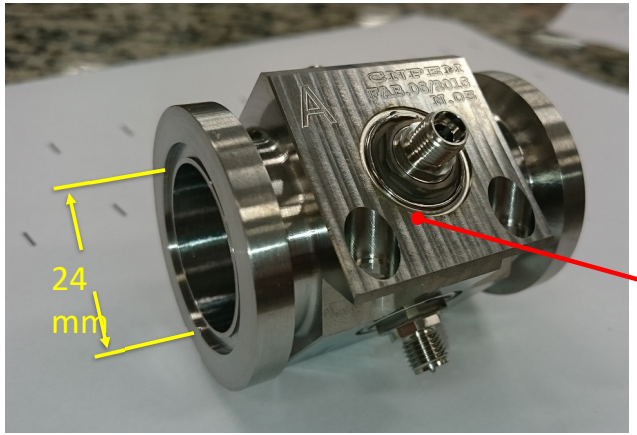


48V DC individual power supply for each RF module.

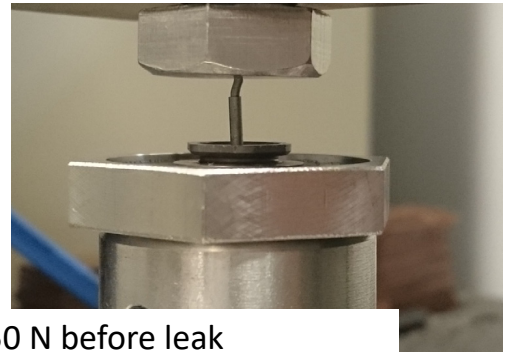
48V DC commercial power supply for all RF module.

