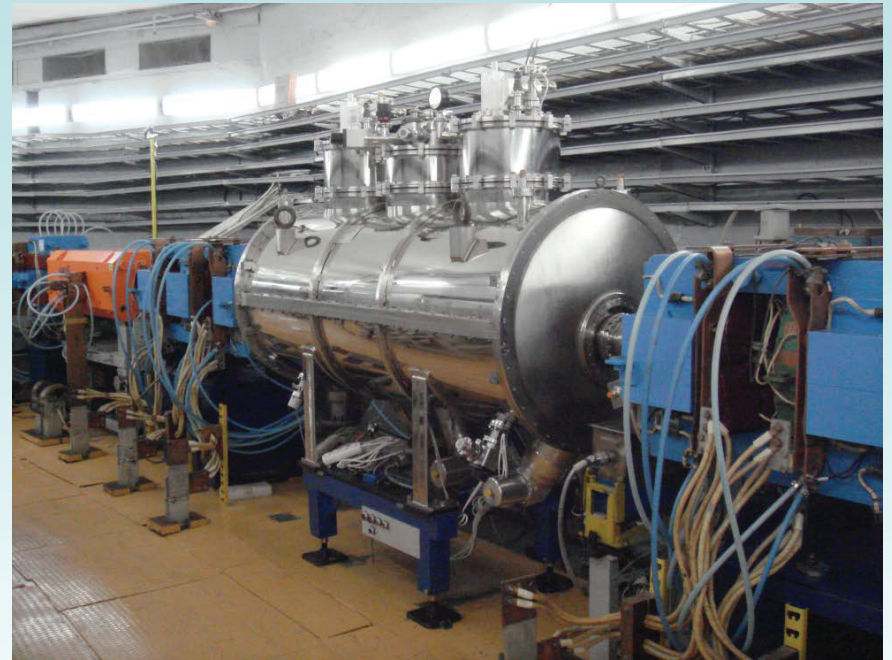




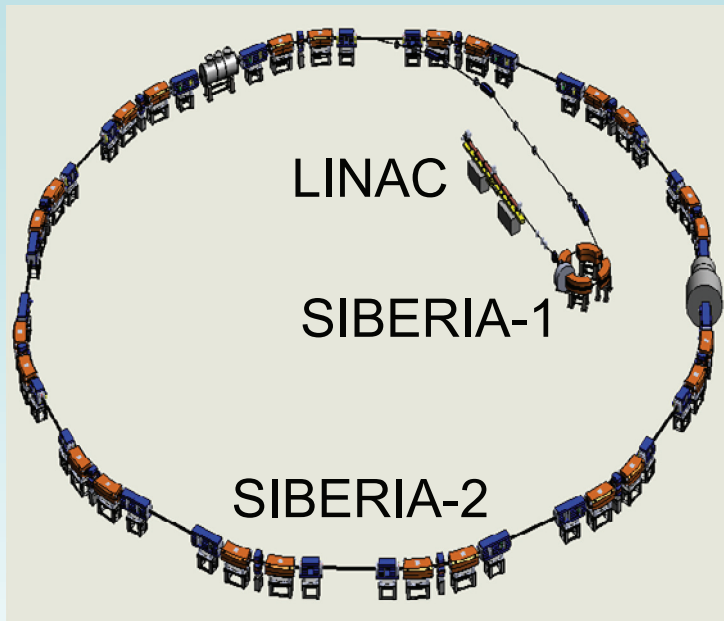
Status of Kurchatov Synchrotron Radiation Source

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, A.Vernov



Content:

- 1. KSRS operation**
- 2. KSRS development in 2017 - 2018**
- 3. Federal Program for KSRS modernization**



3 electron accelerators:

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

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

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

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

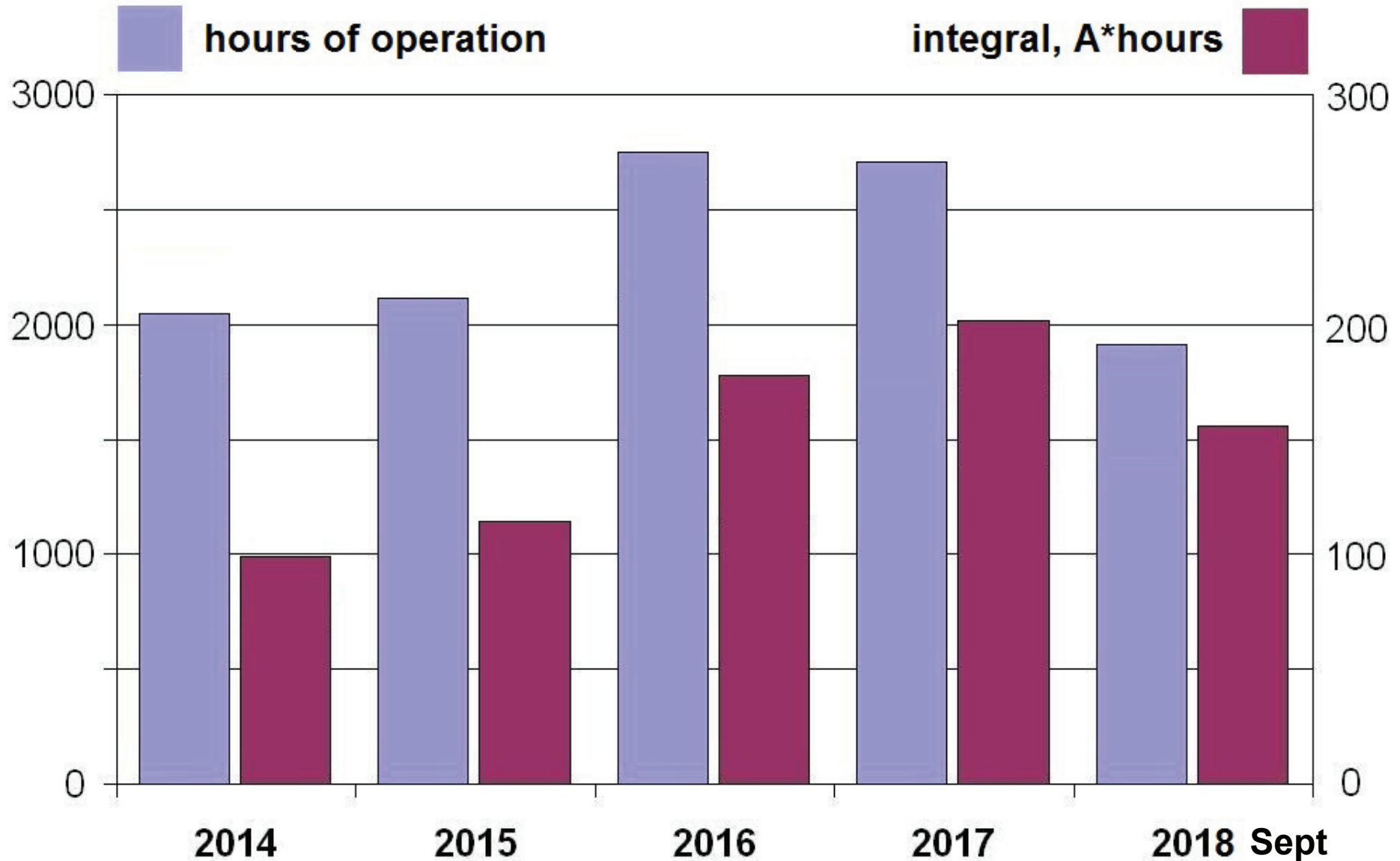


Accelerators' parameters

	SIBERIA-1	SIBERIA-2
Energy, GeV	0.45	2.5
Circumference, m	8.68	124.13
Horizontal. emittance, nm·rad	860	98
Energy spread, $\sigma E/E$	$3.8 \cdot 10^{-4}$	$9.54 \cdot 10^{-4}$
Electron current, mA	up to 200	up to 180
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 2000	2000 – 2700
Consumed electric power at working energy, MW	0.4	2.5

