



JAGIELLONIAN UNIVERSITY  
IN KRAKOW



SOLARIS  
NATIONAL SYNCHROTRON  
RADIATION CENTRE

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# SOLARIS status and development

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**Adriana Wawrzyniak**

*On behalf of Accelerators Department*

National Synchrotron Radiation Center SOLARIS

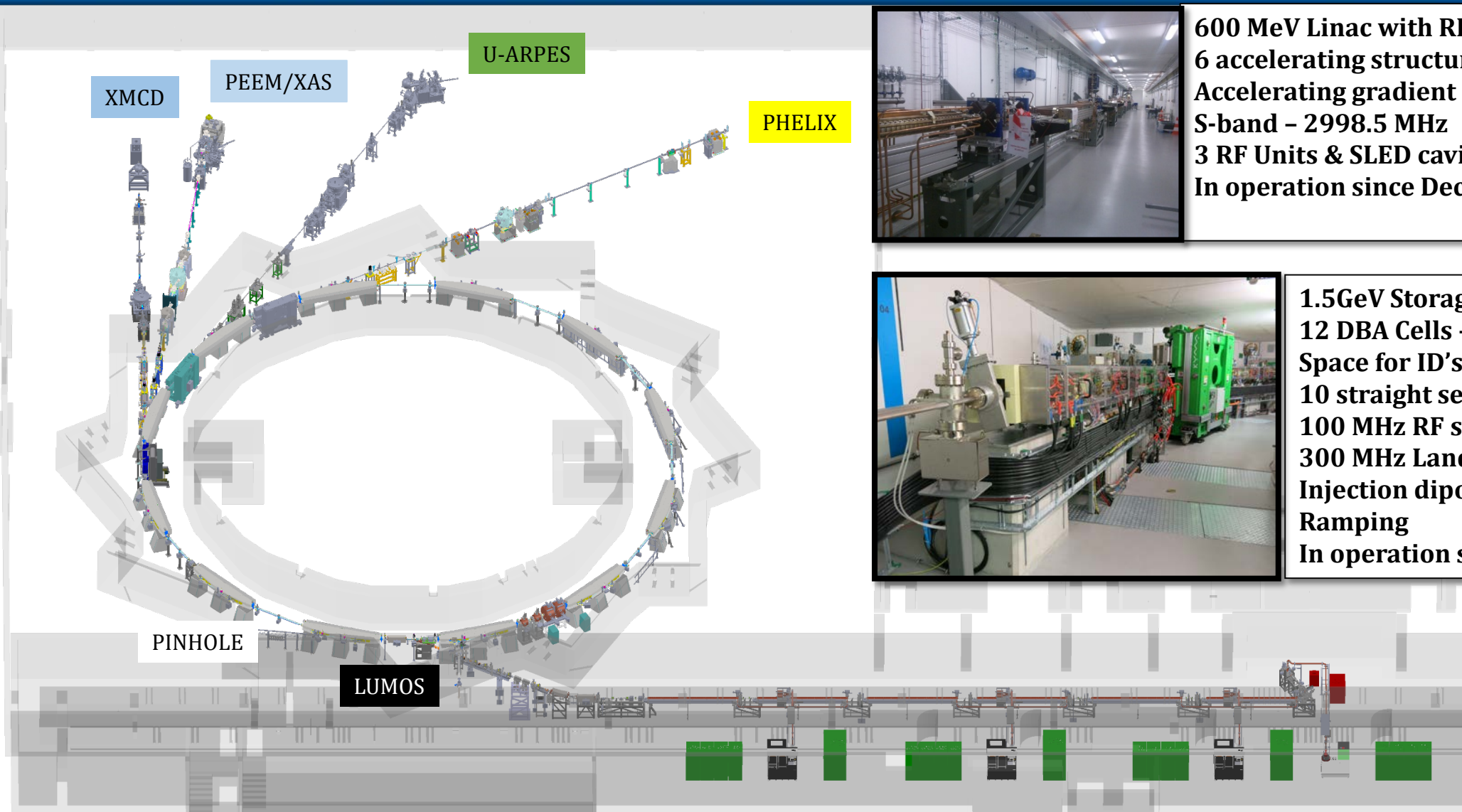
16-17.12.2020

28th European Synchrotron Light Source Workshop (ESLS 2020), remote (ESRF, ZOOM)

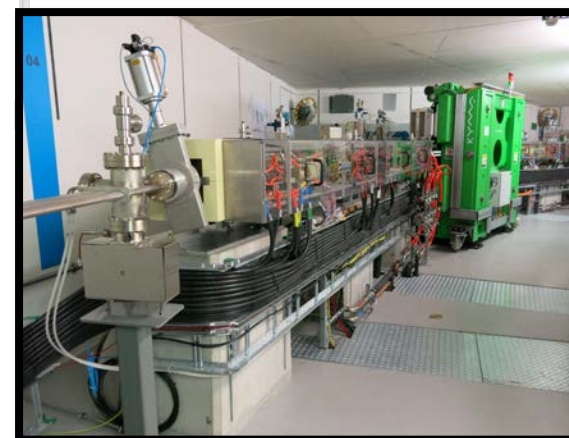
- Overview
- Operation statistics
  - COVID19 management
- Main installations and developments
- Summary



# SOLARIS OVERVIEW

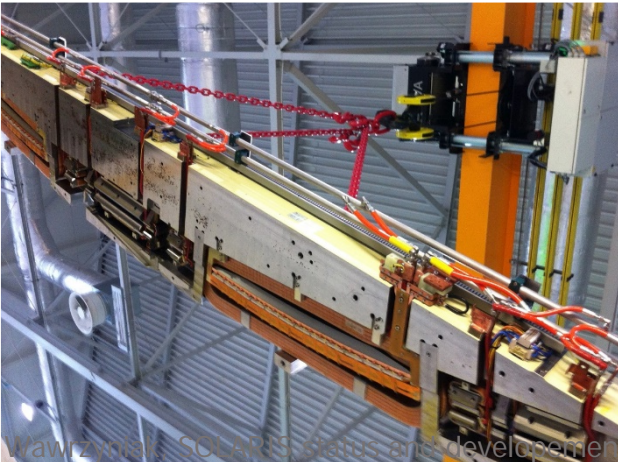
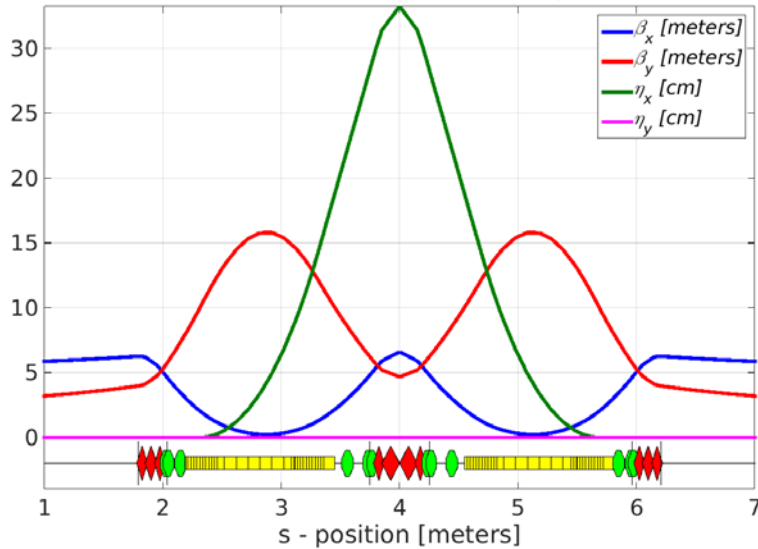


**600 MeV Linac with RF Thermionic Gun**  
**6 accelerating structures combined in 3 units**  
**Accelerating gradient 20 MeV/m**  
**S-band - 2998.5 MHz**  
**3 RF Units & SLED cavities**  
**In operation since Dec. 2014**



**1.5 GeV Storage ring**  
**12 DBA Cells - 96 m circ.**  
**Space for ID's (10 sections) ~ 3.5 m**  
**10 straight sections for IDs**  
**100 MHz RF system**  
**300 MHz Landau Cavities**  
**Injection dipole kicker**  
**Ramping**  
**In operation since May 2015**

Optical Functions ( $\nu_x = 11.220, \nu_y = 3.150$ )



Parameter	Designed	Measured
Energy	1.5 GeV	1.45 ± 0.05 GeV
Max. Current	500 mA	500 mA/400 mA (op)
Harmonic number	32	32
Natural emittance (bare lattice)	5.982 nmrاد	7.5 ± 1.5 nmrاد
Coupling	1 %	0.83 %
Tune $\nu_x, \nu_y$	11.22, 3.15	11.22, 3.15
Corrected chromaticity $\xi_x, \xi_y$	+2,+2 ; +1, +1	+1.4, +1.6; +0.9,+0.9
Energy loss/turn	114.1 keV	103.7 ± 12.3 keV
Momentum acceptance	4%	3.7 ± (0.3)%
Synchronous phase	168°	167.4° ± 2.7°
Synchrotron tune	0.00239	0.00228
Physical acceptance horizontal/vertical	18 / 4 mrad	15.68/3.77 mrad
Lifetime	13h	15 h



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# Operation statistics in 2020

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**3044 h for Beamlines and 824 h for machine studies. In total 3868h/year of machine operation**

**35% increase of beam time with respect to 2019**

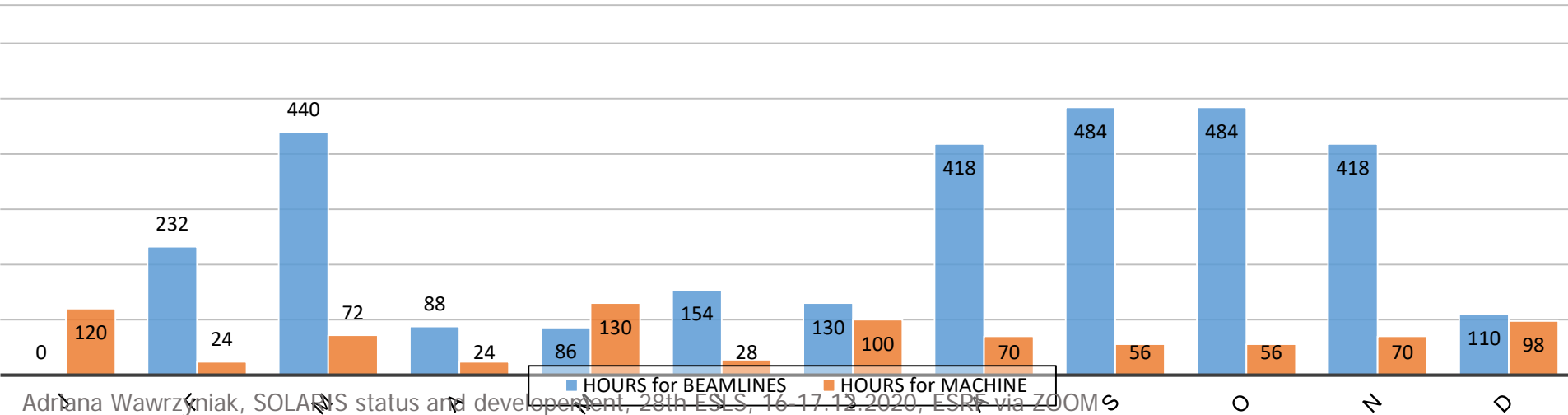
**5% less than it was scheduled for 2020 due to COVID19**

- ❖ 2 Shifts from Tue to Sat
- ❖ 2 Injection per day 8:00-9:00; 20:00-21:00;
- ❖ On call duties up to 2:00 am from Tue-Sat

