

Status of SOLEIL

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On behalf of the Accelerators and Engineering Division

Layout of the presentation

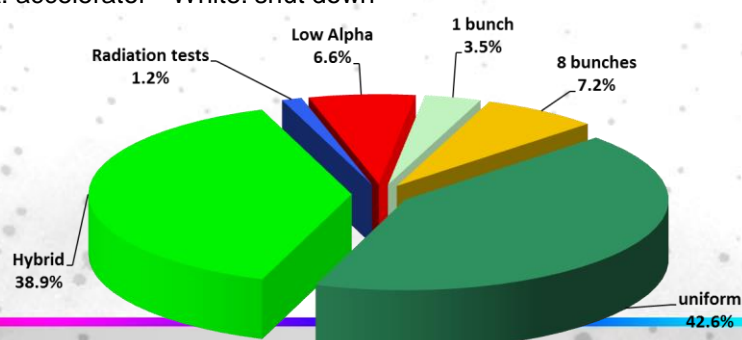
- SOLEIL metrics
- Achievements
- Major failures
- On-going projects
- Upgrade at a glance
- Roadmap for 2018

Beam time schedule in 2017

5091 hours for the beamlines.

janv 2017	févr 2017	mars 2017	avr 2017	mai 2017	juin 2017	juil 2017	août 2017	sept 2017	oct 2017	nov 2017	déc 2017	janv 2018	févr 2018
dim 01	mer 01	mer 01	sam 01	lun 01	jeu 01	sam 01	mar 01	ven 01	dim 01	mer 01	ven 01	lun 01	jeu 01
lun 02	jeu 02	jeu 02	dim 02	mar 02	ven 02	dim 02	mer 02	sam 02	lun 02	jeu 02	sam 02	mar 02	ven 02
mar 03	ven 03	ven 03	lun 03	mer 03	sam 03	lun 03	jeu 03	dim 03	mar 03	ven 03	dim 03	mer 03	sam 03
mer 04	sam 04	sam 04	mar 04	jeu 04	jeu 04	mar 04	ven 04	lun 04	mer 04	sam 04	lun 04	jeu 04	dim 04
jeu 05	dim 05	dim 05	mer 05	jeu 05	lun 05	mer 05	sam 05	mar 05	jeu 05	dim 05	mar 05	ven 05	lun 05
ven 06	lun 06	lun 06	jeu 06	sam 06	mar 06	jeu 06	dim 06	mer 06	ven 06	lun 06	mer 06	mar 06	cp 06
sam 07	mar 07	mar 07	ven 07	dim 07	mer 07	ven 07	lun 07	jeu 07	sam 07	mar 07	jeu 07	dim 07	mer 07
dim 08	mer 08	mer 08	sam 08	lun 08	jeu 08	sam 08	mar 08	ven 08	dim 08	mer 08	ven 08	lun 08	jeu 08
lun 09	jeu 09	jeu 09	dim 09	mar 09	ven 09	dim 09	mer 09	sam 09	lun 09	jeu 09	lun 09	ven 09	mer 09
mar 10	ven 10	ven 10	lun 10	mer 10	sam 10	lun 10	jeu 10	dim 10	mar 10	ven 10	dim 10	mer 10	sam 10
mer 11	sam 11	sam 11	mar 11	jeu 11	dim 11	mer 11	ven 11	lun 11	mer 11	sam 11	lun 11	jeu 11	dim 11
jeu 12	dim 12	dim 12	mer 12	ven 12	lun 12	mer 12	sam 12	mar 12	jeu 12	dim 12	mar 12	ven 12	lun 12
ven 13	lun 13	lun 13	jeu 13	sam 13	mar 13	jeu 13	dim 13	mer 13	ven 13	lun 13	mer 13	sam 13	mar 13
sam 14	mar 14	mar 14	ven 14	dim 14	jeu 14	ven 14	lun 14	jeu 14	sam 14	mar 14	jeu 14	dim 14	mer 14
dim 15	mer 15	mer 15	sam 15	lun 15	jeu 15	sam 15	mar 15	ven 15	dim 15	mer 15	ven 15	lun 15	jeu 15
lun 16	jeu 16	jeu 16	dim 16	mar 16	ven 16	dim 16	mer 16	sam 16	lun 16	jeu 16	sam 16	mar 16	ven 16
mar 17	ven 17	ven 17	lun 17	mer 17	sam 17	lun 17	jeu 17	dim 17	mar 17	ven 17	dim 17	mer 17	sam 17
mer 18	sam 18	sam 18	mar 18	jeu 18	dim 18	mer 18	ven 18	lun 18	mer 18	sam 18	lun 18	jeu 18	dim 18
jeu 19	dim 19	dim 19	mer 19	ven 19	lun 19	mer 19	sam 19	mar 19	jeu 19	dim 19	mar 19	ven 19	lun 19
ven 20	lun 20	lun 20	jeu 20	sam 20	mar 20	jeu 20	dim 20	mer 20	ven 20	lun 20	mer 20	sam 20	mar 20
sam 21	mar 21	mar 21	ven 21	dim 21	jeu 21	ven 21	lun 21	jeu 21	sam 21	mar 21	jeu 21	dim 21	mer 21
dim 22	mer 22	mer 22	sam 22	lun 22	jeu 22	sam 22	mar 22	ven 22	dim 22	mer 22	ven 22	lun 22	jeu 22
lun 23	jeu 23	jeu 23	dim 23	mar 23	ven 23	dim 23	mer 23	sam 23	lun 23	jeu 23	sam 23	mar 23	ven 23
mar 24	ven 24	ven 24	lun 24	mer 24	sam 24	lun 24	jeu 24	dim 24	mar 24	ven 24	dim 24	mer 24	sam 24
mer 25	sam 25	sam 25	mar 25	jeu 25	jeu 25	mar 25	ven 25	lun 25	mer 25	sam 25	lun 25	jeu 25	dim 25
jeu 26	dim 26	dim 26	mer 26	ven 26	lun 26	mer 26	sam 26	mar 26	jeu 26	dim 26	mar 26	ven 26	lun 26
ven 27	lun 27	lun 27	jeu 27	sam 27	mar 27	jeu 27	dim 27	mer 27	ven 27	lun 27	mer 27	sam 27	mar 27
sam 28	mar 28	mar 28	ven 28	dim 28	jeu 28	ven 28	lun 28	jeu 28	sam 28	mar 28	jeu 28	dim 28	mer 28
dim 29	mer 29	mer 29	sam 29	lun 29	jeu 29	sam 29	mar 29	ven 29	dim 29	mer 29	ven 29	lun 29	jeu 29
lun 30	jeu 30	jeu 30	dim 30	mar 30	ven 30	dim 30	mer 30	sam 30	lun 30	jeu 30	sam 30	mar 30	cp 30
mar 31	ven 31	ven 31	lun 31	mer 31	jeu 31	lun 31	jeu 31	mar 31	ven 31	dim 31	mer 31	mer 31	mer 31

