

ALBA Status

Ferran Fernandez

On behalf of the Accelerator Division



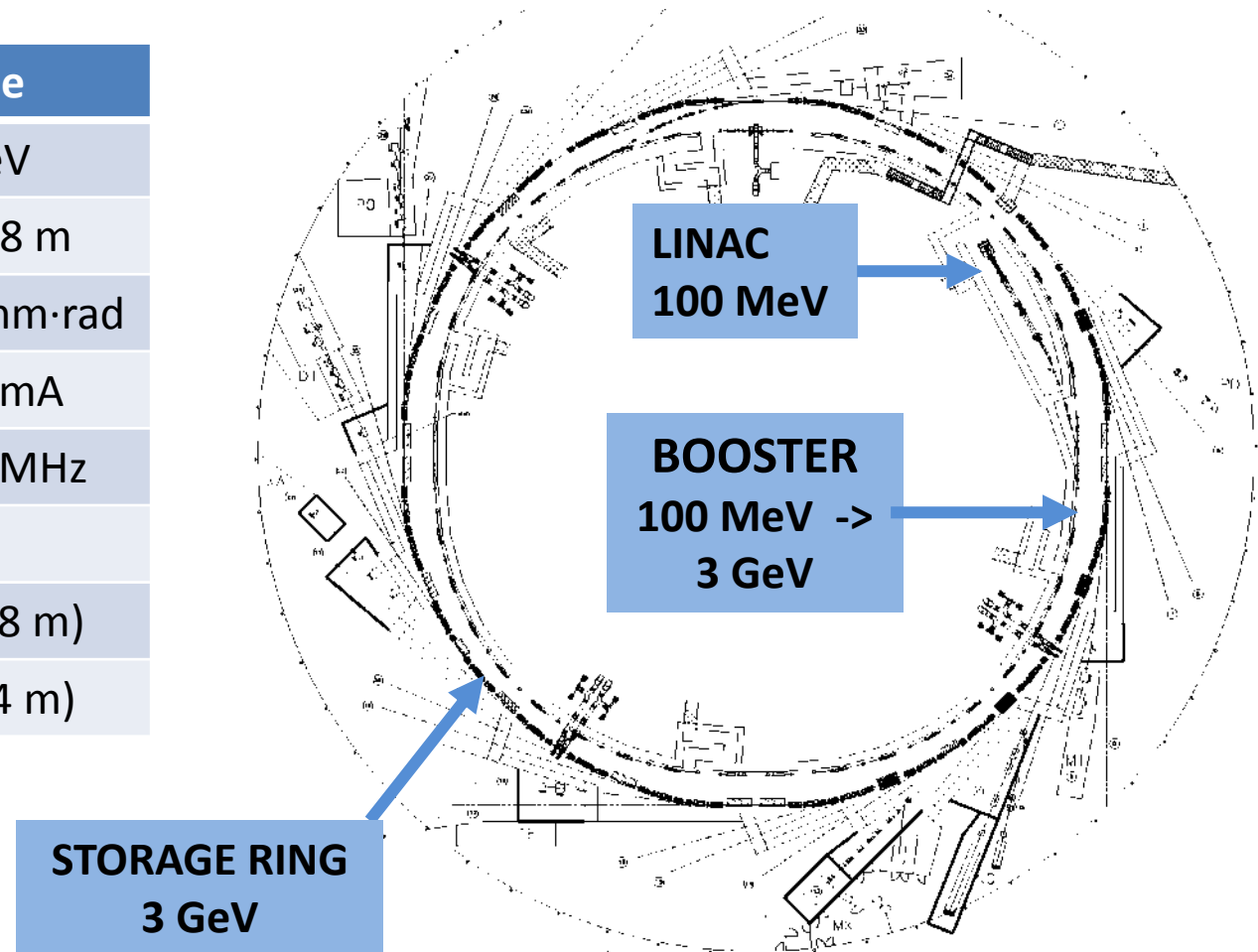
- Introduction & Beamlines status
- Operation
- Accelerator Developments

Introduction & Beamlines status



Layout

Parameter	Value
Energy	3 GeV
Circumference	268.8 m
Emittance	4.5 nm·rad
Current	250 mA
Rf frequency	500 MHz
# cavities	6
Long straights	4 (8 m)
Medium straights	12 (4 m)



BL04: MSPD
SCW31 (8–50 KeV)
HP/HR Powder diffraction

BL01: MIRAS
Bending (0.4–100 μm)
IR Spectroscopy

BL34: XANADU
Bending
 e^- Diagnostics

FAXTOR
Hard X-ray
Tomography

BL29: BOREAS
EU71 (0.08–3.0 KeV)
Resonant Absorption & Scattering

BL24: CIRCE
EU62 (0.1–2.0 KeV)
Photoemission spectroscopies

In Operation
In Construction

BL06: XAIRA
IVU20 (5–25 KeV)
Macromolecular
Cristallography

BL09: MISTRAL
Bending (0.27–2.6 KeV)
X ray Microscopy

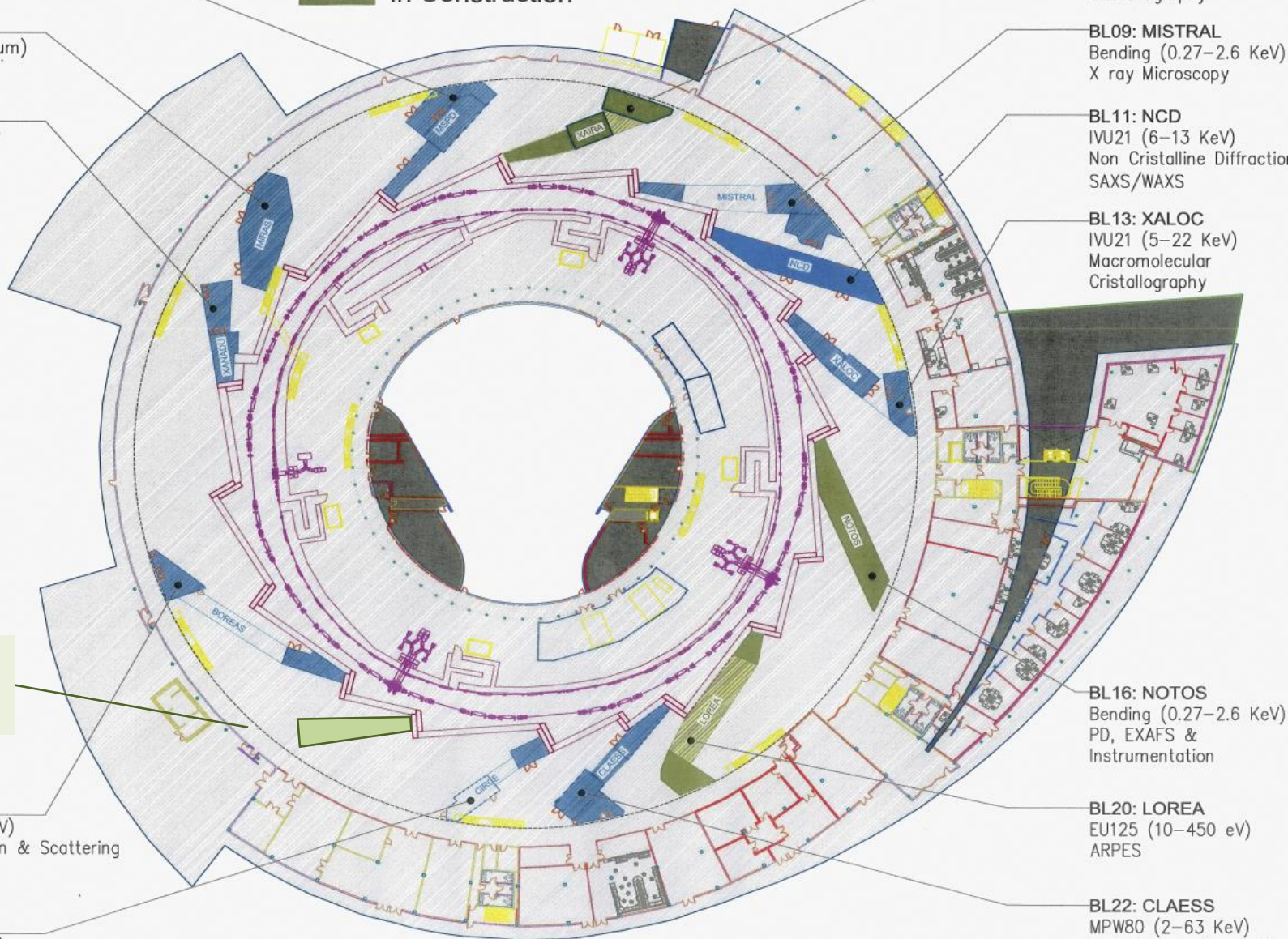
BL11: NCD
IVU21 (6–13 KeV)
Non Crystalline Diffraction
SAXS/WAXS

BL13: XALOC
IVU21 (5–22 KeV)
Macromolecular
Cristallography

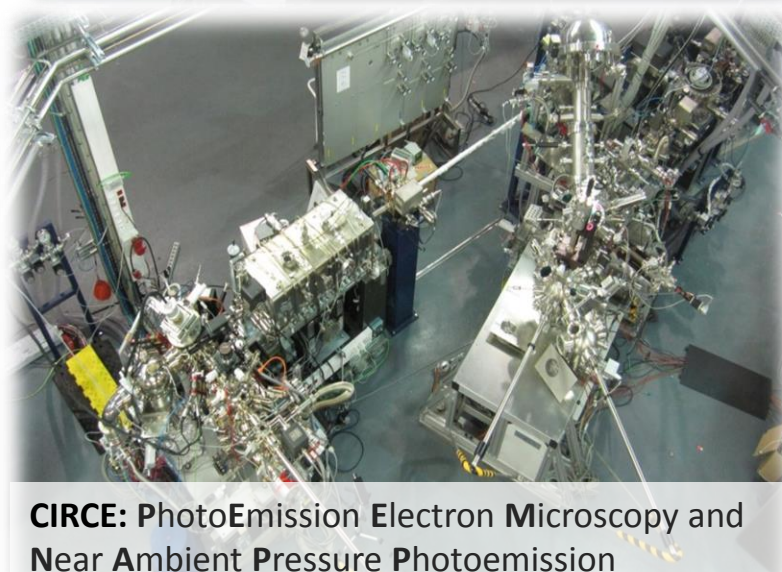
BL16: NOTOS
Bending (0.27–2.6 KeV)
PD, EXAFS &
Instrumentation

BL20: LOREA
EU125 (10–450 eV)
ARPES

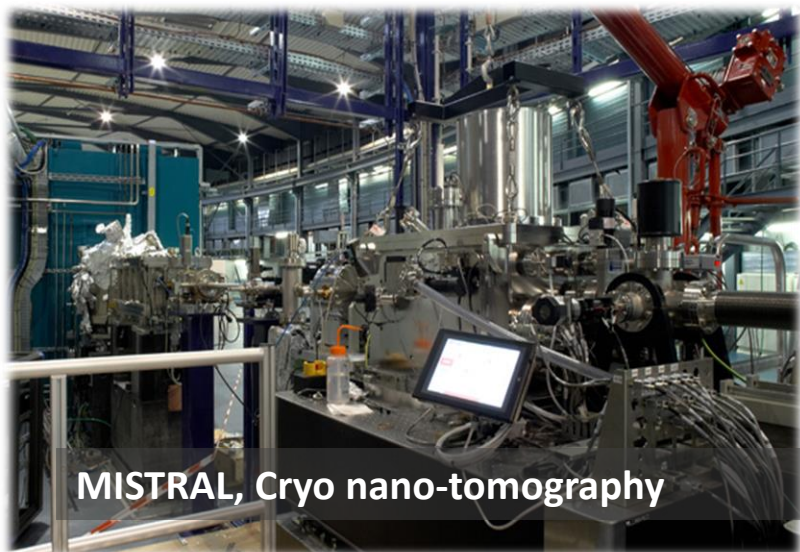
BL22: CLAESS
MPW80 (2–63 KeV)
Emission spectroscopies