**Time distribution between machine and beamlines studies**

Operation schedule for year 2020

Jan 2020	Feb 2020	Mar 2020	Apr 2020	May 2020	Jun 2020	Jul 2020	Aug 2020	Sep 2020	Oct 2020	Nov 2020	Dec 2020
Wed 01 s s s	Sat 01 . . .	Sun 01 . . .	Wed 01 B B B	Fri 01 . . .	Mon 01 M M .	Wed 01 s s s	Sat 01 B B B	Tue 01 B B B	Thu 01 B B B	Sun 01 . . .	Tue 01 B B B
Thu 02 s s s	Sun 02 . . .	Mon 02 M M .	Thu 02 B B B	Sat 02 . . .	Tue 02 B B B	Thu 02 s s s	Sun 02 . . .	Wed 02 B B B	Fri 02 B B B	Mon 02 M M .	Wed 02 B B B
Fri 03 s s s	Mon 03 C . .	Tue 03 B B B	Fri 03 B B B	Sun 03 . . .	Wed 03 B B B	Fri 03 s s s	Mon 03 B B B	Thu 03 B B B	Sat 03 B B B	Tue 03 B B B	Thu 03 B B B
Sat 04 s s s	Tue 04 C . .	Wed 04 B B B	Sat 04 B B B	Mon 04 . . .	Thu 04 B B B	Sat 04 s s s	Tue 04 B B B	Fri 04 B B B	Sun 04 . . .	Wed 04 B B B	Fri 04 B B B
Sun 05 s s s	Wed 05 C . .	Thu 05 B B B	Sun 05 . . .	Tue 05 . . .	Fri 05 B B B	Sun 05 s s s	Wed 05 M M .	Sat 05 B B B	Mon 05 M M .	Thu 05 B B B	Sat 05 B B B
Mon 06 s s s	Thu 06 B B B	Fri 06 B B B	Mon 06 M M .	Wed 06 . . .	Sat 06 B B B	Mon 06 s s s	Thu 06 B B B	Sun 06 . . .	Tue 06 B B B	Fri 06 B B B	Sun 06 . . .
Tue 07 s s s	Fri 07 B B B	Sat 07 B B B	Tue 07 B B B	Thu 07 . . .	Sun 07 . . .	Fri 07 s s s	Mon 07 M M .	Wed 07 B B B	Thu 07 B B B	Sat 07 B B B	Mon 07 M M .
Wed 08 s s s	Sat 08 . . .	Sun 08 . . .	Wed 08 B B B	Fri 08 . . .	Mon 08 M M .	Wed 08 s s s	Sat 08 B B B	Tue 08 B B B	Thu 08 B B B	Sun 08 . . .	Tue 08 M M .
Thu 09 s s s	Sun 09 . . .	Mon 09 M M .	Thu 09 s s s	Sat 09 . . .	Tue 09 B B B	Thu 09 s s s	Sun 09 . . .	Wed 09 B B B	Fri 09 B B B	Mon 09 M M .	Wed 09 M M .
Fri 10 s s s	Mon 10 M . .	Tue 10 B B B	Fri 10 s s s	Sun 10 . . .	Wed 10 B B B	Fri 10 s s s	Mon 10 M M .	Thu 10 B B B	Sat 10 B B B	Tue 10 B B B	Thu 10 M M .
Sat 11 s s s	Tue 11 B B B	Wed 11 B B B	Sat 11 s s s	Mon 11 M M .	Thu 11 . . .	Sat 11 s s s	Tue 11 B B B	Fri 11 B B B	Sun 11 . . .	Wed 11 . . .	Fri 11 M M .
Sun 12 s s s	Wed 12 B B B	Thu 12 B B B	Sun 12 s s s	Tue 12 M M .	Fri 12 . . .	Sun 12 s s s	Wed 12 B B B	Sat 12 B B B	Mon 12 M M .	Thu 12 B B B	Sat 12 . . .
Mon 13 s s s	Thu 13 B B B	Fri 13 B B B	Mon 13 s s s	Wed 13 M M .	Sat 13 s s s	Mon 13 O . .	Thu 13 B B B	Sun 13 . . .	Tue 13 B B B	Fri 13 B B B	Sun 13 . . .
Tue 14 s s s	Fri 14 B B B	Sat 14 B B B	Tue 14 s s s	Thu 14 M M .	Sun 14 s s s	Tue 14 O . .	Fri 14 B B B	Mon 14 M M .	Wed 14 B B B	Sat 14 B B B	Mon 14 M M .
Wed 15 s s s	Sat 15 . . .	Sun 15 . . .	Wed 15 s s s	Fri 15 M M .	Mon 15 s s s	Wed 15 O . .	Sat 15 B B B	Tue 15 B B B	Thu 15 B B B	Sun 15 . . .	Tue 15 M M .
Thu 16 s s s	Sun 16 . . .	Mon 16 M M .	Thu 16 s s s	Sat 16 . . .	Tue 16 s s s	Thu 16 M M .	Sun 16 . . .	Wed 16 B B B	Fri 16 B B B	Mon 16 M M .	Wed 16 s s s
Fri 17 s s s	Mon 17 M . .	Tue 17 B B B	Fri 17 s s s	Sun 17 . . .	Wed 17 s s s	Fri 17 M M .	Mon 17 M M .	Thu 17 B B B	Sat 17 B B B	Thu 17 B B B	Thu 17 s s s
Sat 18 s s s	Tue 18 B B B	Wed 18 B B B	Sat 18 s s s	Mon 18 M M .	Thu 18 s s s	Sat 18 . . .	Tue 18 B B B	Fri 18 B B B	Sun 18 . . .	Wed 18 B B B	Fri 18 s s s
Sun 19 s s s	Wed 19 B B B	Thu 19 B B B	Sun 19 s s s	Tue 19 M M .	Fri 19 s s s	Sun 19 . . .	Wed 19 B B B	Sat 19 B B B	Mon 19 M M .	Thu 19 B B B	Sat 19 s s s
Mon 20 O . .	Thu 20 B B B	Fri 20 B B B	Mon 20 s s s	Wed 20 M M .	Sat 20 s s s	Mon 20 M M .	Thu 20 B B B	Sun 20 . . .	Tue 20 B B B	Fri 20 B B B	Sun 20 s s s
Tue 21 O . .	Fri 21 B B B	Sat 21 B B B	Tue 21 s s s	Thu 21 M M .	Sun 21 s s s	Tue 21 M M .	Fri 21 B B B	Mon 21 M M .	Wed 21 B B B	Sat 21 B B B	Mon 21 s s s
Wed 22 O . .	Sat 22 . . .	Sun 22 . . .	Wed 22 s s s	Fri 22 M M .	Mon 22 s s s	Wed 22 C C .	Sat 22 B B B	Thu 22 B B B	Thu 22 B B B	Thu 22 B B B	Tue 22 s s s
Thu 23 O . .	Sun 23 . . .	Mon 23 M . .	Thu 23 s s s	Sat 23 . . .	Tue 23 s s s	Thu 23 C C .	Sun 23 . . .	Wed 23 B B B	Fri 23 B B B	Mon 23 M M .	Wed 23 s s s
Fri 24 O . .	Mon 24 M . .	Tue 24 M . .	Fri 24 s s s	Sun 24 . . .	Wed 24 s s s	Fri 24 C C .	Mon 24 M M .	Thu 24 B B B	Sat 24 B B B	Tue 24 B B B	Thu 24 s s s
Sat 25 . . .	Tue 25 B B B	Wed 25 M . .	Sat 25 s s s	Mon 25 M M .	Thu 25 s s s	Sat 25 . . .	Tue 25 B B B	Sun 25 . . .	Wed 25 B B B	Wed 25 B B B	Fri 25 s s s
Sun 26 . . .	Wed 26 B B B	Thu 26 M . .	Sun 26 s s s	Tue 26 C C .	Fri 26 s s s	Sun 26 . . .	Wed 26 B B B	Sat 26 B B B	Mon 26 M M .	Thu 26 B B B	Sat 26 s s s
Mon 27 M . .	Thu 27 B B B	Fri 27 M . .	Mon 27 O . .	Wed 27 C C .	Sat 27 s s s	Mon 27 M M .	Thu 27 B B B	Sun 27 . . .	Tue 27 B B B	Fri 27 B B B	Sun 27 s s s
Tue 28 M . .	Fri 28 B B B	Sat 28 . . .	Tue 28 O . .	Thu 28 C C .	Sun 28 s s s	Tue 28 B B B	Fri 28 B B B	Mon 28 M M .	Wed 28 B B B	Sat 28 B B B	Mon 28 s s s
Wed 29 M . .	Sat 29 . . .	Sun 29 . . .	Wed 29 M . .	Fri 29 B B B	Mon 29 s s s	Wed 29 B B B	Sat 29 B B B	Tue 29 B B B	Thu 29 B B B	Sun 29 . . .	Tue 29 s s s
Thu 30 M . .	Mon 30 M M .	Tue 30 M . .	Thu 30 M . .	Sat 30 B B B	Tue 30 s s s	Thu 30 B B B	Sun 30 . . .	Wed 30 B B B	Fri 30 B B B	Mon 30 M M .	Wed 30 s s s
Fri 31 M . .	Tue 31 B B B	Wed 31 B B B	Thu 31 B B B	Sun 31 . . .	Mon 31 M M .	Fri 31 B B B	Mon 31 M M .	Sat 31 B B B	Sun 31 B B B	Mon 31 B B B	Thu 31 s s s



## First lockdown 25.03-30.05.20, second lockdown from 24.10.20

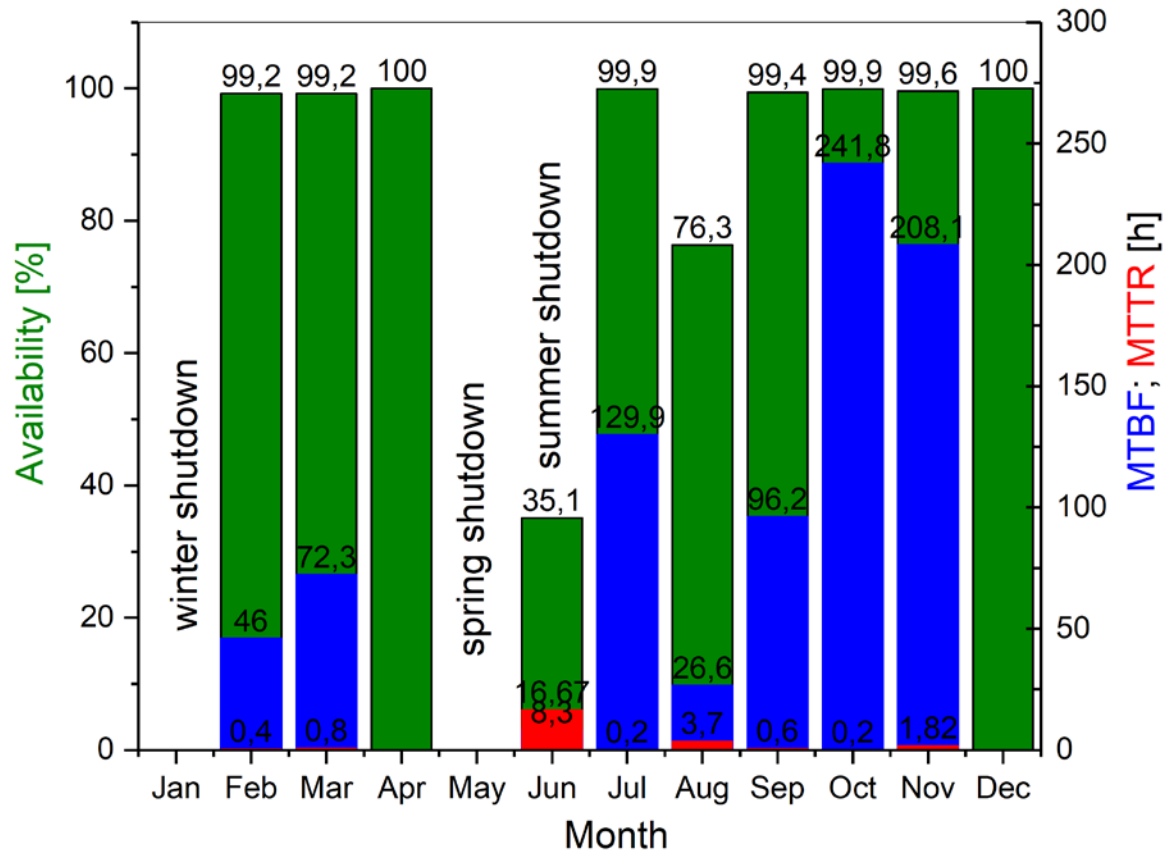
1. Masks, disinfection, social distance- obligatory
2. Hybrid mode of work - work from home whenever it is possible
3. Remote meetings via TEAMS, ZOOM etc..
4. Remote access to the control room via VPN
  1. Operators can monitor and optimise the beam parameters remotely
  2. Injection is done by Operators on shifts from CR (30 min)
  3. It is allowed only up to 3 persons be present at the CR at the same time, keeping the distance and minimise the time
  4. Developing tools to simplify the injection process (one button machine)
5. Remote access and operation of the Beamlines (UARPES)
6. User operation:
  5. We accept the external users but only 2 per beamline at one time with all restrictions
  6. If possible only samples are sent without presence of users (Cryo-EM)



# AVAILABILITY

$$\text{Availability} = \frac{\text{Delivered time}}{\text{Scheduled time}}$$

Statistics per month in 2020



	Availability	MTBF [h]	MTTR[h]
<b>2018</b>	<b>90.4%</b>	<b>16.3</b>	<b>1.5</b>
<b>2019</b>	<b>91.9%</b>	<b>22.8</b>	<b>1.7</b>
<b>2020</b>	<b>93.0%</b>	<b>76.0</b>	<b>3.6</b>

Reliability of UPS: **99.94%**

Reliability of electrical system: **99.90%**





## SOLARIS Machine Status Portal

Thursday, September 10th 2020, 8:57 am

Current

396.68 mA

Energy

1.50 GeV

Lifetime

14.65 h

I·T product

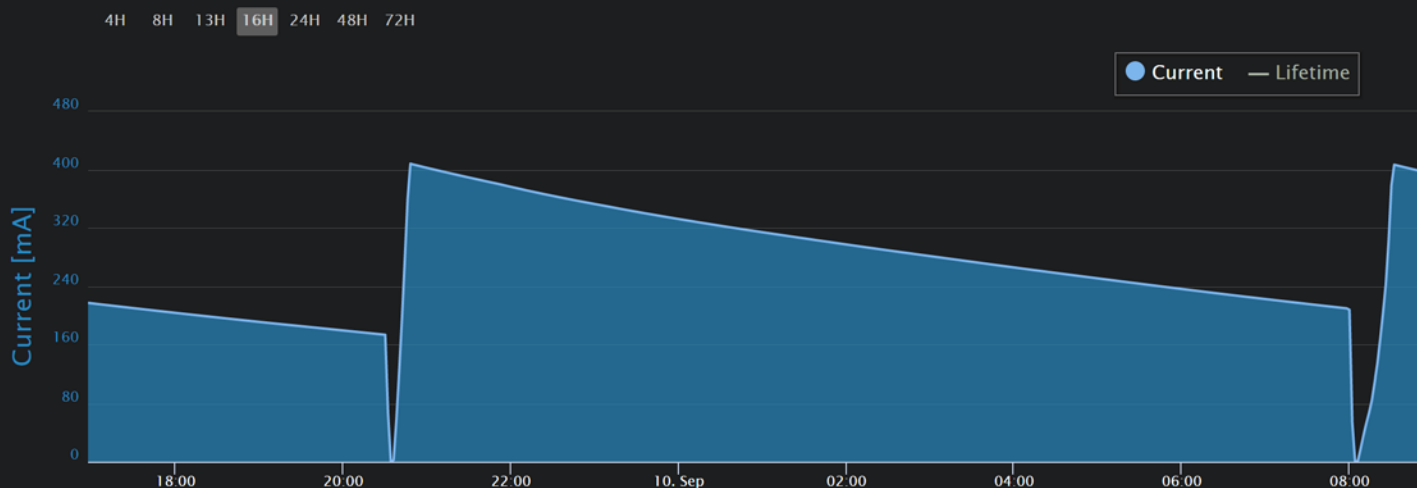
5.81 Ah

ID Beamlines

Name	Gap	State
<a href="#">PHELIX</a>	50.00 mm	CLOSED
<a href="#">UARPE</a>	50.00 mm	OPEN
<a href="#">XMCD</a>	50.00 mm	CLOSED
SOLCRYS	0.00 mm	under construction

