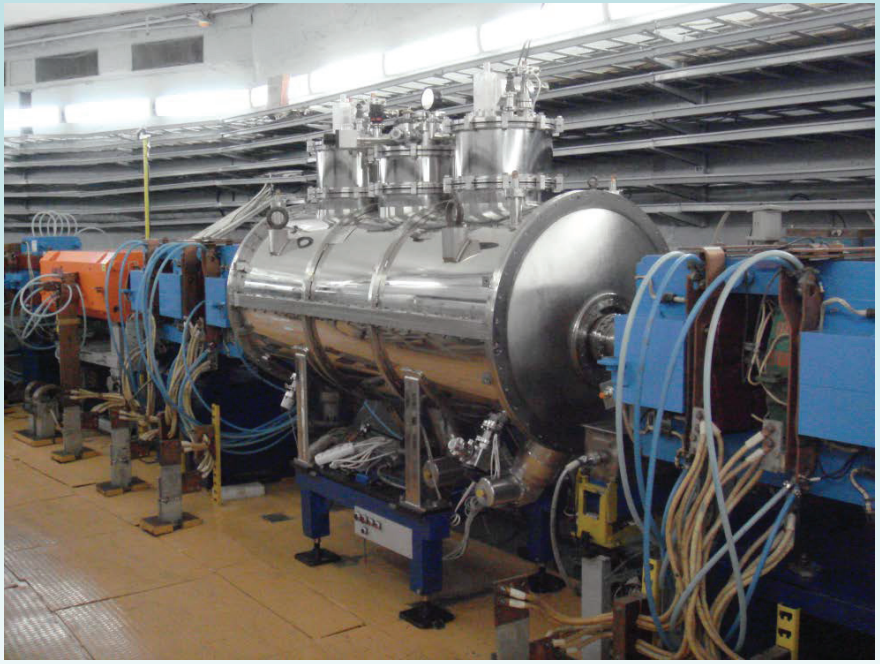


Status of Kurchatov Synchrotron Radiation Source

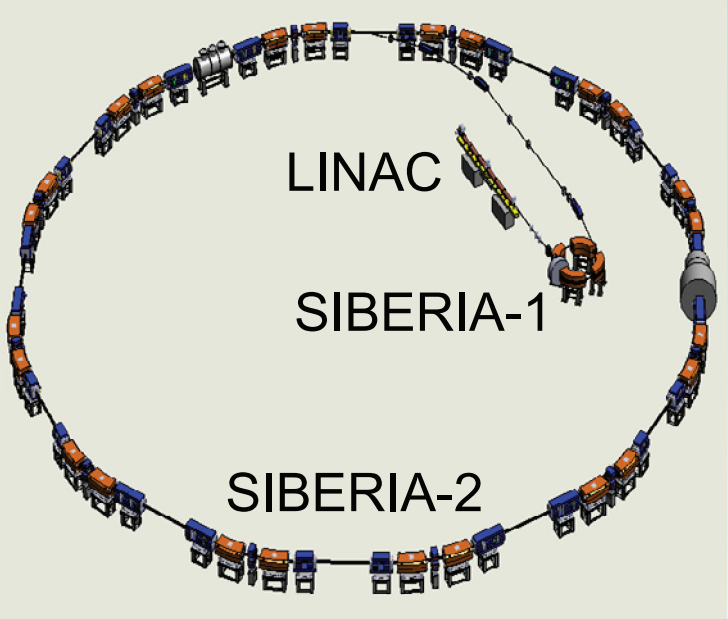
A.Valentinov, A.Belkov, Y.Fomin, E.Kaportsev, V.Korchuganov, Yu.Krylov, V.Moiseev, K.Moseev, N.Moseiko, D.Odintsov, S. Pesterev, A.Smygacheva, A. Stirin, V. Ushakov, V.Ushkov, A.Vernov

NRC Kurchatov Institute, pl. Akademika Kurchatova 1, 123182, Moscow, Russia

Content:

1. KSRS operation
2. KSRS development in 2015 -2016
3. KSRS modernization (Federal Program)

KSRS



3 electron accelerators:

- **80 MeV LINAC (1992)**
- **450 MeV** storage ring **SIBERIA-1 (1993)**
- **2.5 GeV** storage ring **SIBERIA-2 (1995)**

11 experimental stations (**SIBERIA-2**)

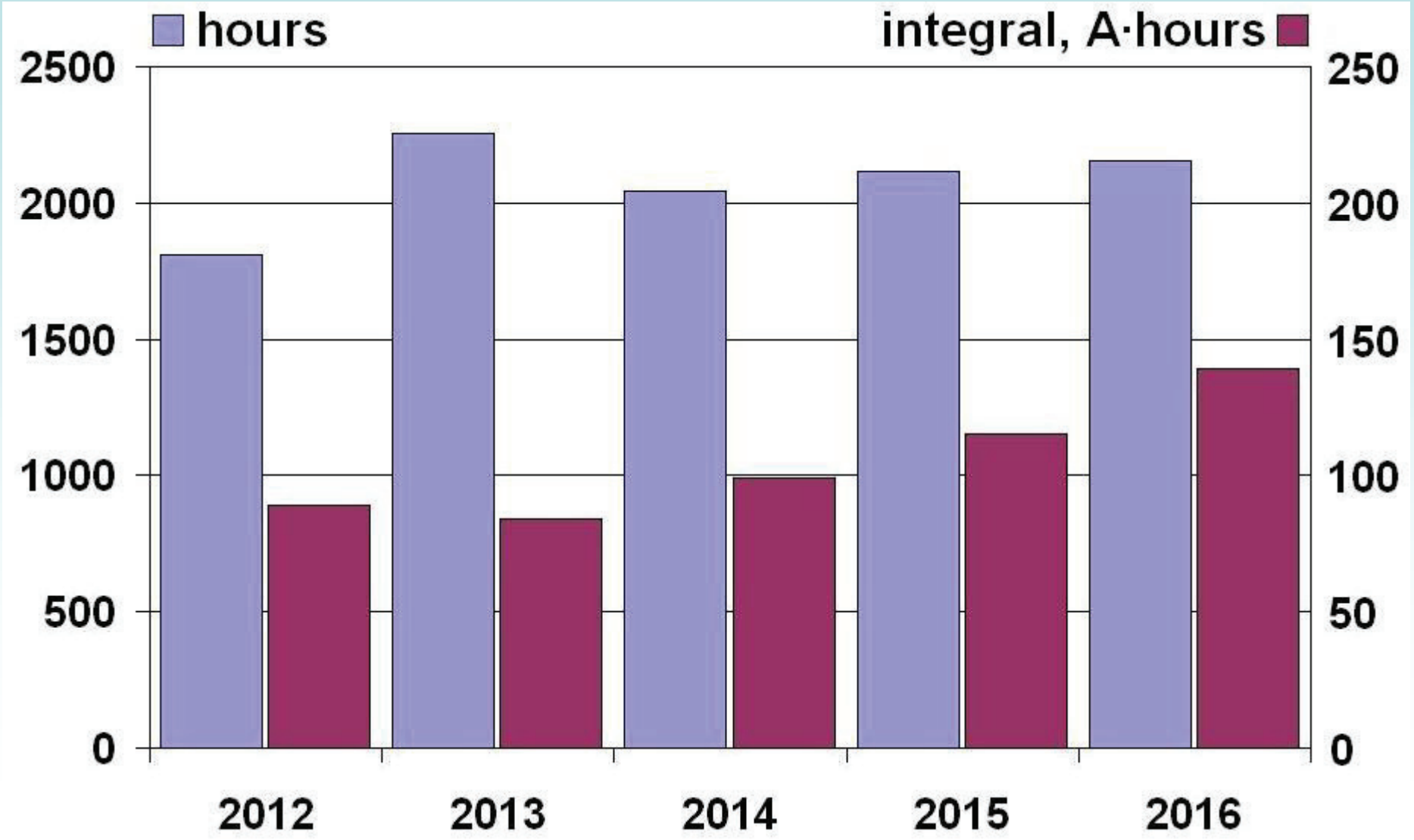
4 experimental stations (**SIBERIA-1**)

Experiments in physics, chemistry, biology, medicine, nanotechnologies and many more…

