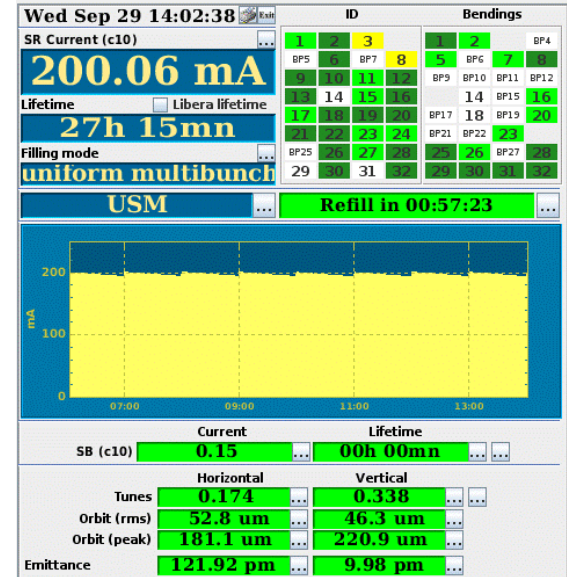


ESRF-EBS: Implementation, Commissioning and Restart of User Operation during COVID-19 pandemic

Jean-Luc Revol, A Franchi, L Hardy, I Leconte

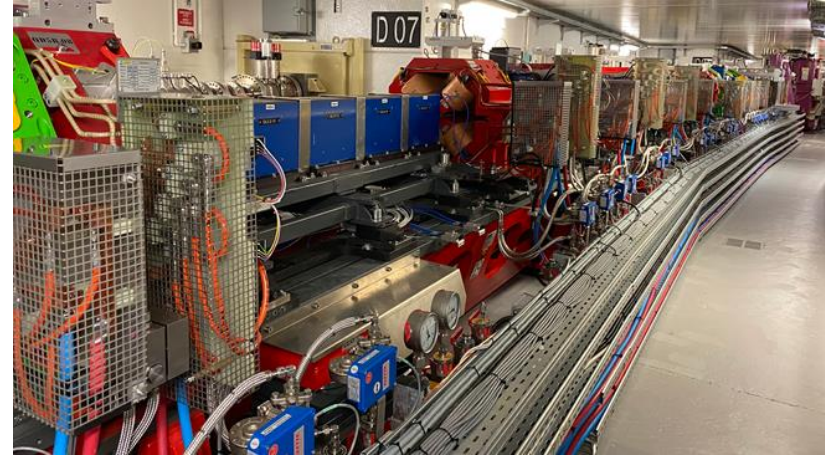
On behalf of the ESRF Accelerator and Source Division



The European Synchrotron



- The ESRF-EBS project
- Implementation and start-up
- Commissioning and restart of user operation
- COVID-19 pandemic: impact and lessons learnt



ESRF FACTS AND FIGURES

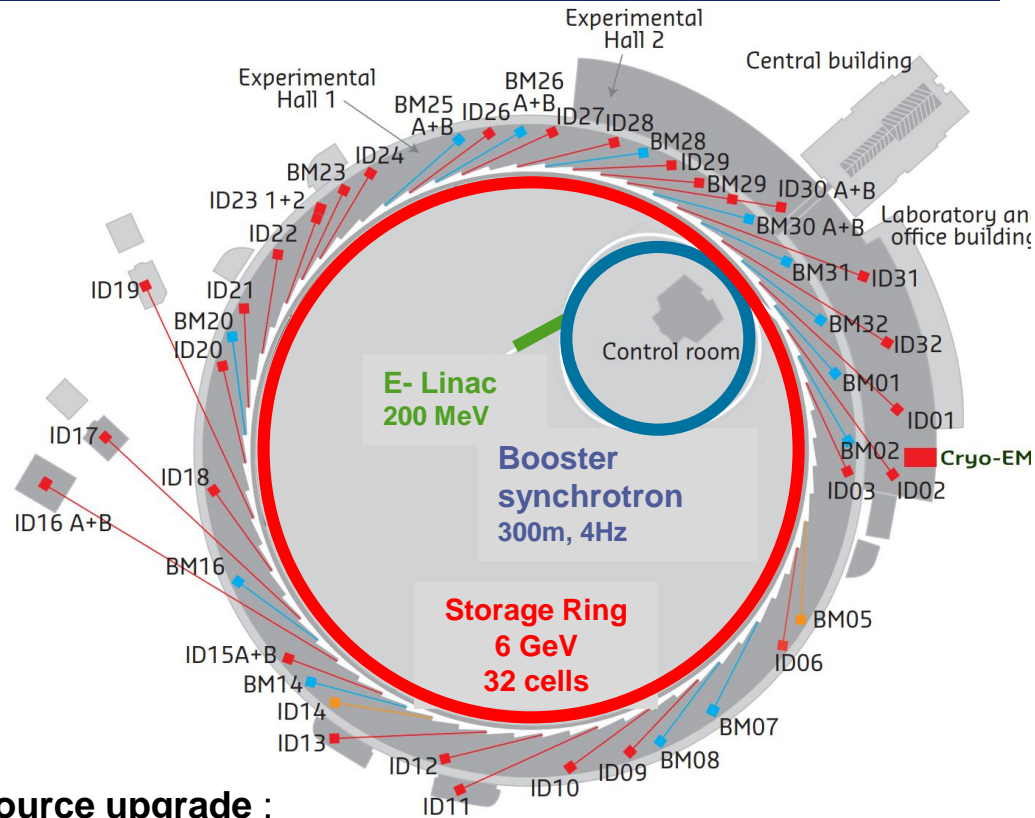
Light source in operation since 1994

Located in Grenoble, France

22 partner nations

Annual budget: 100 million euros

Staff: 650



Purple Book
January 2008

Orange Book
January 2015

ESRF UPGRADE PHASE I
180 M€ (2009-2015):
ESFRI ROADMAP 2006-2016
ON TIME – WITHIN BUDGET

- 19 new beamlines, many specialised in nano-beam science
- Upgrade and renewal of facilities and support laboratories

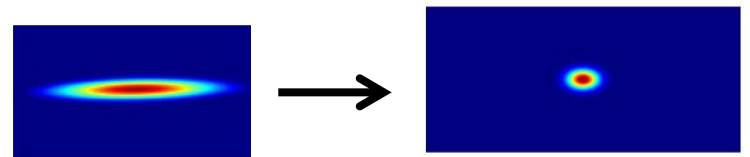
ESRF-EBS
Extremely Brilliant Source
150 M€ (2015-2022):
ESFRI LANDMARK (2016)

Revolutionary design
for a new generation of
synchrotron source storage rings

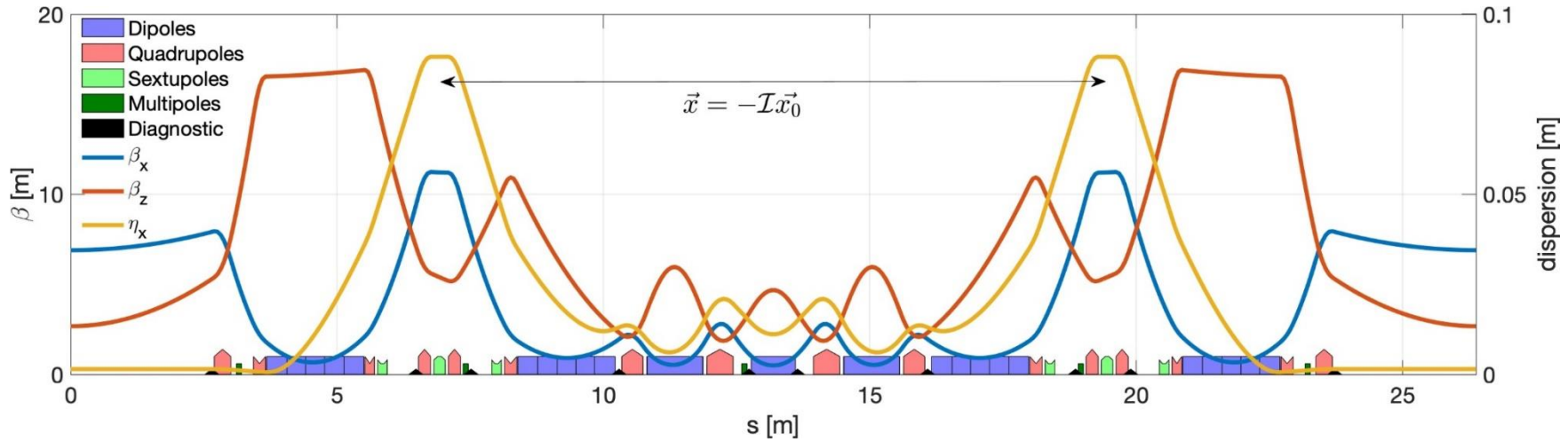
ESFRI

The ESRF Extremely Brilliant Source upgrade :