BM Beamlines

Name	State
<a href="#">PEEM/XAS</a>	OPEN
SOLABS	under construction
SOLAIR	under construction
POLYX	under construction



Storage Ring Status: **Beam Delivered**

Operation Mode: **User Operation**

Next injections: **8am and 8pm during User Operation mode**

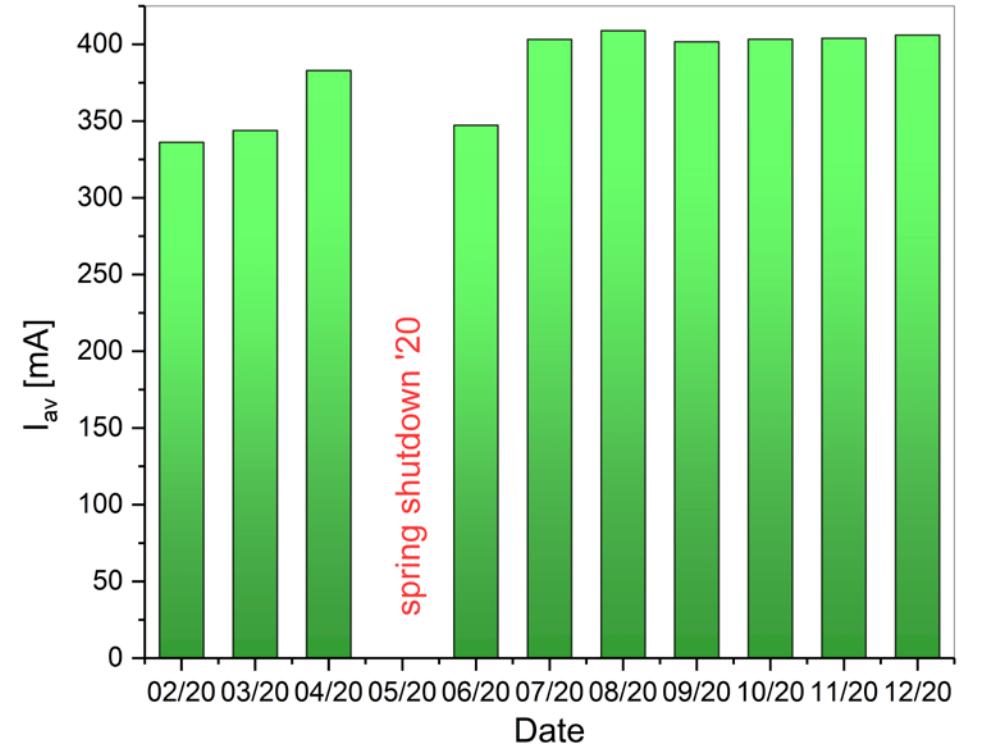
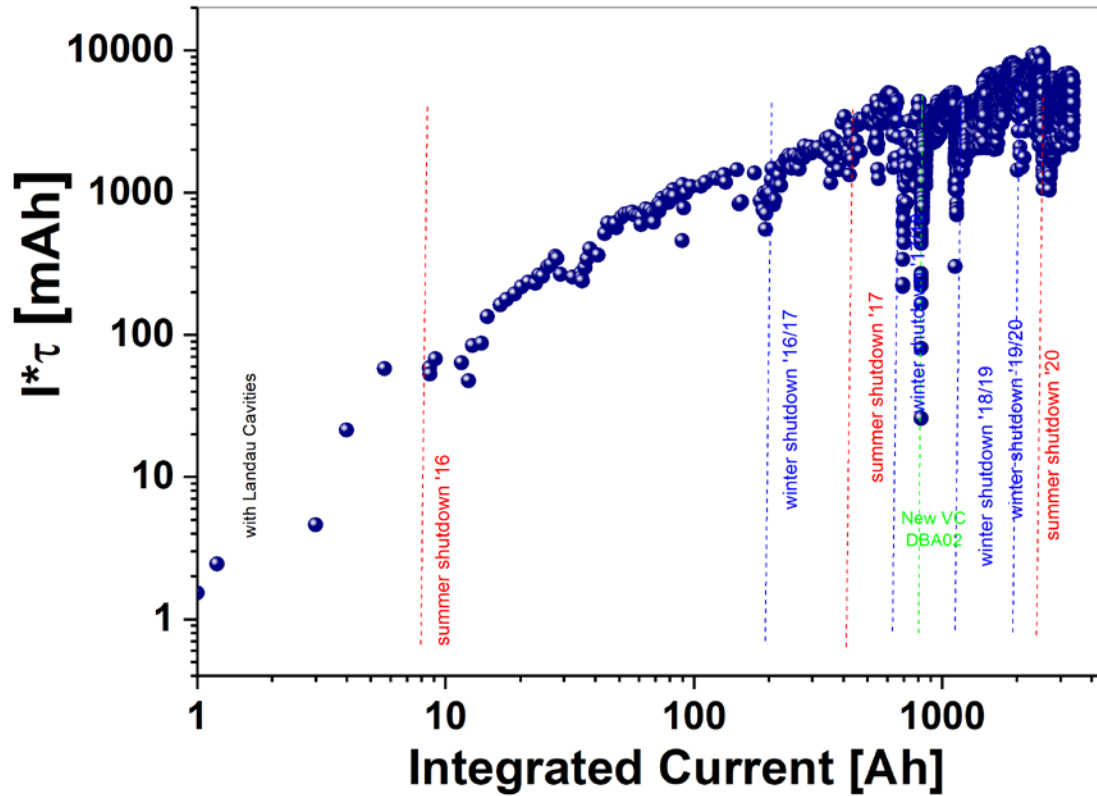
### OPERATOR MESSAGE

20-09-08 09:03

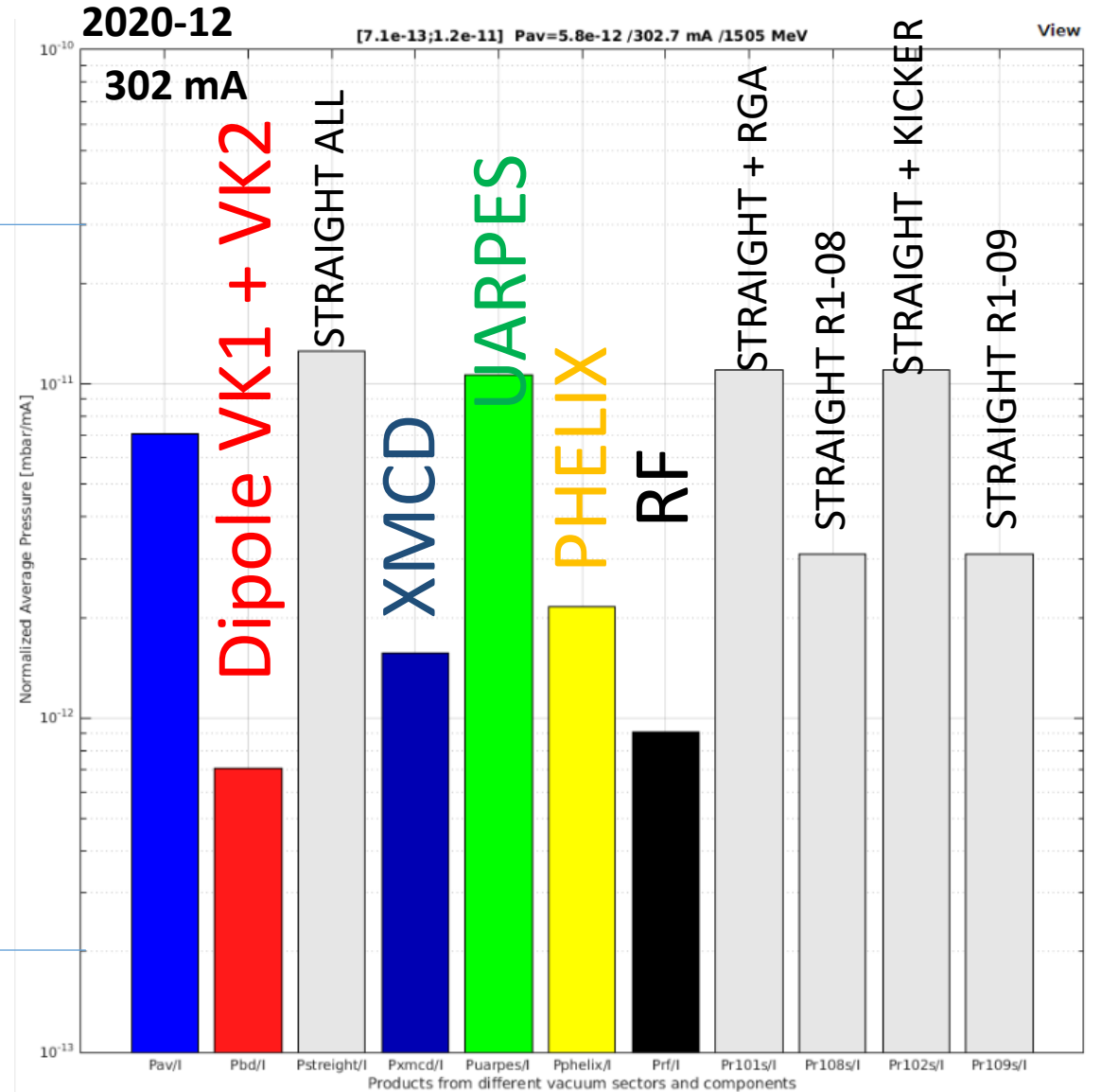
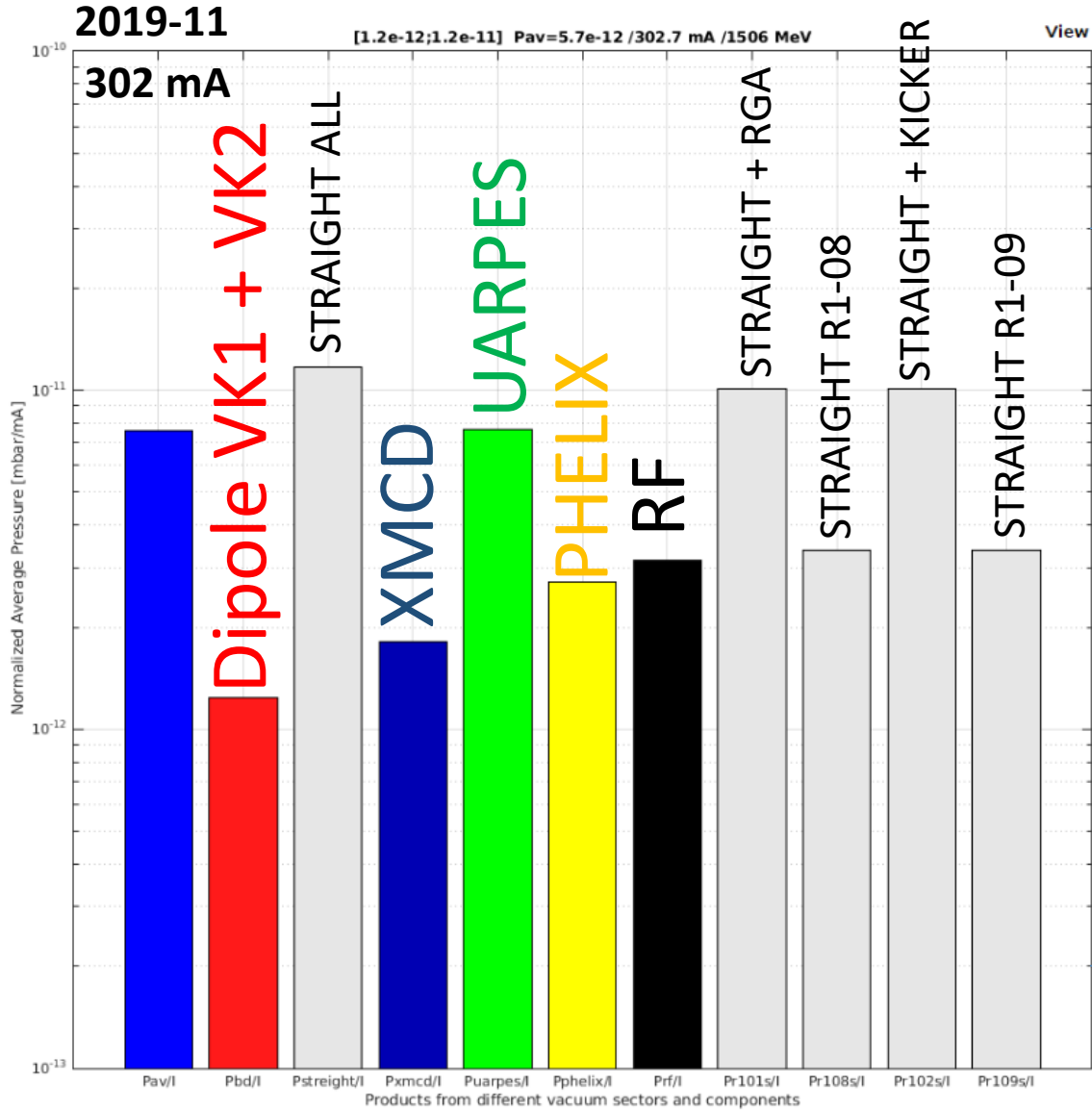
no messages