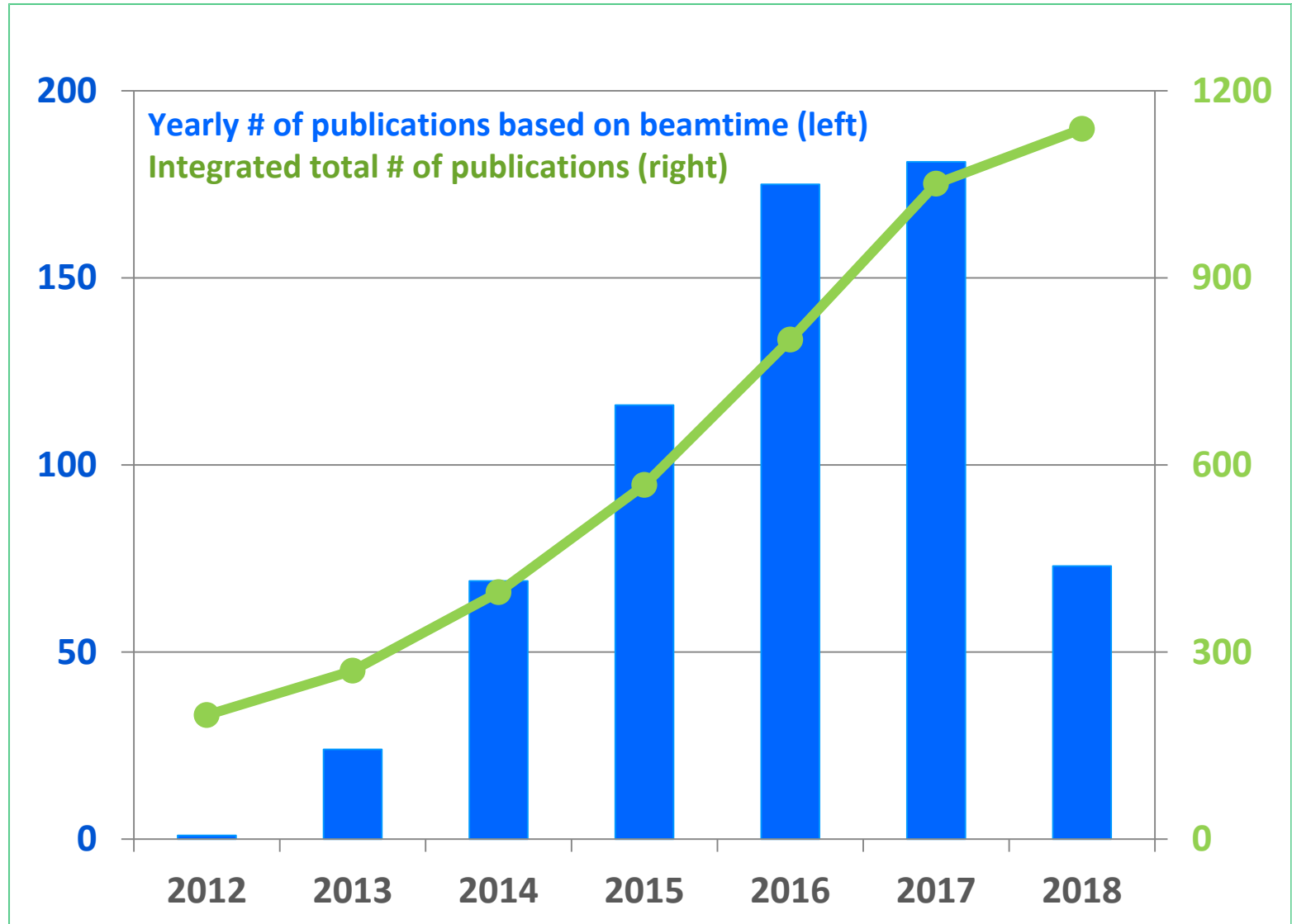
Four Beamlines mainly dedicated to Chemistry, Physics - Condensed Matter



Four beamlines mainly dedicated to Life Sciences



Productivity



Operation





2018 Operation

ALBA Operations Calendar, January 2018-December 2018

BL operation	BL	BL users (external, friendly, in-house & commissioning)
bl operation	bl	BL/FE/ID Commissioning & Accelerator Optimization for BLs
Start-up	M	Start up of accelerators with beam & Accelerator's Studies
Warm-up	W	Warm: Linac & RF & magnets & sub-systems maintenance and optimisation
Shutdown	Off	Civil Engineering, Accelerators and BL maintenance with no beam, installations and upgrades
Public & CELLS holiday		

2018_calendar_v8_20180111.xlsx

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
Weekday	Week Day	Week Day	Week Day	Week Day	Week Day	Week Day	Week Day	Week Day	Week Day	Week Day	Week Day	Week Day
Mo	1	2	3	4	5	6	7	8	9	10	11	12
Tu	2	3	4	5	6	7	8	9	10	11	12	13
We	3	4	5	6	7	8	9	10	11	12	13	14
Th	4	5	6	7	8	9	10	11	12	13	14	15
Fr	5	6	7	8	9	10	11	12	13	14	15	16
Sa	6	7	8	9	10	11	12	13	14	15	16	17
Su	7	8	9	10	11	12	13	14	15	16	17	18
Mo	8	9	10	11	12	13	14	15	16	17	18	19
Tu	9	10	11	12	13	14	15	16	17	18	19	20
We	10	11	12	13	14	15	16	17	18	19	20	21
Th	11	12	13	14	15	16	17	18	19	20	21	22
Fr	12	13	14	15	16	17	18	19	20	21	22	23
Sa	13	14	15	16	17	18	19	20	21	22	23	24
Su	14	15	16	17	18	19	20	21	22	23	24	25
Mo	15	16	17	18	19	20	21	22	23	24	25	26
Tu	16	17	18	19	20	21	22	23	24	25	26	27
We	17	18	19	20	21	22	23	24	25	26	27	28
Th	18	19	20	21	22	23	24	25	26	27	28	29
Fr	19	20	21	22	23	24	25	26	27	28	29	30
Sa	20	21	22	23	24	25	26	27	28	29	30	31
Su	21	22	23	24	25	26	27	28	29	30	31	
Mo	22	23	24	25	26	27	28	29	30	31		
Tu	23	24	25	26	27	28	29	30	31			
We	24	25	26	27	28	29	30	31				
Th	25	26	27	28	29	30	31					
Fr	26	27	28	29	30	31						
Sa	27	28	29	30	31							
Su	28	29	30	31								
Mo	29	30	31									
Tu	30	31										
We	31											
Th												
Fr												
Sa												
Su												
Mo												
Tu												

2018 version 8.0

BL [h]

4680

M [h]

1216

SPR [h]

16

CSN [h]

0

TOTAL [h]