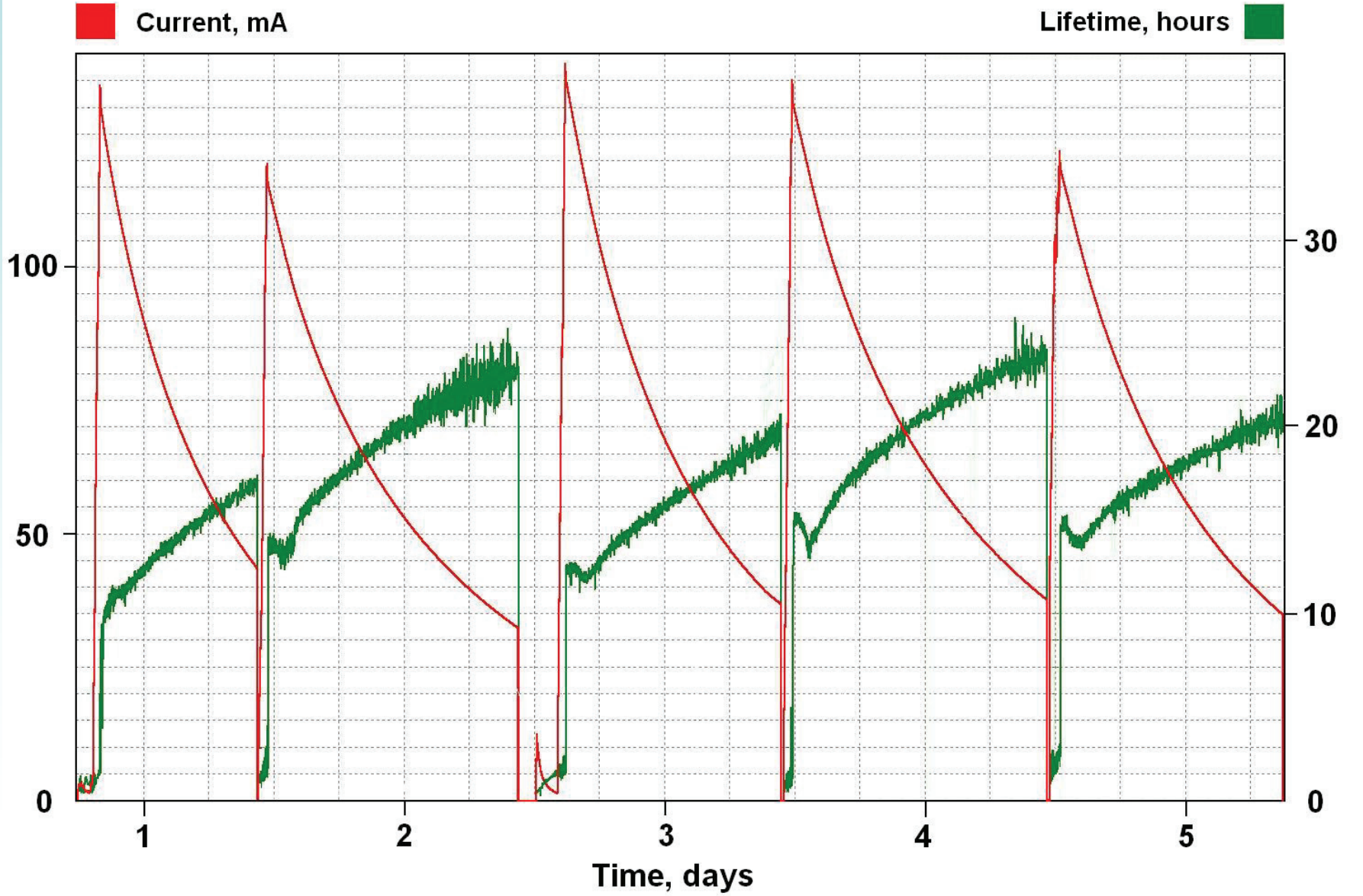
Accelerators' parameters

	SIBERIA-1	SIBERIA-2
Energy, GeV	0.45	2.5
Circumference, m	8.68	124.13
Hor. emittance, nm·rad	860	98
Energy spread, σE/E	$3.8 \cdot 10^{-4}$	$9.54 \cdot 10^{-4}$
Electron current, mA	up to 300	up to 150
Lifetime, hours (at 100 mA)	1.5	20 - 25
SR power, kW (at 100 mA)	0.36	68.5
Time for users per year, hours	up to 2400	2000 – 2400
Consumed electric power at working energy, MW	0.4	2.5

KSRS operation in 2012 - 2016



Week of SIBERIA-2 (October 2016)



VERTICAL ORBIT DISTORTIONS

Main reason:

Machine basis heating by conducting bar of bending magnets power supply. It causes distortions of closed orbit in vertical plane up to 400 microns (after week of operation)

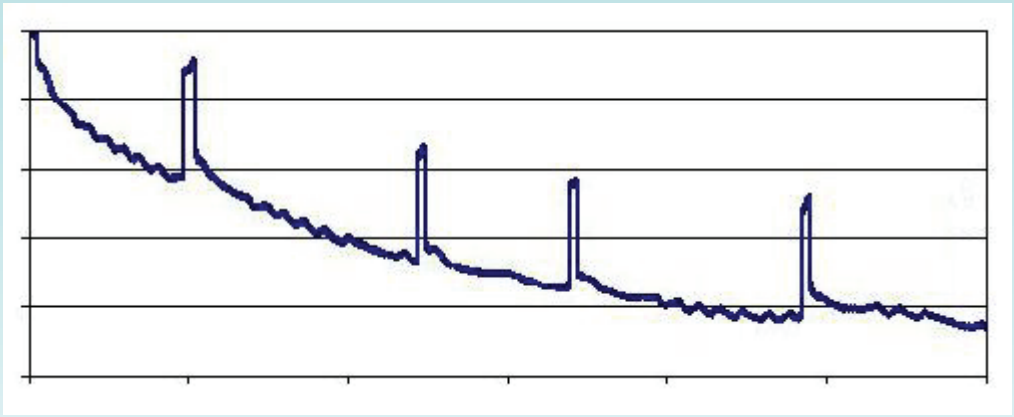
Cure method:

Now: Feedback using luminophor sensor with TV-camera and local orbit bump in order to stabilize photon beam

Future: Improving of conductor cooling by using more powerful water pumps and additional cooling lines