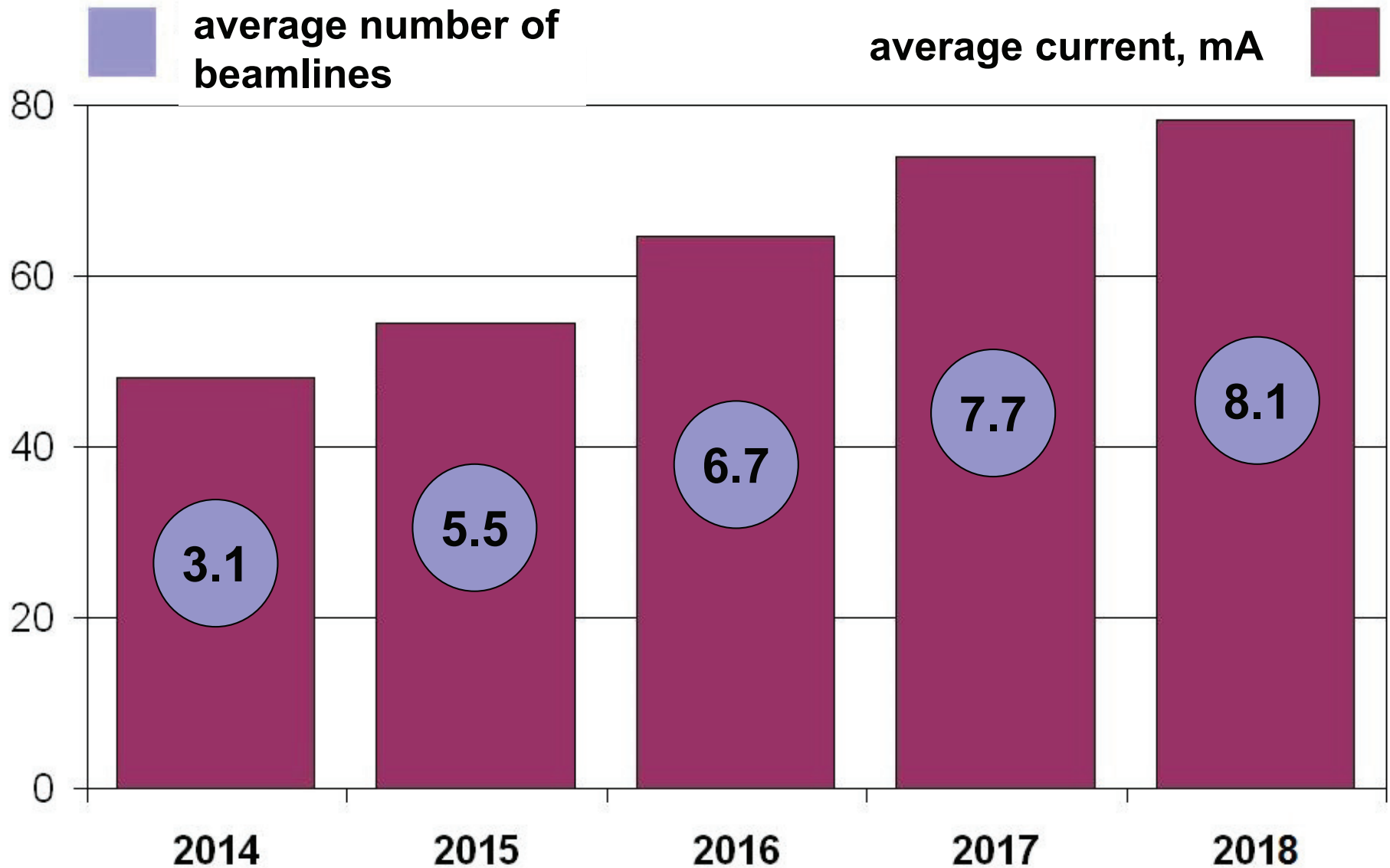


KSRS operation in 2014 - 2018



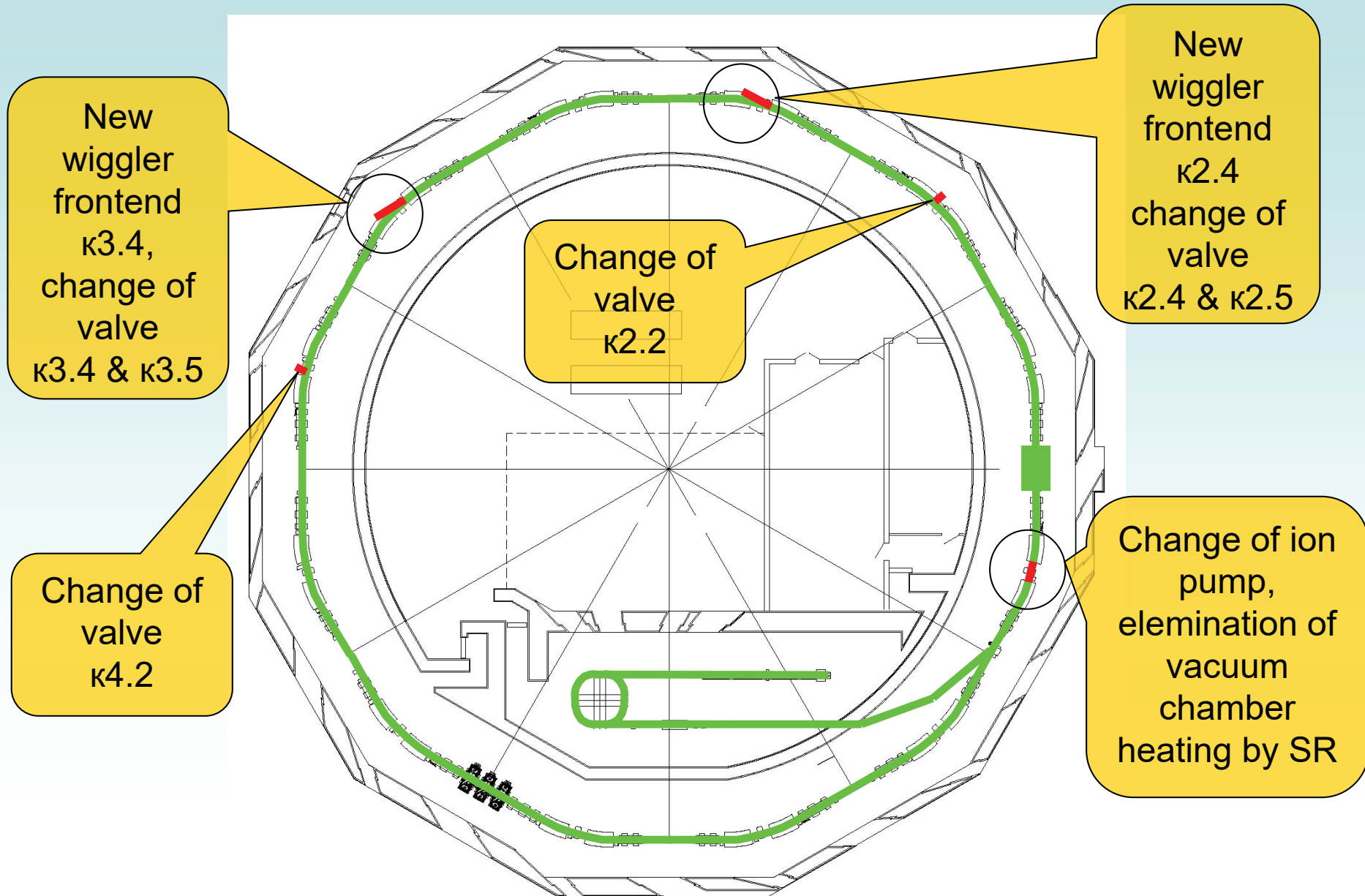


KSRS operation in 2014 - 2018



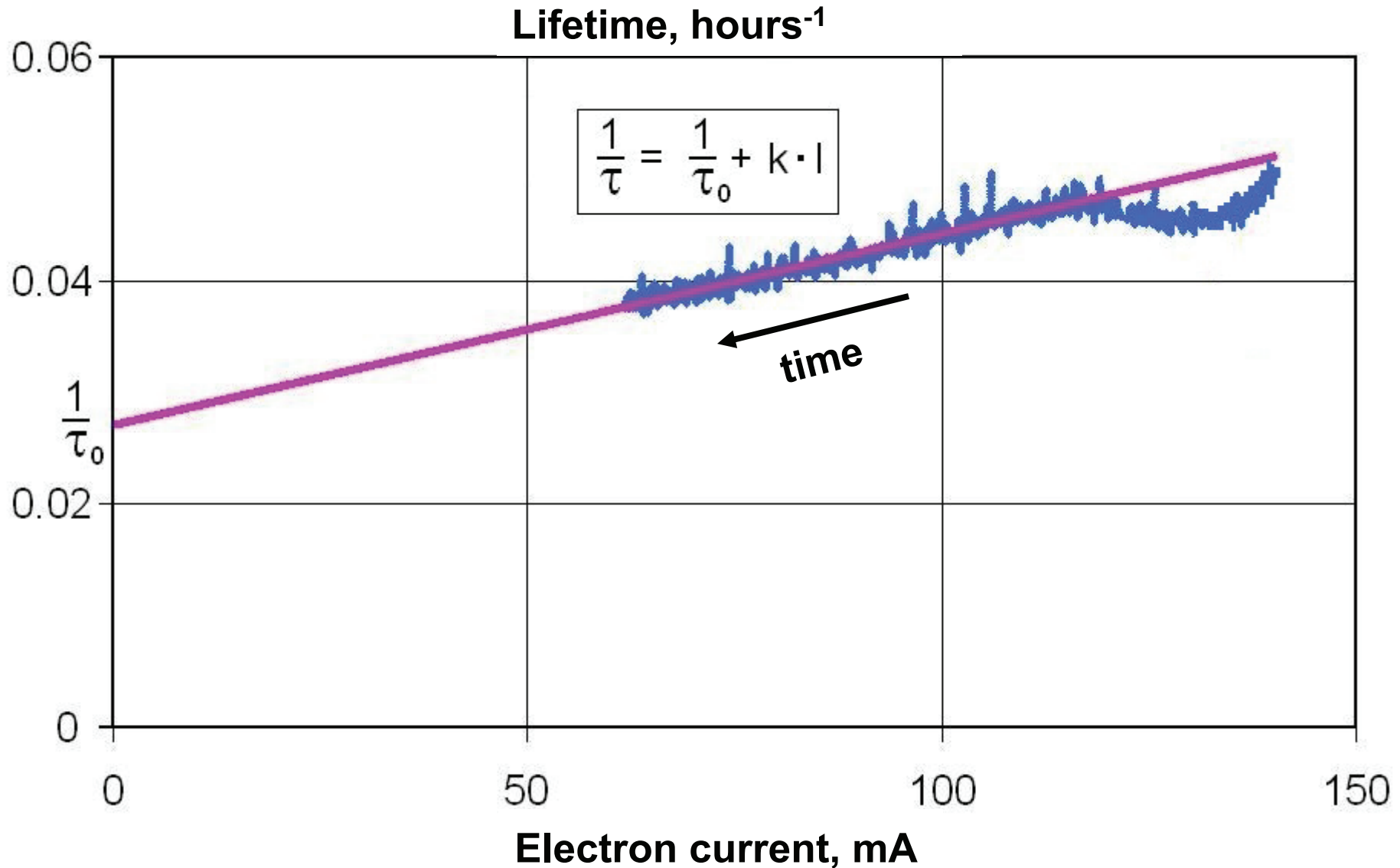


Works on vacuum system in July 2017