5912 h

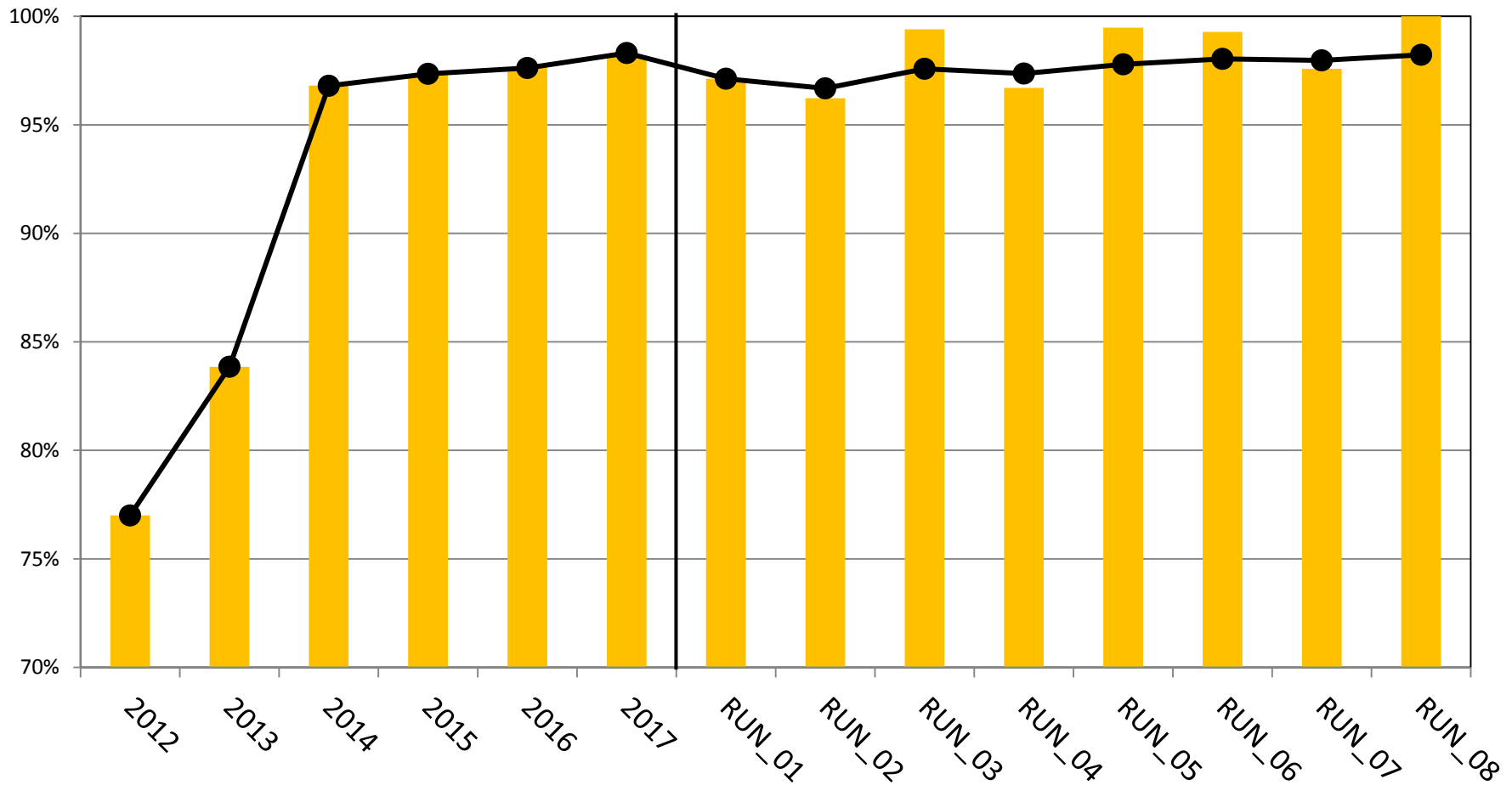
Up to 12/11/2018

3984 h for BLs scheduled

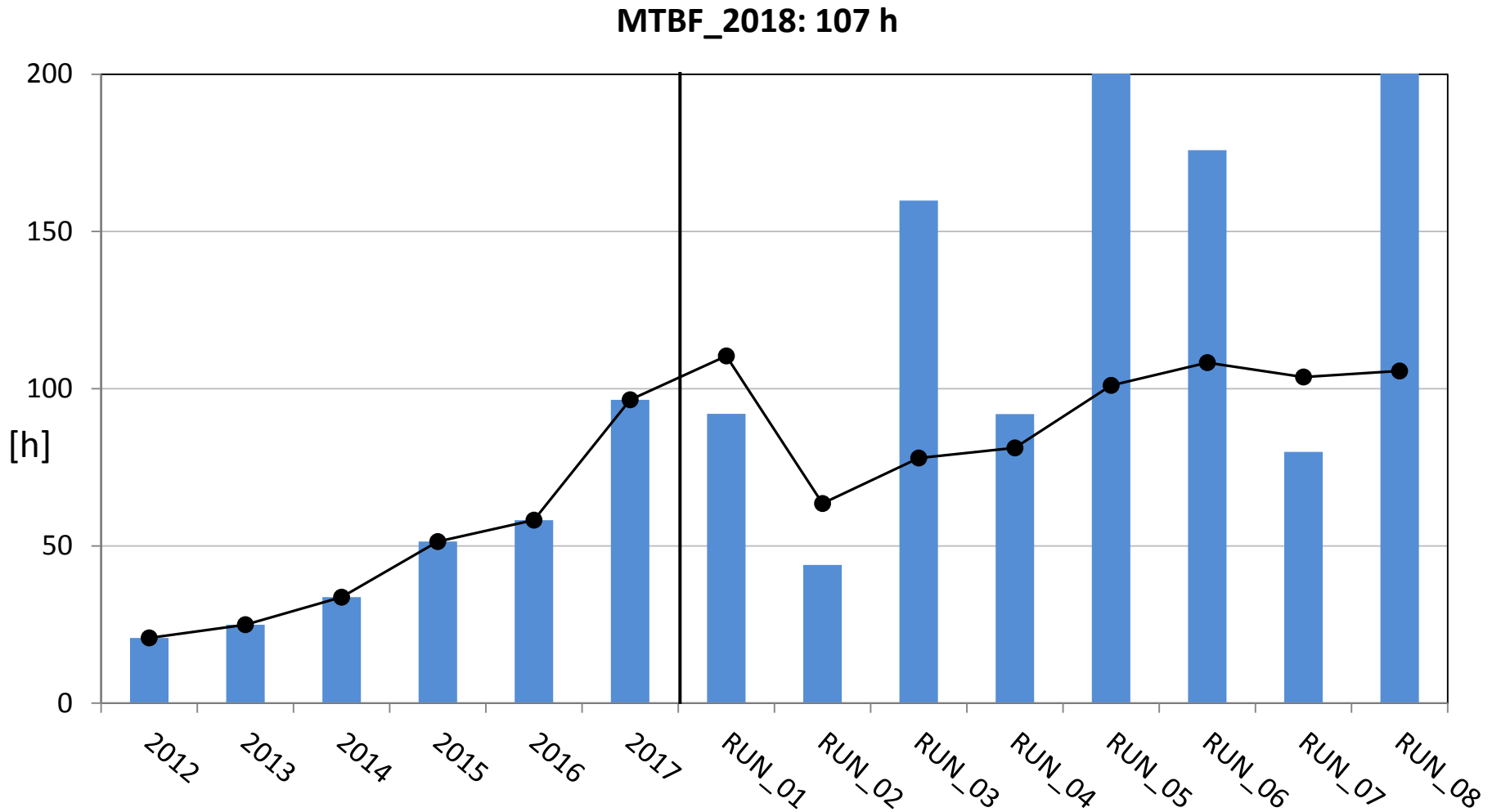
85 % of 2018 beam

Beam Availability (until 12/11/2018)

Beam availability 98.2%

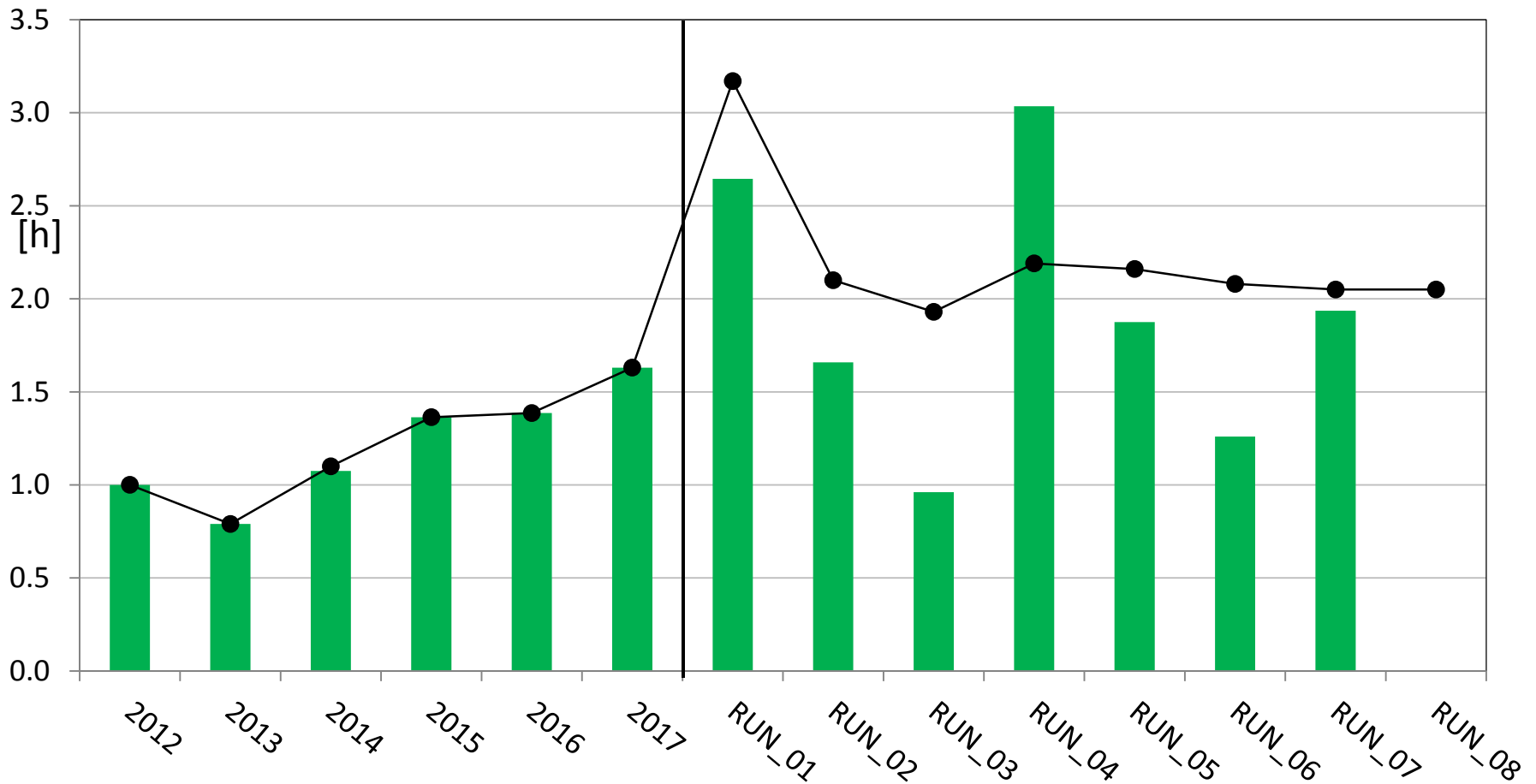


Mean time between failures (until 12/11/2018)

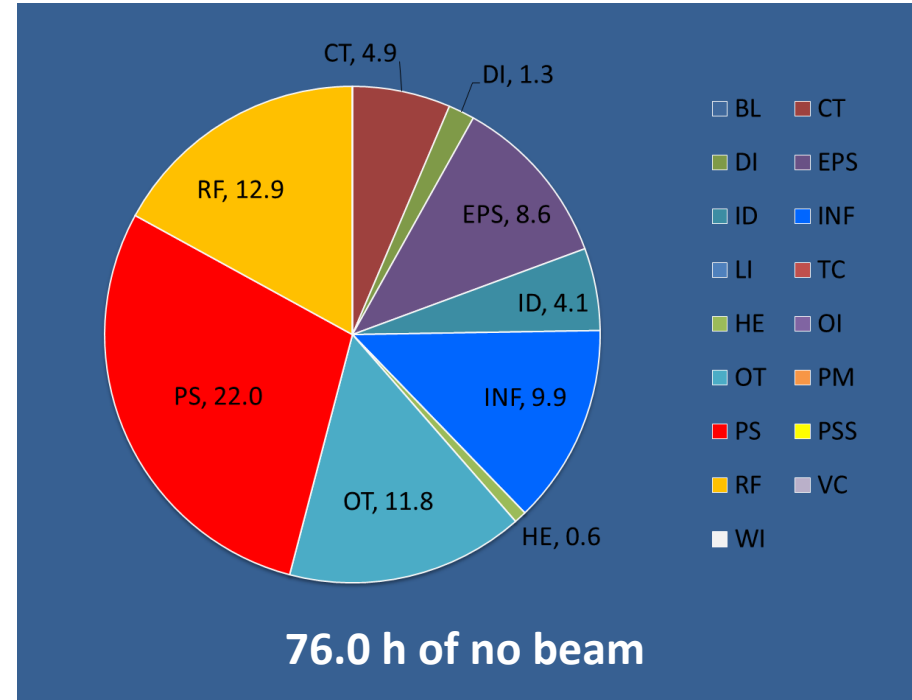
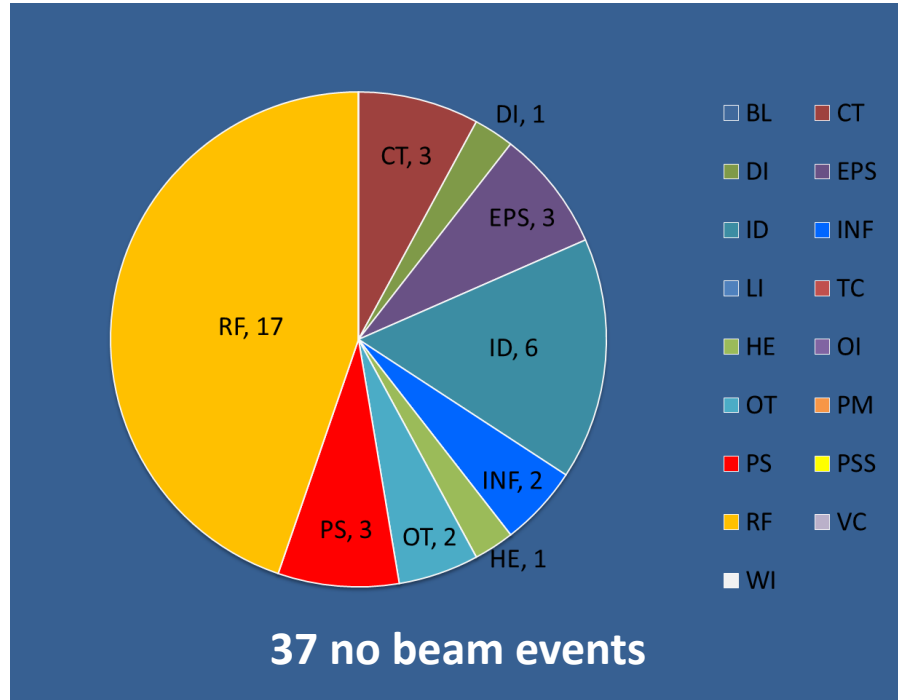