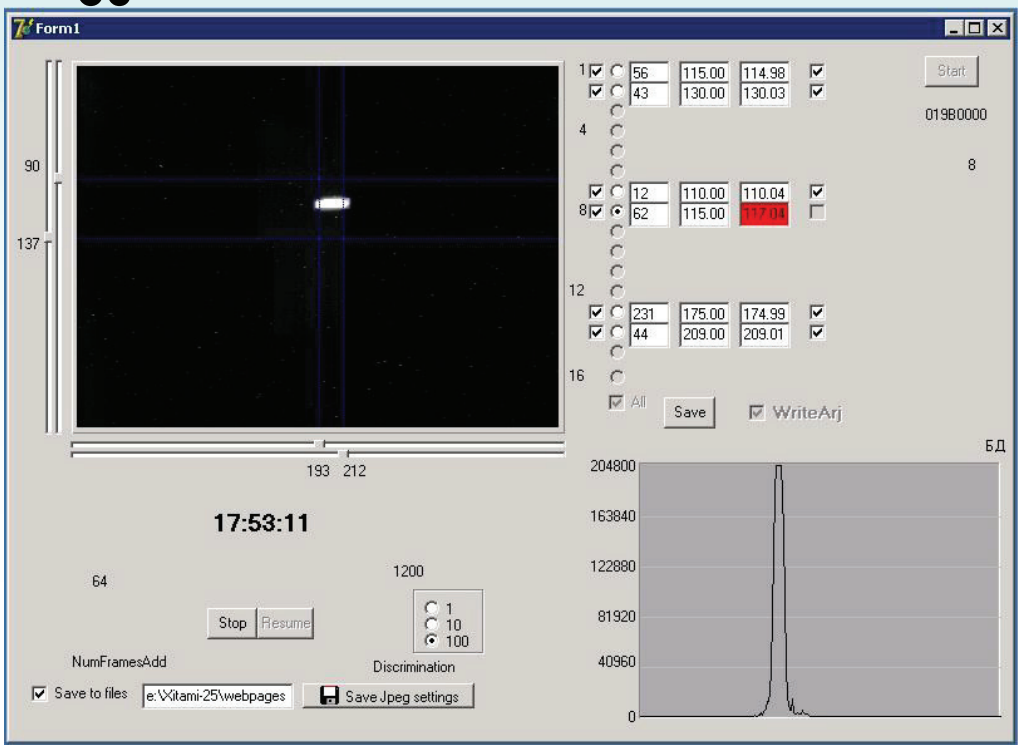
VERTICAL ORBIT DISTORTIONS

Slope of magnet surface vs. time

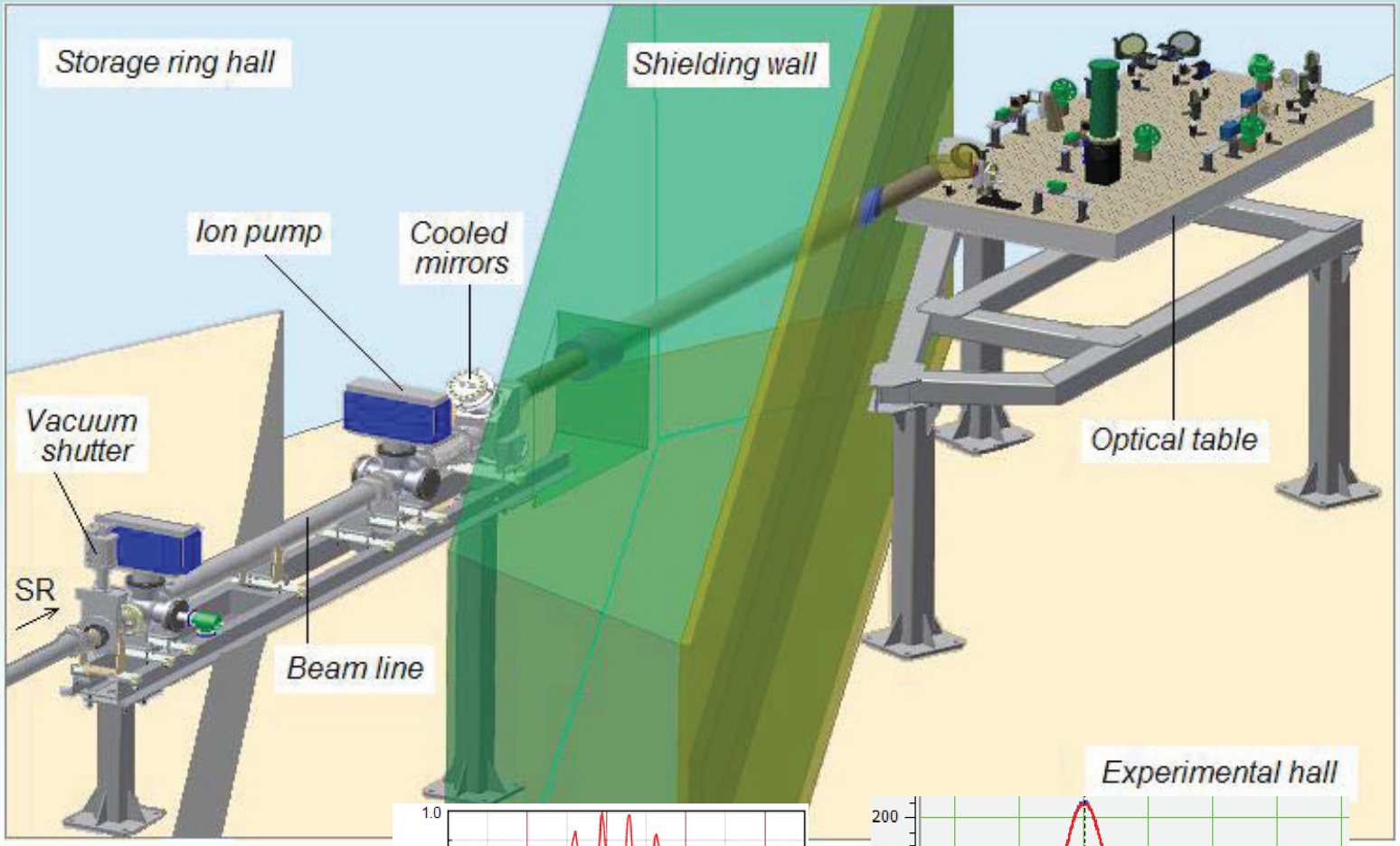


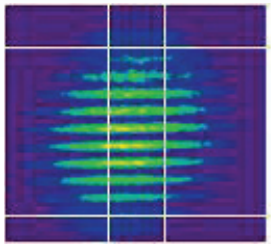
Photon beam stabilization program using luminophor sensors & TV-cameras