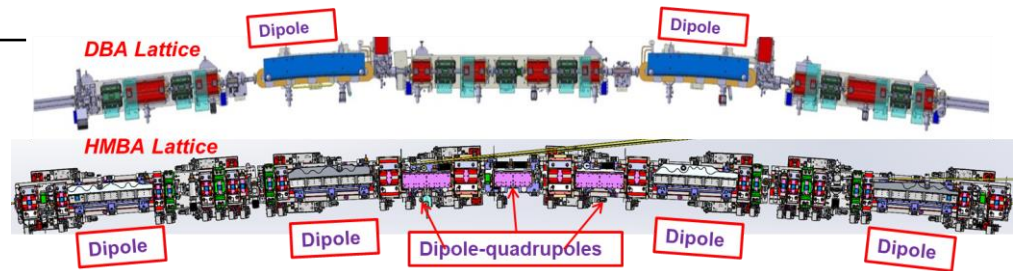
- Decrease the horizontal emittance
- Increase the source brilliance
- Increase the source coherence



THE ESRF-EBS UPGRADE

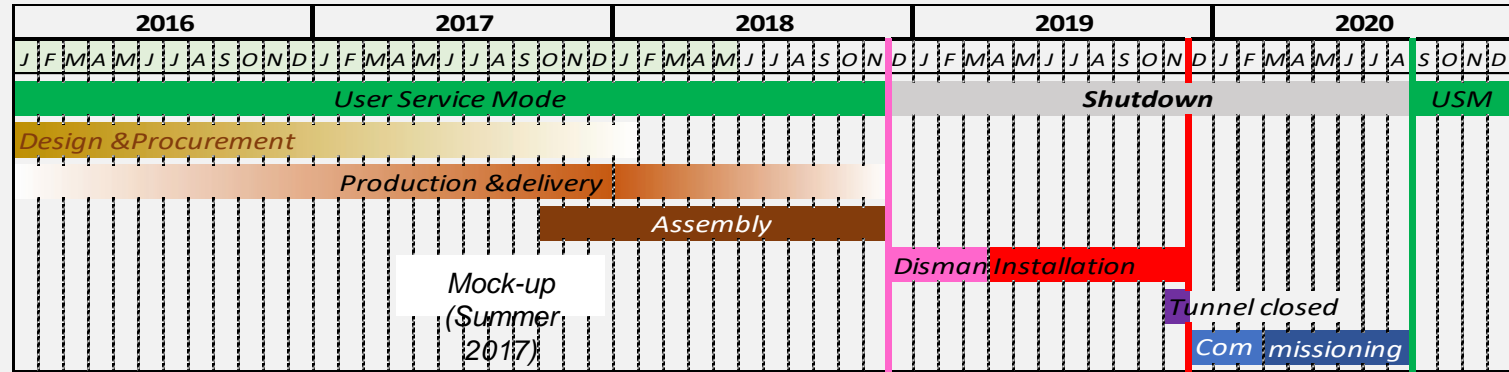


	<i>Units</i>	ESRF	ESRF-EBS
Energy	<i>GeV</i>	6	6
Circumference	<i>m</i>	844.4	844
Lattice		DBA	HMBA
Current	<i>mA</i>	200	200
Lifetime	<i>h</i>	50	25
Emittance H	<i>pm.rad</i>	4000	133
Emittance V	<i>pm.rad</i>	4	10*



31 magnets per cell instead of 17

ESRF-EBS PROJECT IMPLEMENTATION



Old ESRF-Storage Ring



- October 2017 Start of girder assembly
- 10 December 2018 End USM, start shutdown
- Dismantling
- Installation
- 8 November 2019 Tunnel closed
- Tests & Injector restart
- 28 November 2019 Accelerator commissioning
- 2 March 2020 Beamline commissioning
- 25 August 2020 Start User Mode Operation

ESRF-EBS



COVID1-9 impacted the schedule as of 14 March 2020 (only), affecting mostly the beamline and user programme

ESRF-EBS PRE COVID: INSTALLATION IN THE TUNNEL



Dismantling



Entering girders



Interconnection & alignment



Radiofrequency



Dismantling



Moving girders



Piping

Cabling



Straight section for IDs



December 2018



Girder in place



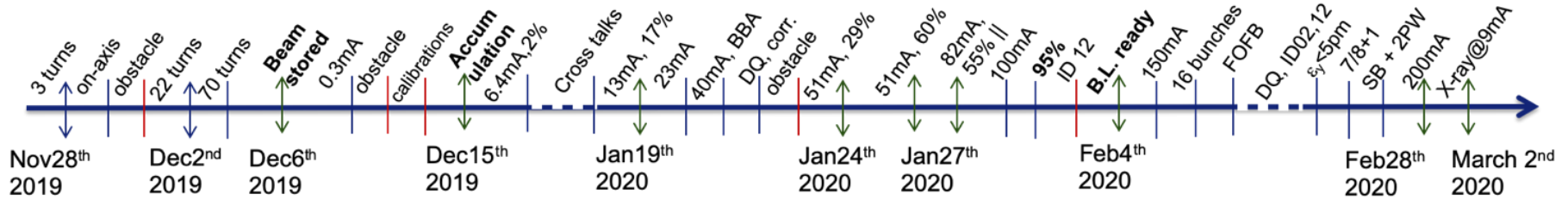
Injection zone



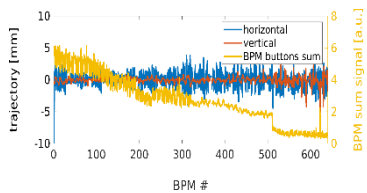
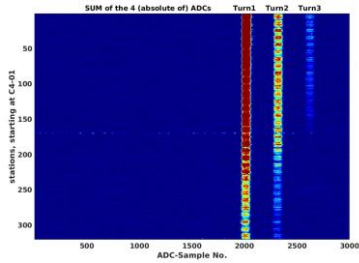
Front ends

November 2019

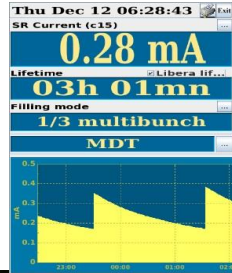
ESRF-EBS PRE COVID: COMMISSIONING



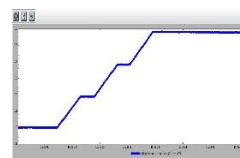
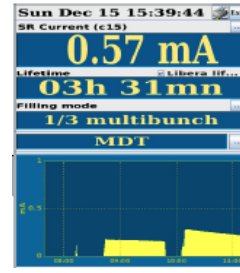
28th November
First turns



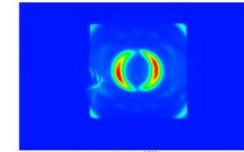
6th December
Beam stored



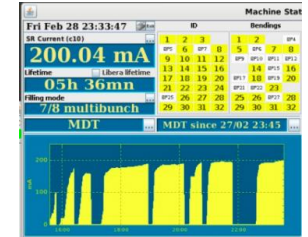
15th December
Accumulation



30th January
First Beam on
26 Beamlines

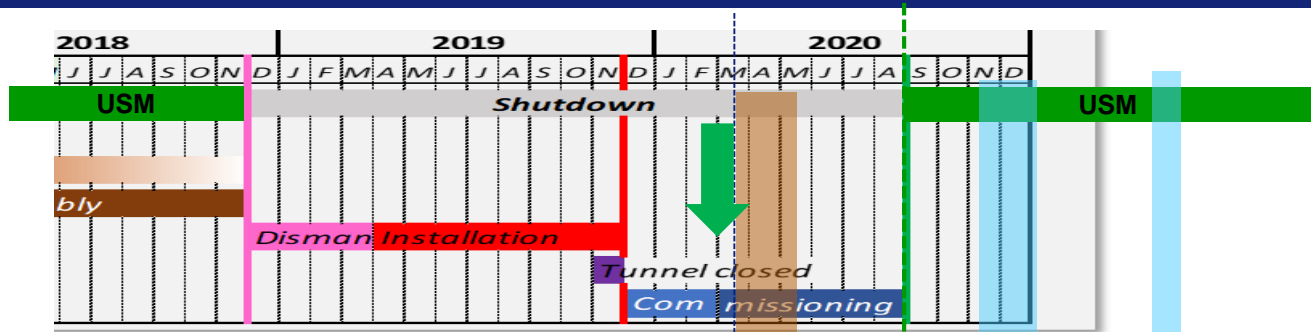
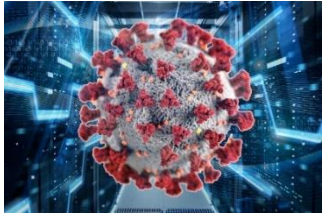


28th February
200 mA achieved



3 physical obstacles in the path of the beam and poor vacuum in a few ID NEG coated chambers slowed down the overall commissioning.