A: accelerator White: shut down

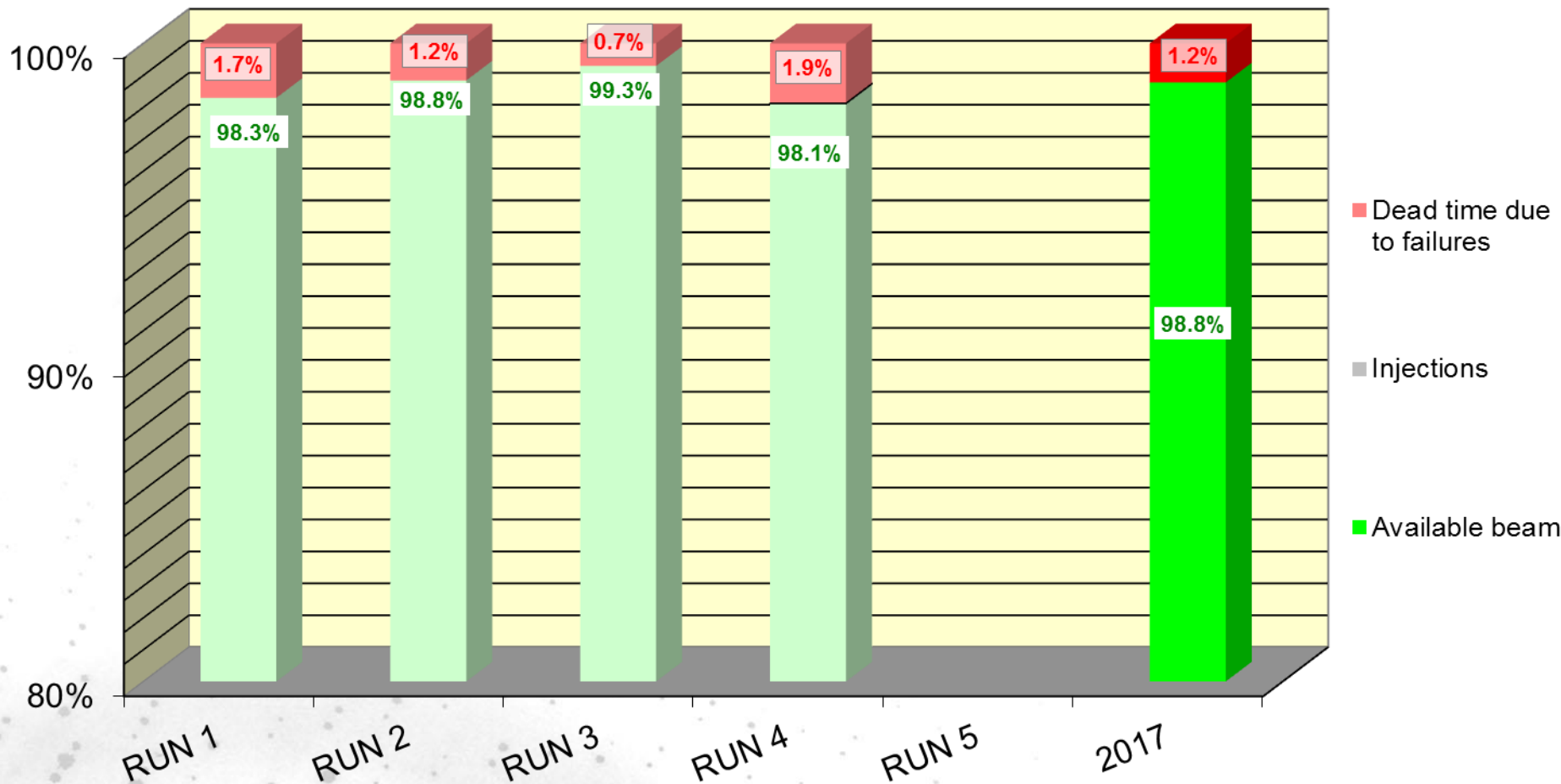


All in top-up mode

Mode of operation Bunch fill. patterns	User Operation in 2017	Ultimate performance achieved
Multibunch (M2)	500 mA	500 mA
Hybrid/camshaft mode (M)	425 mA + 5 mA + Slicing on high intensity bunch	425 mA + 10 mA Slice length < 200 fs FWHM
8 bunches (8)	100 mA	110 mA
1 bunch (S)	16 mA	20 mA
Low- α Hybrid mode (Lp)	204.7 ps RMS for 65 μ A	< 3.2 ps RMS for 15 μ A