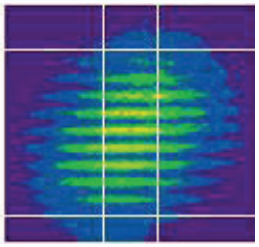
Beam position stability 2 - 4 microns

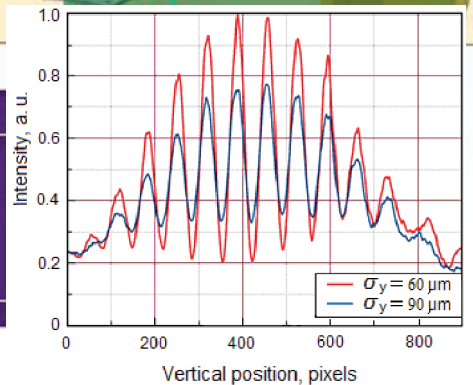


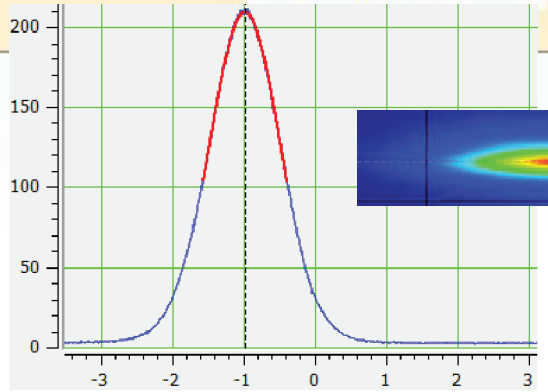
Station of optical supervision

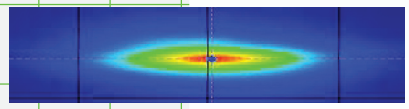




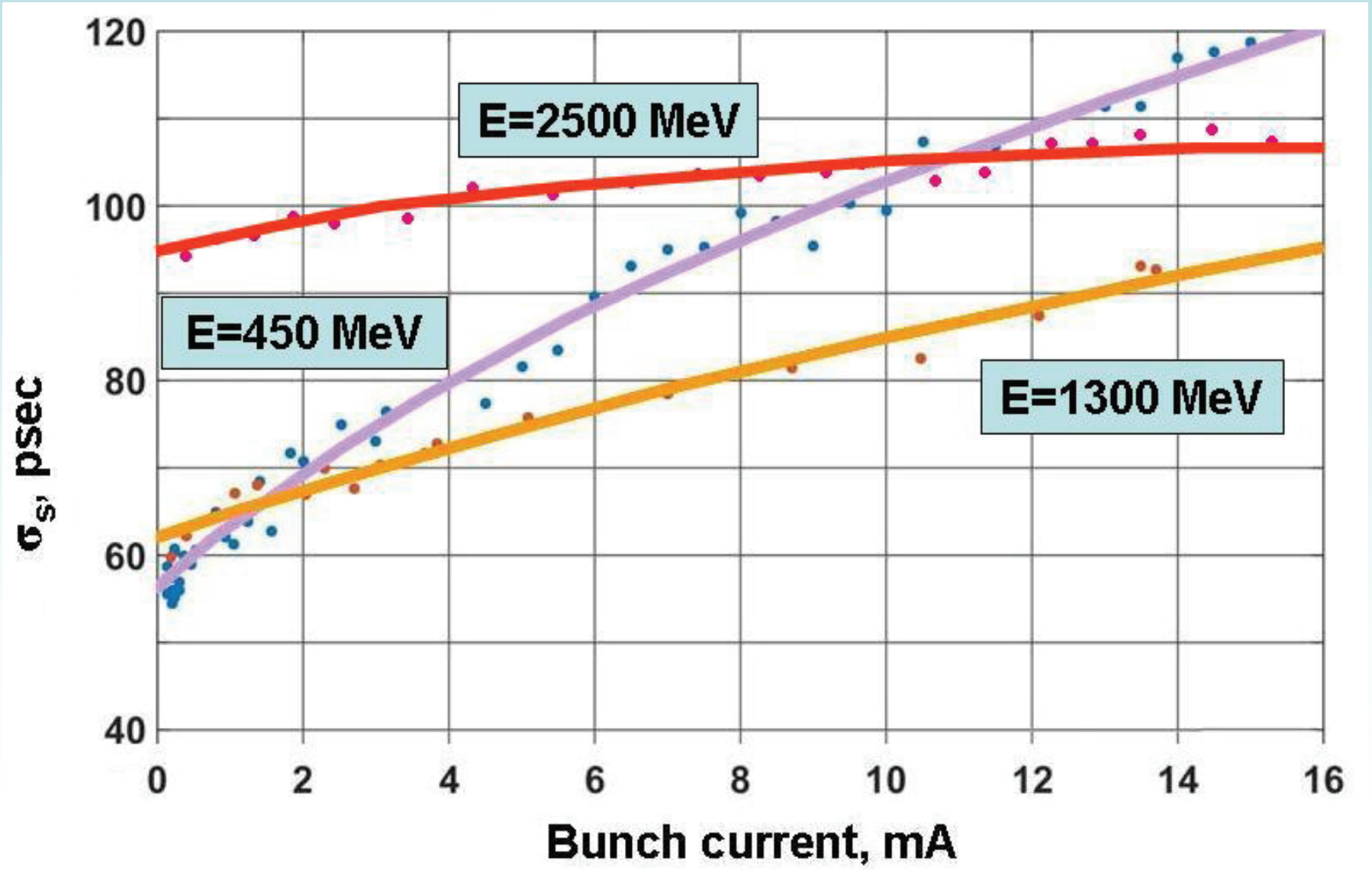




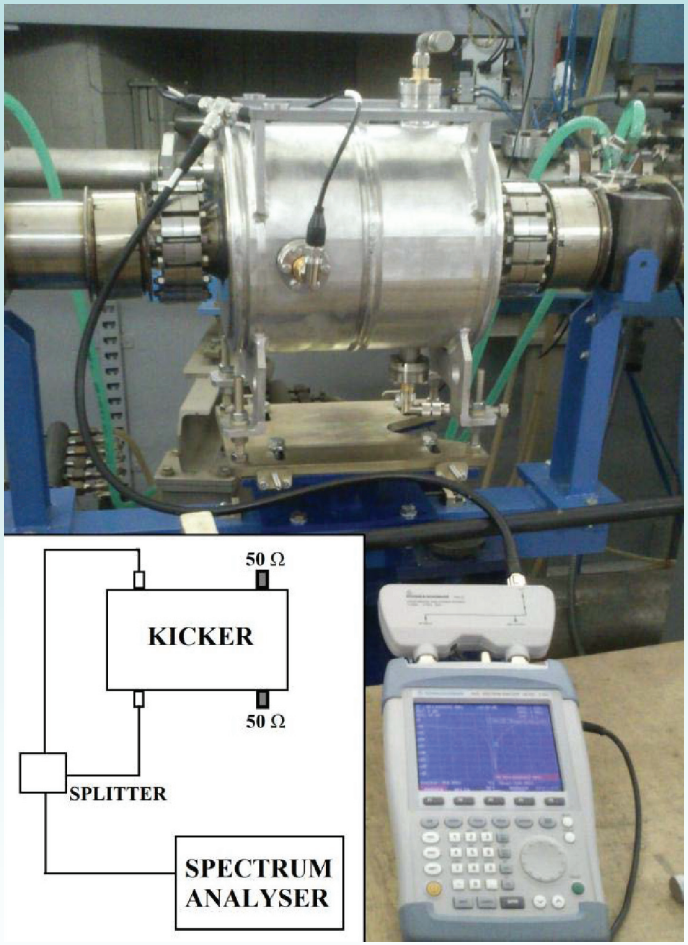




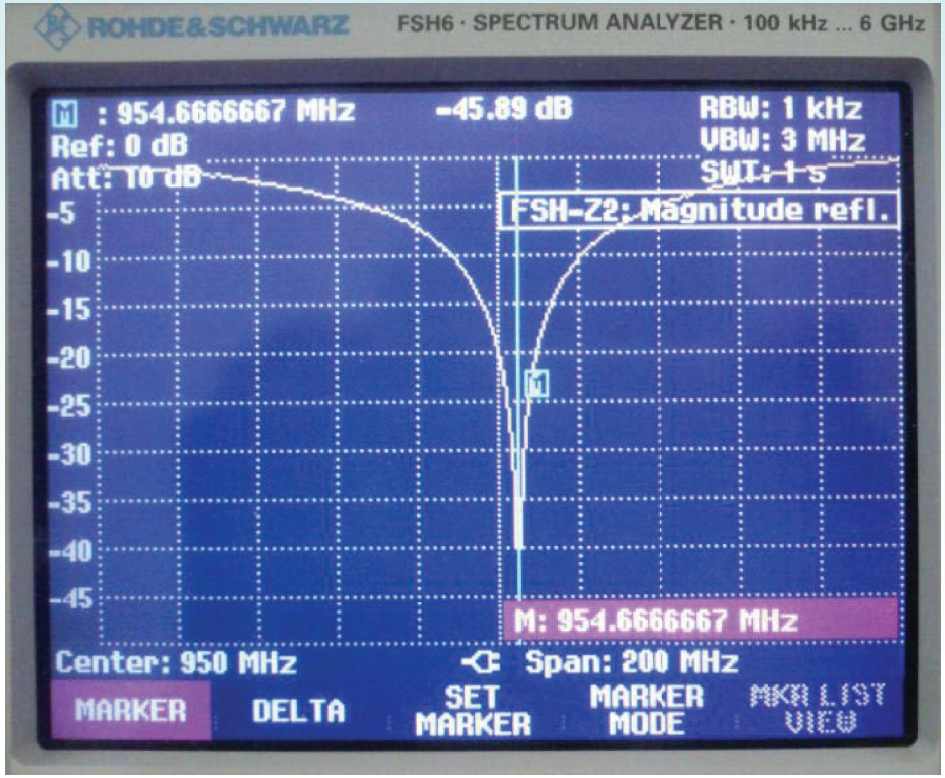
Bunch length in single-bunch mode



Feedbacks for instabilities suppression

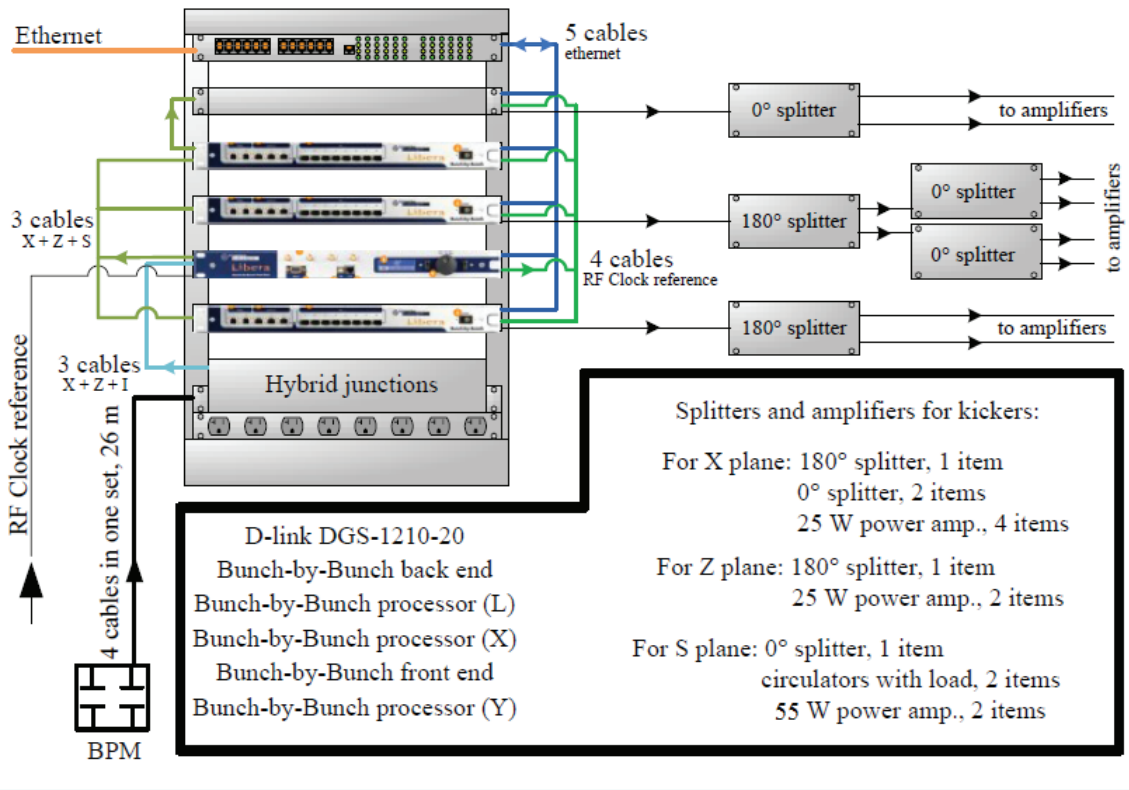


Measured L - kicker parameters:
Operation frequency – 954.67 MHz;
Frequency bandwidth – 104.67 MHz;
Quality factor – 9.12.