ESRF-EBS IMPACT OF COVID-19 PANDEMIC



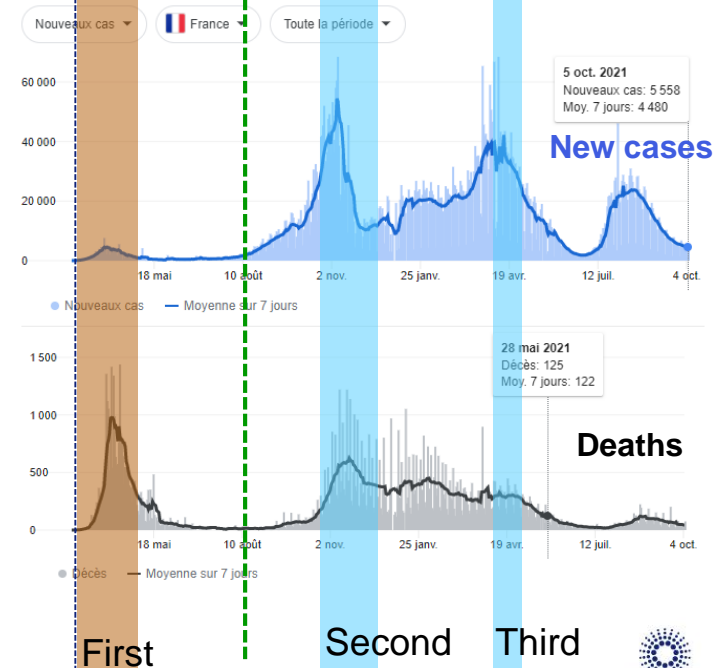
→ 28 Feb. 2020 plan: Machine ready → **Achieved**

→ 03 March 2020 plan: Start of beamline commissioning → **Achieved**

But: *17-03/20 to 11/05/20: First lockdown in France* (declared on 14/03/20)
 → **ESRF Closure** → **Stop operation**

→ 25 August 2020 plan: Start of user operation → **Achieved**

But: *30/10/20 to 15/12/20: Second lockdown*
03/04/21 to 03/05/21: Third lockdown
 → **Adaptation of the operation planning for users**



2020 INITIAL OPERATION SCHEDULE

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	M M C	Sun 01	M M M	Wed 01	B B B	Fri 01	C C C	Mon 01	B B B	Wed 01	B B B	Sat 01	s s s	Tue 01	M M M	Thu 01	.	Sun 01	.	Tue 01	M M M	.	.
Thu 02	s s s	Sun 02	M M C	Mon 02	B B B	Thu 02	B B B	Sat 02	C C C	Tue 02	B B B	Thu 02	B B B	Sun 02	s s s	Wed 02	.	Fri 02	.	Mon 02	.	Wed 02	.	.	.
Fri 03	s s s	Mon 03	M M C	Tue 03	B B B	Fri 03	B B B	Sun 03	C C C	Wed 03	s s s	Fri 03	B B B	Mon 03	s s s	Thu 03	.	Sat 03	.	Tue 03	M M M	Thu 03	.	.	.
Sat 04	s s s	Tue 04	M M C	Wed 04	B B B	Sat 04	B B B	Mon 04	B B B	Thu 04	s s s	Sat 04	B B B	Tue 04	s s s	Fri 04	.	Sun 04	.	Wed 04	.	Fri 04	.	.	.
Sun 05	s s s	Wed 05	M M C	Thu 05	B B B	Sun 05	B B B	Tue 05	B B B	Fri 05	s s s	Sun 05	B B B	Wed 05	s s s	Sat 05	.	Mon 05	.	Thu 05	.	Sat 05	.	.	.
Mon 06	s s s	Thu 06	M M C	Fri 06	B B B	Mon 06	B M M	Wed 06	B B B	Sat 06	s s s	Mon 06	B B B	Thu 06	s s s	Sun 06	.	Tue 06	M M M	Fri 06	.	Sun 06	.	.	.
Tue 07	s s s	Fri 07	M M C	Sat 07	B B B	Tue 07	M M M	Thu 07	B B B	Sun 07	s s s	Tue 07	M M M	Fri 07	s s s	Mon 07	.	Wed 07	.	Sat 07	.	Mon 07	.	.	.
Wed 08	s s s	Sat 08	M M C	Sun 08	B B B	Wed 08	B B B	Fri 08	B B B	Mon 08	s s s	Wed 08	B B B	Sat 08	s s s	Tue 08	M M M	Thu 08	.	Sun 08	.	Tue 08	M M M	.	.
Thu 09	s s s	Sun 09	M M C	Mon 09	B M M	Thu 09	B B B	Sat 09	B B B	Tue 09	s s s	Thu 09	B B B	Sun 09	s s s	Wed 09	.	Fri 09	.	Mon 09	.	Wed 09	.	.	.
Fri 10	s s s	Mon 10	R M C	Tue 10	M M M	Fri 10	B B B	Sun 10	B B B	Wed 10	s s s	Fri 10	B B B	Mon 10	s s s	Thu 10	.	Sat 10	.	Tue 10	M M M	Thu 10	.	.	.
Sat 11	s s s	Tue 11	R M C	Wed 11	B B B	Sat 11	B B B	Mon 11	B B B	Thu 11	s M M	Sat 11	B B B	Tue 11	s s s	Fri 11	.	Sun 11	.	Wed 11	.	Fri 11	.	.	.
Sun 12	s s s	Wed 12	R M C	Thu 12	B B B	Sat 12	B B B	Tue 12	M M M	Fri 12	M M M	Sun 12	B B B	Wed 12	s s s	Sat 12	.	Mon 12	.	Thu 12	.	Sat 12	.	.	.
Mon 13	s s s	Thu 13	s s s	Fri 13	B B B	Mon 13	B B B	Wed 13	B B B	Sat 13	M M M	Mon 13	B B B	Thu 13	s s s	Sun 13	.	Tue 13	.	Fri 13	.	Sun 13	.	.	.
Tue 14	s s s	Fri 14	s s s	Sat 14	B B B	Tue 14	s s s	Thu 14	B B B	Sun 14	M M M	Tue 14	M M M	Fri 14	s s s	Mon 14	.	Wed 14	s s s	Sat 14	.	Mon 14	s s s	s s s	s s s
Wed 15	s s s	Sat 15	s s s	Sun 15	B B B	Wed 15	s s s	Fri 15	B B B	Mon 15	M M M	Wed 15	B B B	Sat 15	s s s	Tue 15	M M M	Thu 15	s s s	Sun 15	.	Tue 15	s s s	s s s	s s s
Thu 16	s s s	Sun 16	s s s	Mon 16	B M M	Thu 16	s s s	Sat 16	V B B	Tue 16	B B B	Thu 16	B B B	Sun 16	s s s	Wed 16	R	Fri 16	s s s	Mon 16	.	Wed 16	s s s	s s s	s s s
Fri 17	M M C	Mon 17	s s s	Tue 17	M M M	Fri 17	s s s	Sun 17	B B B	Wed 17	B B B	Fri 17	B B B	Mon 17	s s s	Thu 17	.	Sat 17	s s s	Tue 17	M M M	Thu 17	s s s	s s s	s s s
Sat 18	M M C	Tue 18	s s s	Wed 18	B B B	Sat 18	s s s	Mon 18	B B B	Thu 18	B B B	Sat 18	B B B	Tue 18	s s s	Fri 18	.	Sun 18	s s s	Wed 18	.	Fri 18	s s s	s s s	s s s
Sun 19	M M C	Wed 19	s s s	Thu 19	B B B	Sun 19	s s s	Tue 19	M M M	Fri 19	B B B	Sun 19	B B B	Wed 19	s s s	Sat 19	.	Mon 19	s s s	Thu 19	.	Sat 19	s s s	s s s	s s s
Mon 20	M M C	Thu 20	s M C	Fri 20	B B B	Mon 20	s s s	Wed 20	B B B	Sat 20	B B B	Mon 20	M M M	Thu 20	s M M	Sun 20	.	Tue 20	s s s	Fri 20	.	Sun 20	s s s	s s s	s s s
Tue 21	M M C	Fri 21	M M C	Sat 21	B B B	Tue 21	s s s	Thu 21	B B B	Sun 21	B B B	Tue 21	M M M	Mon 21	M M M	Mon 21	.	Wed 21	s s s	Sat 21	.	Mon 21	s s s	s s s	s s s
Wed 22	M M C	Sat 22	M M C	Sun 22	B B B	Wed 22	s s s	Fri 22	B B B	Mon 22	B B B	Wed 22	B B B	Sat 22	M M M	Tue 22	M M M	Thu 22	s M M	Sun 22	.	Tue 22	s s s	s s s	s s s
Thu 23	M M C	Sun 23	M M C	Mon 23	B M M	Thu 23	s s s	Sat 23	B B B	Tue 23	M M M	Thu 23	B B B	Sun 23	M M M	Wed 23	.	Fri 23	M M M	Mon 23	.	Wed 23	s s s	s s s	s s s
Fri 24	M M C	Mon 24	M M C	Tue 24	M M M	Fri 24	s s s	Sun 24	B B B	Wed 24	B B B	Fri 24	B B B	Mon 24	M M M	Thu 24	.	Sat 24	M M M	Tue 24	M M M	Thu 24	s s s	s s s	s s s
Sat 25	M M C	Tue 25	M M C	Wed 25	B B B	Sat 25	s s s	Mon 25	B B B	Thu 25	B B B	Sat 25	B B B	Tue 25	.	Fri 25	.	Sun 25	M M M	Wed 25	.	Fri 25	s s s	s s s	s s s
Sun 26	M M C	Wed 26	M M C	Thu 26	B B B	Sun 26	s s s	Tue 26	M M M	Fri 26	B B B	Sun 26	B B B	Wed 26	.	Sat 26	.	Mon 26	M M M	Thu 26	.	Sat 26	s s s	s s s	s s s
Mon 27	M M C	Thu 27	M M C	Fri 27	B B B	Mon 27	s s s	Wed 27	B B B	Sat 27	B B B	Mon 27	s s s	Thu 27	.	Sun 27	.	Tue 27	.	Fri 27	.	Sun 27	s s s	s s s	s s s
Tue 28	M M C	Fri 28	M M C	Sat 28	B B B	Tue 28	s M M	Thu 28	B B B	Sun 28	B B B	Tue 28	s s s	Fri 28	.	Mon 28	.	Wed 28	.	Sat 28	.	Mon 28	s s s	s s s	s s s
Wed 29	M M C	Sat 29	M M C	Sun 29	B B B	Wed 29	M M M	Fri 29	B B B	Mon 29	B B B	Wed 29	s s s	Sat 29	.	Tue 29	M M M	Thu 29	.	Sun 29	.	Tue 29	s s s	s s s	s s s
Thu 30	M M C			Mon 30	B M M	Thu 30	M M M	Sat 30	B B B	Tue 30	M M M	Thu 30	s s s	Sun 30	.	Wed 30	.	Fri 30	.	Mon 30	.	Wed 30	s s s	s s s	s s s
Fri 31	M M C			Tue 31	M M M			Sun 31	B B B			Fri 31	s s s	Mon 31	.			Sat 31	.			Thu 31	s s s	s s s	