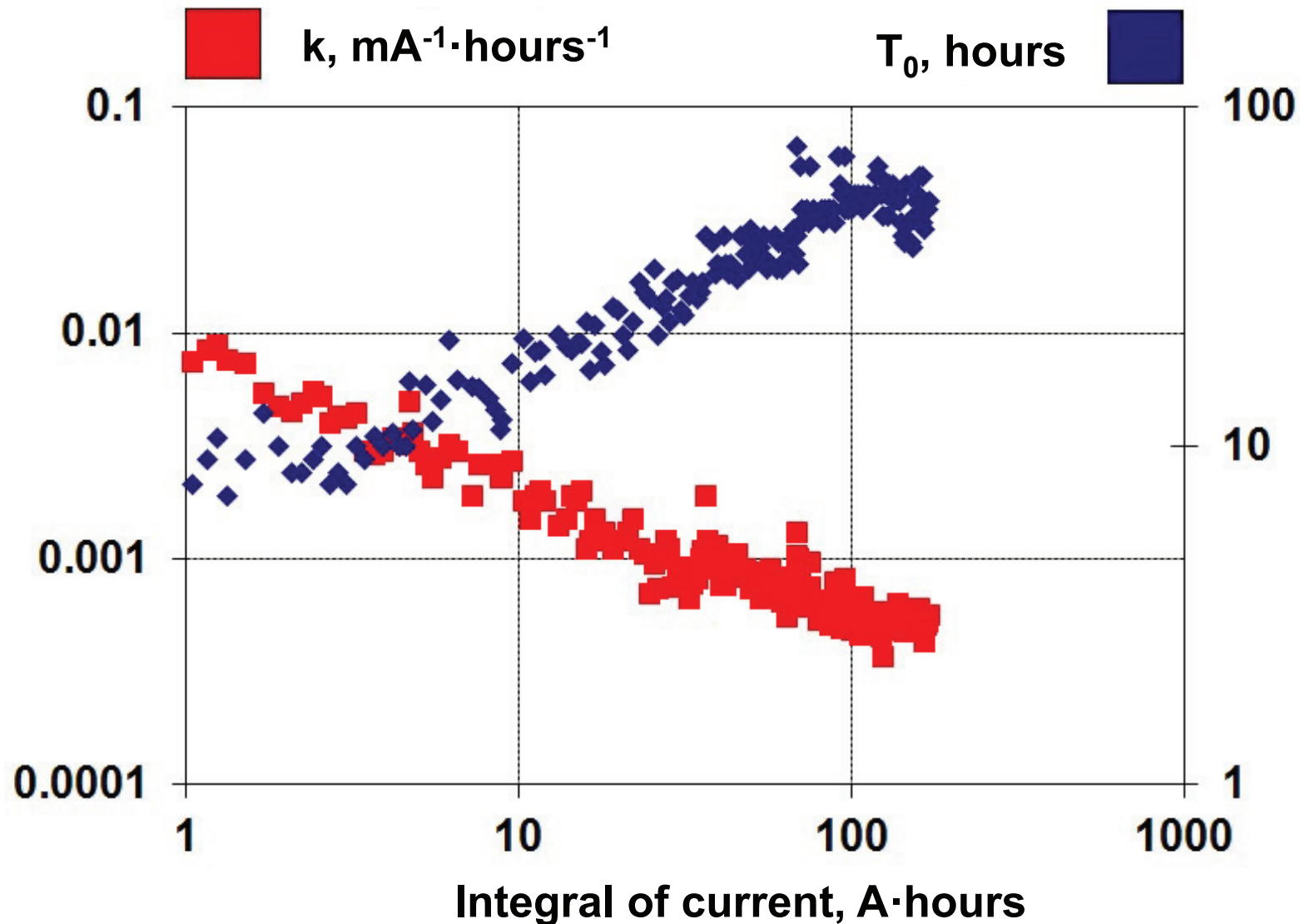


Lifetime dependence on beam current





Outgassing of vacuum chamber by SR beam





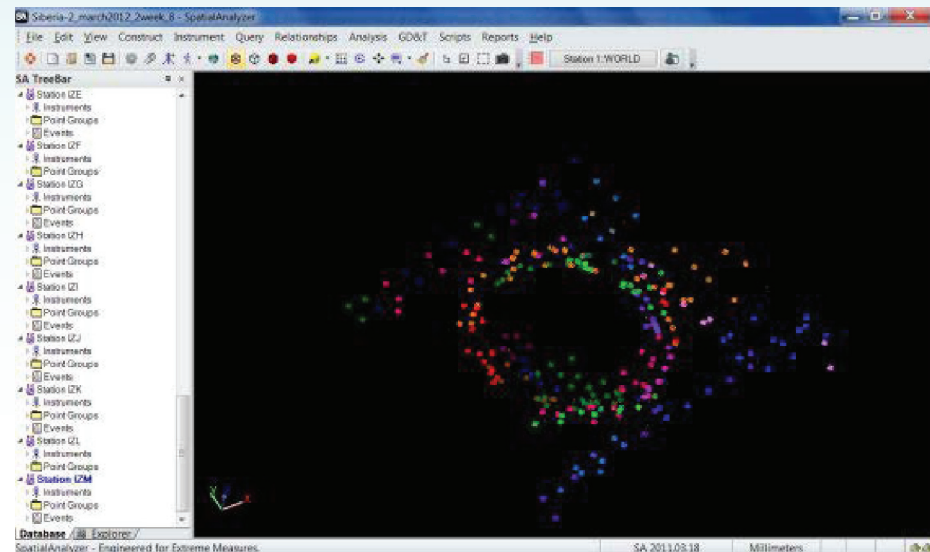
Geodetical alignment

Laser tracker: **API Tracker LTS3-40**

Software: **Spatial Analyzer** в версии **Ultimate**.