Mean time to recover (until 12/11/2018)

MTTR_2018: 2.05 h



No beam events (until 12/11/2018)



Down time main single events

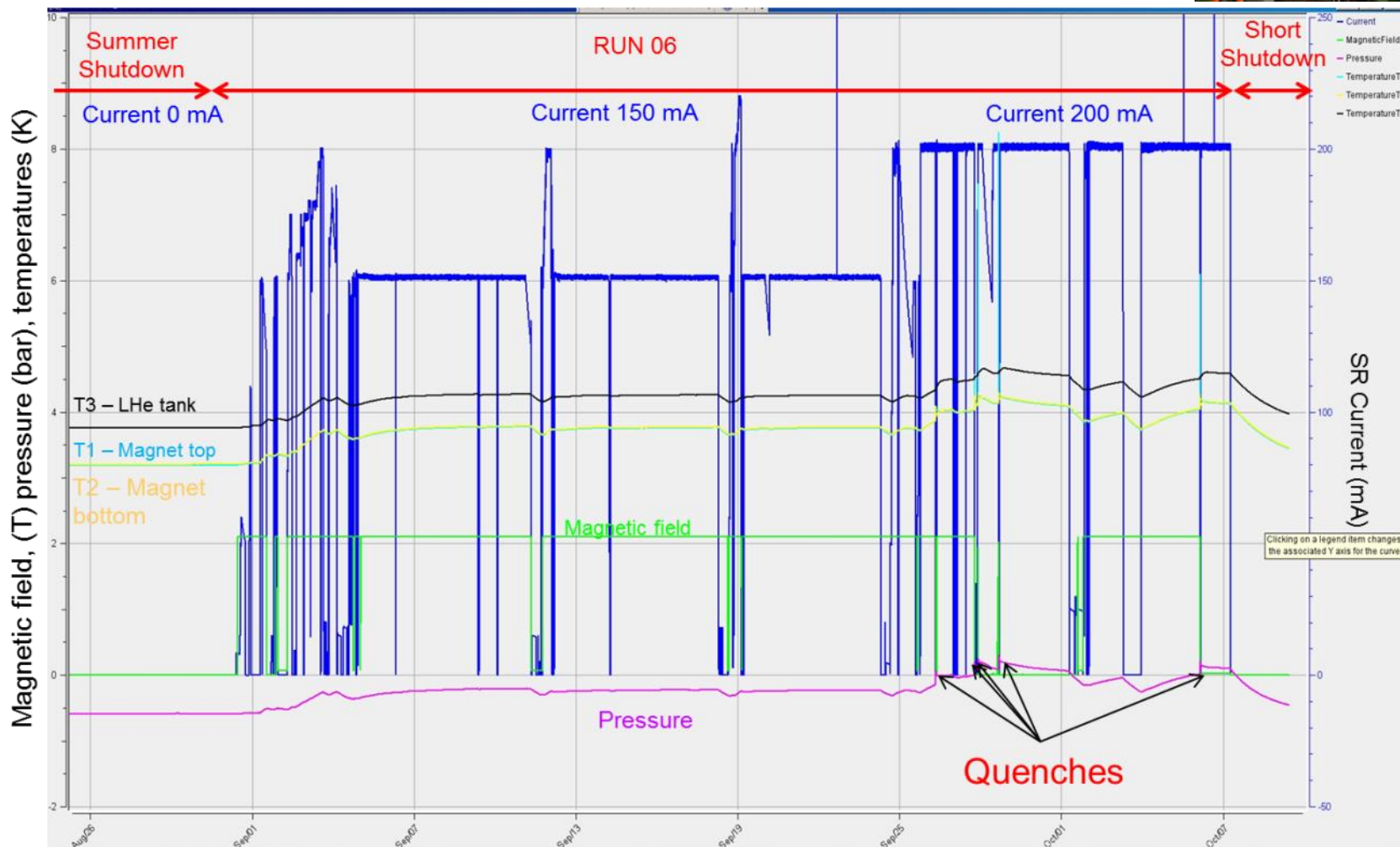
Component	Down Time	%	Comment
PS	11.6 h	19%	1 x SR_BEND_PC
OT	11.8 h	19%	strike (08/03/2018)
INF	8.7 h	11%	Cooling failure (PLC communications module failed)
PS	8.4 h	14 %	1 x BO_PC (PC failure, then RF trips the beam, no injection possible) (recurrent problem due to thermal cycling. Purchasing of new modules ongoing)

*These **four events** represent **50% of the down time***

2.1 T SC Wiggler problem



- After the start of operations at 200mA: recurrent quenches



2.1 T SC Wiggler problem

- Observe that above 150mA & depending on filling pattern, there is always heat dissipation on the liner. Continuous increase of cryostat temperature.

- Is there contact between the liner and the l-He tank?

✗ Re-alignment of the liner wrt l-He tank

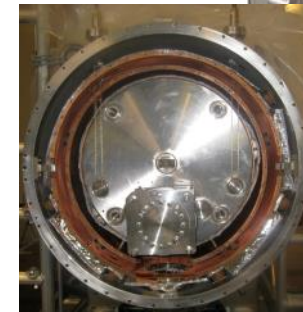
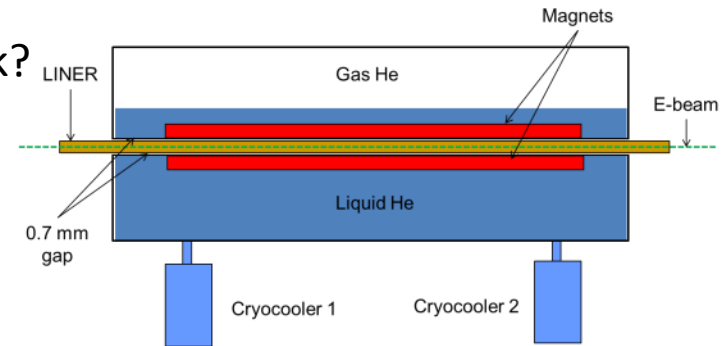
✓ Operate SR with lower charge per bucket:

From 320 to 416 bunches

✓ Operate at reduced RF voltage:

To enlarge bunch length

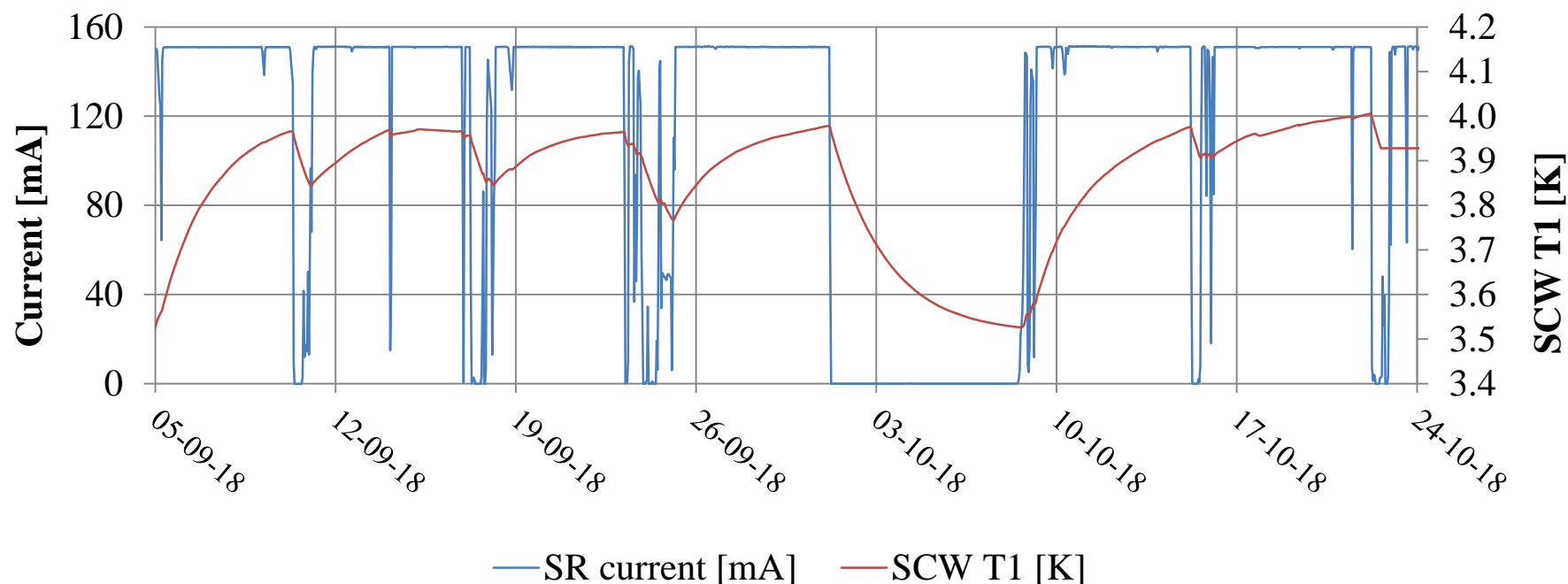
- Warm-up and visual inspection done on Jan'18**



Process of insertion of liner into LHe

2.1 T SC Wiggler problem

- Since June operation at low current (150mA) and at full magnetic field
- Since then magnet operating temperature <4 K. No quenches, no boiling of l-He
- Repair in January 2019



2.1 T SC Wiggler problem

2.	CHECKS AND IMPROVEMENTS TO BE DONE.....	3
2.1.	EXTRACTION OF LINER AND CHECKING OF VACUUM CHAMBER CLEARANCE.....	3
2.2.	UPGRADE OF THE ISOLATION OF LINER TO VACUUM CHAMBER.....	4
2.3.	REPLACEMENT OF RF CONTACTS	5
2.4.	IMPROVEMENT OF SAFETY VALVE CONNECTION	5

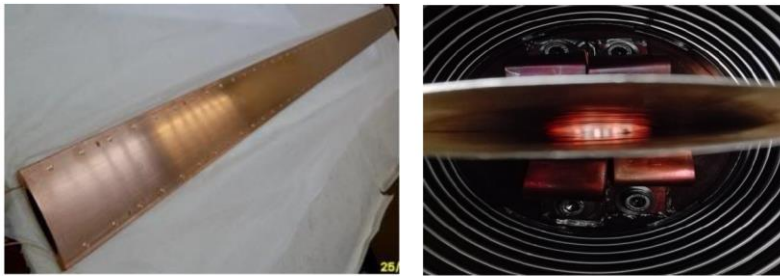
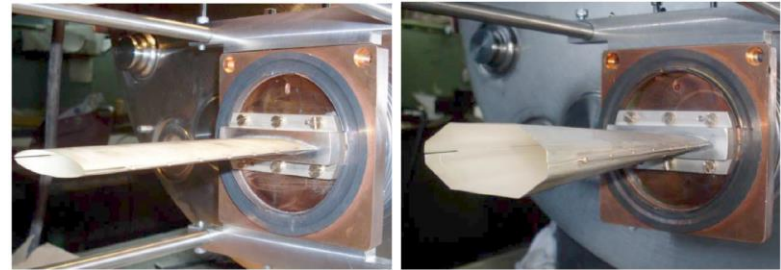


Figure 3. Liner before (left) and after (right) its insertion in vacuum chamber.