Machine Commissioning



Beamline Commissioning



USM

2020 WORKING OPERATION SCHEDULE

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	M M C	Sun 01	M M M	Wed 01	s s s	Fri 01	M M M	Mon 01	B B B	Wed 01	B B B	Sat 01	s s s	Tue 01	. M M	Thu 01	. . .	Sun 01	. . .	Tue 01	B B B
Thu 02	s s s	Sun 02	M M C	Mon 02	B B B	Thu 02	s s s	Sat 02	M M M	Tue 02	B B B	Thu 02	B B B	Sun 02	s s s	Wed 02	. . .	Fri 02	. . .	Mon 02	. . .	Wed 02	. . .
Fri 03	s s s	Mon 03	M M C	Tue 03	B B B	Fri 03	s s s	Sun 03	s s s	Wed 03	B B B	Fri 03	B B B	Mon 03	s s s	Thu 03	. . .	Sat 03	. . .	Tue 03	M M M	Thu 03	. . .
Sat 04	s s s	Tue 04	M M C	Wed 04	B B B	Sat 04	s s s	Mon 04	s s s	Thu 04	B B B	Sat 04	B B B	Tue 04	s s s	Fri 04	. . .	Sun 04	. . .	Wed 04	. . .	Fri 04	. . .
Sun 05	s s s	Wed 05	M M C	Thu 05	B B B	Sun 05	s s s	Tue 05	s s s	Fri 05	B B B	Sun 05	B B B	Wed 05	s s s	Sat 05	. . .	Mon 05	. . .	Thu 05	. . .	Sat 05	B B B
Mon 06	s s s	Thu 06	M M C	Fri 06	B B B	Mon 06	s s s	Wed 06	s s s	Sat 06	B B B	Mon 06	B B B	Thu 06	s s s	Sun 06	. . .	Tue 06	M M M	Fri 06	. . .	Sun 06	M M M
Tue 07	s s s	Fri 07	M M C	Sat 07	B B B	Tue 07	s s s	Thu 07	s s s	Sun 07	B B B	Tue 07	M M M	Fri 07	s s s	Mon 07	. . .	Wed 07	. . .	Sat 07	B B B	Mon 07	M M M
Wed 08	s s s	Sat 08	M M C	Sun 08	B B B	Wed 08	s s s	Fri 08	s s s	Mon 08	s s s	Wed 08	B B B	Sat 08	s s s	Tue 08	M M M	Thu 08	. . .	Sun 08	M M M	Tue 08	B B B
Thu 09	s s s	Sun 09	M M C	Mon 09	B M M	Thu 09	s s s	Sat 09	s s s	Tue 09	s s s	Thu 09	B B B	Sun 09	s s s	Wed 09	. . .	Fri 09	. . .	Mon 09	M M M	Wed 09	. . .
Fri 10	s s s	Mon 10	R M C	Tue 10	M M M	Fri 10	s s s	Sun 10	s s s	Wed 10	s s s	Fri 10	B B B	Mon 10	s s s	Thu 10	. . .	Sat 10	. . .	Tue 10	B B B	Thu 10	. . .
Sat 11	s s s	Tue 11	R M C	Wed 11	B B B	Sat 11	s s s	Mon 11	s s s	Thu 11	s s s	Sat 11	B B B	Tue 11	s s s	Fri 11	. . .	Sun 11	. . .	Wed 11	. . .	Fri 11	. . .
Sun 12	s s s	Wed 12	R M C	Thu 12	B B B	Sun 12	s s s	Tue 12	s s s	Fri 12	s s s	Sun 12	B B B	Wed 12	s s s	Sat 12	. . .	Mon 12	. . .	Thu 12	. . .	Sat 12	B B B
Mon 13	s s s	Thu 13	s s s	Fri 13	B B B	Mon 13	s s s	Wed 13	M M M	Sat 13	s s s	Mon 13	B B B	Thu 13	s s s	Sun 13	. . .	Tue 13	. . .	Fri 13	. . .	Sun 13	M M M
Tue 14	s s s	Fri 14	s s s	Sat 14	B B B	Tue 14	s s s	Thu 14	M M M	Sun 14	s s s	Tue 14	M M M	Fri 14	s s s	Mon 14	. . .	Wed 14	s s s	Sat 14	B B B	Mon 14	s s s
Wed 15	s s s	Sat 15	s s s	Sun 15	s s s	Wed 15	s s s	Fri 15	B B B	Mon 15	s s s	Wed 15	B B B	Sat 15	s s s	Tue 15	M M M	Thu 15	s s s	Sun 15	M M M	Tue 15	s s s
Thu 16	s s s	Sun 16	s s s	Mon 16	s s s	Thu 16	s s s	Sat 16	B B B	Tue 16	s s s	Thu 16	B B B	Sun 16	s s s	Wed 16	R . .	Fri 16	s s s	Mon 16	M M M	Wed 16	s s s
Fri 17	M M C	Mon 17	s s s	Tue 17	s s s	Fri 17	s s s	Sun 17	B B B	Wed 17	s s s	Fri 17	B B B	Mon 17	s s s	Thu 17	. . .	Sat 17	s s s	Tue 17	B B B	Thu 17	s s s
Sat 18	M M C	Tue 18	s s s	Wed 18	s s s	Sat 18	s s s	Mon 18	B B B	Thu 18	s s s	Sat 18	B B B	Tue 18	s s s	Fri 18	. . .	Sun 18	s s s	Wed 18	. . .	Fri 18	s s s
Sun 19	M M C	Wed 19	s s s	Thu 19	s s s	Sun 19	s s s	Tue 19	B B B	Fri 19	s s s	Sun 19	B B B	Wed 19	s s s	Sat 19	. . .	Mon 19	s s s	Thu 19	. . .	Sat 19	s s s
Mon 20	M M C	Thu 20	s M C	Fri 20	s s s	Mon 20	s s s	Wed 20	B B B	Sat 20	s s s	Mon 20	B B B	Thu 20	s M M	Sun 20	. . .	Tue 20	s s s	Fri 20	. . .	Sun 20	s s s
Tue 21	M M C	Fri 21	M M C	Sat 21	s s s	Tue 21	s s s	Thu 21	B B B	Sun 21	s s s	Tue 21	M M M	Fri 21	M M M	Mon 21	. . .	Wed 21	s s s	Sat 21	B B B	Mon 21	s s s
Wed 22	M M C	Sat 22	M M C	Sun 22	s s s	Wed 22	M M M	Fri 22	B B B	Mon 22	s s s	Wed 22	B B B	Sat 22	M M M	Tue 22	M M M	Thu 22	s M M	Sun 22	M M M	Tue 22	s s s
Thu 23	M M C	Sun 23	M M C	Mon 23	s s s	Thu 23	M M M	Sat 23	B B B	Tue 23	s s s	Thu 23	B B B	Sun 23	M M M	Wed 23	. . .	Fri 23	M M M	Mon 23	M M M	Wed 23	s s s
Fri 24	M M C	Mon 24	M M C	Tue 24	s s s	Fri 24	M M M	Sun 24	B B B	Wed 24	s s s	Fri 24	B B B	Mon 24	M M M	Thu 24	. . .	Sat 24	M M M	Tue 24	B B B	Thu 24	s s s
Sat 25	M M C	Tue 25	M M C	Wed 25	s s s	Sat 25	M M M	Mon 25	B B B	Thu 25	s M M	Sat 25	B B B	Tue 25	. . .	Fri 25	. . .	Sun 25	M M M	Wed 25	. . .	Fri 25	s s s
Sun 26	M M C	Wed 26	M M C	Thu 26	s s s	Sun 26	M M M	Tue 26	B B B	Fri 26	M M M	Sun 26	B B B	Wed 26	. M M	Sat 26	. . .	Mon 26	M M M	Thu 26	. . .	Sat 26	s s s
Mon 27	M M C	Thu 27	M M C	Fri 27	s s s	Mon 27	M M M	Wed 27	B B B	Sat 27	M M M	Mon 27	s s s	Thu 27	M M M	Sun 27	. . .	Tue 27	. . .	Fri 27	. . .	Sun 27	s s s
Tue 28	M M C	Fri 28	M M C	Sat 28	s s s	Tue 28	M M M	Thu 28	B B B	Sun 28	M M M	Tue 28	s s s	Fri 28	M . .	Mon 28	. . .	Wed 28	. . .	Sat 28	B B B	Mon 28	s s s
Wed 29	M M C	Sat 29	M M C	Sun 29	s s s	Wed 29	M M M	Fri 29	B B B	Mon 29	M M M	Wed 29	s s s	Sat 29	. . .	Tue 29	M M M	Thu 29	. . .	Sun 29	M M M	Tue 29	s s s
Thu 30	M M C			Mon 30	s s s	Thu 30	M M M	Sat 30	B B B	Tue 30	B B B	Thu 30	s s s	Sun 30	. . .	Wed 30	. . .	Fri 30	. . .	Mon 30	M M M	Wed 30	s s s
Fri 31	M M C			Tue 31	s s s			Sun 31	B B B			Fri 31	s s s	Mon 31	. . .			Sat 31	. . .			Thu 31	s s s