Result: precision of transverse magnet elements' position $\sigma_{\Delta x, \Delta z} = 0.3 \text{ мм}$

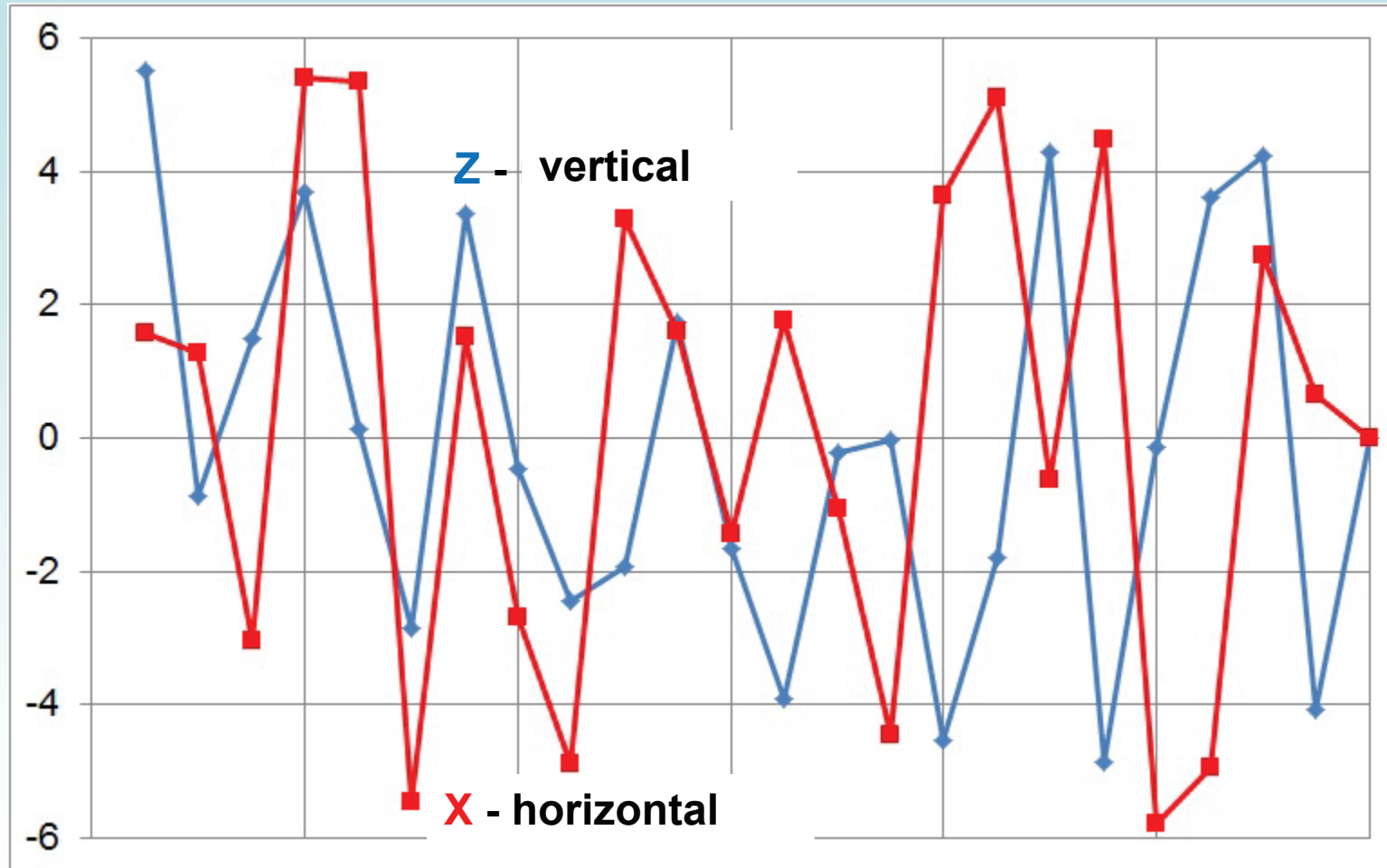
SIBERIA-2 circumference changes in winter/summer cycle by $5 \cdot 10^{-5}$