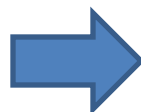
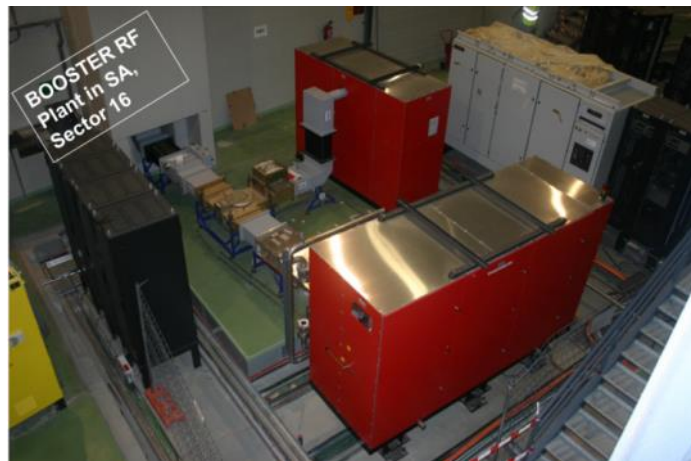
Intervention foresee (*BINP availability*)

8 – 20 January 2019

Accelerator Developments



RF upgrade - Booster 48kW SSA



In operation since 21st August 2018

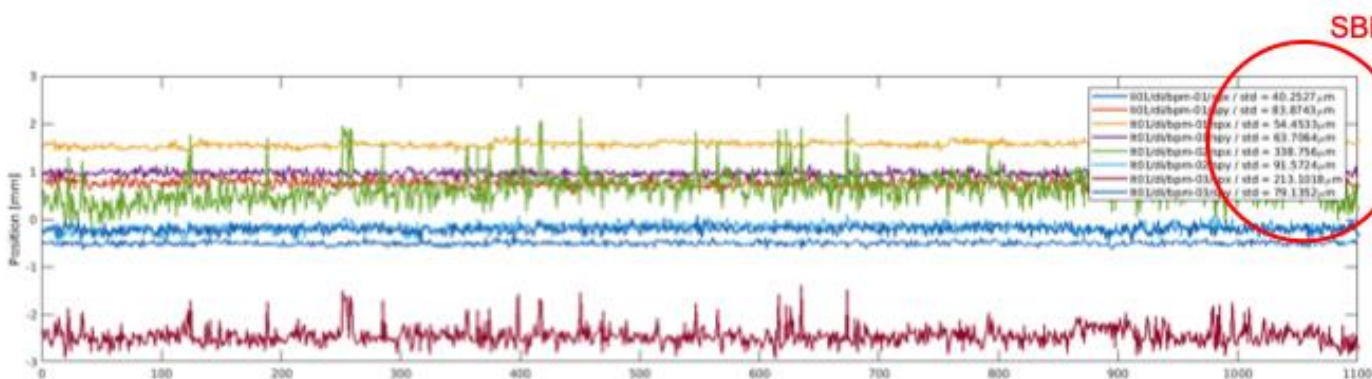
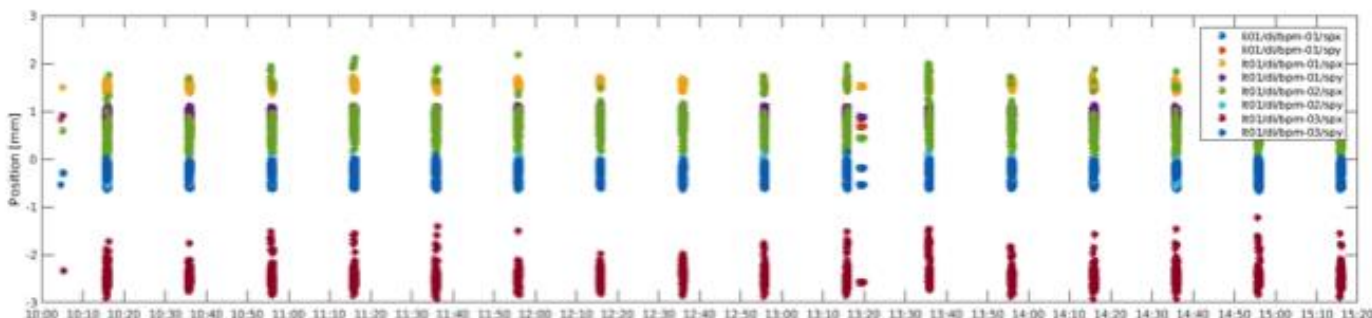
The change had no impact on the operation

Redundancy: 2/12 modules can fail. Hot swap

Operating frequency:	499.654 MHz
Nominal output power (1dB compression):	40 kW
Output power (2dB compression):	48 kW
Nominal duty cycle:	CW
Gain:	>78dB.
Transmitter efficiency:	>60%.
RF power with one module off:	40kW.
Quick fittings for cooling connection.	
Power supplies efficiency:	>95%.

Libera SPARK Single Pass

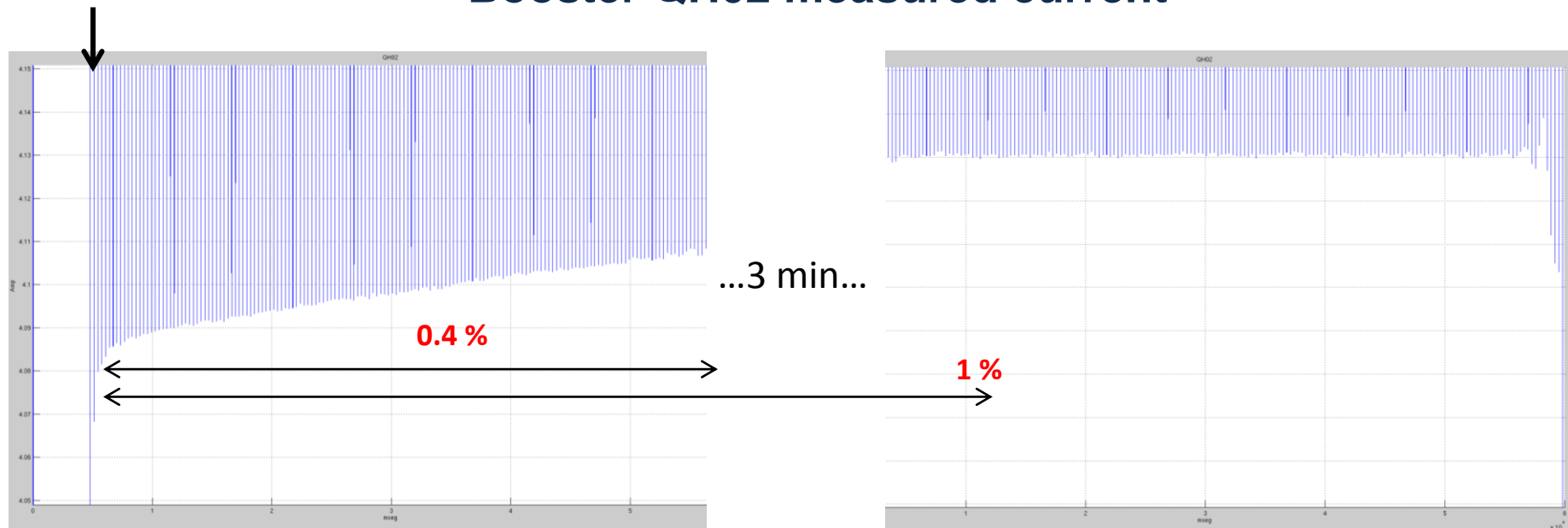
- BPM electronics for LINAC and LTB were upgraded to Sparks
- They are now up and running
- Resolution improved from 'mm' down to tens of 'um' in Single Bunch Mode



Booster PS warm up in DC

Ramping
starts
here

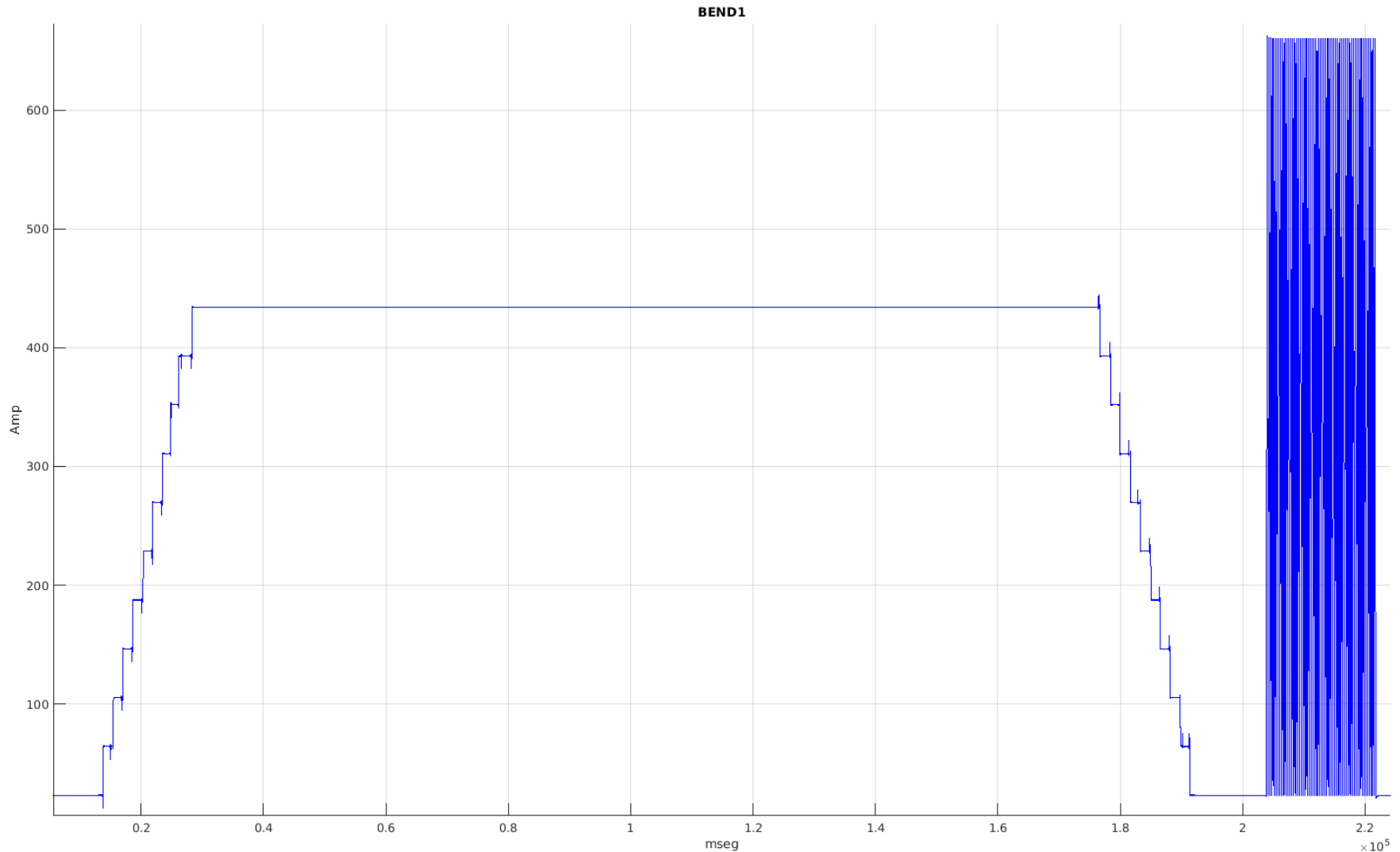
Booster QH02 measured current



300 waveforms right after ramping starts

300 waveforms after 3 minutes

Booster PS warm up in DC

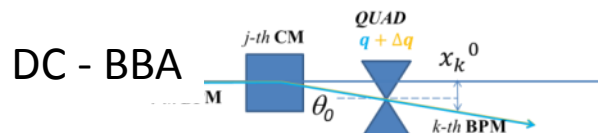


Proceedings of IPAC2018, Vancouver, BC, Canada - Pre-Release Snapshot 27-May-2018 12:00 UTC