60 Kw RF tower for the storage ring (8x)

Accelerators subsystems: BPMs

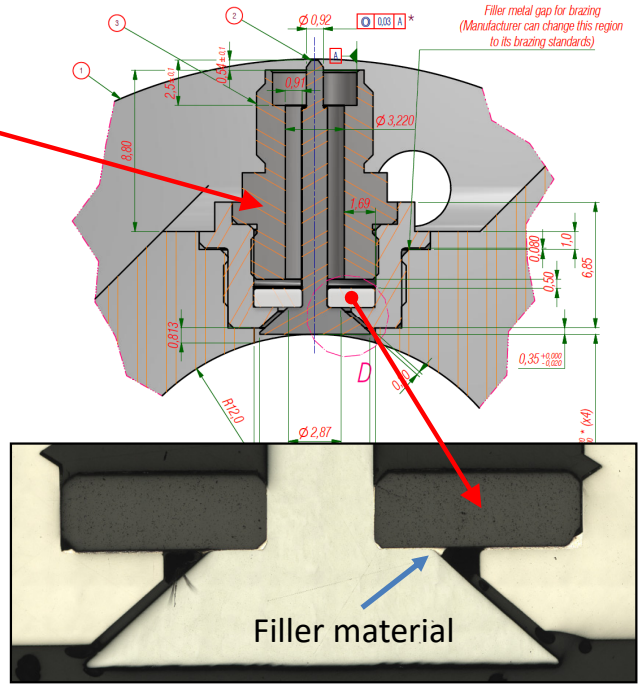


LNLS BPM made of Titanium

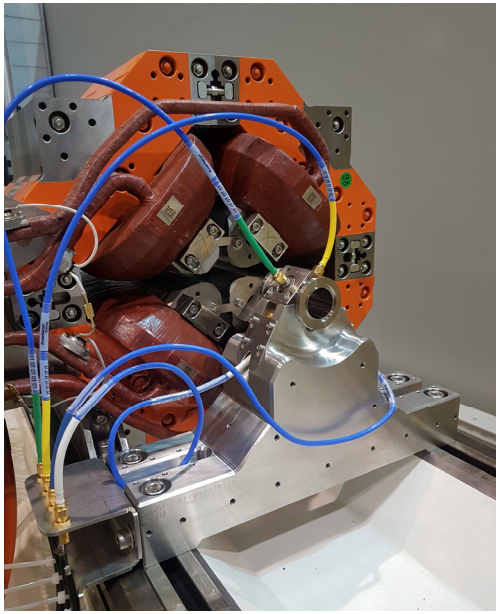


450 N before leak

Design optimization that can reduces up to 50% the input power on each bottom



1 mm thick brazed Al2O3 insulator



- All needed units (162) are ready, vacuum tested, waiting for NEG coating

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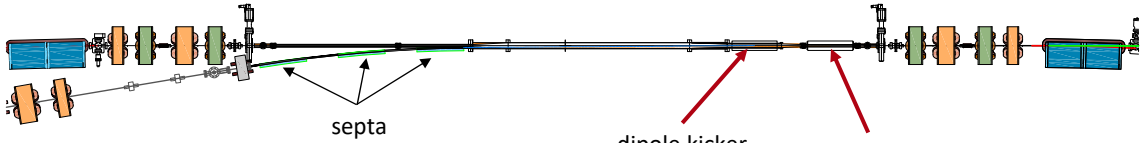
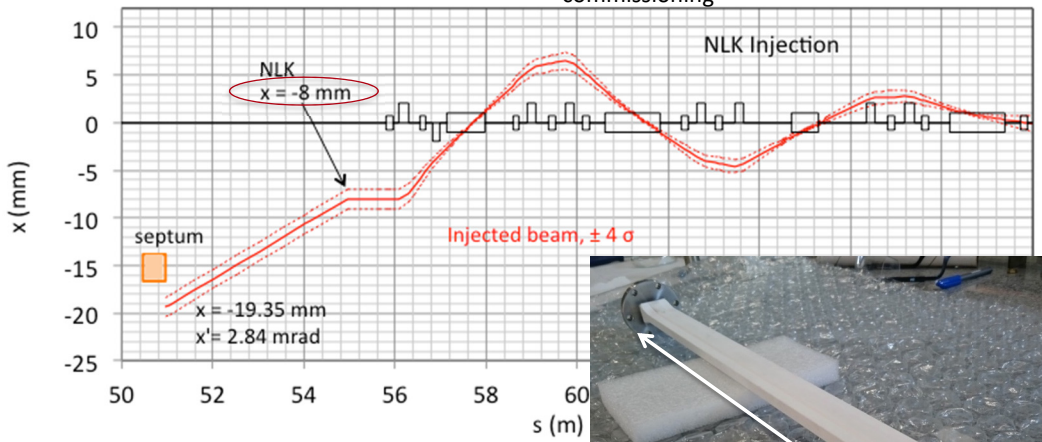
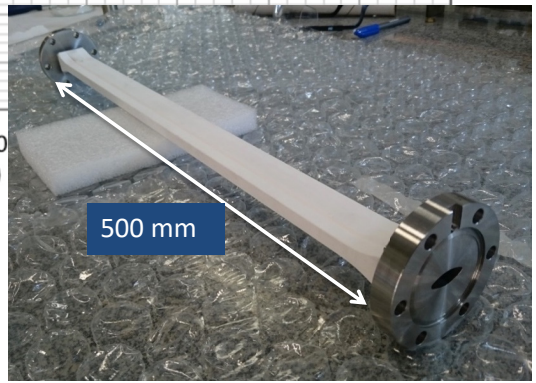
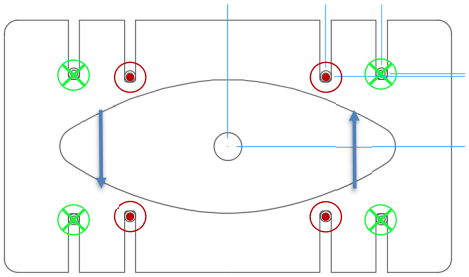
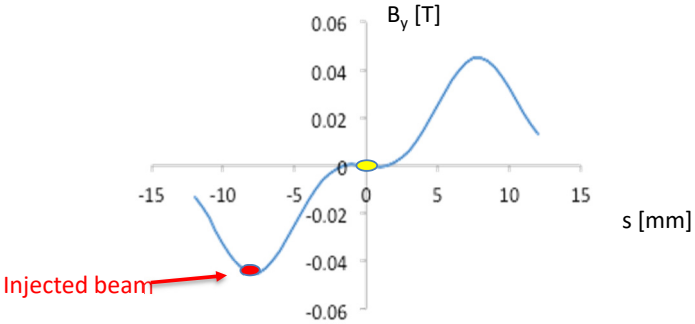
Accelerators subsystems: Injection System