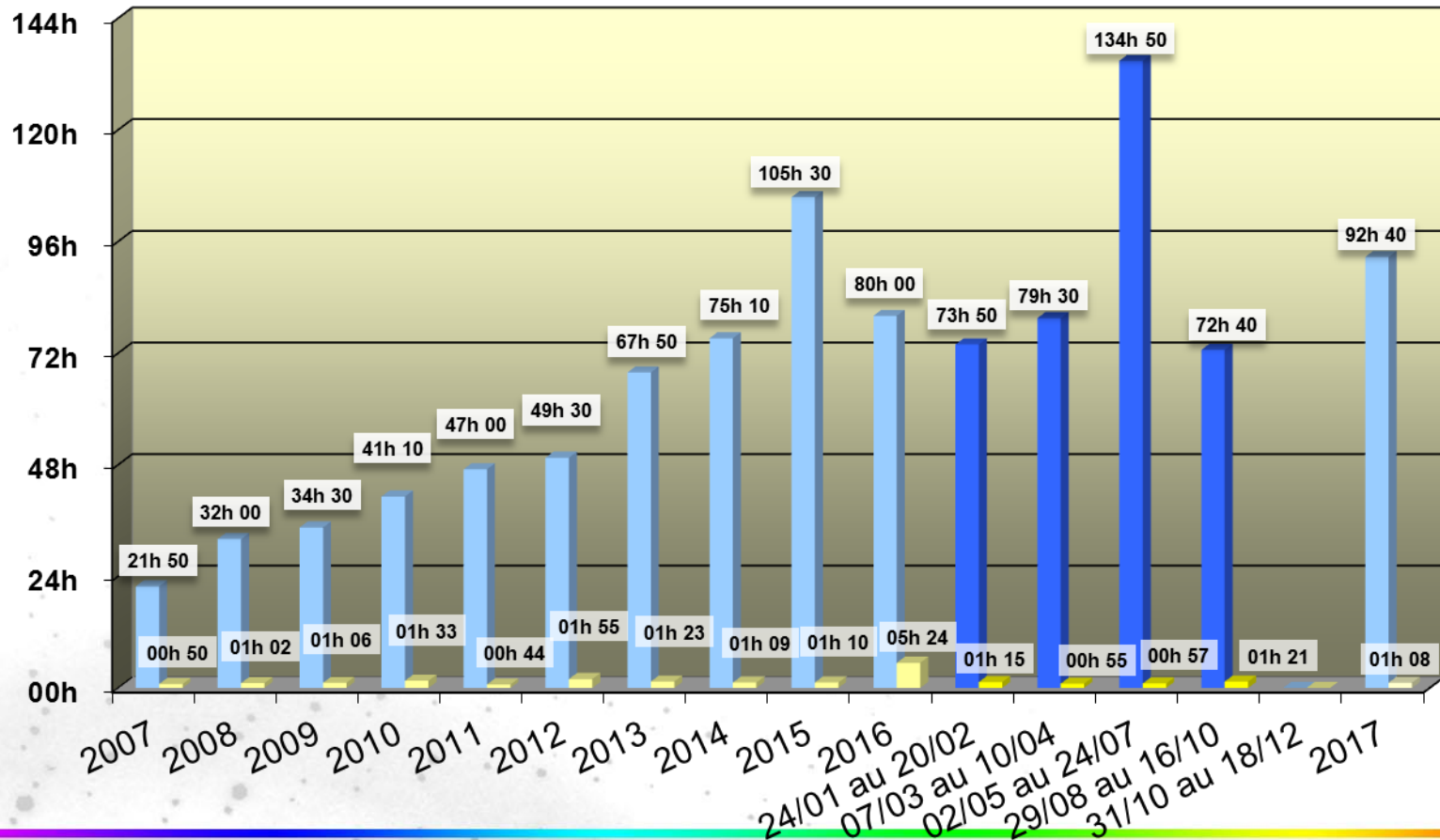
Photon Beam Availability (2017: Run1 to Run4 out of 5)



MTBF (Mean Time Between Failures) & MTTR (Mean Time To Recovery) during beamlines and RP sessions in 2017 (Run1 to Run4)

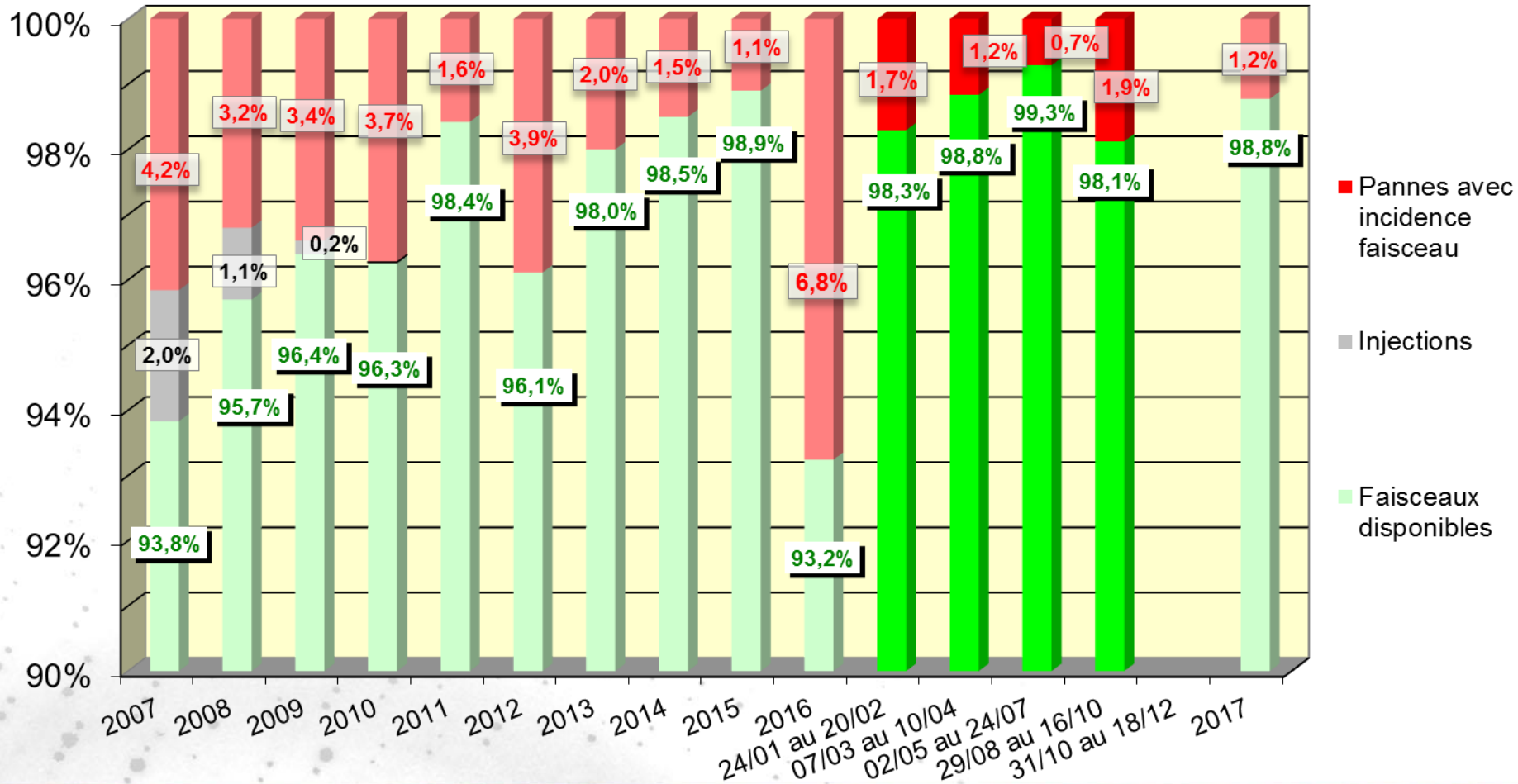


**MTBF: Temps moyen entre 2 pannes (92h40)
 et MTTR: temps moyen d'une interruption faisceau (01h08)
 durant les sessions Lignes et RP sur l'année 2017**