Feedbacks for instabilities suppression

The schematic layout of the feedback system



X- and Z- Kickers:

The X-kicker is the four electrode stripline structure, turned on 45°;
The Z-kicker is the two electrode stripline structure.

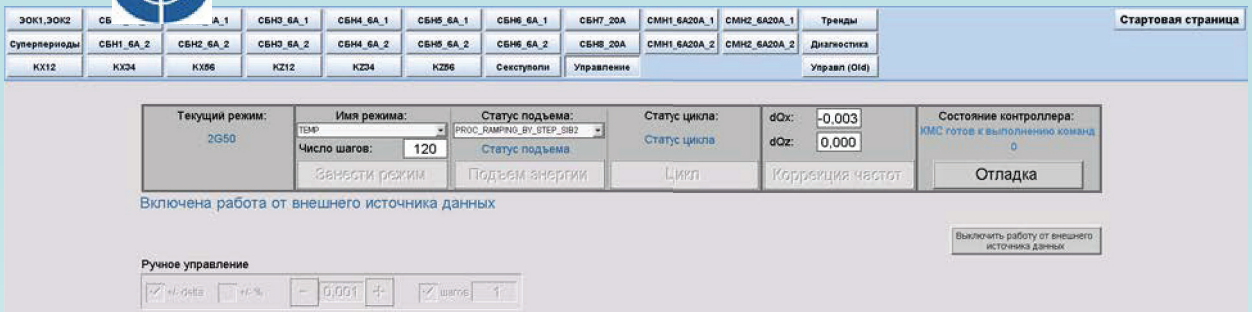
- The Hybrid junctions and Bunch-by-Bunch Front End module is used for an amplitude and phase conversion of broadband pickup signals.
- The Bunch-by-Bunch processor calculates the correction signal for damping coupled bunch instabilities:
  - The 12 bit ADC with the sampling frequency 181 MHz;
  - FPGA device, 4 processing chains with 16 tap FIR filter;
  - The 14 bit 500 MHz DAC.
- The Bunch-by-Bunch Back End module forms the correction signal for the longitudinal kicker.

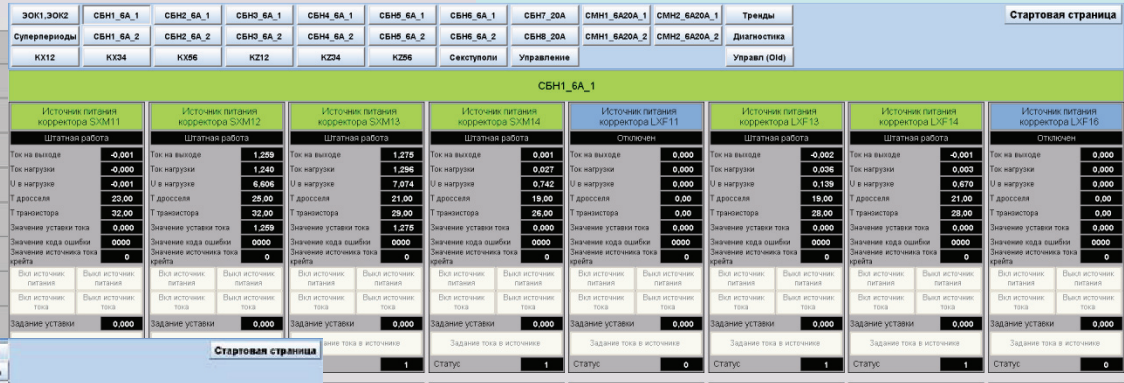
Control System: CitectSCADA

- Vacuum system
- Temperature measurements and temperature stabilization of linac structure
- Siberia-2 RF generators measurements
- Siberia-2 magnetic system control, including ramping process, cycle of remagnetization, betatron tune correction and so on.
- Control of photon absorbers in SR beamlines
- Control of equipment in superconducting wiggler beamline.

Plans: All other system control

Control System: CitectSCADA





Перенасыщено и непонятно…

RUPAC 2016 REPORTS

THPSC063
SYSTEM OF THERMOMONITORING AND THERMOSTABILIZING FOR KSRS

THPSC026
THE AUTOMATION OF ENERGY RAMPING FOR THE MAIN STORAGE RING OF KSRS

THPSC084
THE NEW CONTROL FOR MAGNET SYSTEM OF KSRS

THPSC054
MODERNIZATION OF THE ELECTRON BEAM STABILIZATION SYSTEM IN THE KSRS

WEPSB016
COUPLED BUNCH INSTABILITIES IN THE STORAGE RINGS

WEPSB010
THE USE OF MULTI-OBJECTIVE GENETIC ALGORITHMS FOR ACCELERATOR AND LIGHT SOURCE OPTIMIZATION

TUPSA055
COMPUTER CODE FOR SIMULATION OF WIGGLER RADIATION POWER DISTRIBUTION

KSRS modernization in 2018 - 2020

Problems:

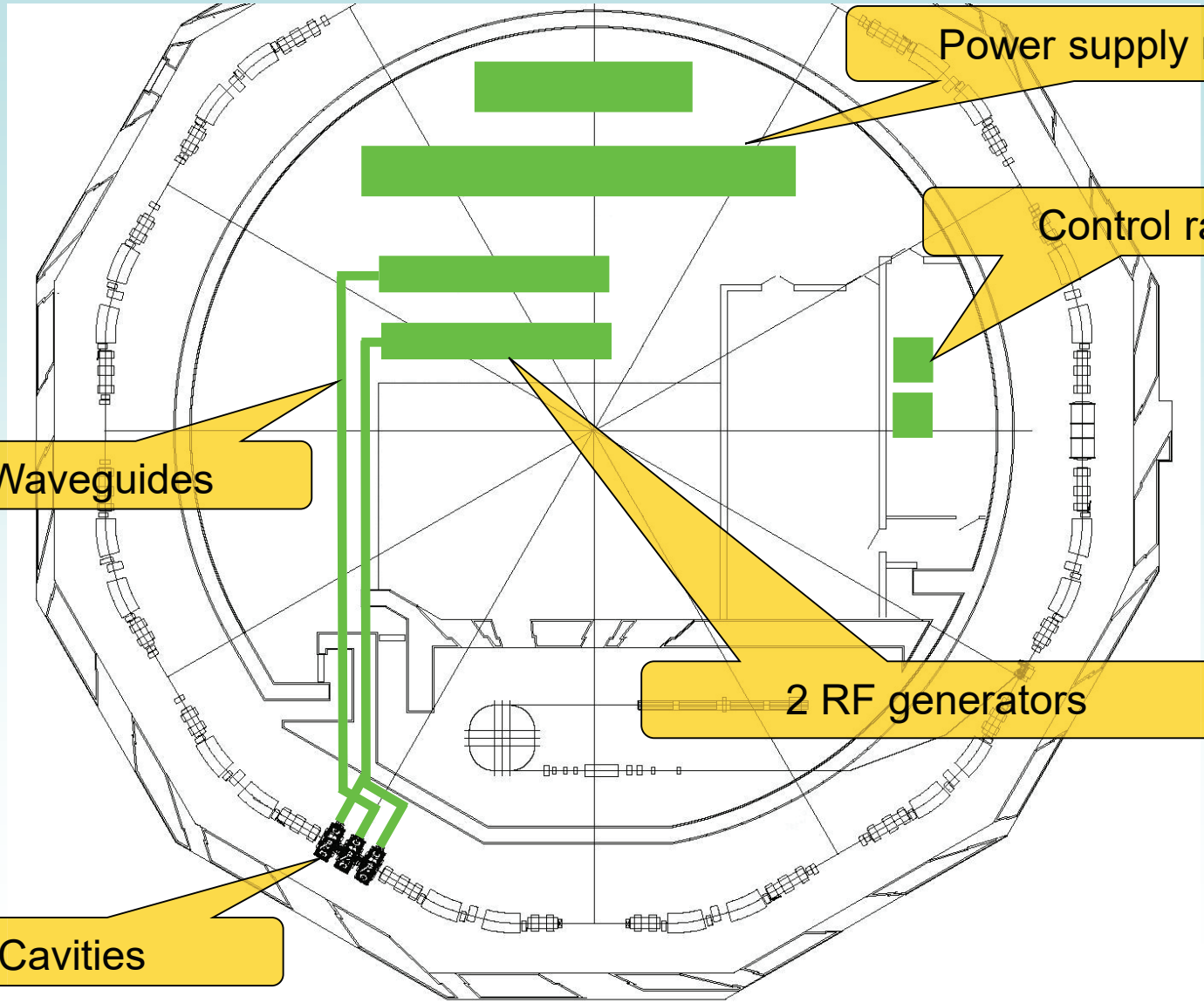
- Non-adequate condition of technical systems: water and air cooling, electric circuits, air conditioning
- Old accelerators' equipment: high-current power supply systems, pulse generators, control system hardware
- Number of vacuum equipment must be changed: inoperative valves, ion pumps, titanium evaporation units
- Not-optimal RF system scheme of SIBERIA-2 (2 generators + 3 cavities) limits electron current, doesn't allow operation with all planned wigglers
- Complicated structure of control system