# AVERAGE CURRENT DELIVERED

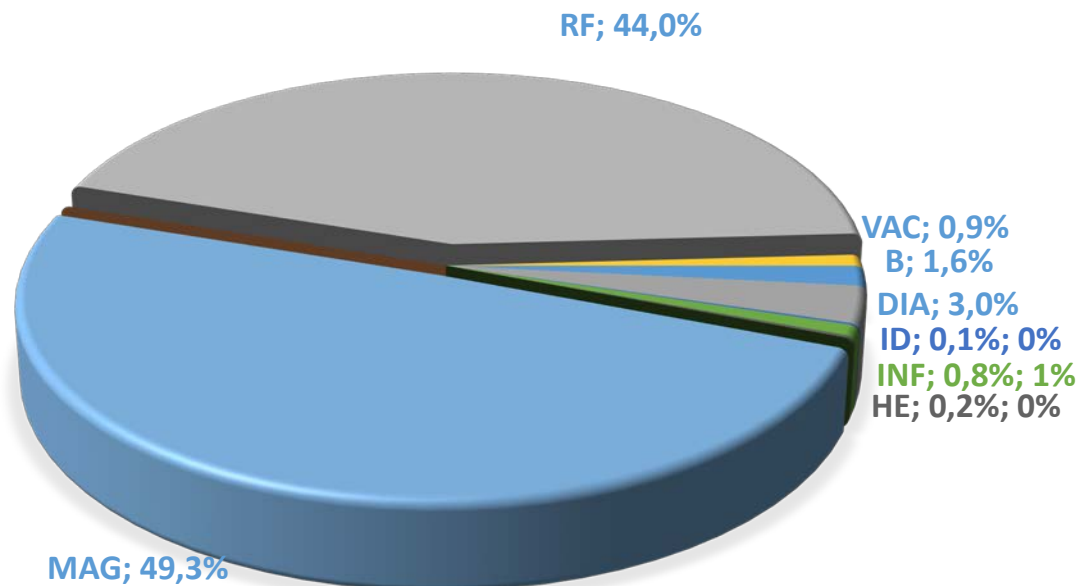


# VACUUM CHAMBERS PERFORMANCE

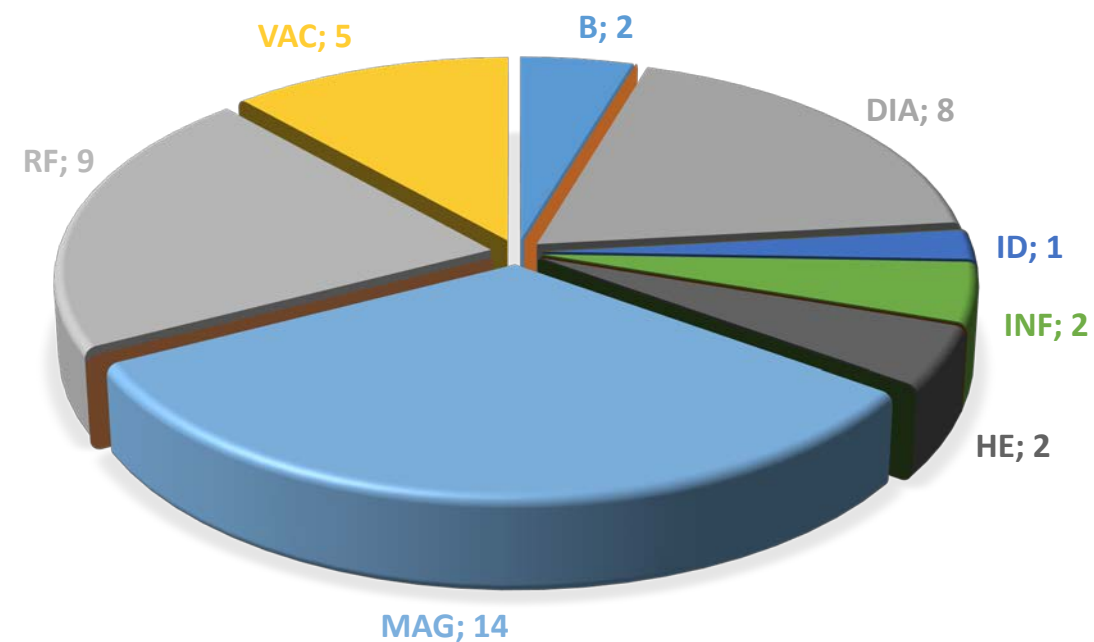




## Failures by time



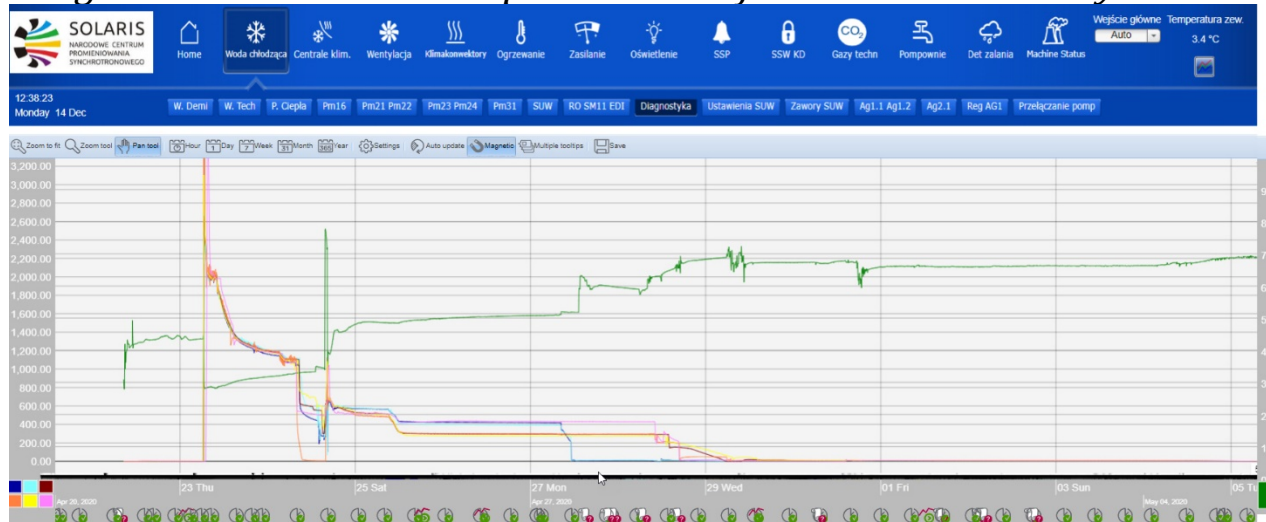
## Failures by number



## Main failures

### 1. Demi water contamination (April 2020)

*2 weeks of cleaning the whole water circuits with water exchange to get back to the nominal parameters of PH and conductivity.*



### 2. Short circuit in sextupole magnet (MAG) (June 2020)

### 3. Injection modulator problem (RF) (August 2020)

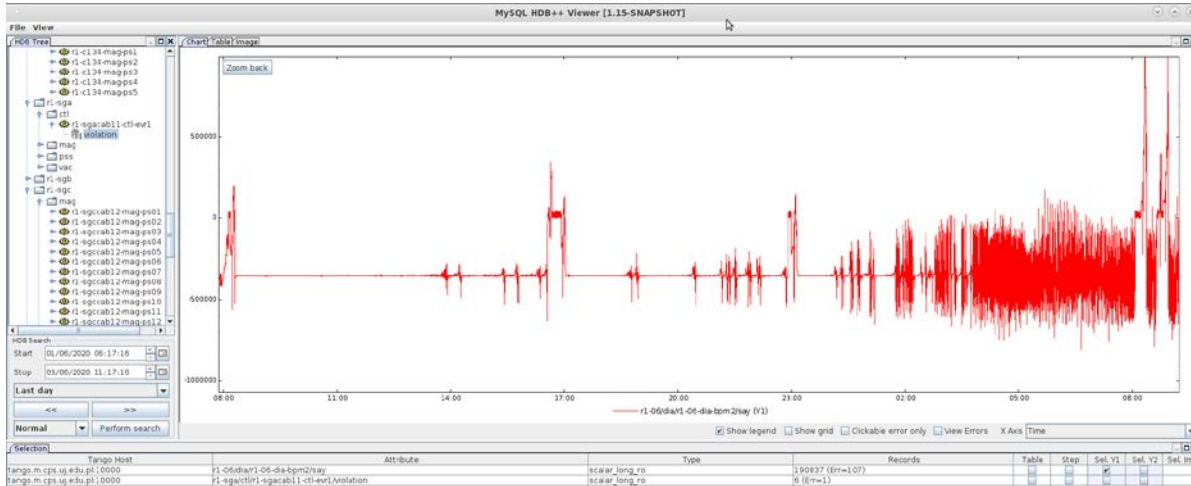
*The gun klystron was arcing more frequently – replaced with new. The switching unit was replaced the spare SU contained a different firmware version and did not pulse when the modulator was in trig made. This caused the abnormal pulse shape*

### 4. K02 Modulator problem (RF) (October 2020)

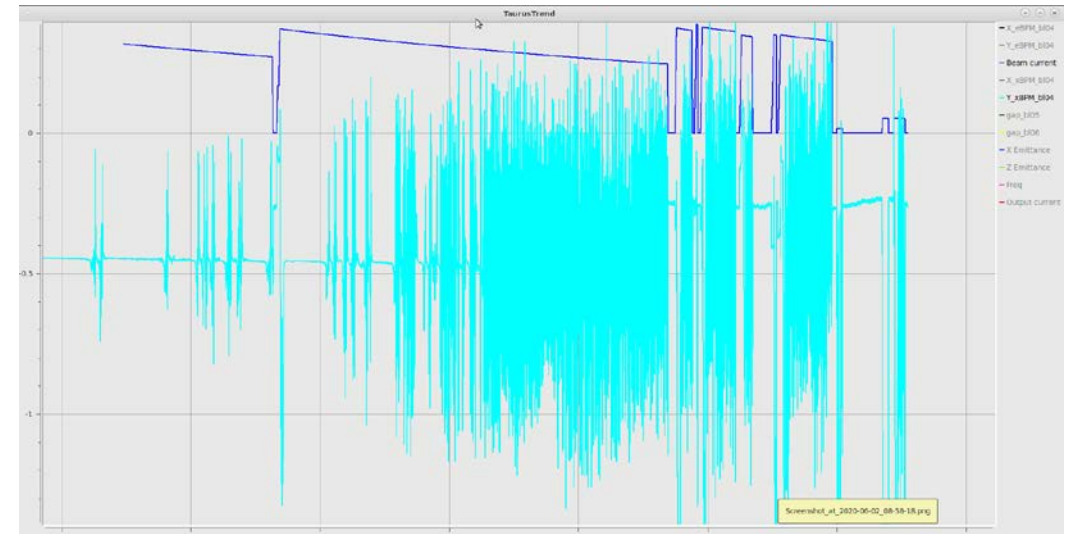
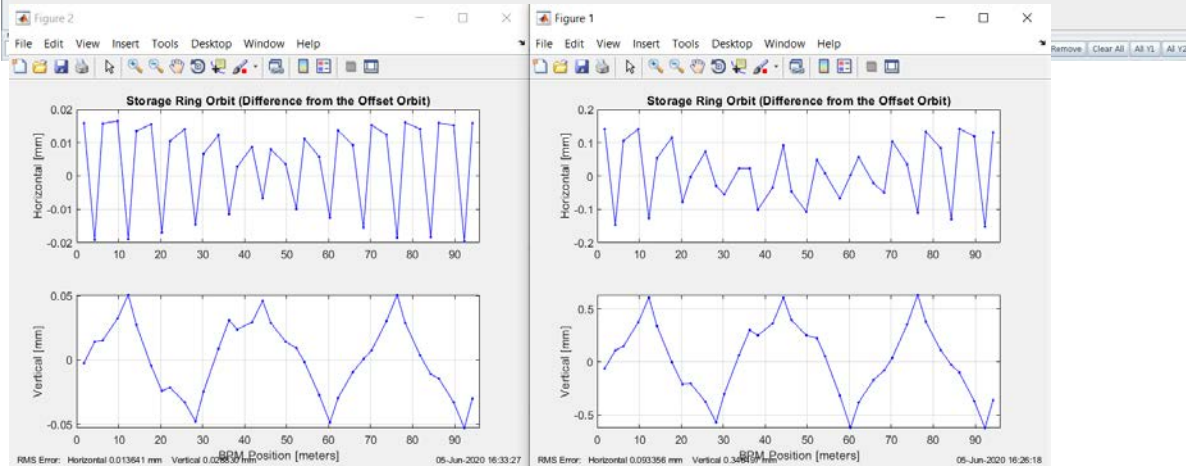
*High power switching unit had a faulty IGBT module*