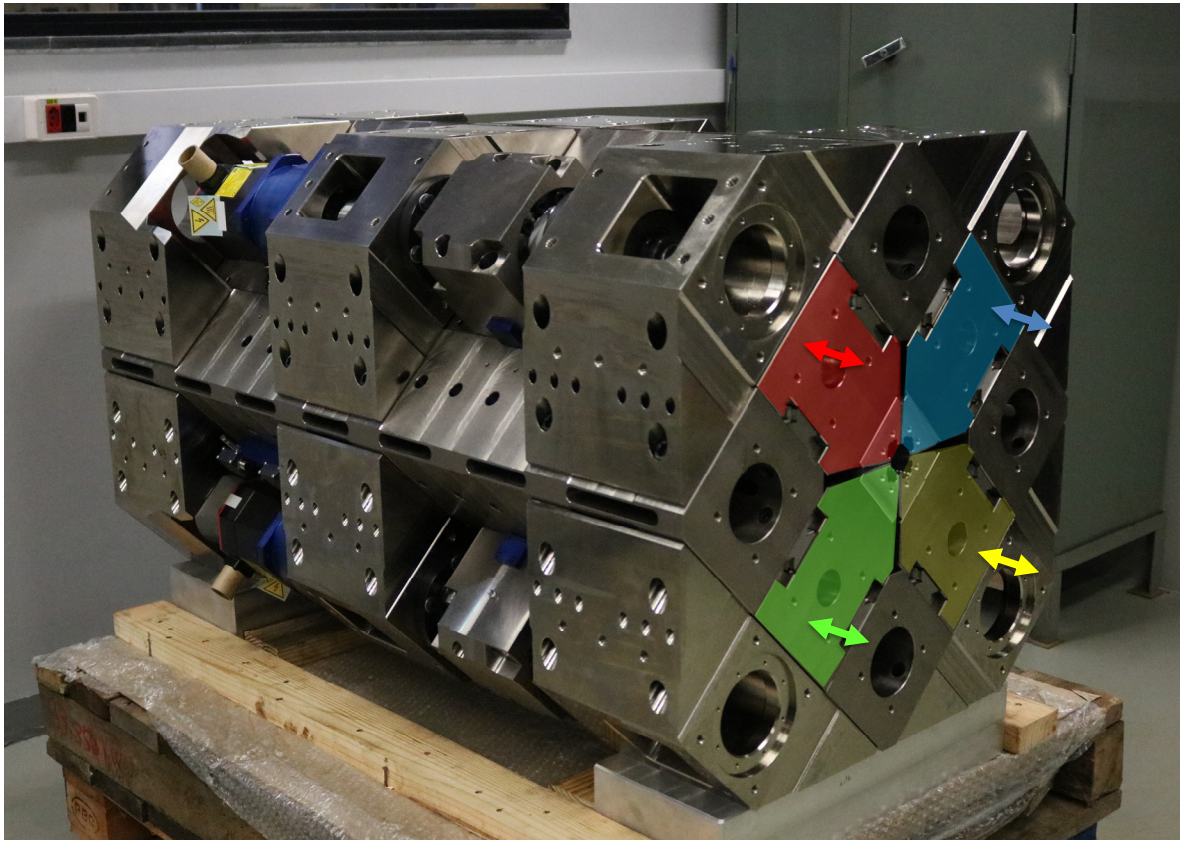






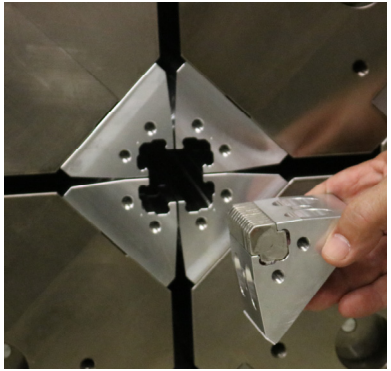
Field @ peak	800 Gauss
Current	1600 A
Voltage	900 V
Pulse width	3.4 µs