KSRS modernization in 2018 - 2020

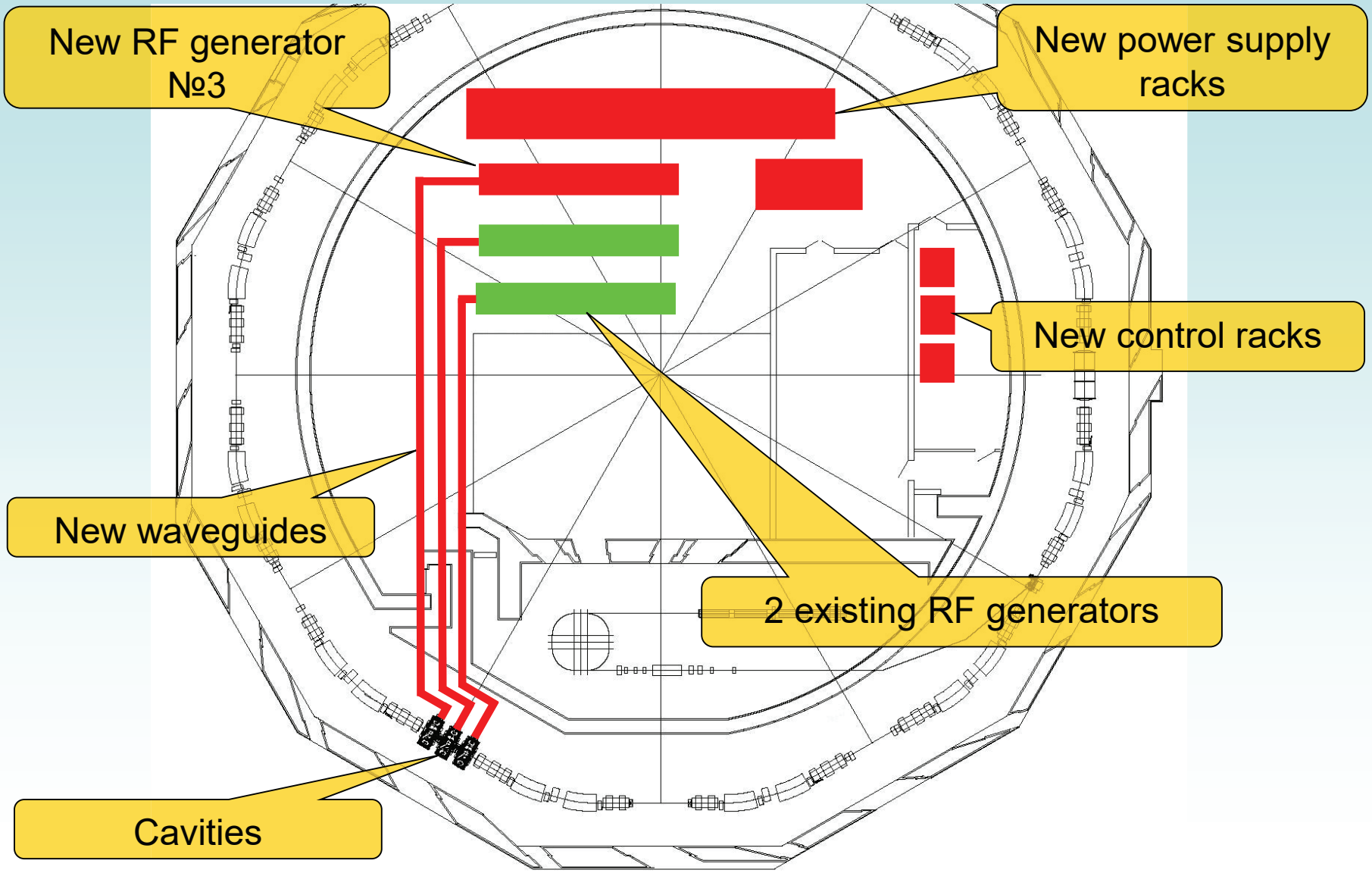
Goals:

- **Maintenance of reliable and effective operation of all KSRS systems**
- **Improvement of KSRS essential parameters: electron current, beam lifetime, operation time**
- **New experimental possibilities for users: beamlines, experimental stations, new superconducting wigglers**