FAST QUADRUPOLE BEAM BASED ALIGNMENT USING AC CORRECTOR EXCITATIONS

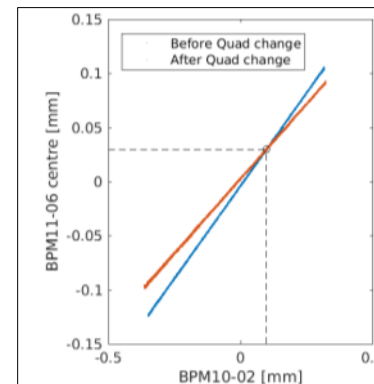
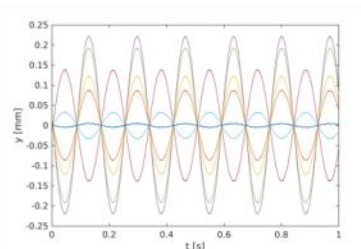
Z. Martí*, G. Benedetti, U. Iriso, ALBA-CELLS Synchrotron Radiation Facility,
Carrer de la Llum 2-26, 08290 Cerdanyola del Vallés, Spain

Beam2bpm:



- **Slow** (Both CM and quads are scanned, ~5h at ALBA!)
- **Model independent**, no need to correct after each measurement.
- There is a systematic error in case of large misalignments depending on the orbit angle.

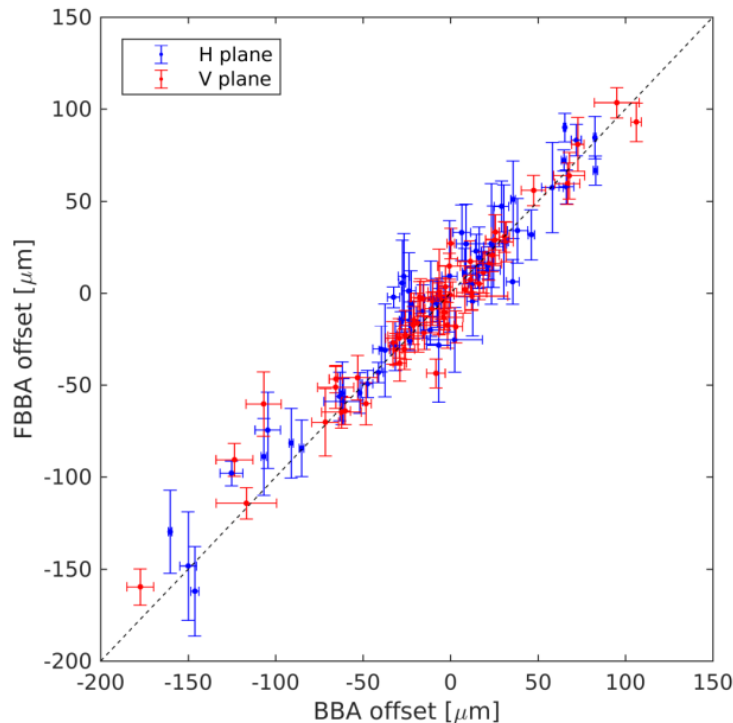
While the j -th CM changes the kick $\theta_j(t)$, the BPM readings are linearly related:



- 10kHz **Fast Acquisition Archiver**
- **AC** corrector magnets excitation.

The intersection of each BPM couple relation when the quadrupole is changed is the **offset**.

Fast Beam Based Alignment

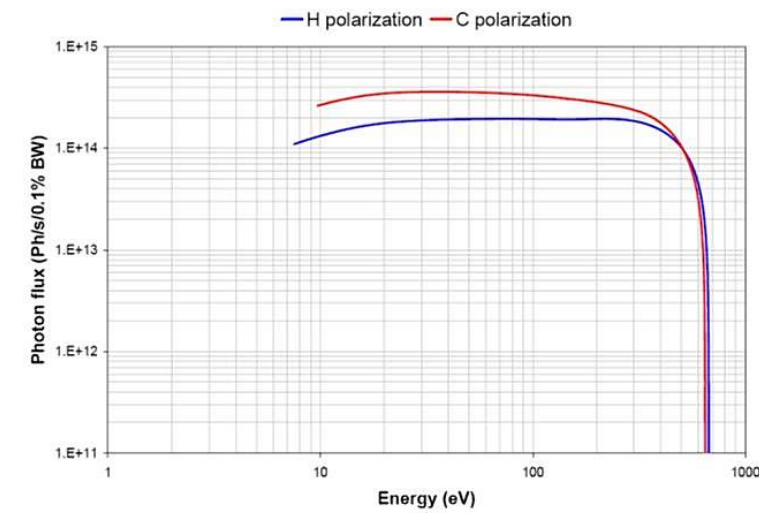
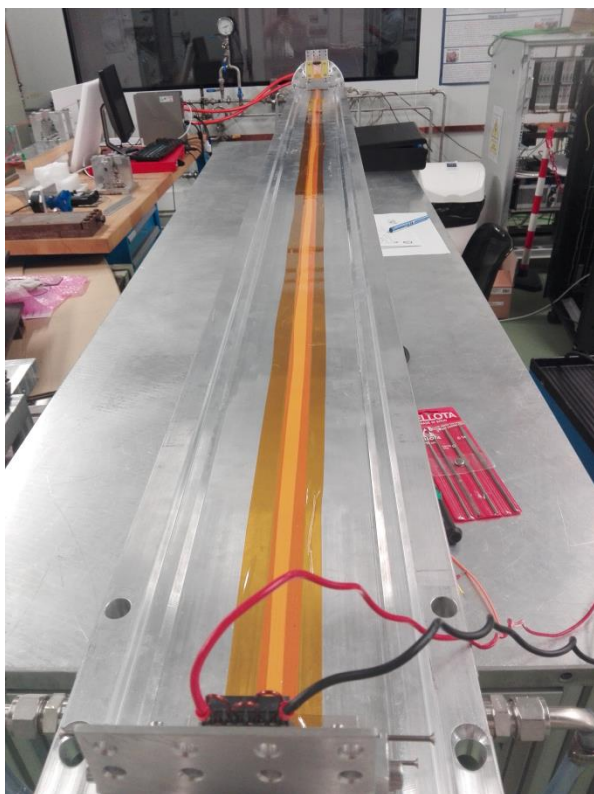


Perfect
correlation
between
standard BBA
&
Fast BBA

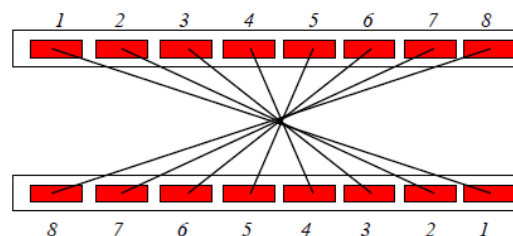
- The FBBA is **~30 times faster** (10 min vs 5h) than the standard BBA.
- The level of accuracy is similar.

LOREA ID distortion

- Low energies, long period: EU125
 - Tune shift
 - Dynamic aperture



- Correction scheme is based on two thin foils (<0.5mm) with 8 printed cables (cross section 3x0.3mm) placed on the Al chamber



Dynamic aperture

Dyn. Aper. & Inj. Eff.

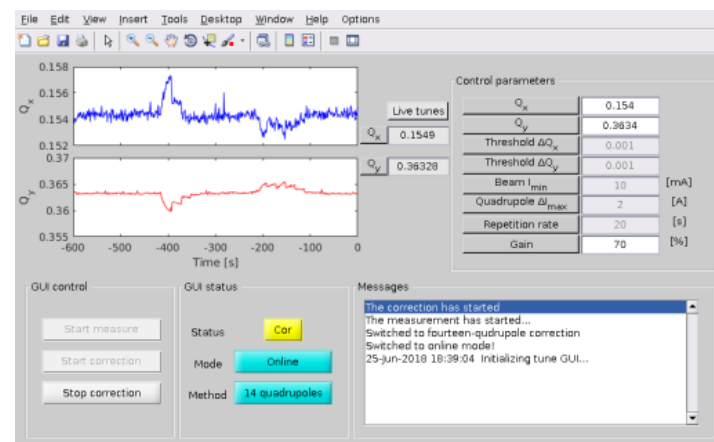
Lorea's ID Minimum gap
Injection efficiency test

Phase	Inj Eff
H	90.92%
C	88.62%
V	52.15%
V(step tune [+0.015 0])	47.06%
V(step tune [0 -0.012])	59.59%

Correction will be needed

Tune Feedback

Pol. Mode.	ΔQ [1e-2]	$\Delta\beta/\beta$ [%]
<i>EPU125_H</i>	0.31/0.07	1.98/0.35
<i>EPU125_C</i>	-0.60/0.63	4.02/3.39
<i>EPU125_V</i>	-1.48/1.15	10.60/6.41
<i>EPU125_H + strips</i>	0.18/0.15	1.17/0.81
<i>EPU125_C + strips</i>	0.15/0.13	0.98/0.67
<i>EPU125_V + strips</i>	0.02/0.19	0.15/1.00

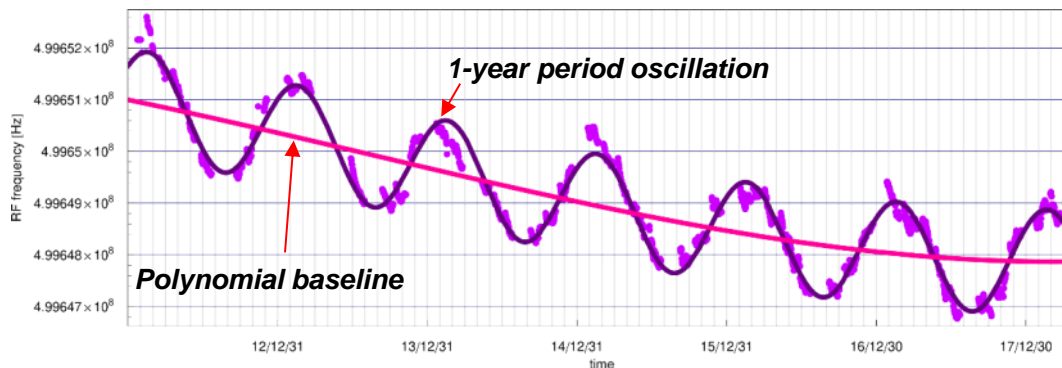


Global Stability Study

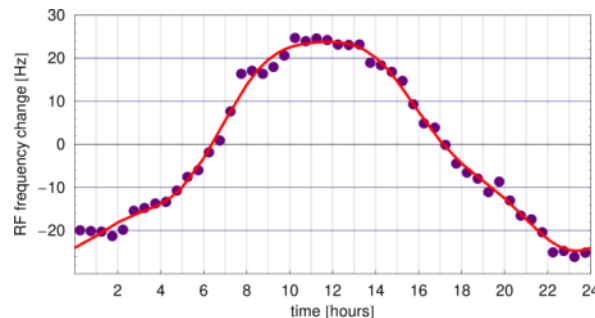
- We have **launched a study** aimed to determine and **correlate electron beam motion, concrete slab motion and ground motion** at different time scales.
- Set an **interdisciplinary working group** to put in common and share knowledge in different areas relevant for this topic (Survey & Alignment, BPMs, XBPMs), reanalyze from a new point of view data stored up to now, and propose new sets of measurements to shed light on it.
- Several observables followed now for 2 runs.