Efficacité durant les sessions Lignes et RP sur l'année 2017

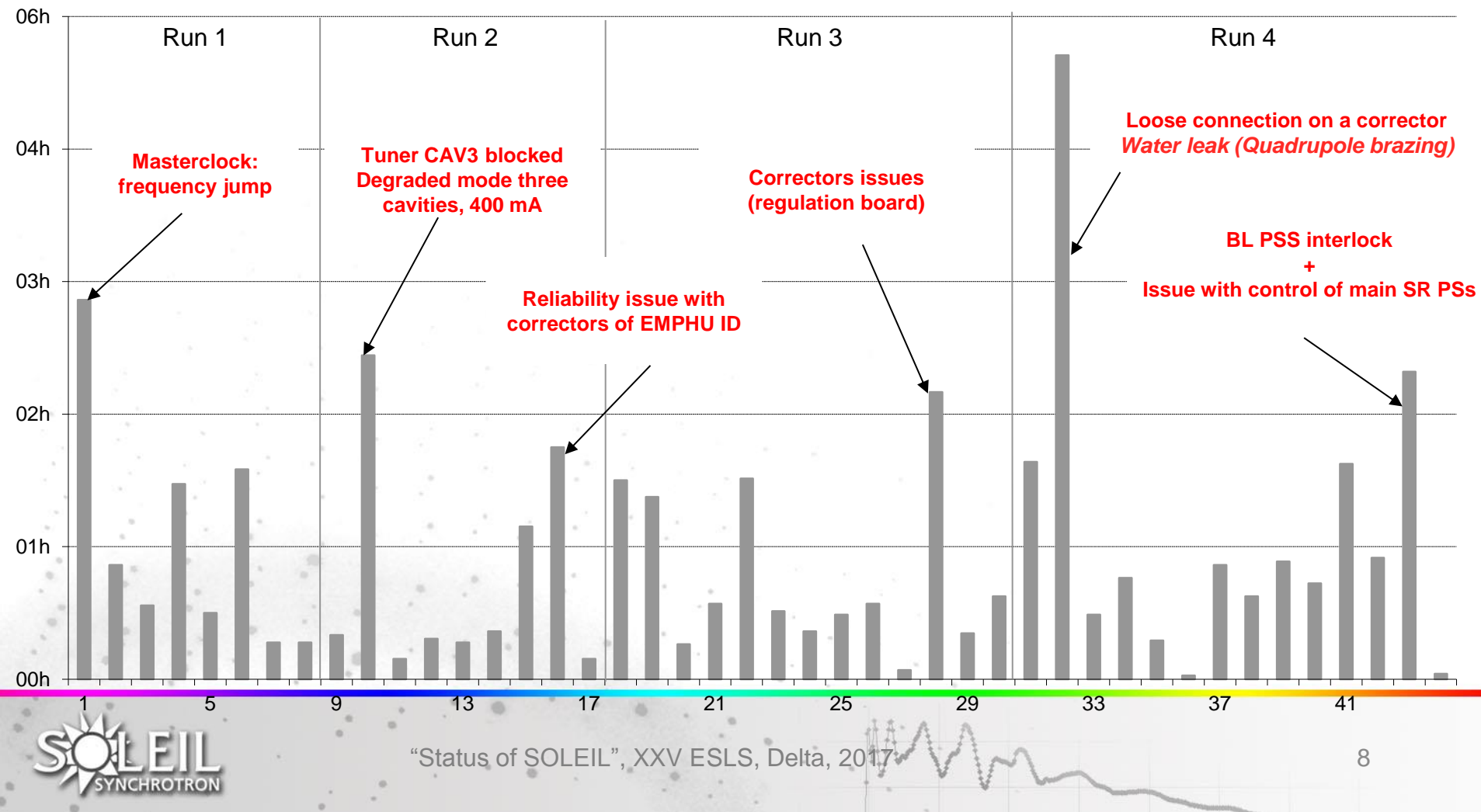
4027 heures de faisceau ont été délivrées
soit **98,8 %** du temps de faisceau programmé



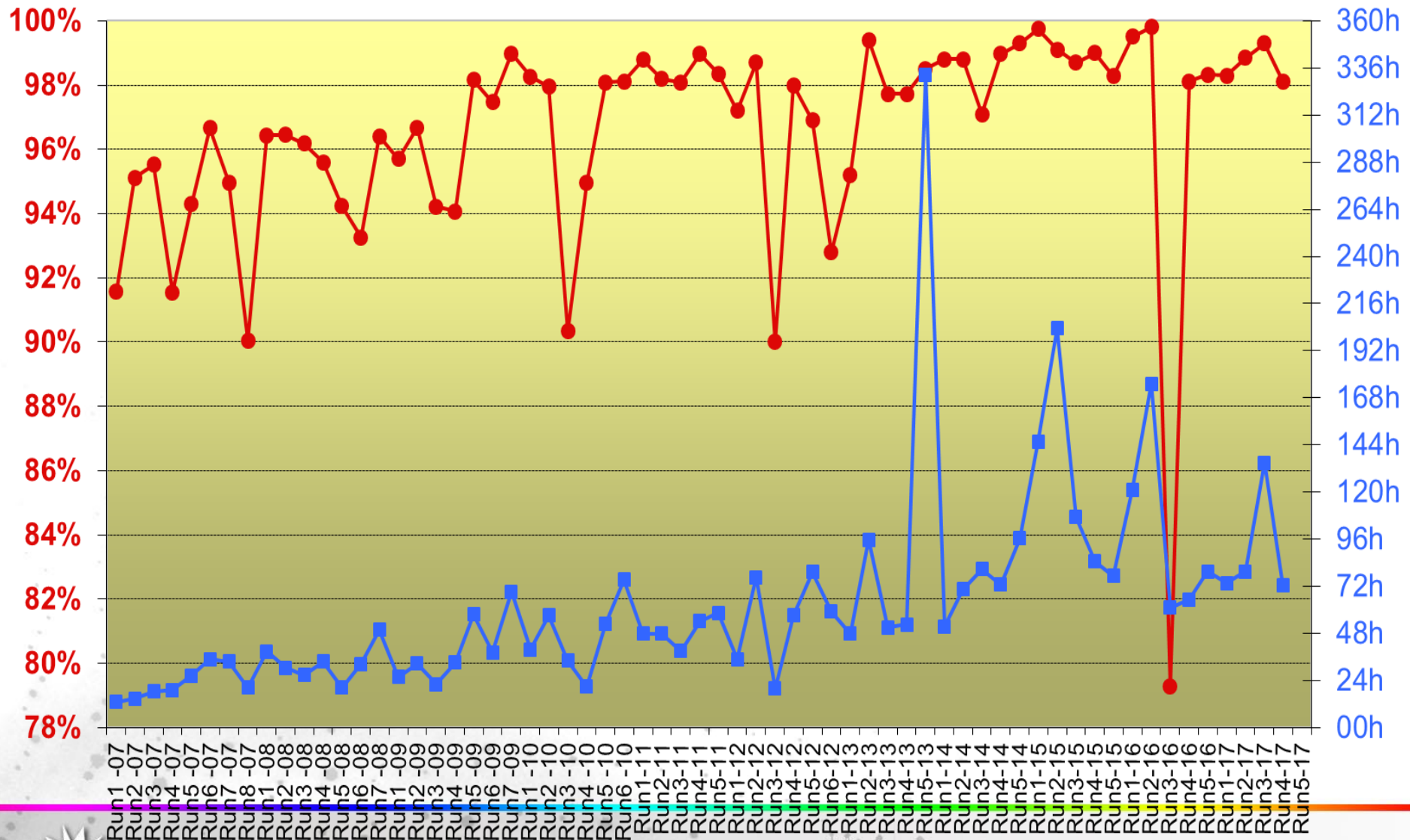
Duration of every interruption (Run 1 to 4)