Accelerators subsystems: Undulators



Delta type undulator

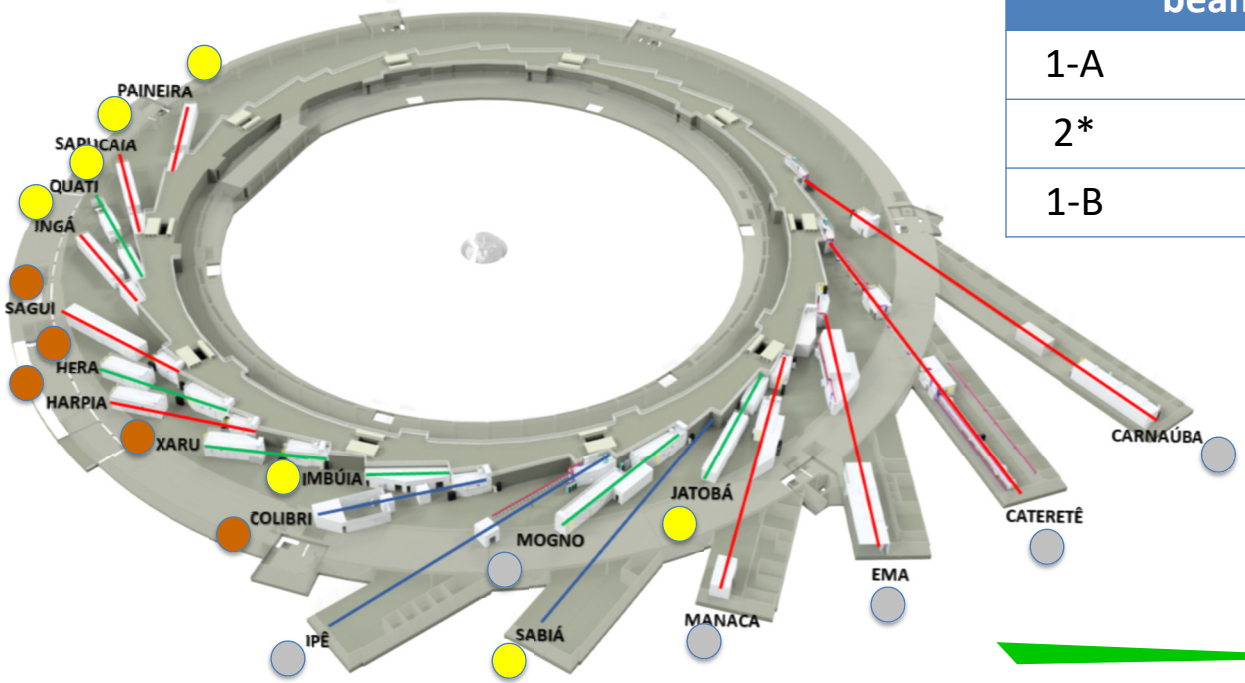
- Compatible with Sirius Low Beta
- 1.3 T maximum magnetic field
- Adjustable phase undulator
- Module with 1200 mm length
- 7 mm gap (diagonal)
- 20 mm period



See TUPMK003 for more details

Beamlines

Phase	Number of beamlines	Status	First Beam
1-A	6	Construction	2019
2*	5	Funding	2020
1-B	7	Design	2021