Closure

Adaptation for the users

Machine Commissioning



Beamline Commissioning



USM

IMPACT OF COVID-19 ON THE SCHEDULE IN 2020 AND 2021

- Commissioning of the SR completed when the first lockdown was declared in France.
- The two-month restrictions impacted the beamline commissioning.
- During the second and third lockdowns, the number of user shifts was reduced.

Year	2020		2021	
	Initial	Final	Initial	Final
Shutdown [h]	2328	3368	1888	1936
Machine commissioning & development (MDT) [h]	2024	2256	1352	1544
Beamline commissioning [h]	2336	1232		
User Service Mode (USM) [h]	2056	1632	5520	4648
Beamlines Buffer [h]	0	264	0	624

First confinement (March-May 2020): 2 Month lock down
Second confinement (Nov-Dec 2020): 3 USM days/week
Third confinement (April-May 2021): 4 USM days/week



More MDT days and buffer days for beamlines

ESRF AT THE TIME OF THE COVID-19 PANDEMIC

- Ensuring safe working conditions on site , strictly following French regulations
- Restarting user service mode (USM) on 25 August 2020 with a maximum number of beamlines open
- Implementing the USM programme – remote access on all beamlines and 41/46 beamlines open to users
- **ESRF KEPT FULLY OPERATIONAL FROM 25-08-2020 TO DATE!**



2020

Normal operation of accelerators

CLOSURE

Less than 10 people on site

1st WAVE

Less than 100 people on site

2nd WAVE

Gradual Increase of people on site

RESUME OPERATION

Complete USM preparation

USM OPERATION

Back to USM

16 March – 11 May

Closure & implementation of the ESRF continuity plan for pandemic:
Teleworking,
Dedicated working group with regular meetings

12 May – 1 June

Resume gradually storage ring commissioning, beamline restart and COVID-19 research

2 June – 10 July

Ramp-up number of people on site: commissioning activities restart

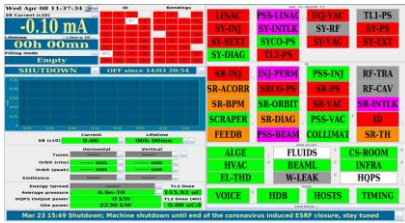
13 July – 24 August

Back to full operation and complete USM preparation

From 25 August

Back to USM strict COVID-19 sanitary and safety policy
Telework privileged

OPERATION DURING CLOSURE



Component	SR	PS	DIAG	RF	BEAM	INSTR	OTHER
SR	SR-ACORR	SR-BPM	SR-DIAG	SR-DIAG	SR-DIAG	SR-DIAG	SR-DIAG
PS	PS-ACORR	PS-BPM	PS-DIAG	PS-DIAG	PS-DIAG	PS-DIAG	PS-DIAG
DIAG	DIAG-ACORR	DIAG-BPM	DIAG-DIAG	DIAG-DIAG	DIAG-DIAG	DIAG-DIAG	DIAG-DIAG
RF	RF-ACORR	RF-BPM	RF-DIAG	RF-DIAG	RF-DIAG	RF-DIAG	RF-DIAG
BEAM	BEAM-ACORR	BEAM-BPM	BEAM-DIAG	BEAM-DIAG	BEAM-DIAG	BEAM-DIAG	BEAM-DIAG
INSTR	INSTR-ACORR	INSTR-BPM	INSTR-DIAG	INSTR-DIAG	INSTR-DIAG	INSTR-DIAG	INSTR-DIAG
OTHER	OTHER-ACORR	OTHER-BPM	OTHER-DIAG	OTHER-DIAG	OTHER-DIAG	OTHER-DIAG	OTHER-DIAG

- Beam killed on Saturday 14 March at 21:00
- On Monday 16 March the accelerators were put into a secure condition
- Closure of the facility on 17 March (No access except duly authorized). During closure only one person (an operator) in the CTRM working in two 12h shifts (instead of three 8h shifts) to limit the contacts
- Some operators were suspected “close contact cases” (no infection) and stayed in quarantine and were replaced on the spot by other members of the operation group
- On 22 April we were allowed to restart with 3 persons max in CTRM and strict hygiene rules (one operator + 2 specialists max for tuning) for beamline radiation protection validation and COVID19 research.
- The restart and operation were supported by people working remotely and people on standby for interventions
- Water leak on a vacuum chamber
-No more accelerator activities during closure



From 12-05-2020 normal functioning of the control room:
One operator + one Part Time Shift worker, three 8h shifts

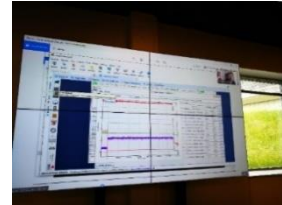
IMPACT OF COVID-19 FOR THE CONTROL ROOM



- *Strict application of sanitary policy (face masks, cleaning, dedicated workstations,.. and distancing)*
- *Limited number of persons in CTRM (8 max)*
- *During lockdown no problem to find PTS (happy to leave home!)*
- *After lockdown more difficulties to motivate PTS (teleworking, accumulated holidays,...)*

Limited access to the site:

- *Loosing social and interactive contacts*
- *Opportunity to improve remote control access*
- *Implementation of dedicated chat channels*
- *Confluence, jira and jlogbook have been actively used*
- *Development shift/interventions/training were often performed via video-conferencing*
→ *Very efficient for short and fast support*



Video-conferencing and chat also useful for exchange with beamlines:

- *Beam stability issues*
- *MDT shift (such as injection perturbations)*
- *Bumps to move source angle vertically or horizontally when requested by beamlines (<math><40 \mu\text{rad}</math>)*

Role of video-conferencing in the future and remote control:

- *Video-conferencing has become an ESSENTIAL tool for the CTRM.*
- *Complete MDT shifts can be done using remote live connection with experts and the CTRM.*
- *Failures can be diagnosed and sometimes even repaired from home.*
- *Efficient way of intervention, since we save time on travel but also, we can quickly identify, after discussion, the most relevant people to contact or who should come on site.*
- *Video-conferencing is also an excellent tool to perform tuning with beamlines like orbit bumps, dedicated tests,....*



We will continue to use it.

BUT, a chart for a "good use" should be applied: people are not supposed to be available 24/24 7/7 365/365..... We should not over use it...