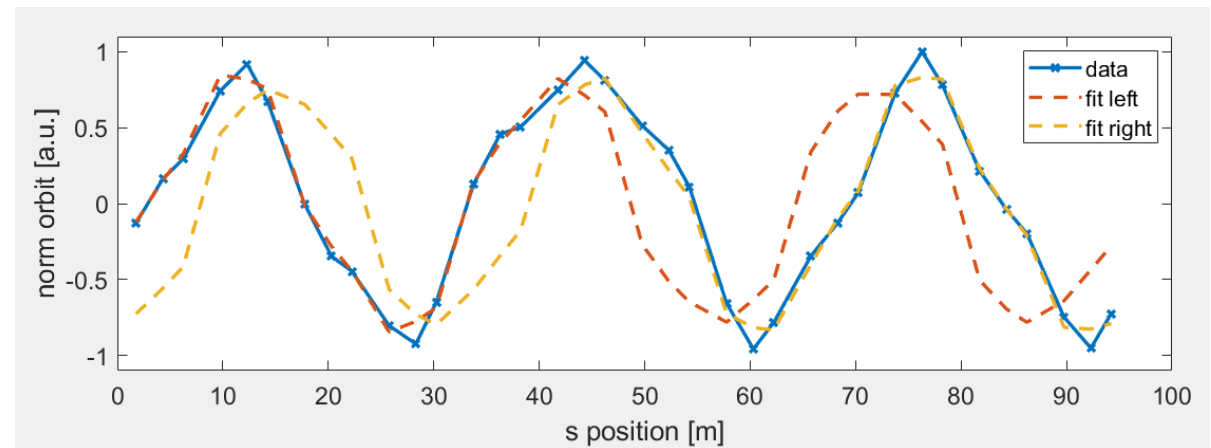
## Beam instability observed in the vertical plane



## Closed orbit blow up of 2 orders of magnitude



## Phase advance measurement revealed the kick in mid of DBA06



## Magnets & power supplies checking

- Dipole, Sextupole, Quadrupole (SQFO, SQFI, DIP, SDI, SDO) magnets resistance measurement was done, but didn't reveal any deviations. The measurement was too short to check the effects of temperature and material expansion.
- Danfysik power supply checking
  - Ripple measurement with a current transducer and an oscilloscope.
  - Measurement of resistance of screw's connections
  - Check all relevant connections
  - High temperature ( $\sim 130^{\circ}\text{C}$ ) has been detected on one of the power supplies phase wire, near main switch. After replacing the main switch's current release, the problem returned after some time. The reason was a faulty connection between the cable and the cable lug. All power cables in all power supplies has been replaced for a larger diameter, with a new cable lugs. Problem has been fixed, but the beam was still unstable...
- Burned pins on the correctors magnets plugs (on the DBA) has been found. It has been replaced and changed every plugs for a new one for higher current (16A). The beam was still unstable...
- **Decision to open DBA06.**  
In the upper half of the magnet, a suspicious point was found that, as a result of thermal expansion, could lead to a short circuit of one of the sextupole magnets coils. Bad insulation has been fixed.





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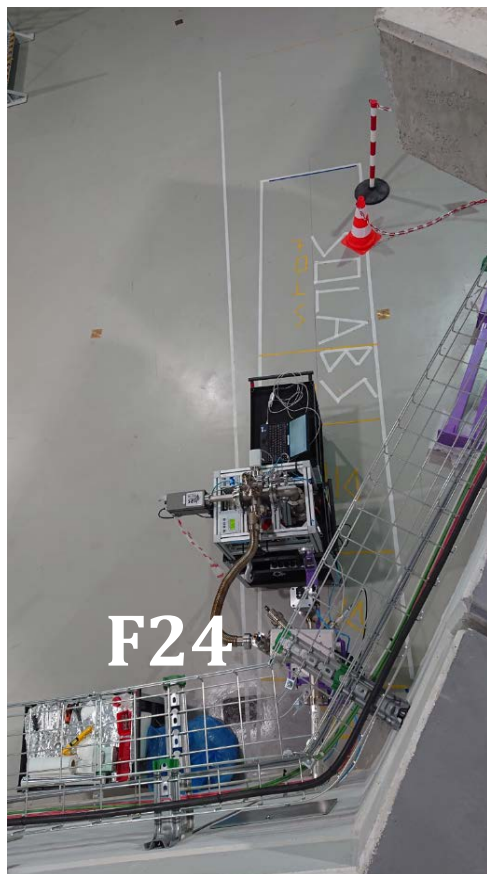
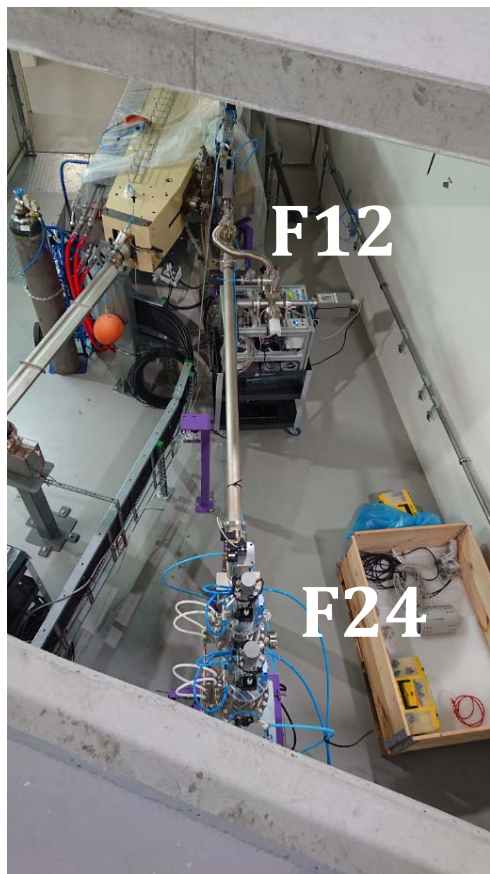
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# New installations and developments

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## SOLABS FE installation in two stage: group F12 and F24

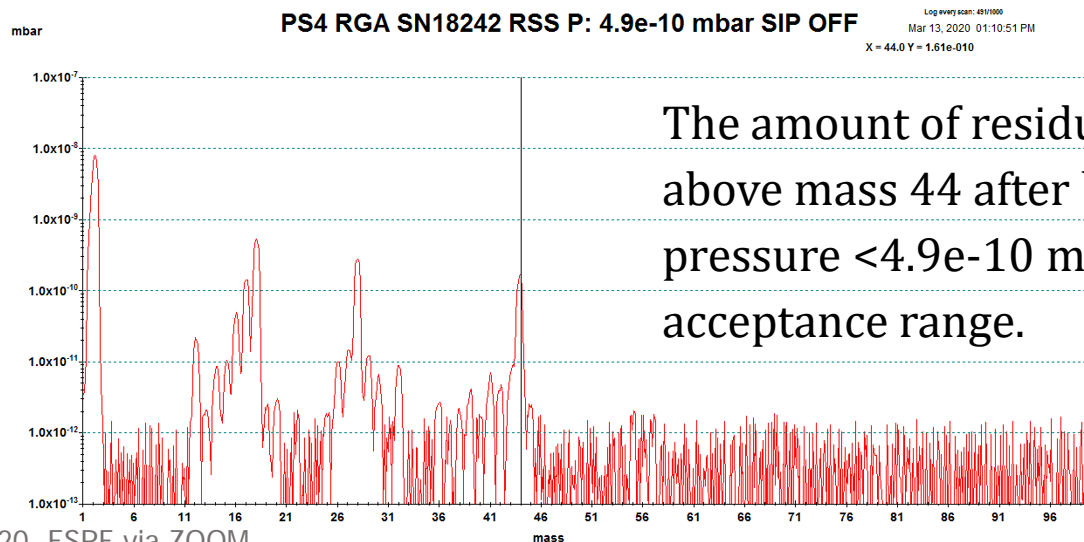


### Leak check values:

Pressure:  $4.5e-10$  mbar  
Background:  $2.0e-10$  mbarl/s  
Leak check:  $2.0e-10$  mbarl/s

### Sputter ion pumps:

Pump unit:  $1.0e-11$  mbar  
Radiation safety shutter:  $4.7e-10$  mbar  
Trigger unit:  $1.0e-11$  mbar



After bakeout in the Test Stand area installation and pumping in the storage ring – **one week**.

## SOLABS FE degassing in three stages

- 1. First degassing process:** radiation safety shutter with 15 mA. Pressure value with 15 mA electron beam  $8e-9$  mbar and decreasing, after 4 hours  $6e-9$  mbar
- 1. Second degassing process:** fluorescent screen with 15 mA. Pressure value with 15 mA electron beam  $4e-7$  mbar, significant degassing. Improvements was very fast, after 6 hours was reached  $6e-9$  mbar
- 2. Third degassing process:** radiation safety shutter with current from 50 to 360 mA. For 360 mA pressure in the chamber  $1.7e-8$  mbar and very slowly decreasing. Degassing of the fluorescent screen with current 110 mA, pressure in the chamber  $2e-8$  mbar and very slowly decreasing, after 45 min pressure value is  $1.6e-8$  mbar.

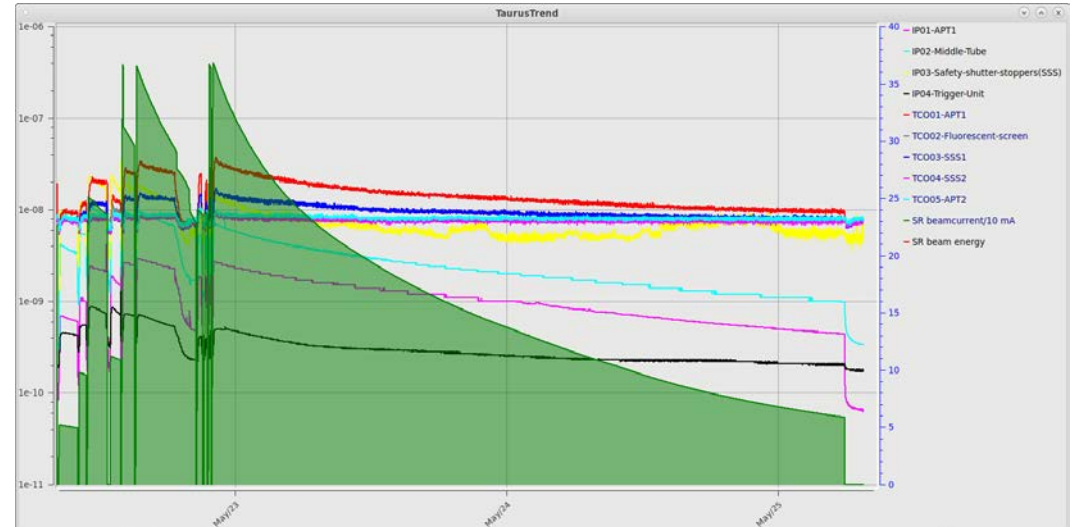
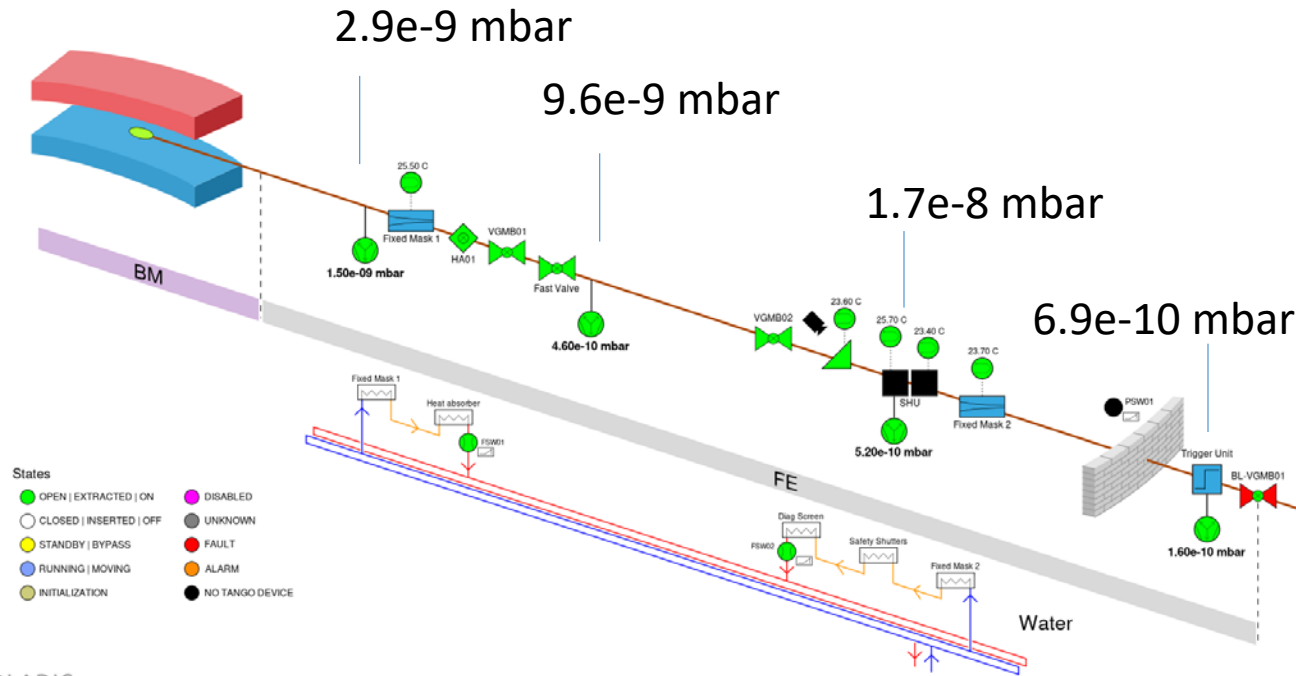
**Thermocouples:** for SR current 350 mA: aperture1 = 27.9 C, fluorescent screen = 23.3 C, radiation safety shutter 1 = 25.1 C,  
radiation safety shutter 2 = 23.3 C, aperture2 = 23.4 C