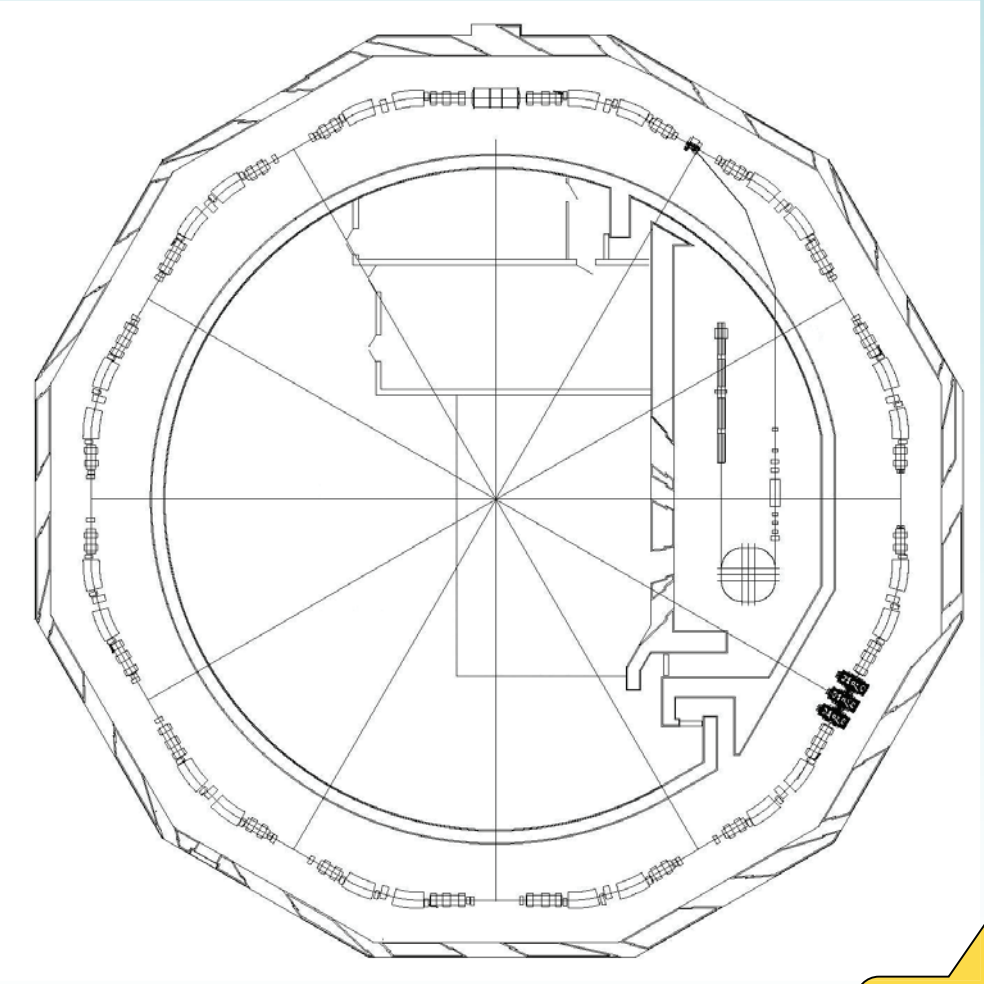
SIBERIA-2 RF SYSTEM

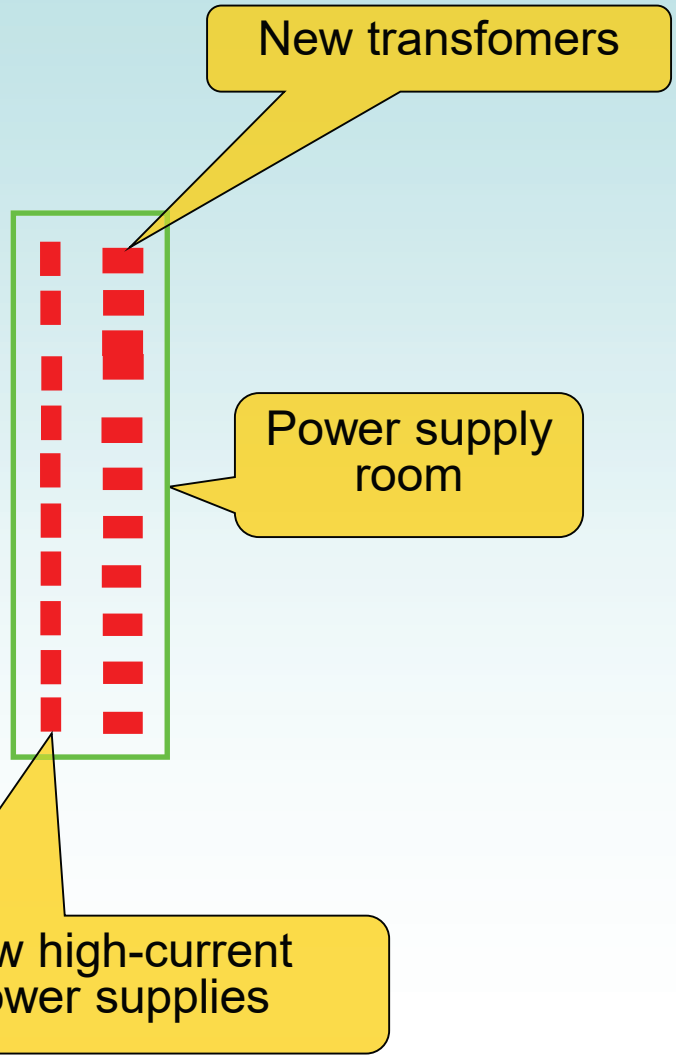


RF system after modernization

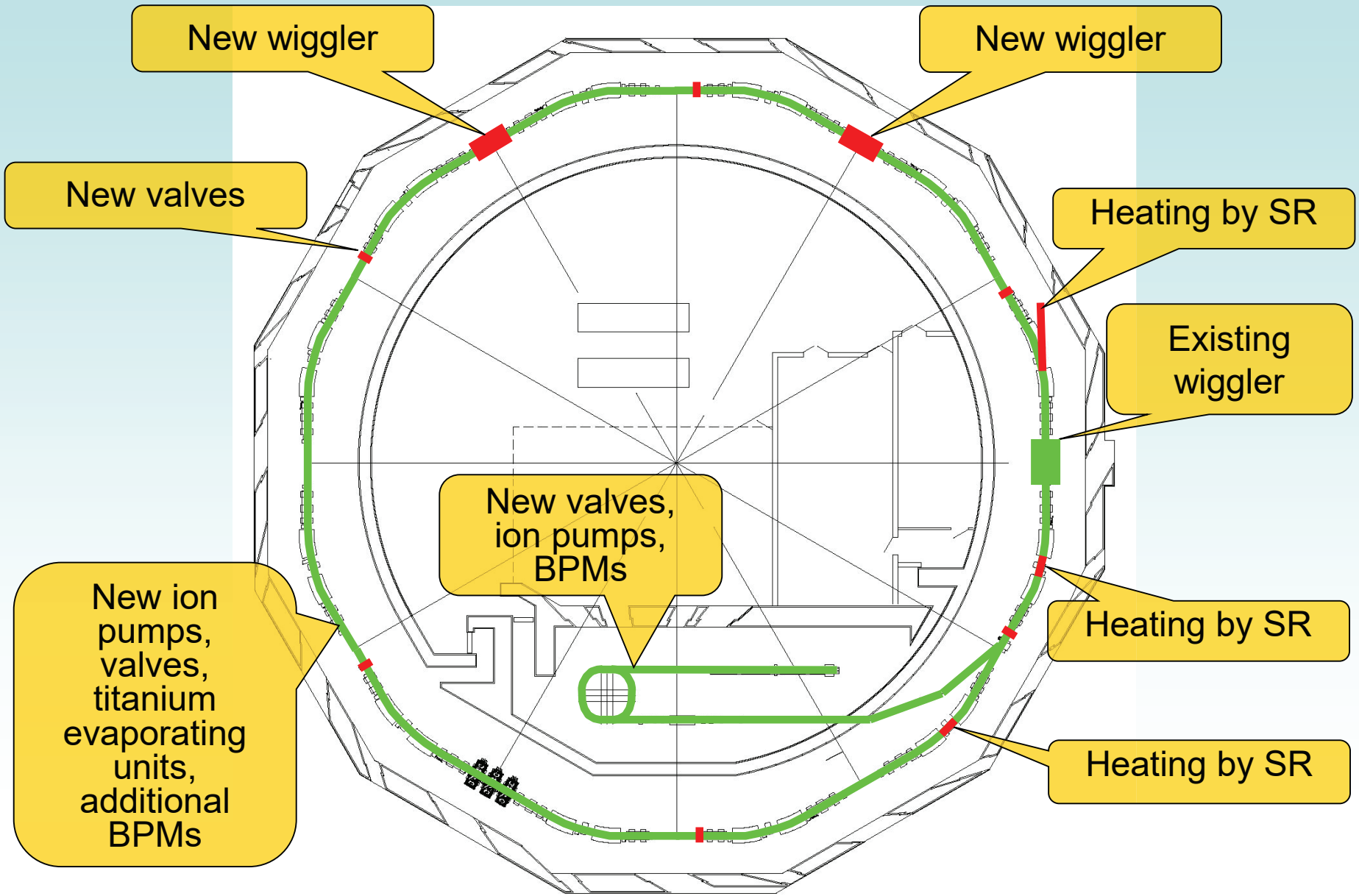


Magnet system modernization





Vacuum system modernization



Superconducting wigglers

Parameter	SCW-1	SCW-2,3
Max. field	7.5 (4) T	3 T
Field period	164 mm	46 mm
Number of poles	19+2	50+4
Undulator factor, K	115 (61)	12.9
SR power at 2.5 GeV, 100 mA	35 (10) kW	4.1 kW
Max. angle, K/γ	23 (12.2) mrad	2.6 mrad