Geodetical alignment

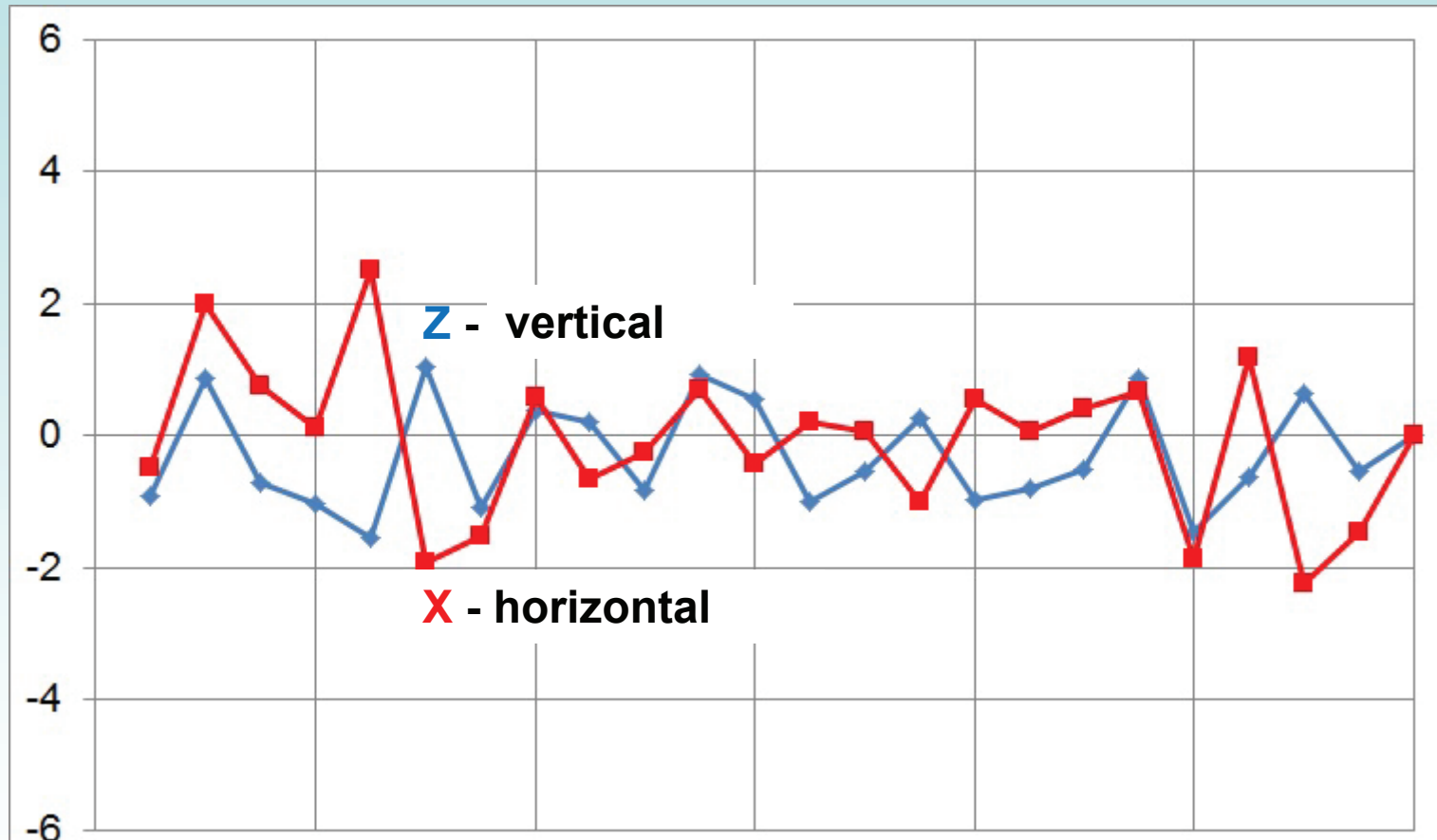
Electron orbit without dipole correctors – January 2018 (in millimeters)





Geodetical alignment

Electron orbit without dipole correctors – September 2018 (in millimeters)



	X sigma	X max		Z sigma	Z max
before:	3.7	5.8		3.1	5.5
after:	1.2	2.5		0.8	1.5



Works on KSRS systems

- **Vacuum system** – elimination of leaks in vacuum chamber, elimination of vacuum chamber heating by synchrotron radiation
- **Linac** – new master generator for klystron station, new digital oscillograph for linac pulses
- **Control system** - control of pulse magnets and SIBERIA-1 operation modes by CitectSCADA
- **Pulse magnets** – generators for SIBERIA-2 insertion and SIBERIA-1 extraction septum magnets with thyristor switch (instead of thyatron)
- **Diagnostics** – observation of longitudinal and transverse beam sizes by new optical observation station
- **Cooling system** – additional water cooling lines for aluminum conductor bar of SIBERIA-2 bending magnets



Results

- Stable SIBERIA-1 operation – 1 injection cycle to SIBERIA-2 per 30 seconds with 140 mA electron current (10 mA in SIBERIA-2)
- Increasing of maximal injection coefficient in SIBERIA-2 60 – 63%, 10% more than one year ago
- Increasing of storing speed in SIBERIA-2 - storing of 180 mA takes approximately 1 hour
- Electron current in SIBERIA-2 at 2.5 GeV achieved maximal possible value for RF system condition
- Record rate of beam integral - more than 200 A·hours per year
- 100% accordance with SR users requirements (operational time)



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 methods:

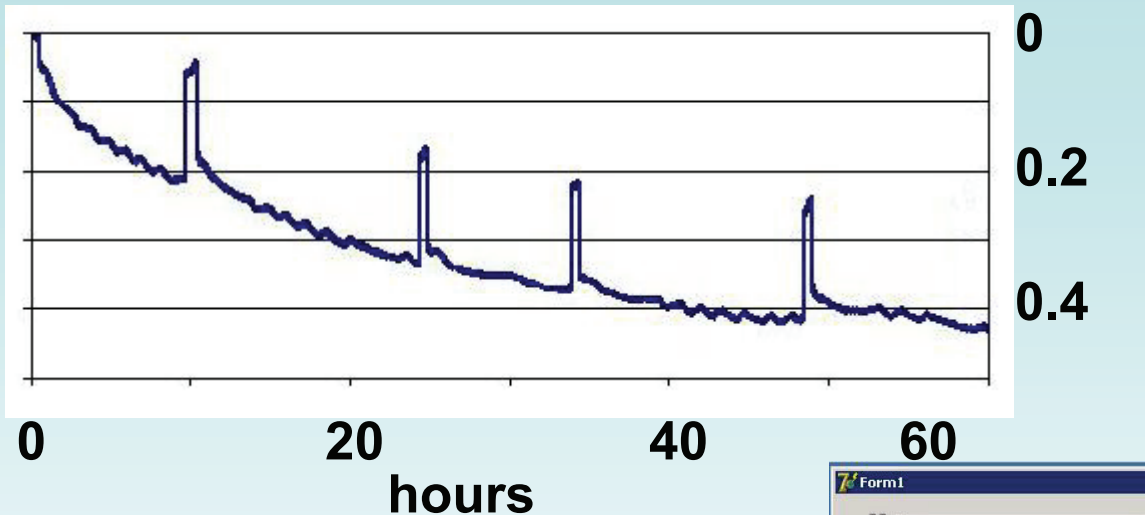
Now: Feedback using luminophor sensor with TV-camera and local orbit bump in order to stabilize photon beam. **Improving of conductor bar cooling by additional cooling lines.**

Future: Improoving of conductor cooling by using more powerful water pumps and exact water temperature stabilization