Global Stability Study

- RF frequency follows the **oscillations** of the external **meteorological parameters**, with two main periodicities: **1 year** and **1 day**.
- On top the periodic oscillations of the RF frequency, it exists a **monotonic decrease** with time. May it be associated to long-term deformations of the ground not linked to thermal-driven expansion/contraction cycles? (**settlement of soil**). Apparently this drift is **decreasing** with time.

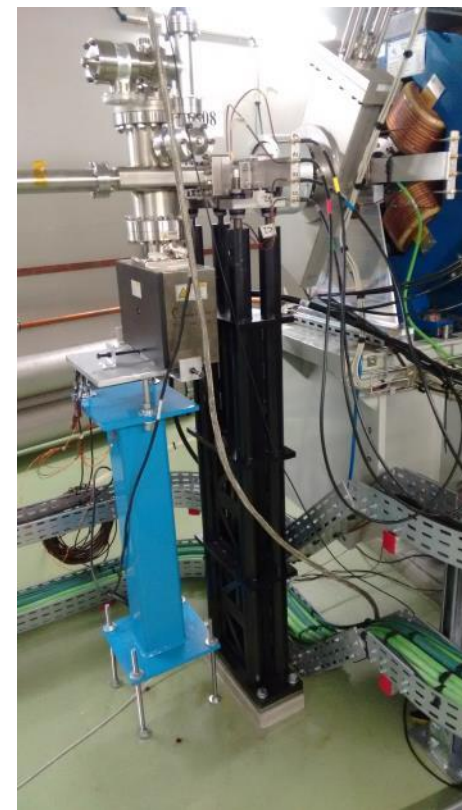
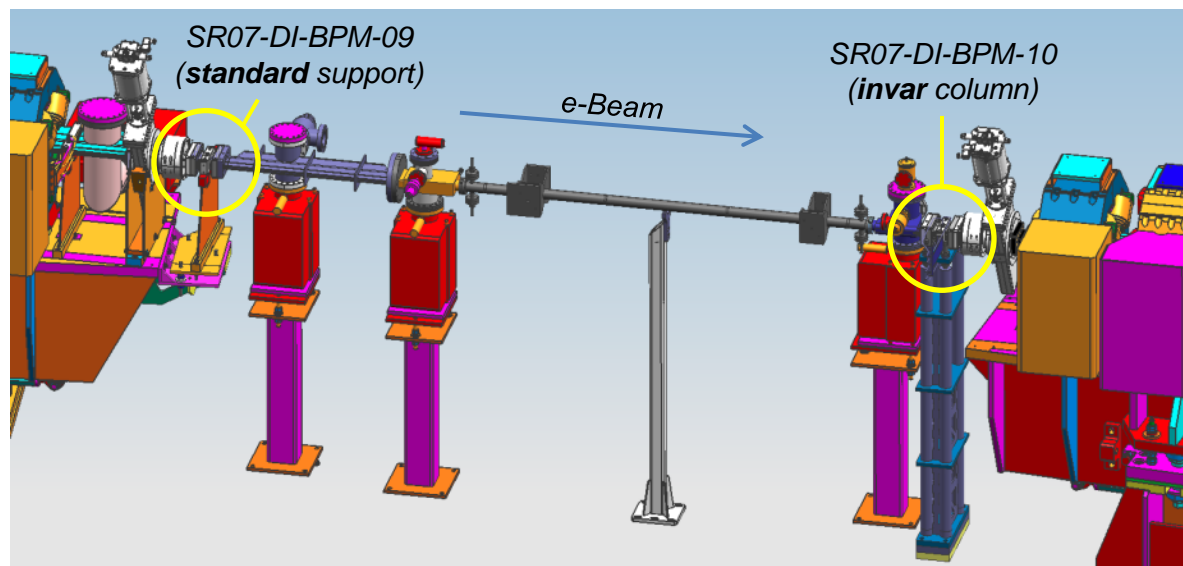


$$\Delta \ell(2012 \rightarrow 2018) \simeq +1.7\text{mm}$$

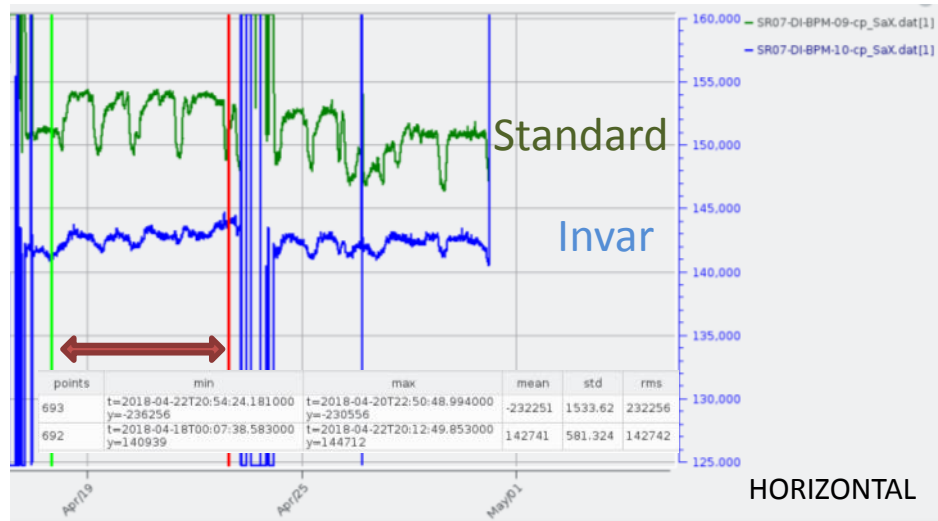


$$\Delta \ell(\text{day} - \text{night}) \simeq \pm 13\mu\text{m}$$

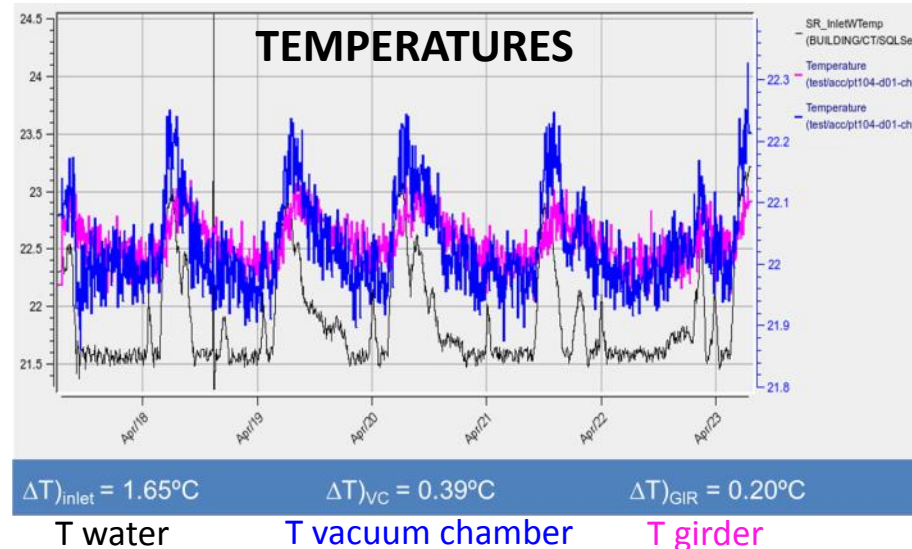
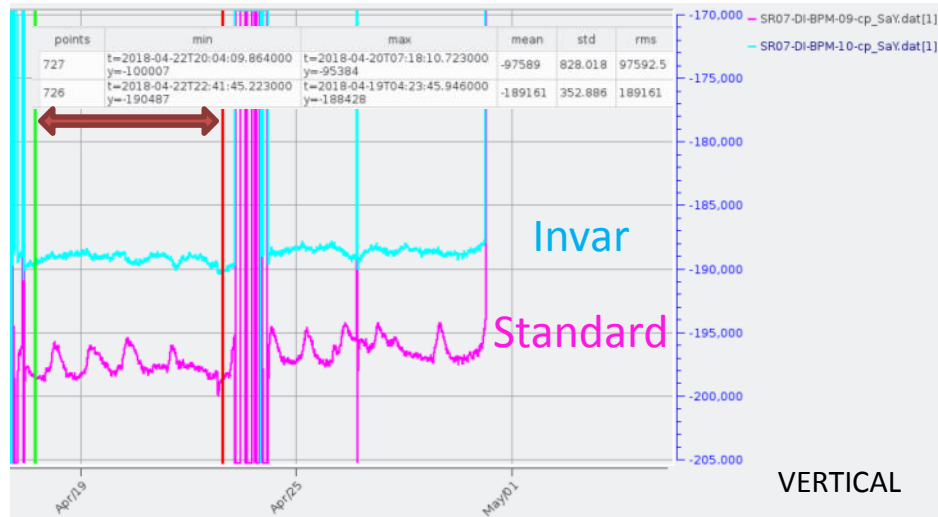
Beam transversal position



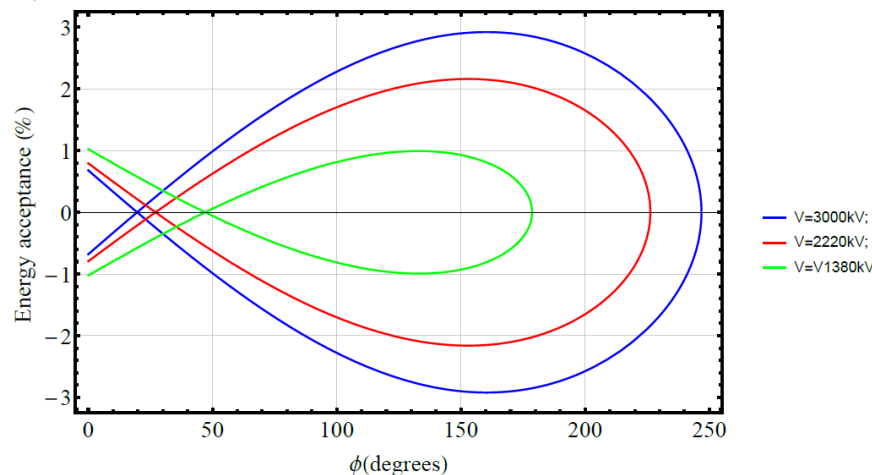
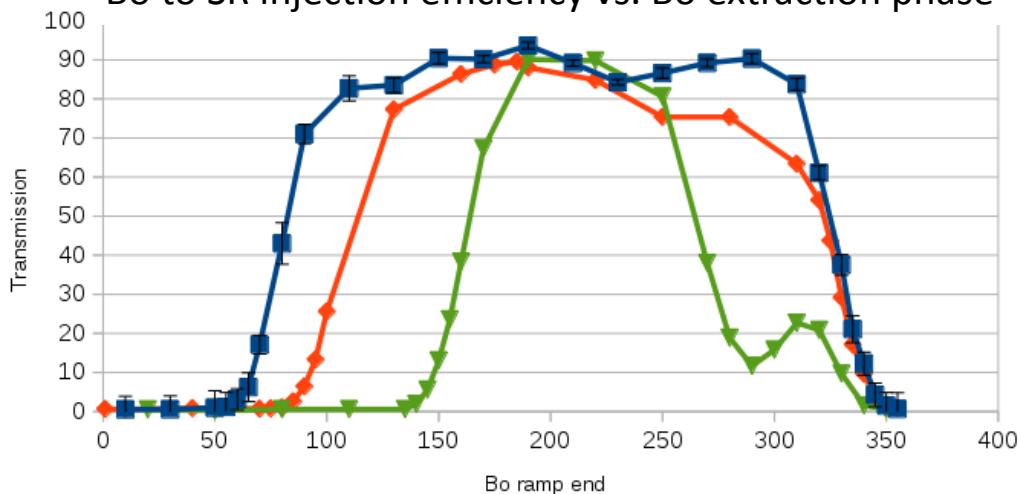
- BPMs not on the FOFB
- 1 x standard support (bracket to the girder)
- **1 x invar column** (1/10 thermal expansion coefficient of steel)