## SOLABS FE degassing in three stages

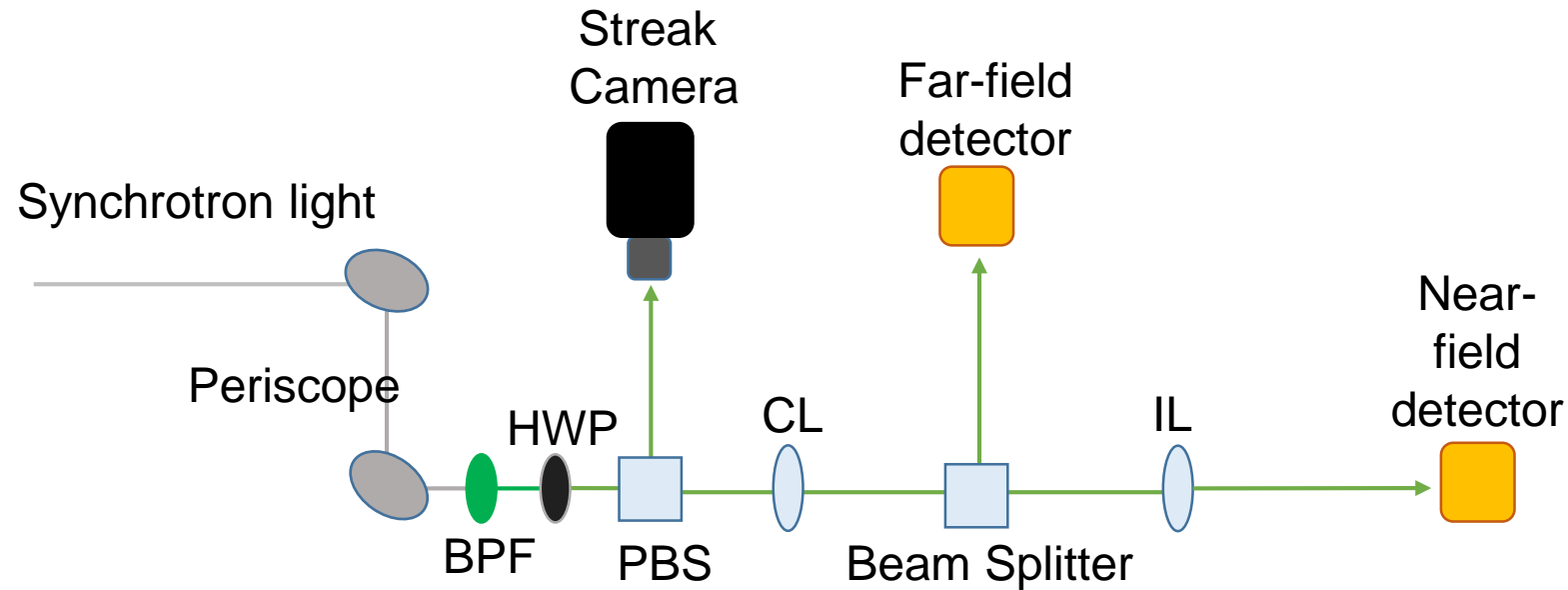
*Afater 6 days of degassing...*

Beam current: 350 mA

Energy: 1.5 GeV



## Scheme of the experimental setup



**BPF:** Band Pass Filter (to select a narrow band)

**PBS:** Polarizing Beam Splitter

**HWP:** Half-Wave Plate (to rotate the polarization)

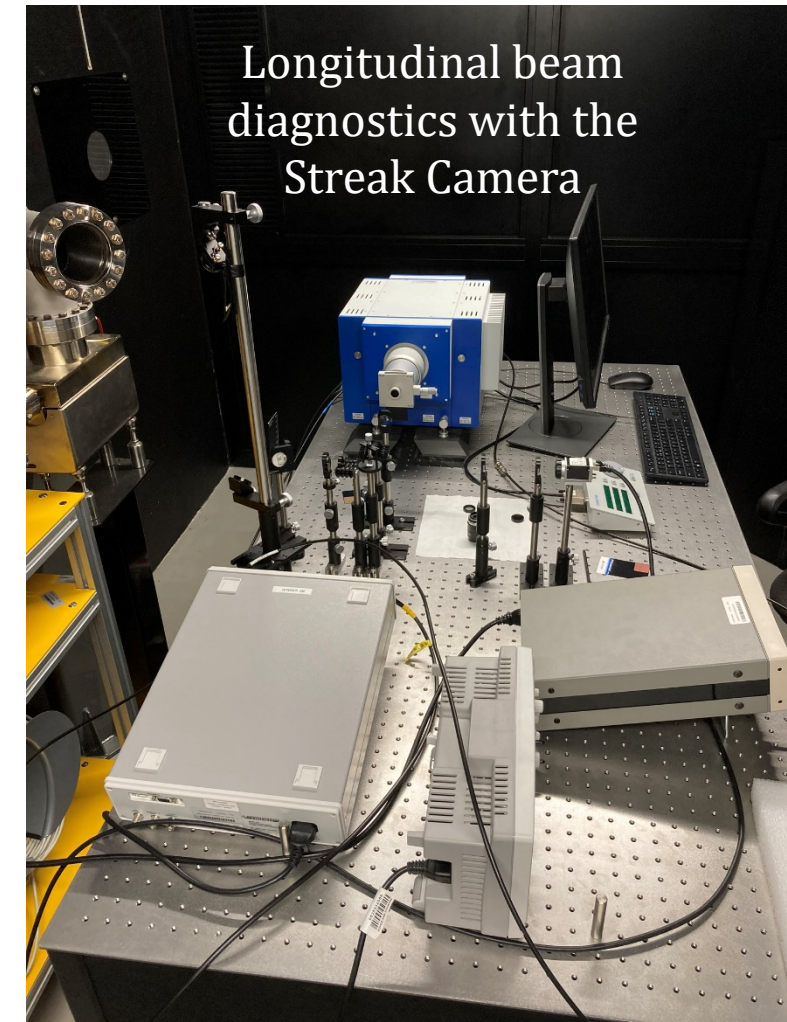
**CL:** Collimation Lens (to parallelize the light beam)

**IL:** Imaging Lens (to form an image of the beam in the focal plane)

**Detector:** CCD Camera/Power Meter

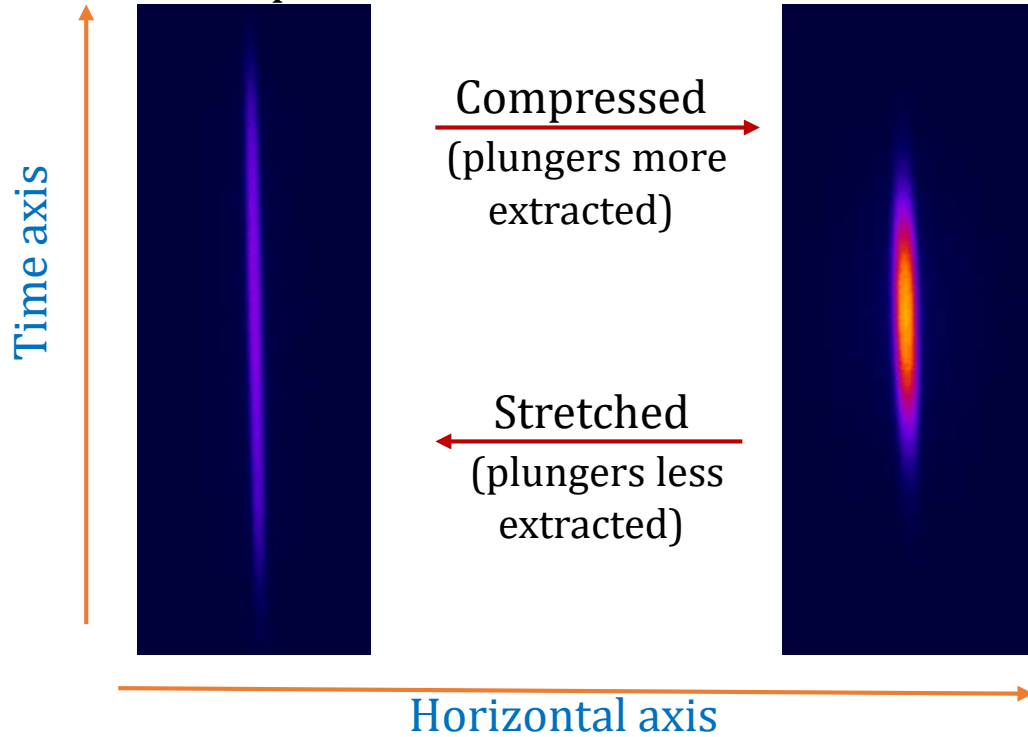
**Streak camera (Optronis SC-10, res. 1.5ps FWHM)**

## View of the LUMOS diagnostic beamline



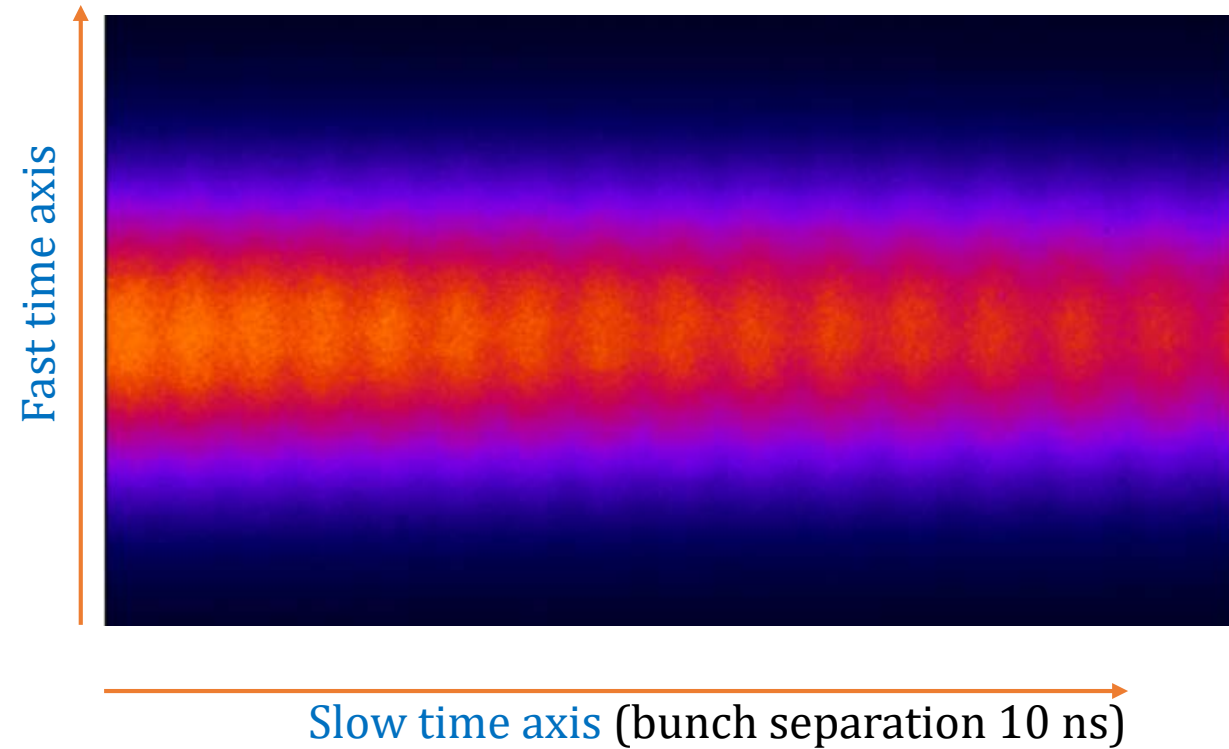
## Streak-camera measurements @SOLARIS Storage Ring

1.5 GeV, 30 mA, all bunches overlapped,  
i.e. one sweep unit



Measured bunch lengths **415-130 ps rms**

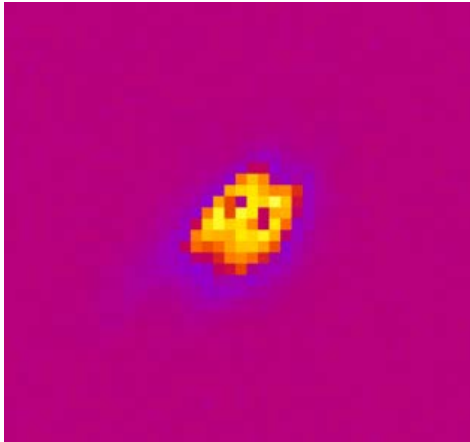
1.5 GeV, 30 mA, portion of the filling pattern,  
i.e. two sweep units



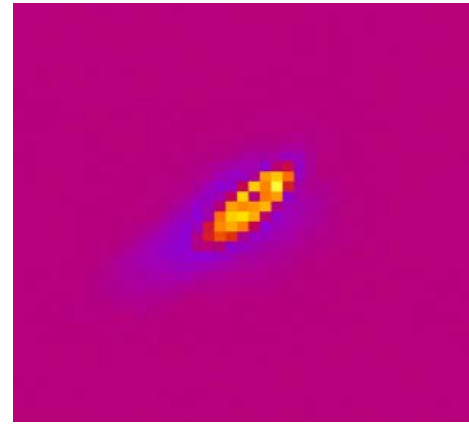
Measured bunch length **130 ps rms**

## Near and far field images for different polarizations (PSF not yet measured)

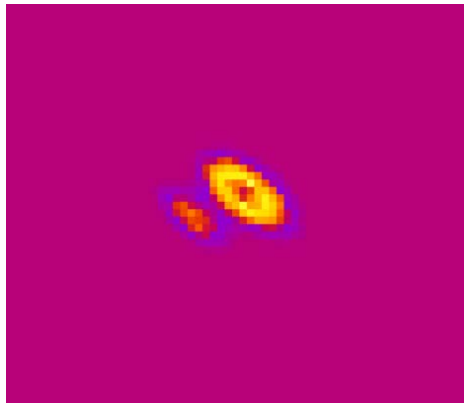
V-pol, far field



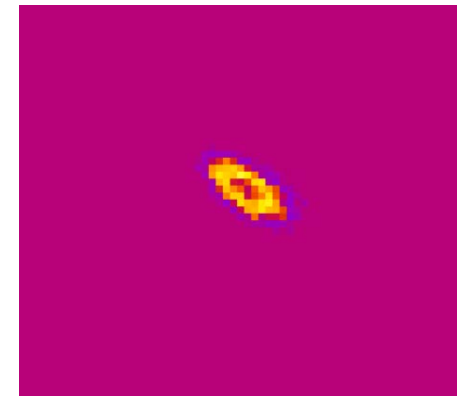
H-pol, far field



V-pol, near field



H-pol, near field



## Fast Orbit Feedback - update

- 9 pairs of fast correctors is already installed on the DBA's
- 1 pair will be install in this winter shutdown
- Last 2 pairs will be installed when installing frontends in 2021
- Fast power supplies (iTest BE5494) have been delivered to Solaris , and will be installed during winter shutdown.
- The cables powering the magnets have been prepared for laying, which will be done in the winter shutdown.
- The first tests to check the communication and current setting changes with 10kHz frequency between Libera and the power supply were successively done.
- Software under development.