Time duration of the **44 beam interruptions** (beam losses or equipment failures) impacting the beamline or Radiation Safety Tests

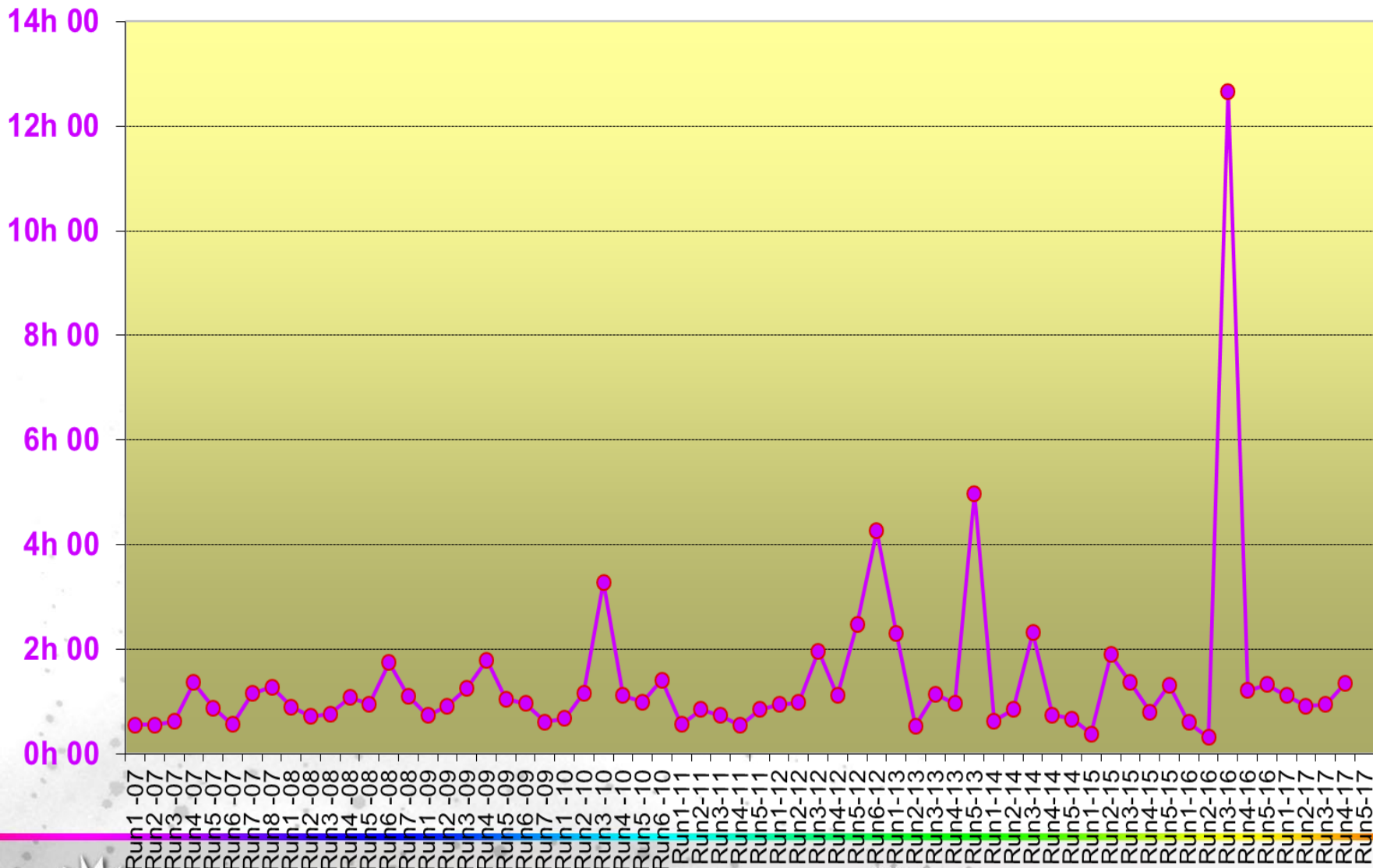
Total 49:55
Min 00:02
Max 05:39
Mean 01:08
RMS 01:05