IMPACT OF COVID-19 ON RADIATION PROTECTION VALIDATION OF BEAMLINES

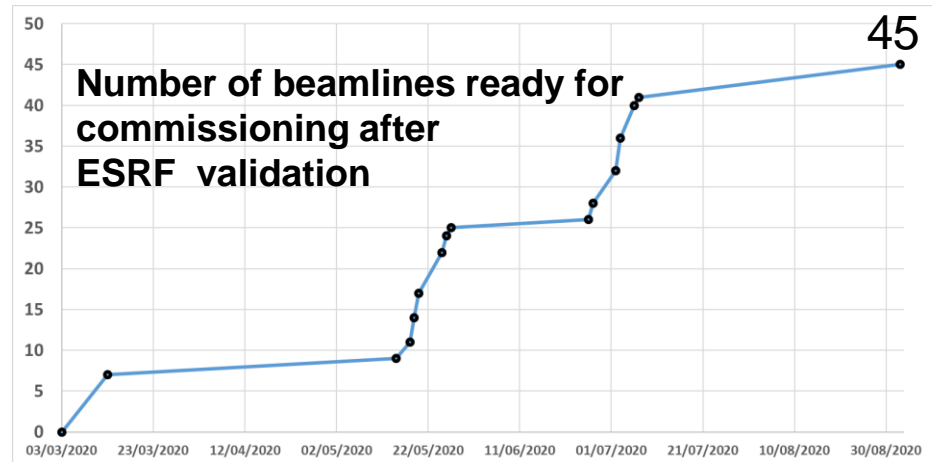
Beamline Insertion device	Date of ESRF test	Date of APAVE test
ID01	15/05/2020	19/05/2020
ID02	13/03/2020	20/05/2020
ID03 (Upgrade)		
ID06-HXM	25/05/2020	27/05/2020
ID06-LVP	25/05/2020	27/05/2020
ID08 (Future ASD beamline)		
ID09	19/05/2020	19/05/2020
ID10-1	20/05/2020	20/05/2020
ID10-2	18/05/2020	18/05/2020
ID11	20/05/2020	20/05/2020
ID12	02/07/2020	13/07/2020
ID13	20/05/2020	25/05/2020
ID14 (ASD SS, futur beamline)		
ID15A	13/03/2020	19/05/2020
ID15B	13/03/2020	19/05/2020
ID16A	27/05/2020	27/05/2020
ID16B	27/06/2020	27/05/2020
ID17 OH1 EH1	27/06/2020	27/05/2020
ID17 OH2 EH2	02/07/2020	13/07/2020
ID18	25/05/2020	26/05/2020
ID19	02/07/2020	13/07/2020
ID20	26/05/2020	27/05/2020
ID20 EH3	02/07/2020	13/07/2020
ID21	26/06/2020	27/05/2020
ID22	18/05/2020	18/05/2020
ID23-1	19/05/2020	19/05/2020
ID23-2	13/03/2020	18/05/2020
ID24 (Upgrade)		
ID26	19/05/2020	19/05/2020
ID27	15/05/2020	28/05/2020
ID28	26/05/2020	26/05/2020
ID29 (Upgrade)		
ID30A	13/03/2020	18/05/2020
ID30B	13/03/2020	18/05/2020
ID31	25/05/2020	26/05/2020
ID32	25/05/2020	26/05/2020

Beamline BM Sources	Date of ESRF test	Date of APAVE test
BM01	06/07/2020	15/07/2020
BM02	03/07/2020	15/07/2020
BM05	13/03/2020	18/05/2020
BM07 (10 mA)	18/11/2020	
BM08	03/07/2020	15/07/2020
BM14 (10 mA)	18/11/2020	
BM16	03/07/2020	15/07/2020
BM18 (10 mA)	18/11/2020	
BM20	03/07/2020	15/07/2020
BM23	02/09/2020	04/09/2020
BM25	02/09/2020	04/09/2020
BM26	02/09/2020	07/09/2020
BM28	02/09/2020	04/07/2020
BM29	06/07/2020	09/07/2020
BM30	06/07/2020	16/07/2020
BM31	06/07/2020	16/07/2020
BM32	07/07/2020	16/07/2020

BM sources delayed and installed during June/August/October shutdowns instead of March/April machine days

Impact:

- Delay in the beamline commissioning
- Necessity to run shifts at low current for initial RP validation
- Most of the sources installed at restart instead of doing it on a running machine (more risky) but very successful





IMPLEMENTING REMOTE ACCESS SOLUTIONS TO KEEP SCIENCE AT THE FOREFRONT

- New protocols for user programme operation, so that a majority of experiments can be conducted or followed up remotely
- Implementation of Apache Guacamole, a free and open-source solution that allows users to interact remotely with beamline control software and tools
- Implementation of large-scale sample mail-in solutions for user experiments
- Remote data analysis with improved data transfer

FIRST USM YEAR WITH THE NEW EBS STORAGE RING A MILESTONE FOR THE X-RAY COMMUNITY



43/44

43 out of 44
beamlines hosted
user experiments

13 175

13 175 shifts (105 400
hours) delivered: 10 687 for
public users, 2024 for CRG,
464 for proprietary research

1 872

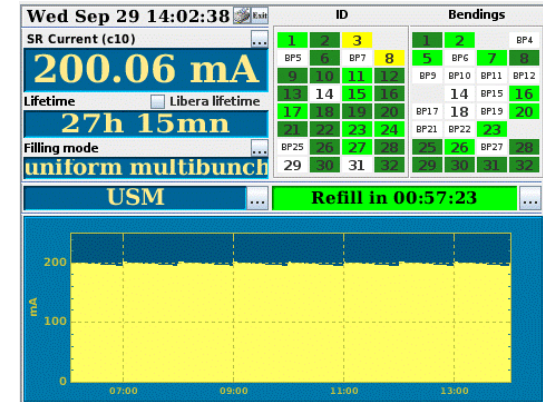
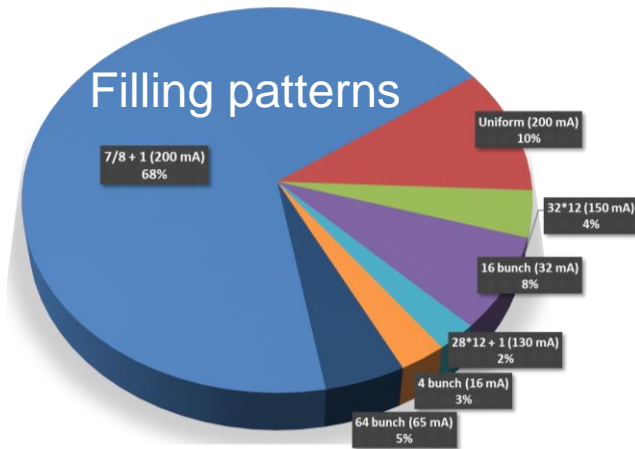
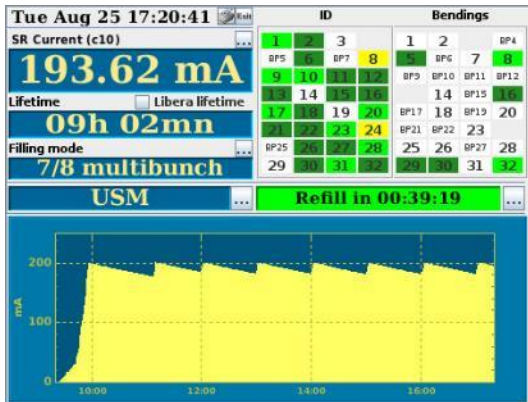
1 872 user
experiments, 1405 for
public users (75%), 156
for CRG (8%) and 311
for proprietary
research (17%)

1 262

1262 fully remote
(68%), 192 only one
user (10%), and 418
with users (22%)



BEAM DELIVERY FROM 25/08/2020 TO 29/09/2021



	7/8 + 1	Uniform	32*12	28*12+1	62 bunch	16 bunch	4 bunch
I_{max} (mA)	196+4 * (192+8)	200	150 * (200)	125+3* (200)	65*	35* (90)	20* (40)
Lifetime (hours)	> 22	> 25	> 22	> 23	~ 14	~ 8	~ 5
ε_v (pm) *	10	10	20	20	20	20	20