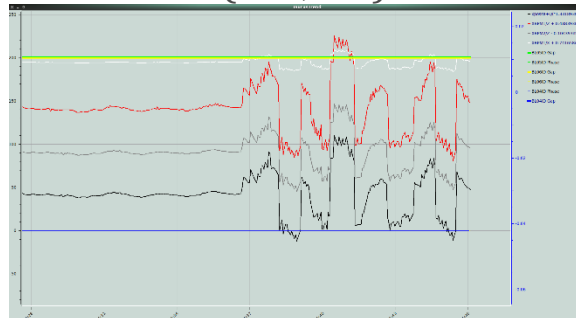
## Undulators feedforward correction matrices

- The new feedforward tables for UARPES and PHELIX insertion devices were measured and implemented.



## BL04ID undulator correction coils upgrade

- Installation and first tests of the new corection coils for BL04ID (-5A; 5A).



Old coils



New coils





1. Python SOFB correction device server for storage ring
2. GUI for LIBERA Brillinace + status
3. Device server for beam stability monitoring and automatic pause/start the scans on BL
4. „One button” machine for injection development



One Button Machine v.0.0.0-75-gde58885

**Prepare ring**

**INTERLOCK**

- Open valves: Open Pinhole, Open Lumos
- Set cavity voltage: Cav1 50.00 mV, Cav2 50.00 mV
- Reset Transmitter1, Reset Transmitter2
- Transmitter1 On, Transmitter2 On
- K00 HV, K01 Trig, K02 Trig, K03 Trig
- Reset Libera interlocks, AGC On
- Start injection, PLENA
- Cycling
- Load snapshot: Snapshot ID 2613
- Set plungers: P1 30.00 mm, P2 30.00 mm
- Open beam stoppers
- Kicker On, Voltage 1600.00 V

**Injection**

- Injection On
- Injection in progress: Current limit 410.00 mA, Stop, Cavity thresholds...
- Injection Off
- Kicker Off
- Close beam stoppers
- Lift cavity voltage: Cav1 261.15 mV, Cav2 261.15 mV
- Auto voltage, Ramping, Context 0, Snapshot 0
- Move plungers: P1 41.00 mm, P2 40.00 mm
- Energy 1.10 GeV
- Continue, Run correction
- Tune plungers: P1 40.96 mm, P2 39.87 mm
- Insert current
- Fire skew quads: SCOSKW 0.00 A, SCISKW 1.50 A
- Enable tuning, AGC Off

**Machine state** BeamStored

Current 356.55 mA, Lifetime 17.97 h  
Energy 1.51 GeV, I-τ 6.41 Ah  
Slope -4.36 uA/s, Injection ETA inf s

PLC and flags... Spectrum...  
MAG Linac, MAG Ring

**Valves linac**  
**Valves ring**

**Pinhole Lumos**

**Cavities**  
1 248.82 m 42.46 kW  
2 248.82 m 41.50 kW  
Q7 Q8/9 Power locked

**Plungers**  
1 40.96 mm  
2 39.87 mm

**Skew quads**  
SCOSKW 0.01 A, SCISKW 1.50 A

**Insertion devices**  
BL04ID 201.00 mm, BL05ID 200.00 mm, BL06ID 50.00 mm

**Kicker Pinger**  
1635.20 V, 37.10 V

**Beam stoppers** 1 2

**Operation log**

02	03	04	05	06	07	08	09	10	11	12
ONLINE	ONLINE	ONLINE	ONLINE	ONLINE	ONLINE	ONLINE	ONLINE	ONLINE	ONLINE	ONLINE
RTC	RTC	RTC	RTC	RTC	RTC	RTC	RTC	RTC	RTC	RTC
LOCKED	LOCKED	LOCKED	LOCKED	LOCKED	LOCKED	LOCKED	NOT LOCKED	LOCKED	LOCKED	LOCKED
BPM1	BPM1	BPM1	BPM1	BPM1	BPM1	BPM1	BPM1	BPM1	BPM1	BPM1
BPM2	BPM2	BPM2	BPM2	BPM2	BPM2	BPM2	BPM2	BPM2	BPM2	BPM2
BPM3	BPM3	BPM3	BPM3	BPM3	BPM3	BPM3	BPM3	BPM3	BPM3	BPM3
OFFLINE	OFFLINE	OFFLINE	OFFLINE	OFFLINE	OFFLINE	OFFLINE	OFFLINE	OFFLINE	OFFLINE	OFFLINE
RUNNING	RUNNING	RUNNING	RUNNING	RUNNING	RUNNING	RUNNING	RUNNING	RUNNING	RUNNING	RUNNING
LOADED	LOADED	LOADED	LOADED	LOADED	LOADED	LOADED	LOADED	LOADED	LOADED	LOADED
RUNNING	RUNNING	RUNNING	RUNNING	RUNNING	RUNNING	RUNNING	RUNNING	RUNNING	RUNNING	RUNNING

**Beam dump**

- Beam dump On, PLENA
- Pinger On, Voltage 6500.00 V, Step 500.00 V, Time 7.00 s
- Drop cavity voltage: Cav1 50.00 mV, Cav2 50.00 mV
- Pinger Off

**Deliver beam**

- Configure IDs, Options...
- Configure all frontends
- User operation
- Start experiment, PLENA

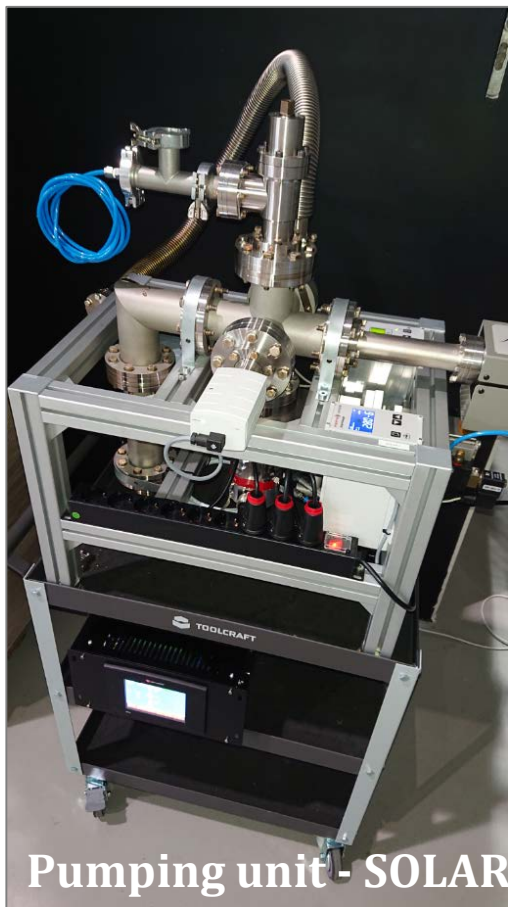
**Storage ring not ready for injection**

**Injection not finished**

**Beam not delivered**

## Upgrade of Solaris pumping unit with PLC controller

Due to limited access to the front-end (missing doors) and to avoid long bellows during pumping customize pump station was needed.



Pumping unit - SOLARIS



Heating Unit Controller - HUC

Pumping unit compatible with Heating Unit Controller in case of information exchange like pressure level or interlock status

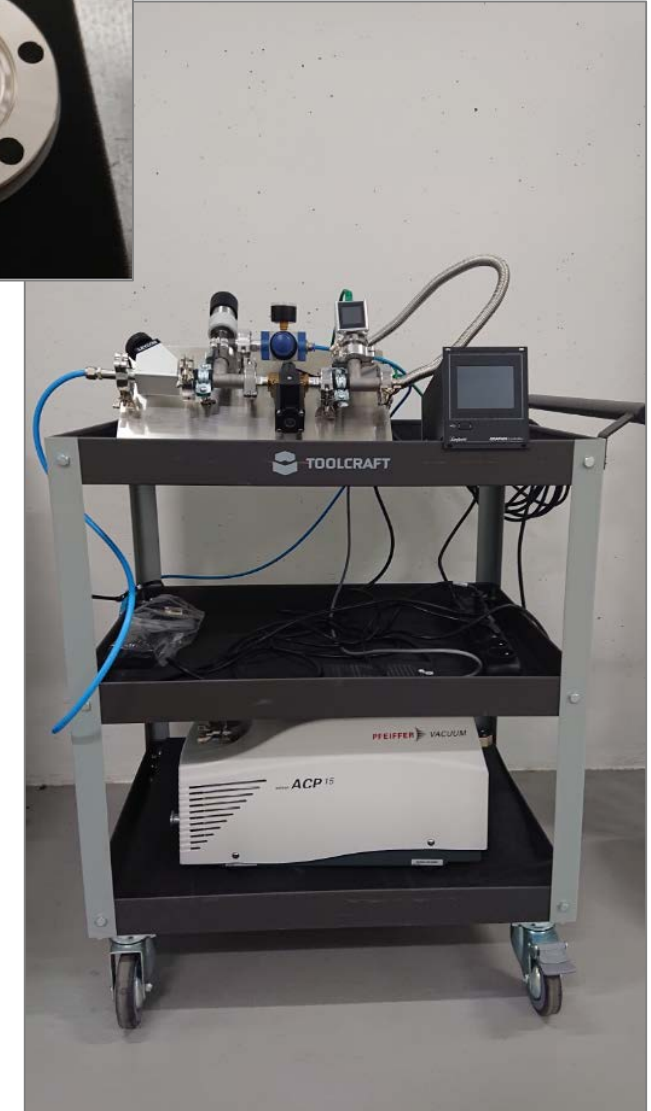
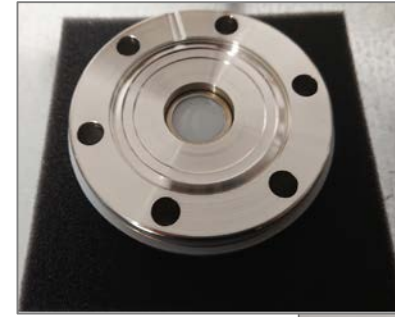


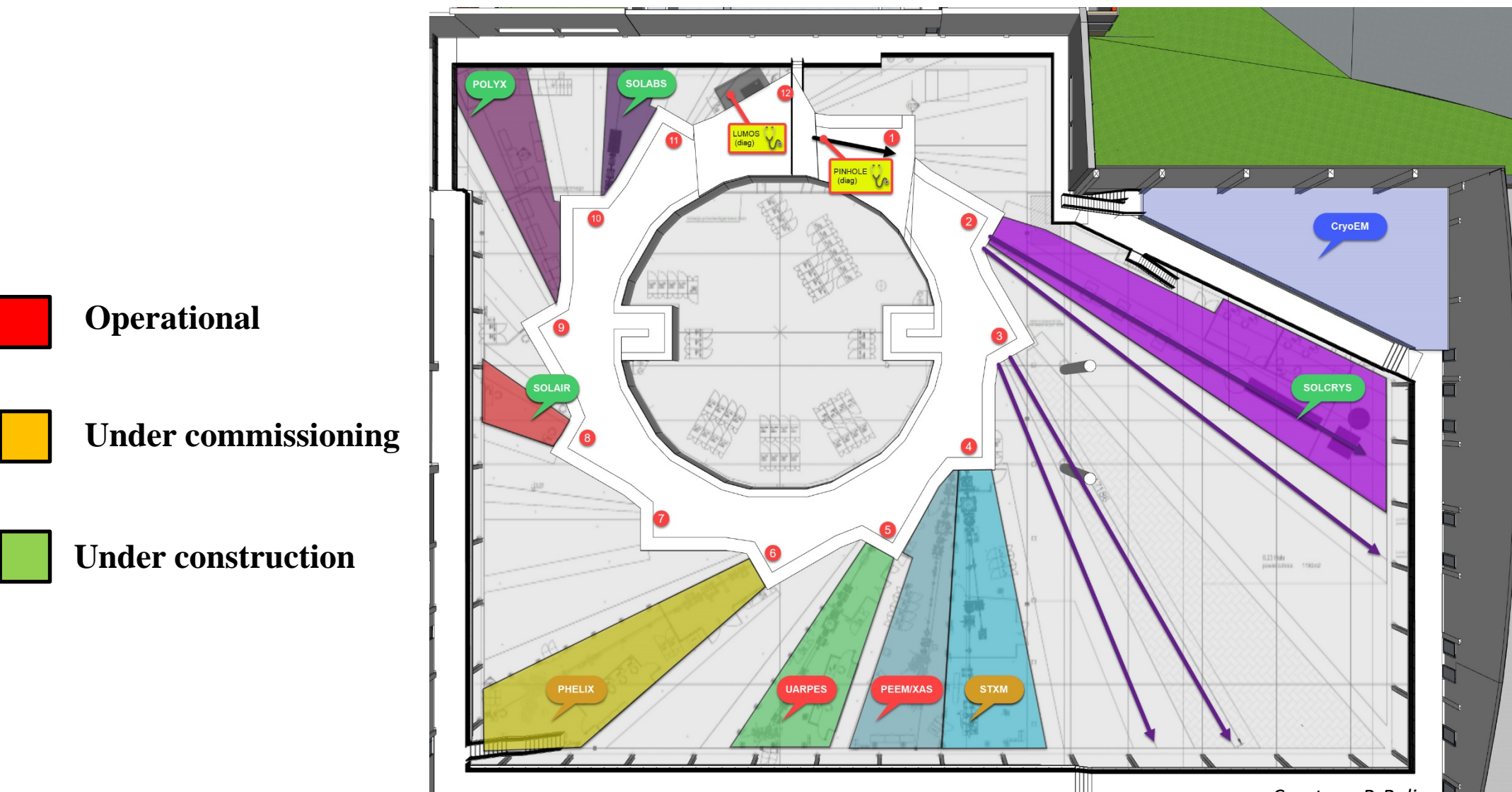
## Construction of Solaris venting unit

In case of precise venting of vacuum system in the domain of time and defined pressure level, dedicated venting unit was designed. Useful in case of venting vacuum systems equipped with sensitive vacuum components like beryllium windows.