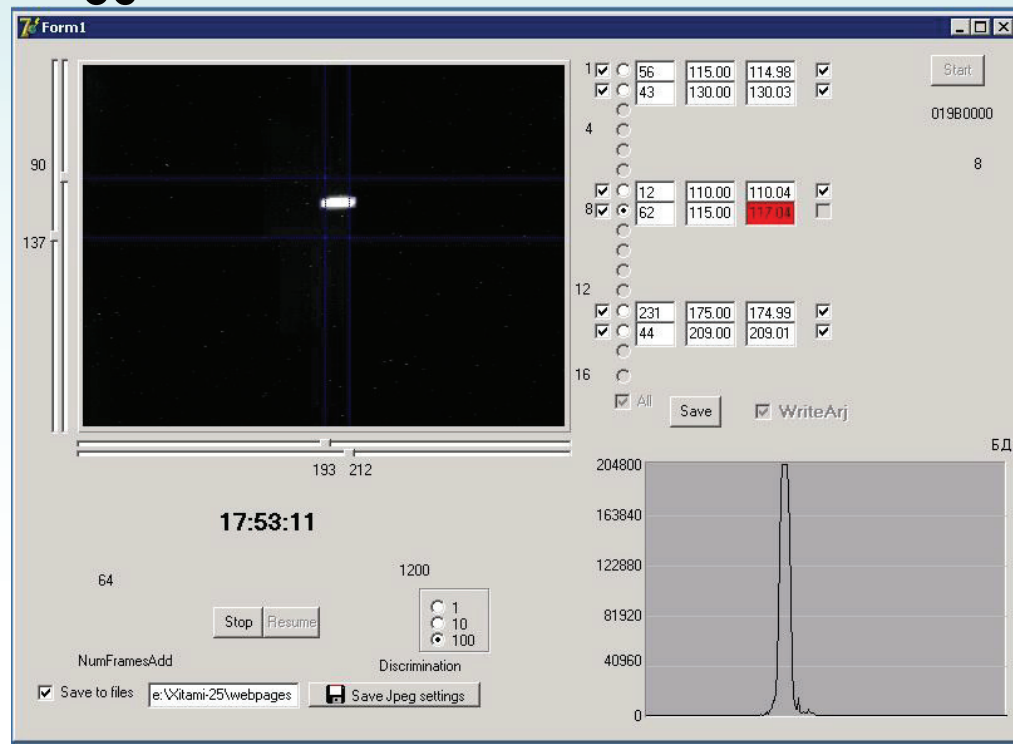
VERTICAL ORBIT DISTORTIONS

Slope of magnet surface vs. time



**Photon beam
stabilization program
using luminophor
sensors & TV-cameras**

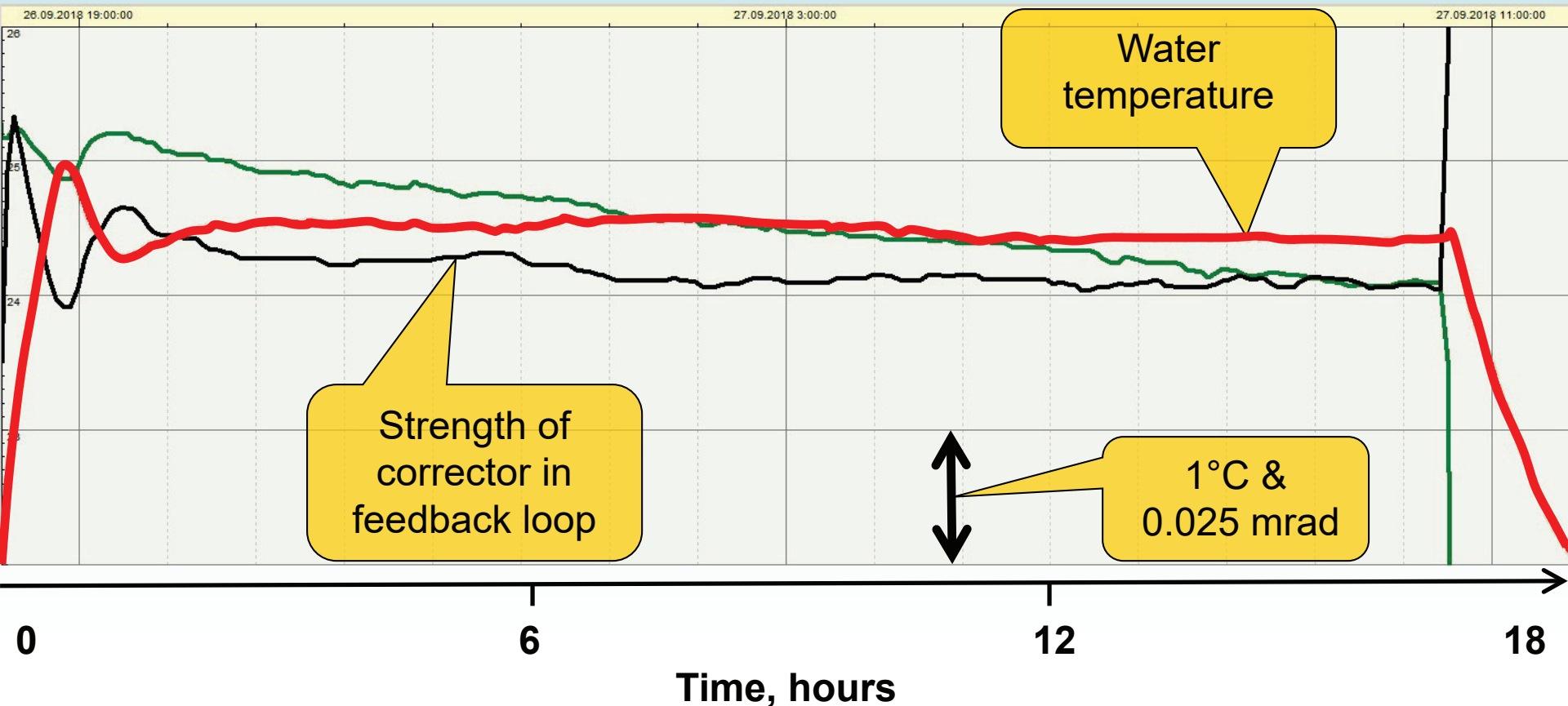
**Beam position
stability 4 - 6 microns**





VERTICAL ORBIT DISTORTIONS

Orbit distortion strongly depends on input water temperature in bending magnets' conductor bar