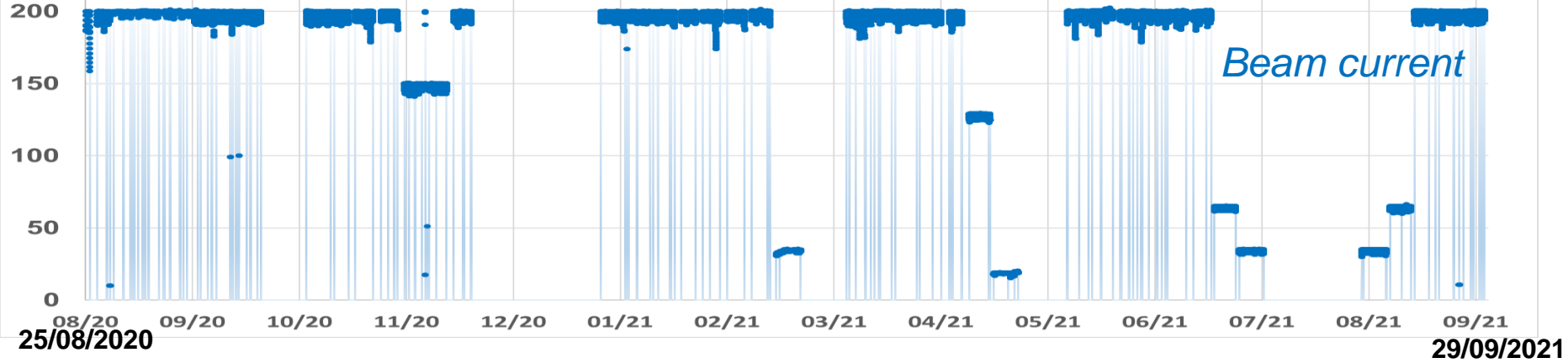


* Intensity limitation for timing modes due to mechanical weakness of the kicker ceramic chambers

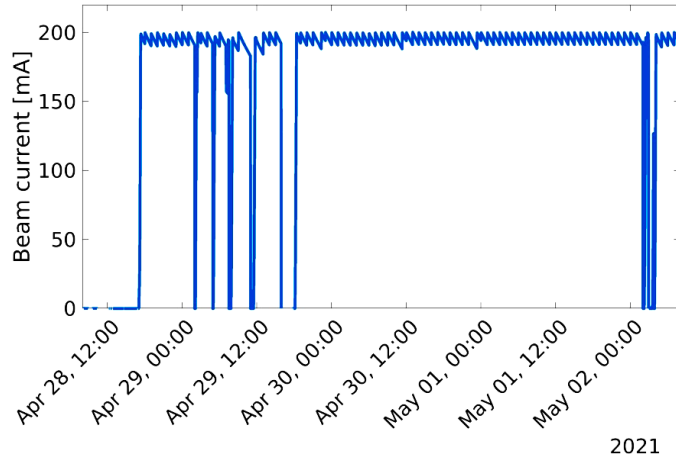
* Vertical emittance artificially increased from 1 to 10 pm rad for an operational lifetime

* All timing modes delivered with a purity of 10^{-9} with cleaning process in the booster

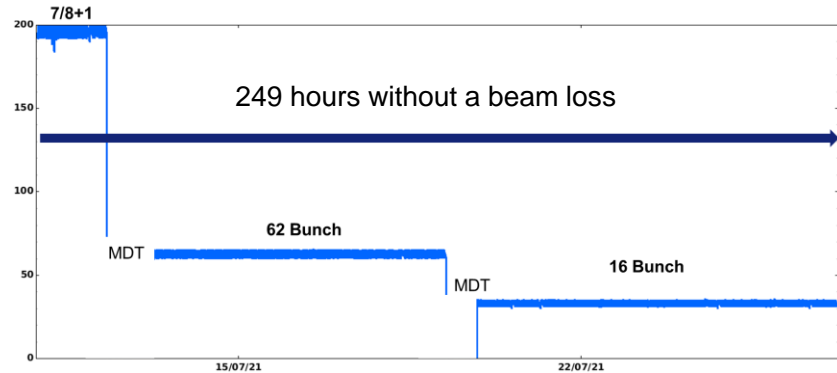
BEAM DELIVERY SINCE THE START OF USM



Some disturbed weeks !!



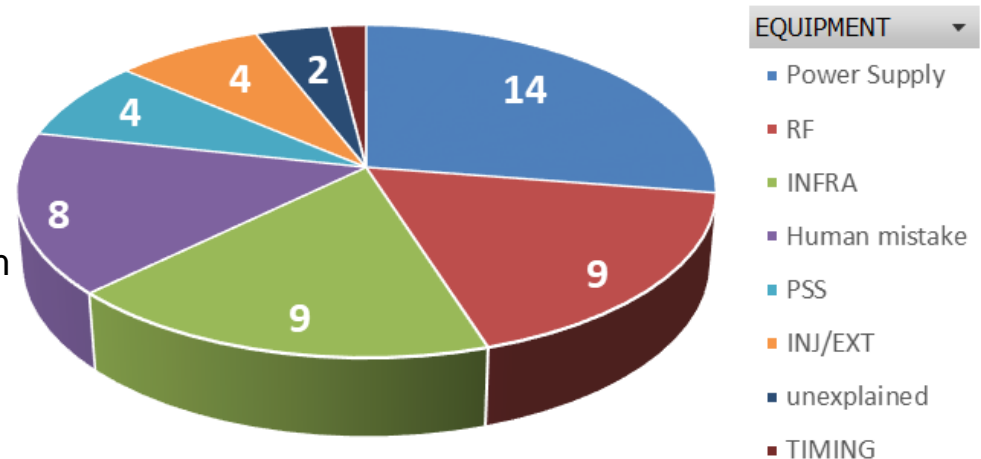
But also quiet time !



RELIABILITY

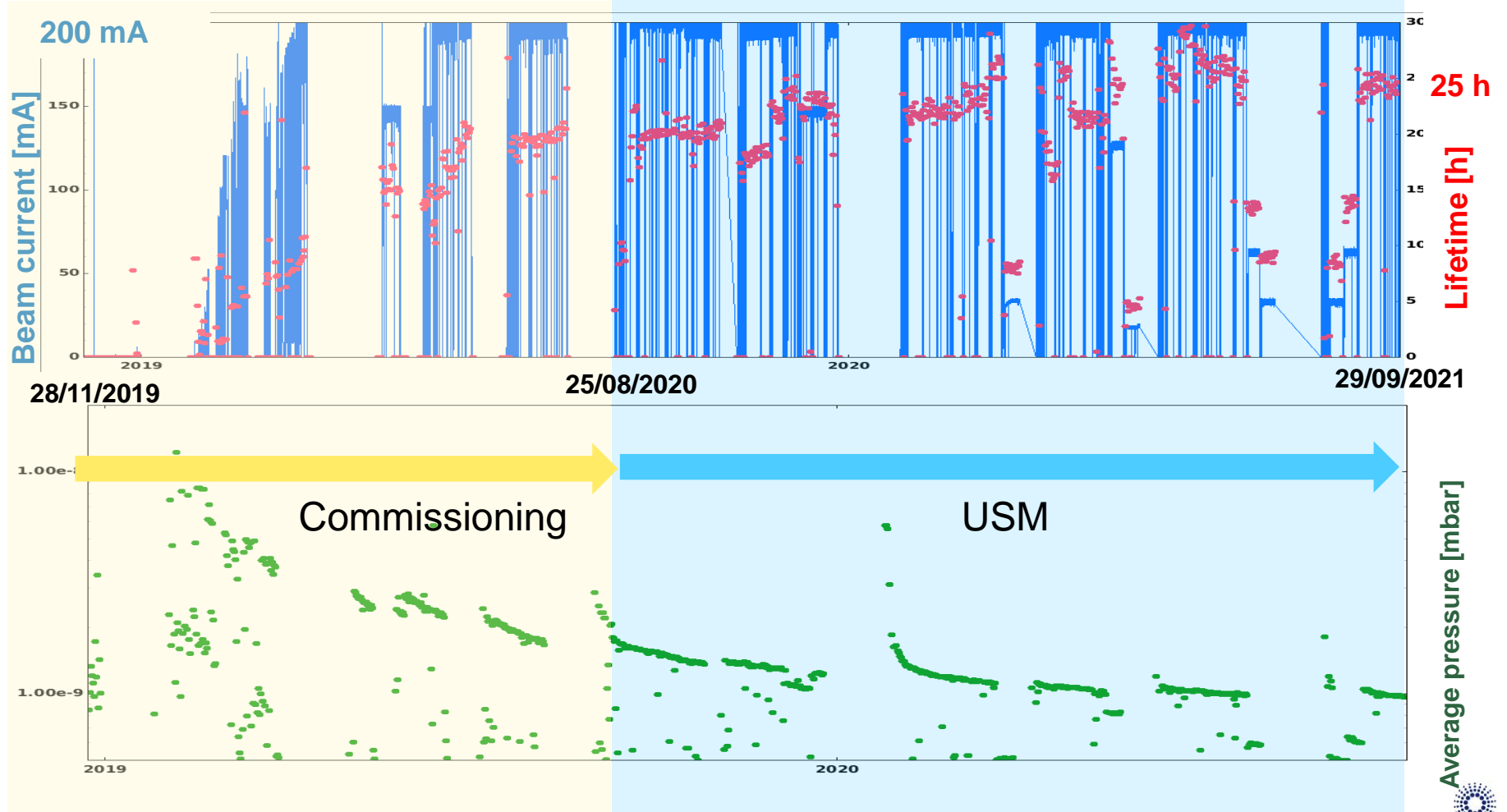
- Overall reliability comparable to that of the old source
- Magnet power supply system was the most complex hardware to develop and commission
 - ✓ *Hot swap system under commissioning*
- Human mistakes due to development (*mostly at the beginning*)
- Infrastructure (*mains, cooling, doors*)
- RF highly reliable
- Operation disturbed by a few long failures from sub-systems not linked to EBS design
 - ✓ *aluminum NEG coated ID vacuum chambers*
 - ✓ *RF master source*
 - ✓ *20 KV high voltage cable defect*