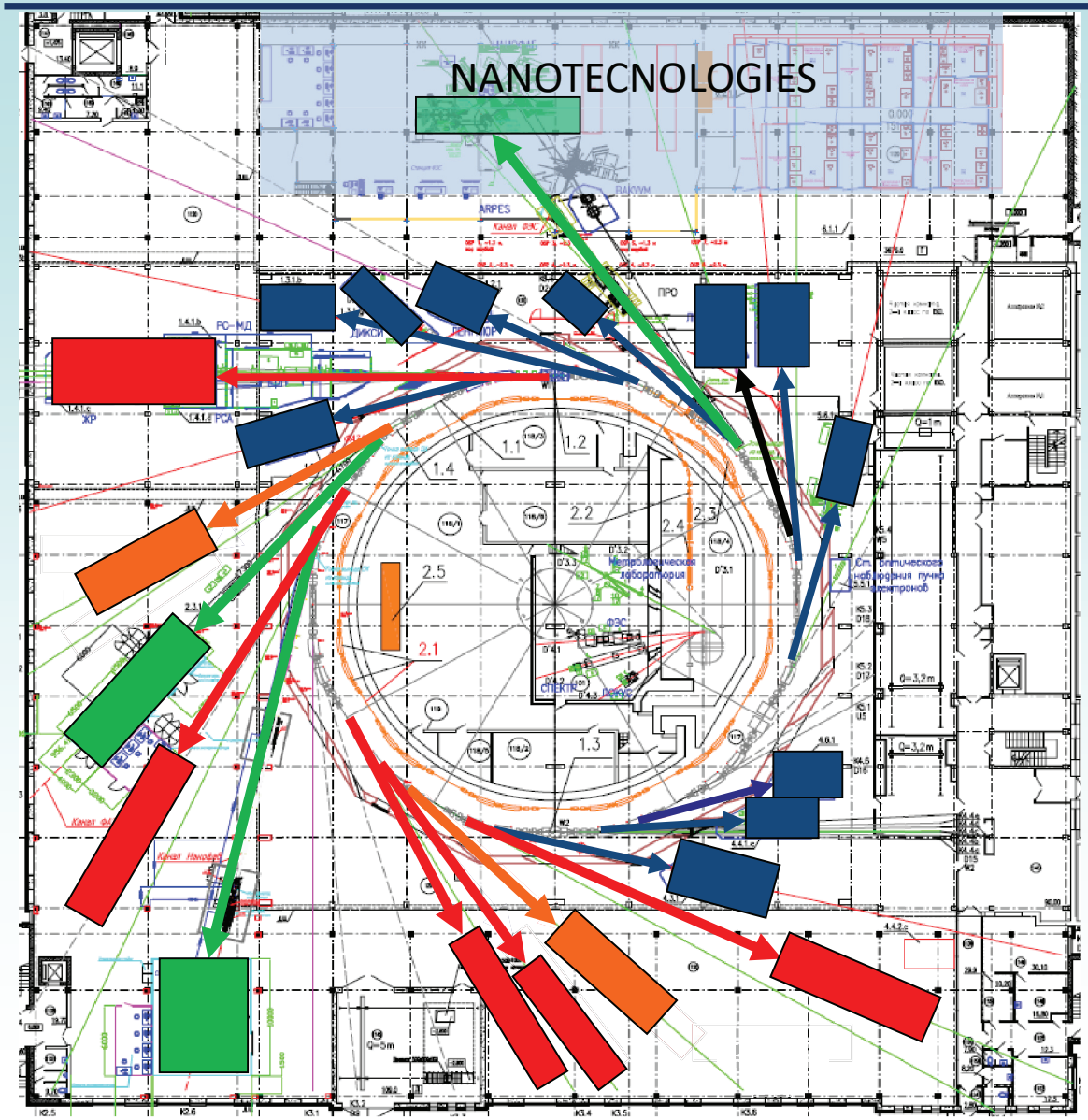
MODERNIZATION of TECHNICAL SYSTEMS

- New water pumps and distillers
- New electricity transformers and high-voltage circuits for RF generator #3
- Equipment for trouble-proof power supplies
- New air-cooling equipment for RF generators and waveguides
- Modernization of ground circuits
- New pneumatic lines for vacuum valves
- Air conditioning (equipment rooms and experimental halls, main storage ring tunnel)
- New admission and safety systems

RESULTS of MODERNIZATION

SIBERIA-2 parameters	before 2016	2020
Time for users per year, hours	2000 - 2400 (in 24/5 mode)	3000 4200 (in 24/7 mode)
Maximal current, mA	200	300
Maximal total RF voltage, MV	2.0	2.7
Lifetime, hours (at 100 mA)	20 - 25	35 - 40
Lifetime restoring after vacuum chamber repair	2 weeks	3 – 4 days
Number of wigglers	1	3
Number of experimental stations	11	21

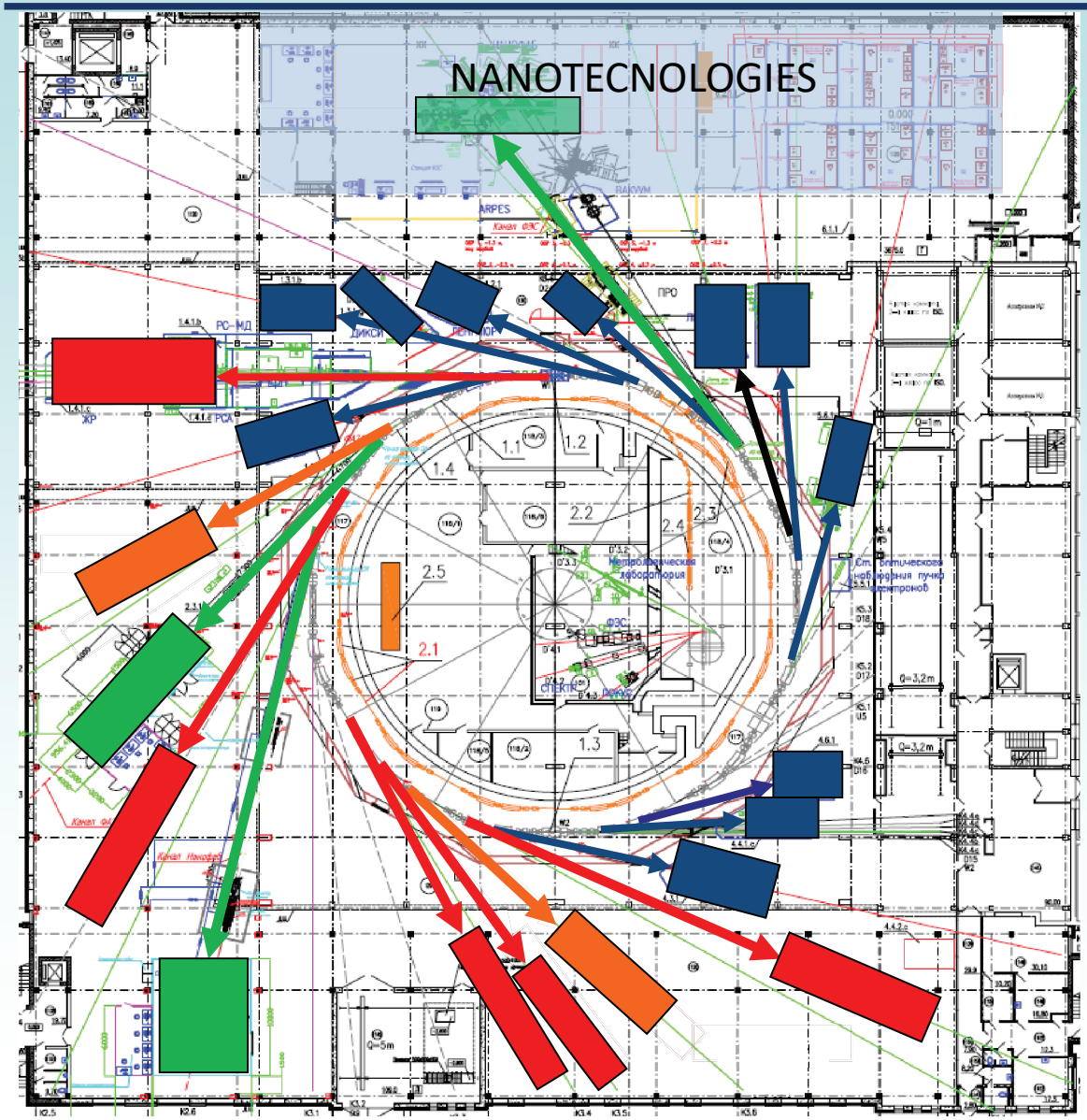
SIBERIA-2 EXPERIMENTAL STATIONS



In operation (11)

DESY (2)

SIBERIA-2 EXPERIMENTAL STATIONS



In operation (11)

New 2016 (3)

New 2019 (5)

DESY (2)

Thank you for your attention!