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**

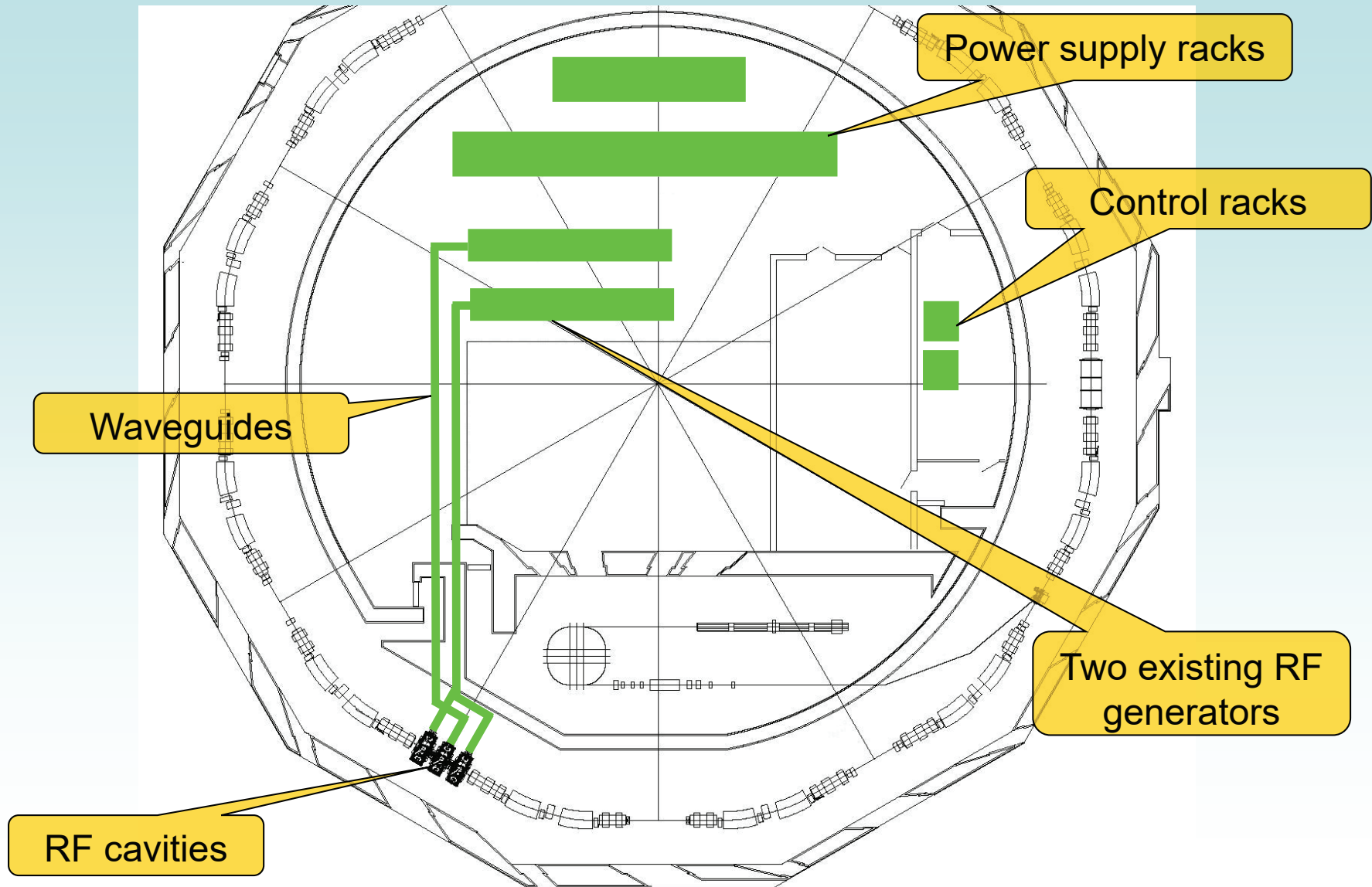


Main features of modernization

Systems	Brief description
RF	New additional RF generator #3 and waveguide, new preliminary amplification cascades for all 3 generators, new power supply and control racks, modernization of cooling and electric systems
Magnets	New power supply for bending magnets (7.5 kA). New current monitors and electronics for all high-current power supplies (10 items)
Vacuum	Change of all ion pumps (>60 items) new beam position monitors, valves, bells, vacuum meters
Supply systems	Modernization of water and air cooling systems of KSRS equipment. Modernization of engineering systems of building 348.
Superconducting wigglers	Two new 3 T superconducting wigglers. Additional equipment (compressors, water cooling, power supplies, computers and so on)
Control system	Connecting of new and modernized systems with KSRS control system