	2017	2018	2020	2021
			<i>EBS</i>	<i>EBS</i>
Availability (%)	98.3	98.5	96.1	98
Mean time between failures (hrs)	64.3	104.3	46.0	73.4
Mean duration of a failure (hrs)	1.11	1.60	1.80	1.46

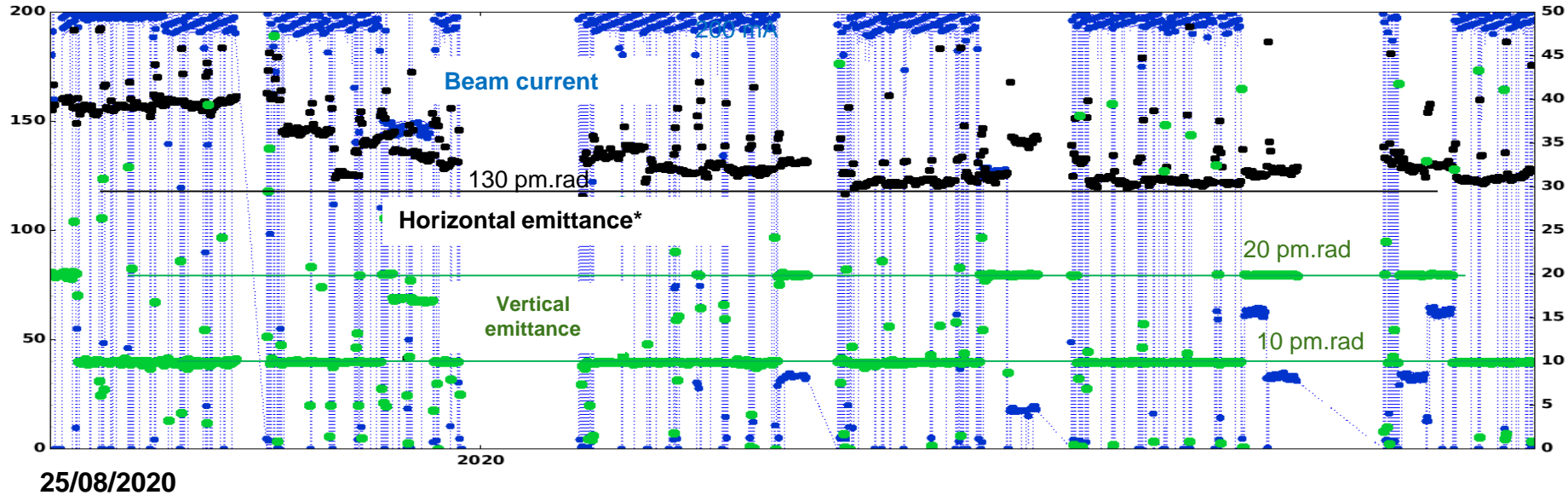


Number of failures 2021

OVERVIEW: BEAM CURRENT & LIFETIME



VERTICAL AND HORIZONTAL EMITTANCES FROM 25/08/2020 TO 29/09/2021



Horizontal emittance diagnostics modified and calibrated during run 2020-06 and run 2021-1

→ Typical today: 130 ± 20 pm.rad

Vertical emittance artificially blown up using white noise excitation up from 1 pm.rad to 10 or 20 pm.rad to get an operational lifetime

→ Typical today: 10 pm \pm 1 pm.rad

COMPONENT DATA BASE

The data base used since the beginning of the project to follow component technical data, location, administrative information during procurement, assembly, installation, commissioning is **now fully available for operation**

Group	Family	Component	Request Location	Color	ERM ID	Serial Number	Manufacturer	Drawing Number	CPT	Budget Code	Documents
INSTALLATION DEVICES	DR Source	2 Pinax Wapler	CA011	DR Family	DR 0000383	DPWA_1	DR0F 004			DR000405	DR1115 DR1116 DR1274
INSTALLATION DEVICES	DR Source	Single Board Wapler	CA010	DR Family	DR 0000197	DPWA_1	DR0F 004	DR000900	-	DR01163	DR00010 DR00011 DR00012
INSTALLATION DEVICES	DR Source	2 Pinax Wapler	CA010	DR Family	DR 0000100	DPWA_2	DR0F 004	DR000943	-	DR01163	DR00013 DR00014 DR00015
INSTALLATION DEVICES	DR Source	2 Pinax Wapler	CA017	DR Family	DR 0000184	DPWA_3	DR0F 004	DR000945	-	DR01163	DR00017 DR00018 DR00019
INSTALLATION DEVICES	DR Source	Single Board Wapler	CA010	DR Family	DR 0000000	DPWA_2	DR0F 004	DR000941	-	DR01163	DR00020 DR00021 DR00022
INSTALLATION DEVICES	DR Source	2 Pinax Wapler	CA014	DR Family	DR 0000199	DPWA_1	DR0F 004	DR000942	-	DR01163	DR00023 DR00024 DR00025
INSTALLATION DEVICES	DR Source	Single Board Wapler	CA016	DR Family	DR 0000197	DPWA_3	DR0F 004	DR000945	-	DR01163	DR00026 DR00027 DR00028
INSTALLATION DEVICES	DR Source	2 Pinax Wapler	CA014	DR Family	DR 0000194	DPWA_1	DR0F 004	DR000941	-	DR01163	DR00029 DR00030 DR00031
INSTALLATION DEVICES	DR Source	Single Board Wapler	CA010	DR Family	DR 0000100	DPWA_4	DR0F 004	DR000900	-	DR01163	DR00032 DR00033
INSTALLATION DEVICES	DR Source	2 Pinax Wapler	CA013	DR Family	DR 0000104	DPWA_4	DR0F 004	DR000943	-	DR01163	DR00034 DR00035 DR00036
INSTALLATION DEVICES	DR Source	2 Pinax Wapler	CA015	DR Family	DR 0000193	DPWA_5	DR0F 004	DR000945	-	DR01163	DR00037 DR00038 DR00039
INSTALLATION DEVICES	DR Source	Single Board Wapler	CA016	DR Family	DR 0000199	DPWA_3	DR0F 004	DR000945	-	DR01163	DR00040 DR00041 DR00042
INSTALLATION DEVICES	DR Source	Single Board Wapler	CA010	DR Family	DR 0000101	DPWA_6	DR0F 004	DR000900	-	DR01163	DR00043 DR00044 DR00045
INSTALLATION DEVICES	DR Source	2 Pinax Wapler	CA019	DR Family	DR 0000190	DPWA_2	DR0F 004	DR000943	-	DR01163	DR00046 DR00047 DR00048
INSTALLATION DEVICES	DR Source	Single Board Wapler	CA010	DR Family	DR 0000100	DPWA_2	DR0F 004	DR000900	-	DR01163	DR00049 DR00050 DR00051
INSTALLATION DEVICES	DR Source	2 Pinax Wapler	CA011	DR Family	DR 0000105	DPWA_6	DR0F 004	DR000943	-	DR01163	DR00052 DR00053 DR00054
INSTALLATION DEVICES	DR Source	Single Board Wapler	CA013	DR Family	DR 0000184	DPWA_8	DR0F 004	DR000945	-	DR01163	DR00055

Already

- 20000 Components for the tunnel
- 2720 Components for the technical zone

Filling and updating was an ideal task for teleworking! but still a lot of work to integrate all components and maintain it up to date.

(1.5 person fully occupied for the data management and 0.5 person for the software management)

Results:

- Despite the impact of the Covid-19 pandemic, users recovered the beam on the scheduled day and with an adapted operation planning
 - Main performances achieved (beam current, beam modes, lifetime, emittances, stability)
 - Excellent reliability of the hardware
 - Delay in the beamline commissioning and upgrade programme
 - Additional operating and support tools and methods have emerged
- Beamlines are now progressing and upgrading to take full benefit of the source
- Users are starting to come back

Objectives for the machine:

- Fine tuning of beam parameters
- Implementation of the hot-swap system for the power supplies
- Reduce injection perturbation and go back to injection from every 1 hour to every 20 mn
- Nominal beam current in time-structured modes

MANY THANKS FOR YOUR ATTENTION