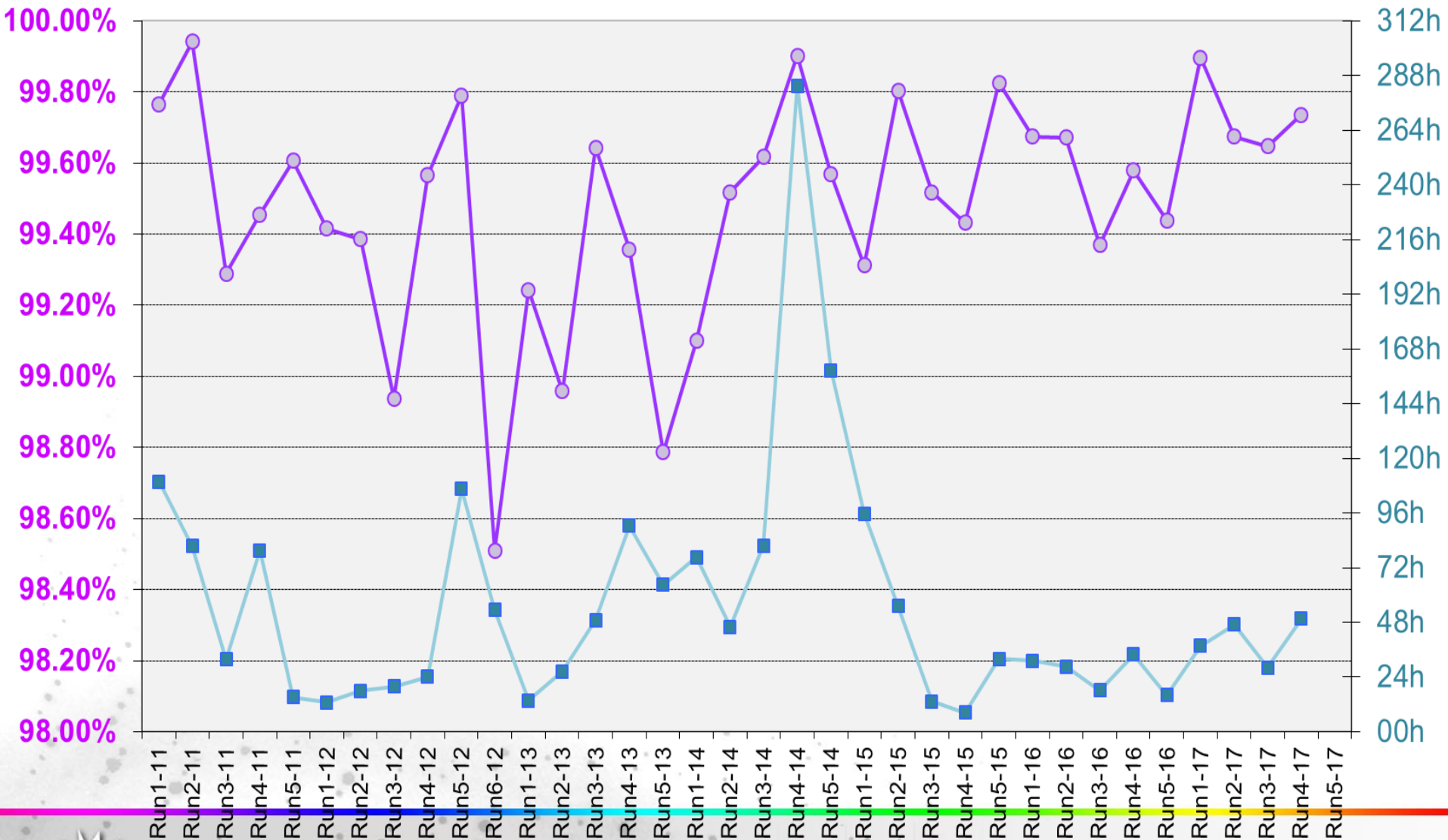
Efficacité et MTBF par RUN durant les sessions Lignes et RP de 2007 à 2017



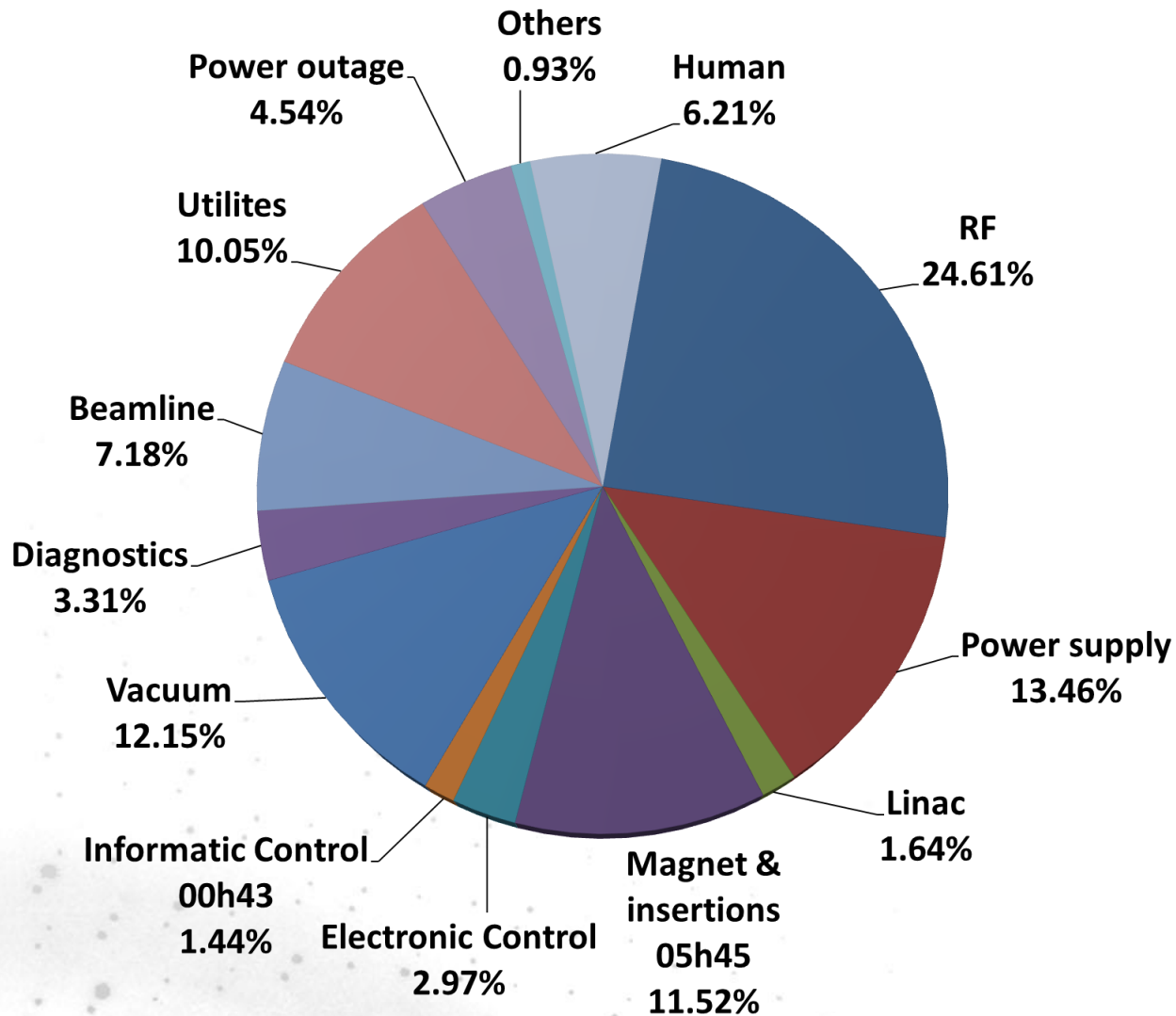
MTTR par RUN durant les sessions Lignes et RP de 2007 à 2017



Efficacité et MTBF du TOP-UP durant les sessions Lignes et RP par RUN de 2011 à 2017



Origin of the 46 hours Beam time LOST in 2017 (RUN1 to RUN4)