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3.2T Superbend

Short period undulator

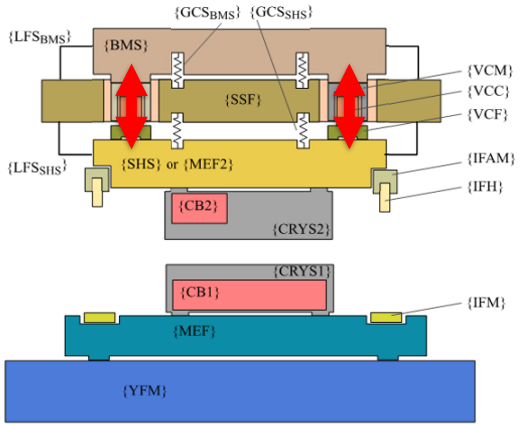
Long period undulator

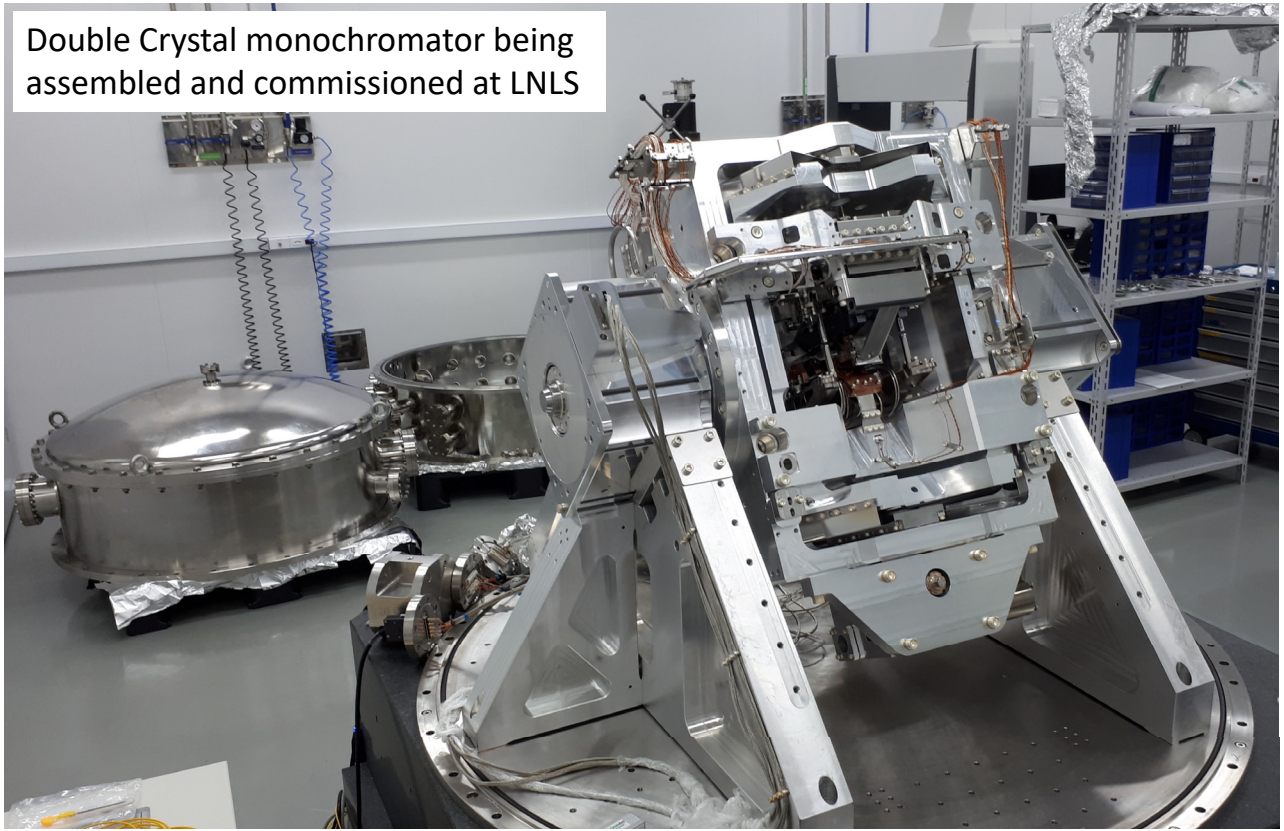
* Mainly refurbished beamlines from the UVX machine

Beamlines

Bragg angle stability (up to 2.5 khz)
- In-position: <50 nrad (rms)
- Flyscan: <100 nrad (rms)

Pitch/Roll stability (up to 2.5 kHz)
- In-position: <10 nrad (rms)
- Flyscan: <60 nrad (rms)





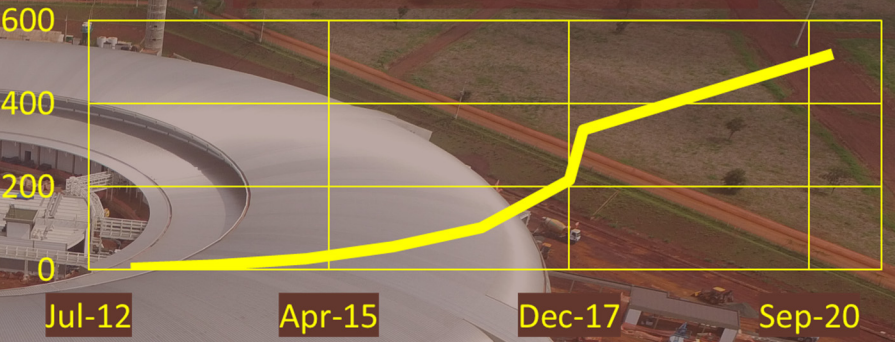
Developed in partnership with MI Partners, Netherlands

Budget and schedule overview

Budget (up to 2020)

•Building	200 M US$
•13 beamlines	120 M US$
•Accelerator	110 M US$
•Human Res	60 M US$
•Infrastructure	30M US$
•Total	**520 M US$**

Integrated Resources (M US$)



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Schedule

- May 2018 end of Linac commisioning
- Aug. 2018 start of Booster commissioning
- Dec. 2018 start of SR commissioning
- Jul. 2019 phase 1 operation (up to 50mA, NCC)
- Jul. 2020 phase 2 operaton (up to 350mA, SCC)

www.ipac21.org

We are looking forward to seeing you in Brazil

Thank you

regis.terenzi@lnls.br