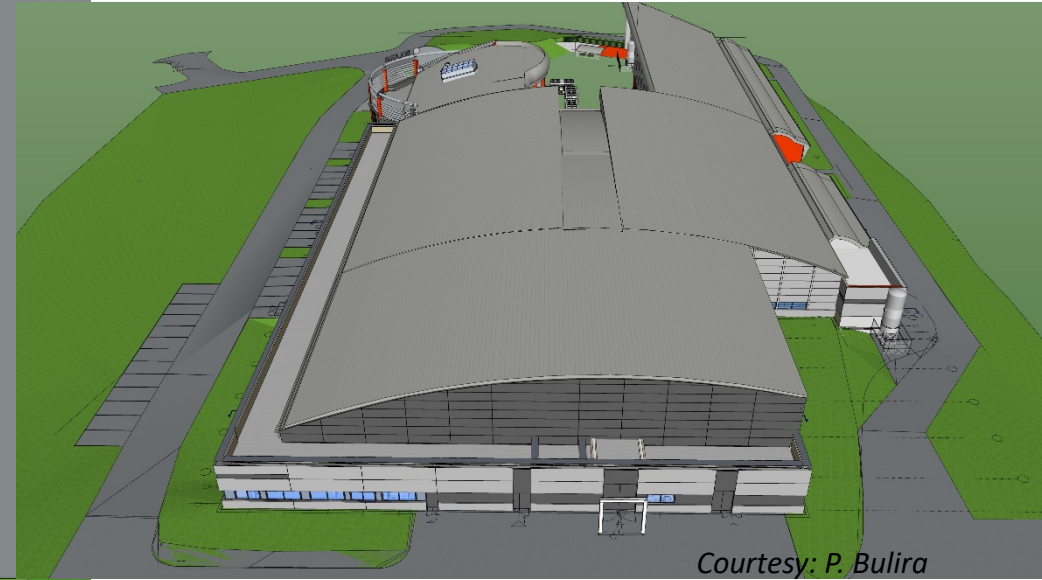
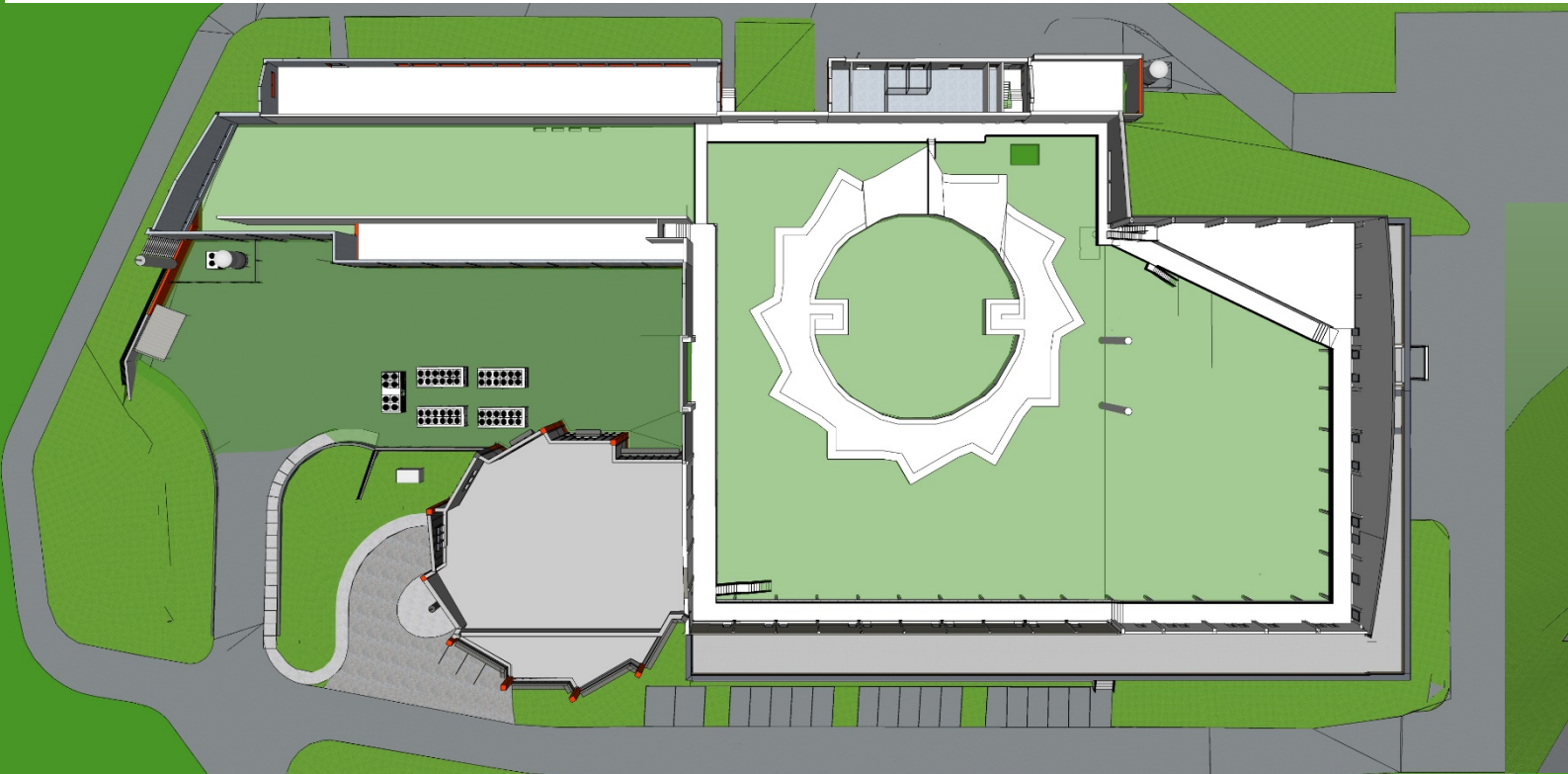
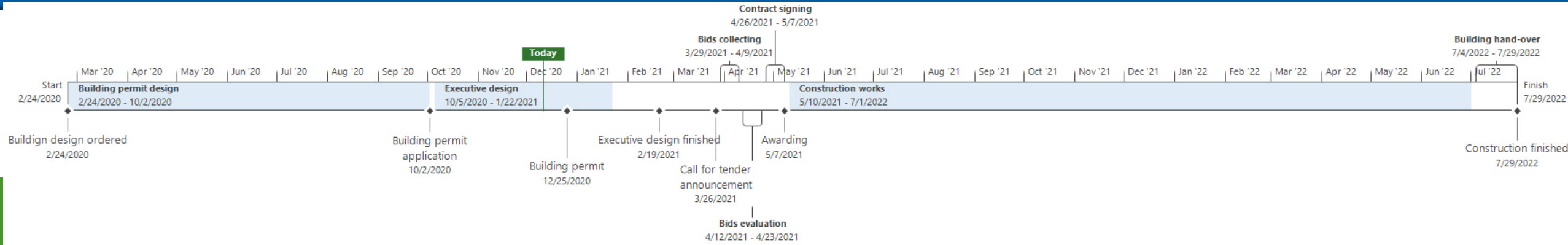
Mechanical and electrical fuse for overpressure protection





Courtesy: P. Bulira

# BUILDING EXTENSION



Courtesy: P. Bulira

Daily operation (Injections 8:00, 20:00 current 400 mA)

Focus on beam stability

- ☺ Fixing the short circuit in SDI sextupole – main reason of the beam instabilities
- ☺ Implementation of slow orbit correction feedback in Python – correction more stable than in MATLAB
- ☹ Suppressing impact of the UARPES, PHELIX & XMCD EPU's on the beam position (ongoing)
- ☹ Installation of the FOFB – in progress

Development of 'one button' machine for injection

Equipment development (vacuum pump station, venting station)

Four new beamlines under design and construction

New insertion device for SOLCRY'S Beamline: Superconducting Multipole Wiggler (contracted)

Front end design for SOLCRY'S beamline (under design)

Front end installation for POLYX beamline (delivery in mid 2021)

Redesign and installation of the dipole chamber for SOLAIR beamline (delivery end of 2021)

2 Beamlines under commissioning and will be available for users from next year

Diagnostics setup design for the bunch length measurement in the linac

**From 2020 more shifts scheduled for users (35% more than in 2019) and machine development (35%)!**

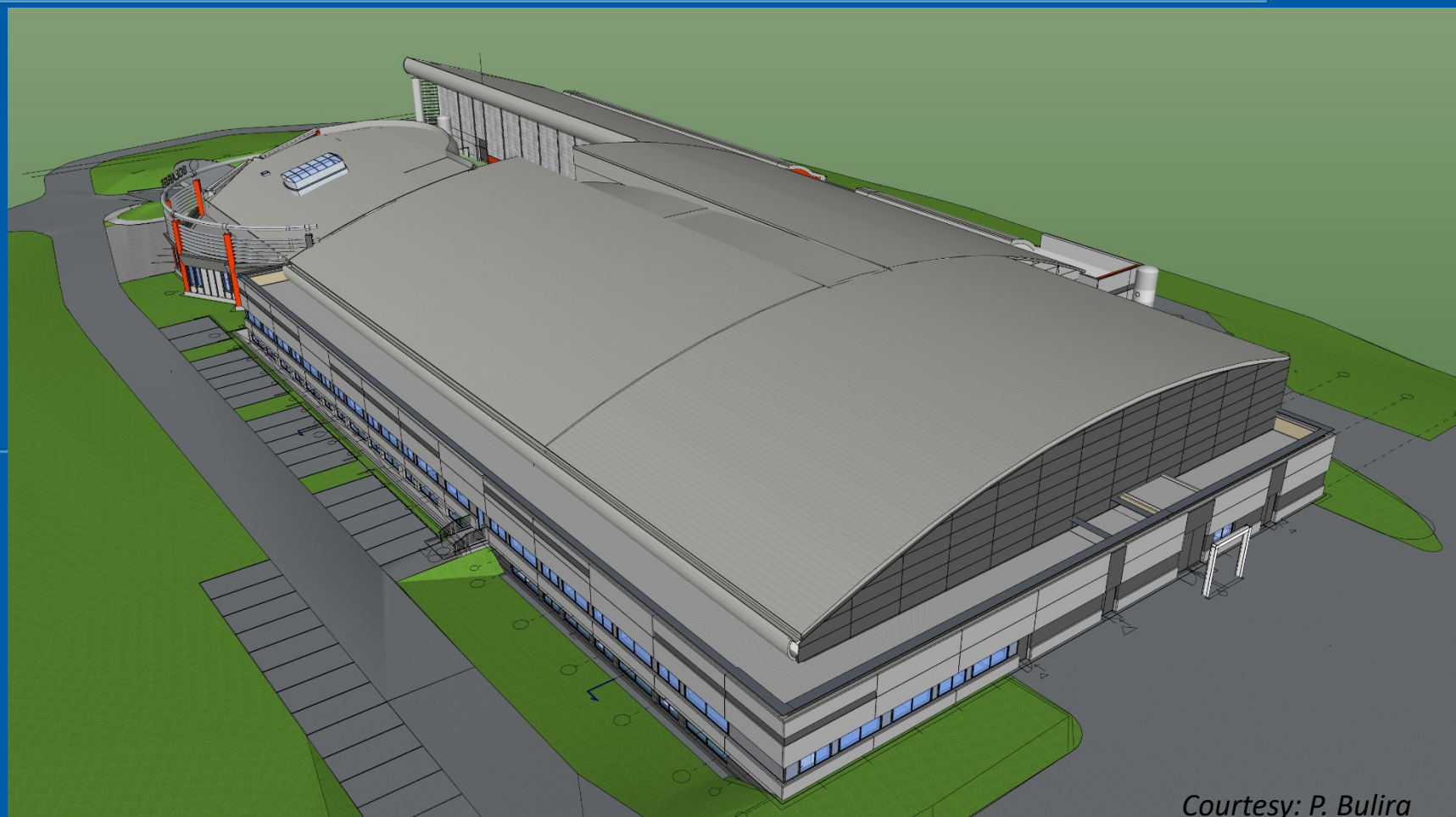


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IN KRAKOW



SOLARIS  
NATIONAL SYNCHROTRON  
RADIATION CENTRE

# Thank you !



*Courtesy: P. Bulira*