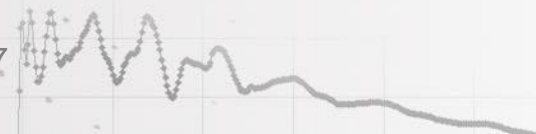


Beam intensity delivered RUN 1 to RUN 4 2017

MACHINE

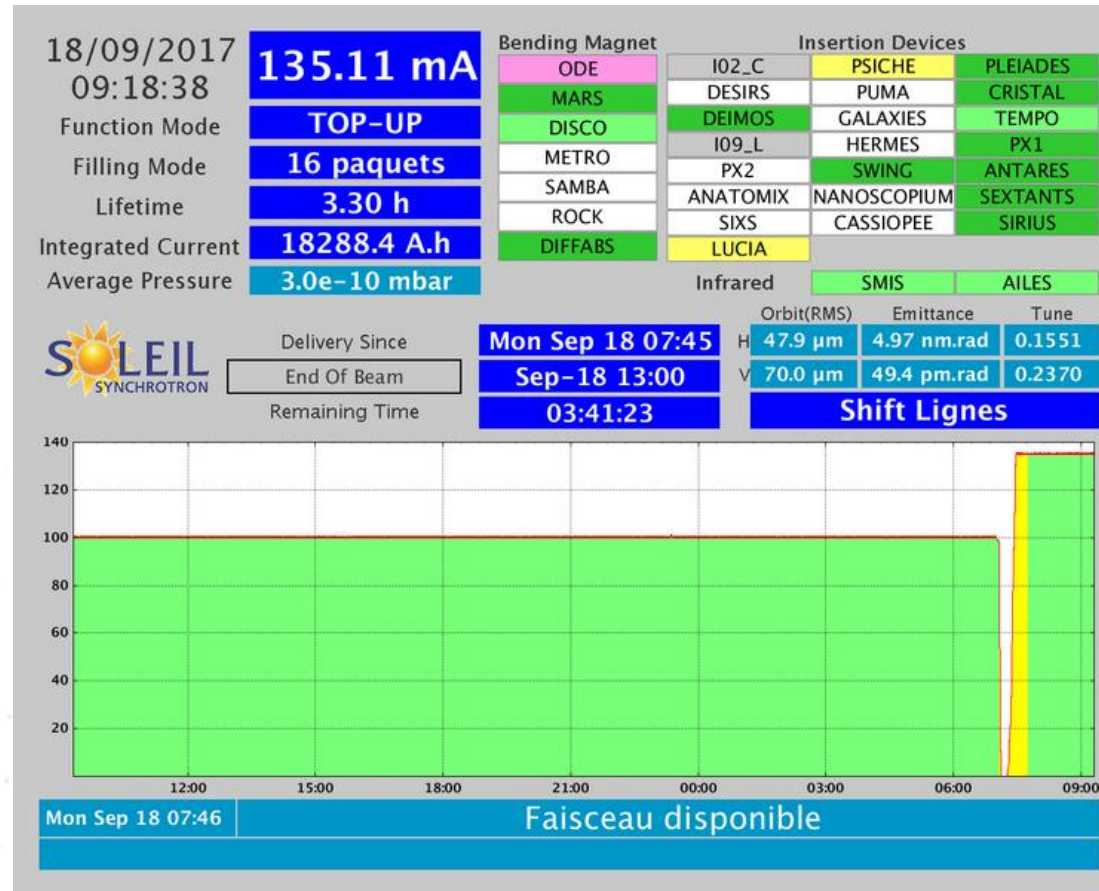
USER

USER-RP

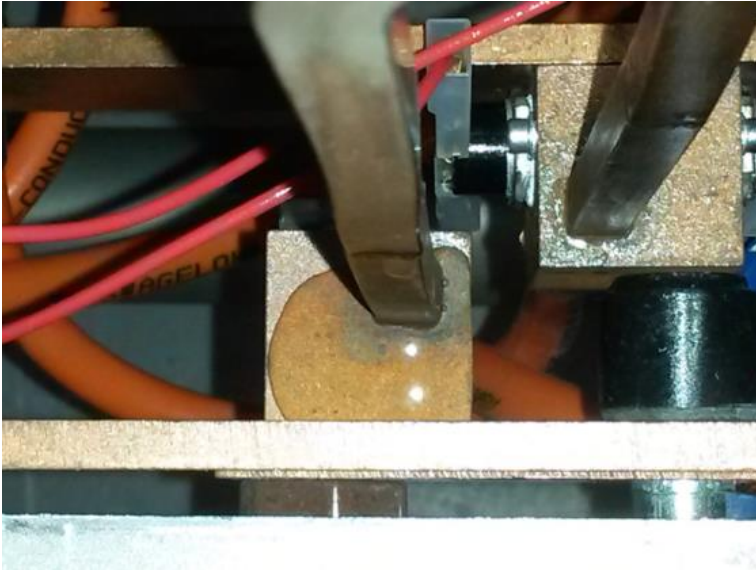


16 bunch filling pattern

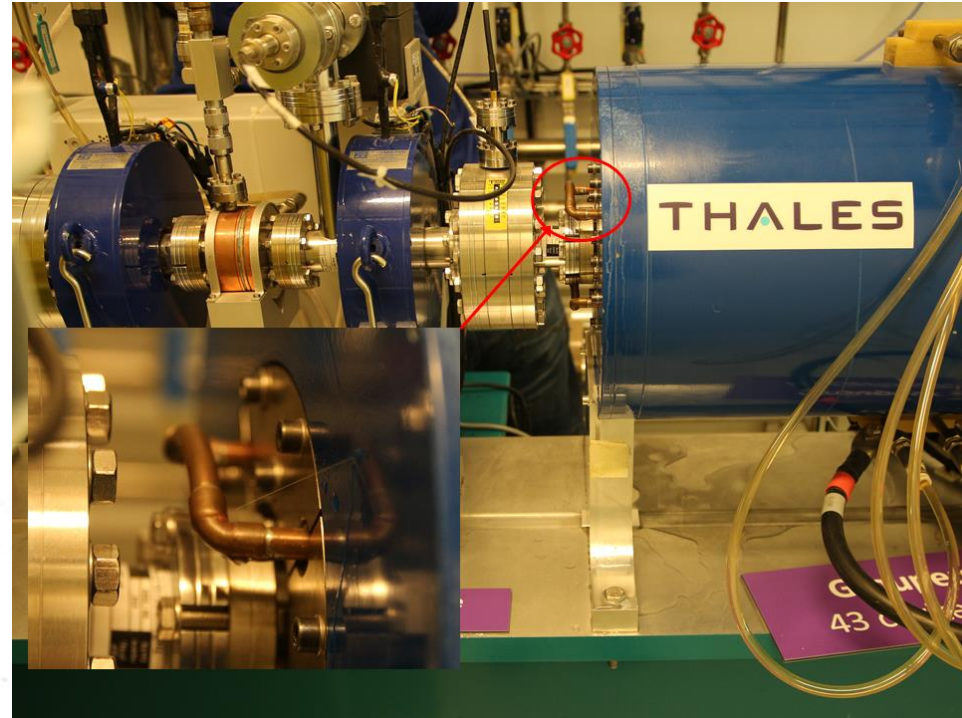
- A new filling pattern for time resolved experiment
- Total current: 130 mA, 3.5 h, 1% coupling, top-up
- Tested in September 2017