BPMs not in the FOFB	
BPM	rms (1 week)
X Standard support	1.5 μm
X Invar support	0.6 μm
Y Standard support	0.8 μm
Y Invar support	0.3 μm



Bo to SR injection efficiency vs. Bo extraction phase



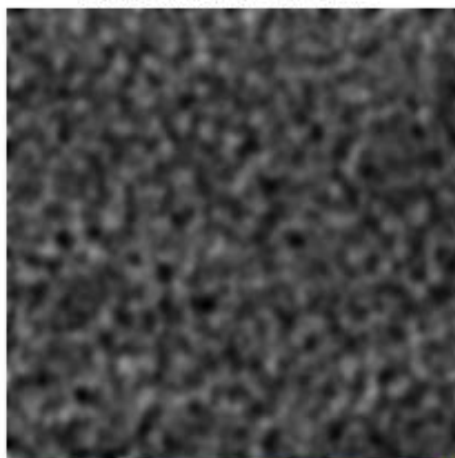
Energy acceptance		
Vrf	energy acceptance measurement	energy acceptance theory
500kV/Cav	3,06	3,06
370kV/Cav	2,33	2,27
230kV/cav	0,9	1,04

Speckle beam size measurements

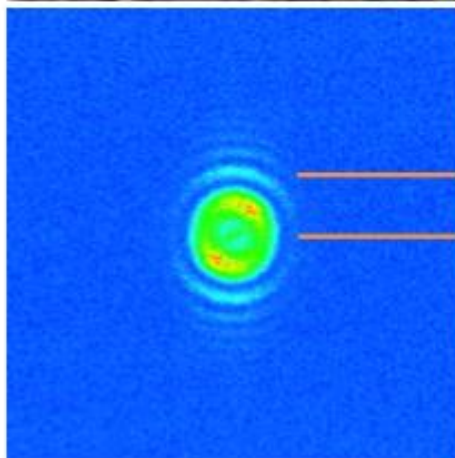
PSA: Speckle measurements at NCD, 16-July-2018

Success!

Achieved with 20x mag @ 25 cm
WD, 0.1 mm YAG, 150 mA

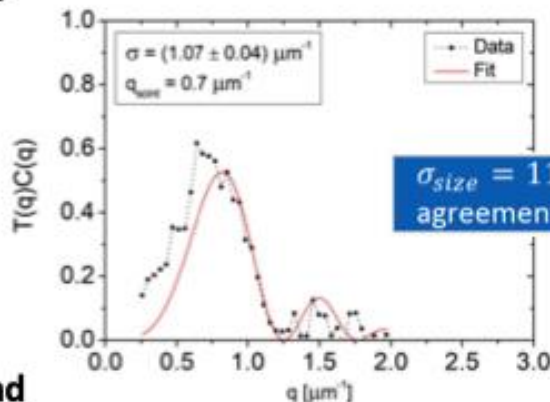
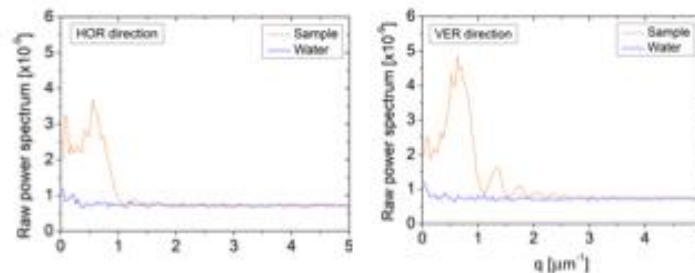


150 μm



$\theta \approx 20 \text{ urad}$

$\Delta r \approx 5 \text{ } \mu\text{m}$



$\sigma_{size} = 111 \pm 10 \text{ } \mu\text{m}$ (fair agreement with 130 μm)

Transverse beam profile measurement using the Heterodyne Near Field Speckles method at ALBA

S. Mazzoni, F. Roncarolo, G. Trad (CERN, Geneva)

U. Irigo, C. S. Kamma-Lorger, A. A. Nosych (ALBA CELLS Synchrotron, Cerdanyola del Vallès)

B. Paroli, M. A. C. Potenza, M. Siano (Università degli Studi di Milano, Milano)

7th International Beam Instrumentation Conference, 9-13 September 2018, Shanghai, China

在上海举行的IBIC2018会议上发表 →

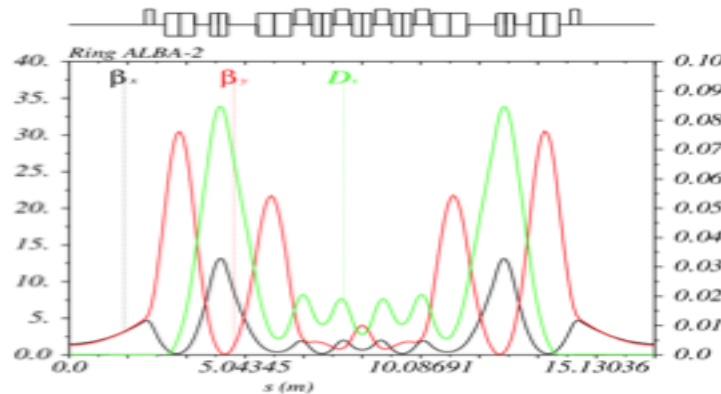
Started to study a baseline hybrid 7BA + Anti Bend cell preserving circumference and energy; without longitudinal gradient in bending magnets.

$$\epsilon_x = 160 \text{ pm}\cdot\text{rad}$$

16 identical cells - 16 straight sections

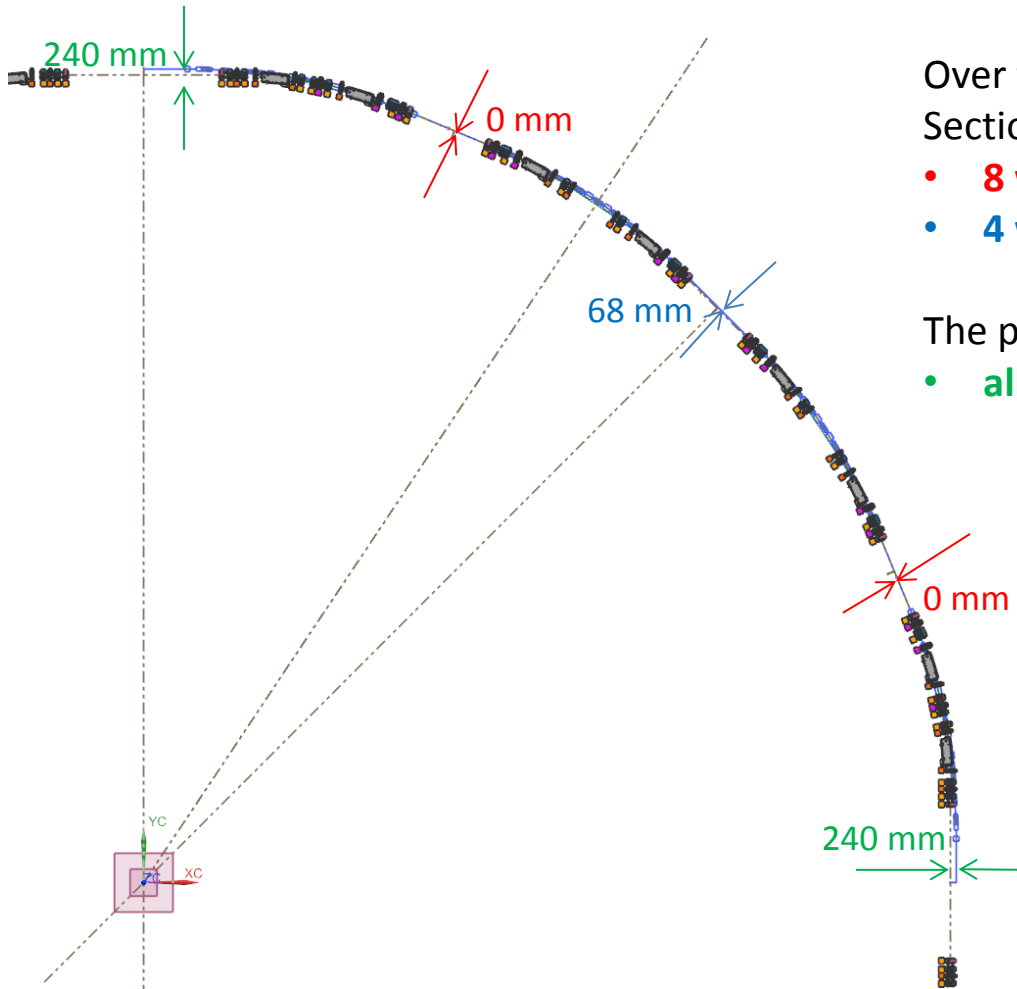
$$L_{ss} = 4.35 \text{ m}$$

$$\beta_x = \beta_y = 1.5 \text{ m}$$



PRELIMINARY

PostDoc position foresee for 2019



Over the present 12 Medium Straight Sections:

- **8 would be preserved**
- **4 would be shifted by 68 mm**

The present 4 Long Straight Sections:

- **all would be shifted by 240 mm**

PRELIMINARY

PostDoc position foresee for 2019

- *H2020 - XLS*

→ 1st Annual Meeting hosted by ALBA, 10 – 12 Dec 2018

→ Post Doc

Compact 



- FCC-CERN – HTS-BS-FCC

→ PhD student



HTS Coated Conductors for FCC
beam screen

HTSCC-Beam Screen Proposal

- EU H2020 Project EuroCirCol

→ PhD student



- Collaboration with CLIC-CERN



- H2020 - ARIES – ADA

→ Fast Feed Back Workshop hosted by ALBA, 12 -14 Nov 2018



- *ESRF - EBS – BPM tool*



- *SIRIUS - Digital LLRF*



Brazilian Synchrotron
Light Laboratory

THANK YOU FOR YOUR ATTENTION

And thanks to the Accelerator Division