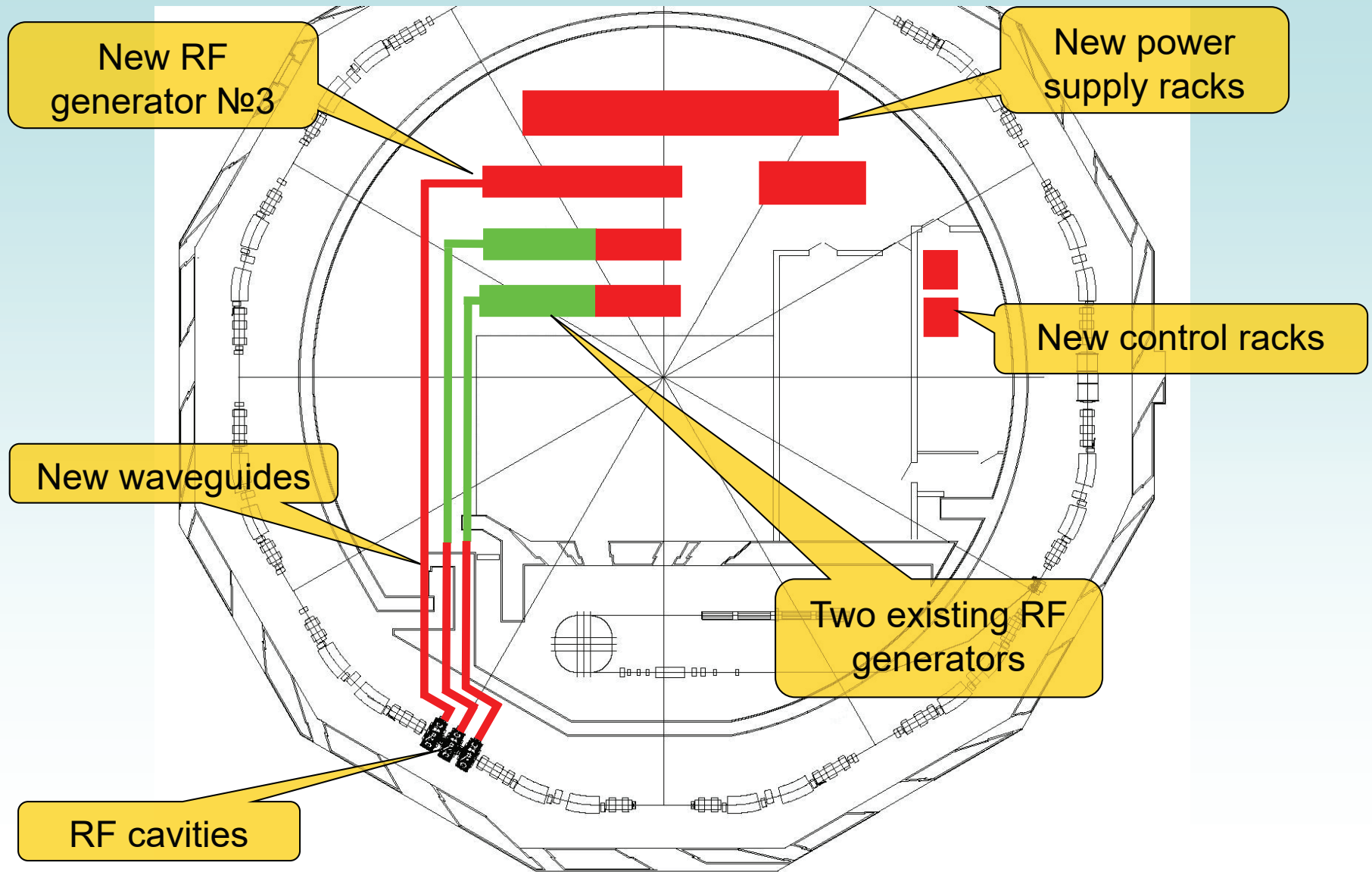


Existing scheme of RF system



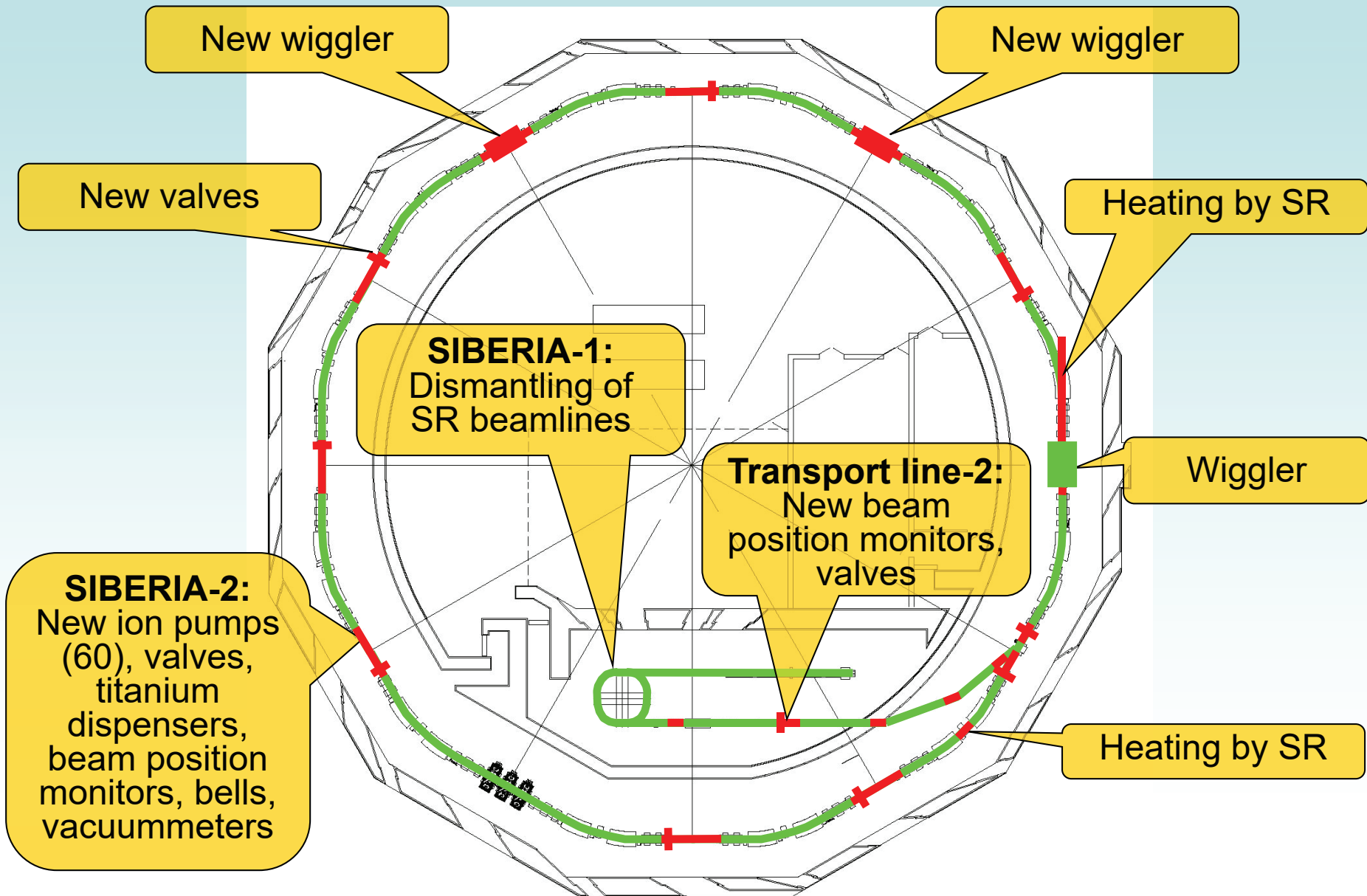


Future scheme of RF system



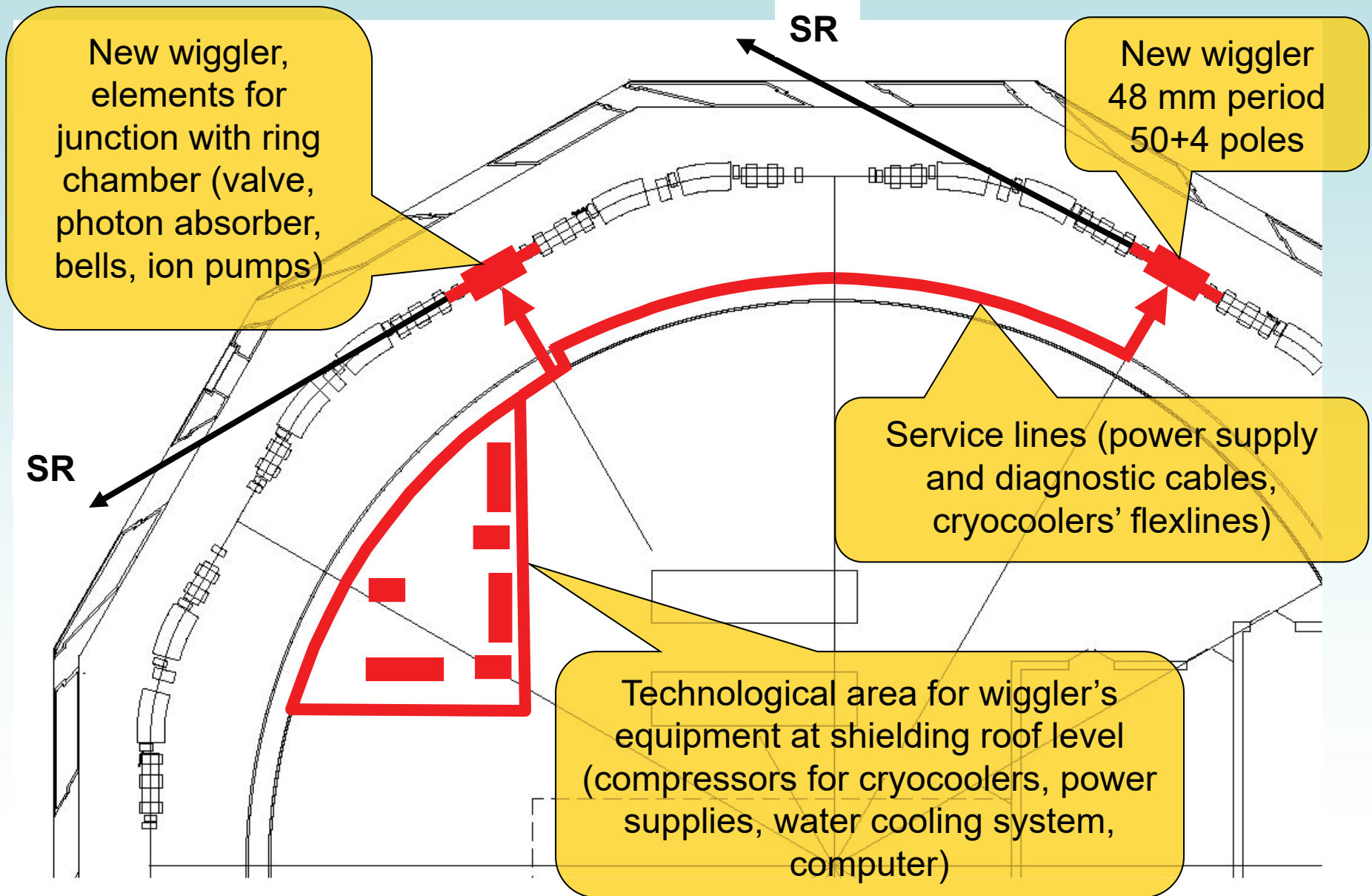


Vacuum system





New 3 T superconducting wigglers





Thank you for your attention!