Major Failures: Several solder/welding water leaks

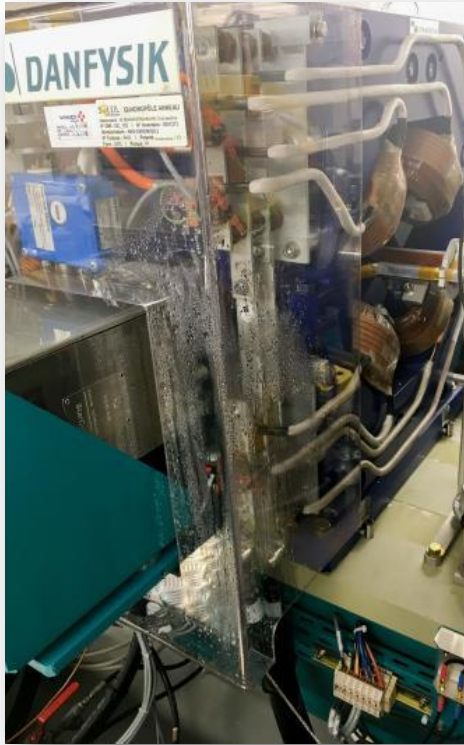


Water leak on coil 45 of the
Electromagnetic HU640 ID

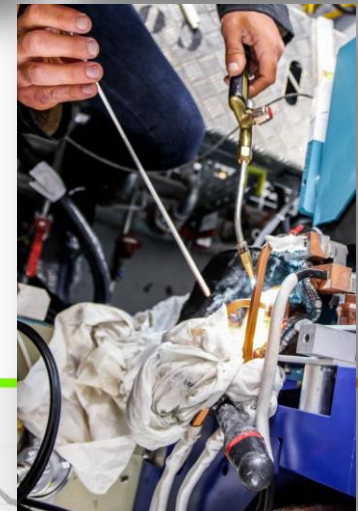


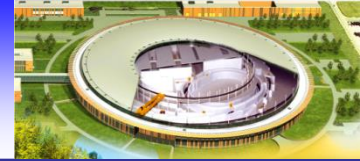
LINAC buncher
A pinhole size water leak in cooling circuit

Water leak on a quadrupole connection



Aging facility (10 – 15 year old equipment)
Cu concentration if carefully follow as in indicator of corrosion
Cu is collected by resin
Not monitoring or control of dissolved O₂ rate
What is the experience of other facilities?



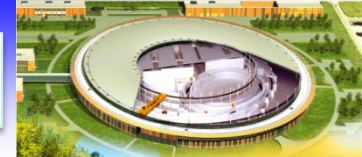


SOLEIL RF SYSTEMS

- 1) Refurbishment of the SR 180 kW SSPA's** (new transistor & upgrade of the 2.5 kW combiners)
 - Ampli_1 (4 towers) completed ; going on at rate of 2 towers a year → 2022
 - + 10 % efficiency → investment cost compensated in ~ 3 years
- 2) The last of the four new SR cavity input couplers was implemented in January; all of them were tested up to 260 kW with beam during 2017**
- 3) Modification of the waveguide network under way, using SOLEIL Magic Switches**
 - ↳ **In 2018, (1) + (2) + (3) → Possible operation @ 450 mA with**
 - 3 running amplifiers or cavities ;
 - a single cryomodule (combining 2 amplifiers per cavity).
- 4) 2nd Booster RF station (spare RF cavity, new 60 kW SSPA, LLRF & control)**
 - Doubling of the injection efficiency in low- α mode
 - Cavity under conditioning in our test area, using the new 60 kW SSPA
 - Commissioning beginning of 2018

OTHER PROJECTS

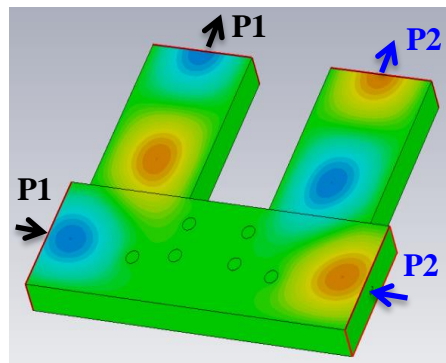
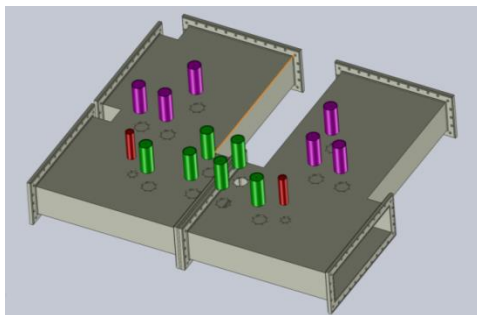
- **The 4 SSPA's supplied to SESAME are in operation in their SR**
 - The 1st one was built by SOLEIL as a demonstrator,
 - The 3 other ones were built on the same model by SigmaPhi Electronics, the SOLEIL licensee
- **Installation & commissioning of the ThomX LINAC and SR RF system → 2017 - 2018**
- **LUCRECE / LUNEX5 : R&D about RF technology for CW LINAC (2016 – 2020)**
 - 20 kW 1.3 GHz SSPA using GaN instead of LDMOS transistors & LCLS2 type cavity
- **Upgrade of SOLEIL towards a DLSR → Longitudinal kick for on-axis injection + harmonic system**



Together with the SSPA refurbishment,

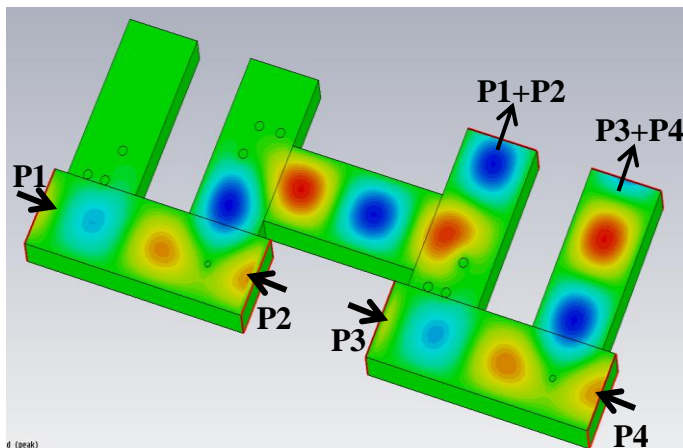
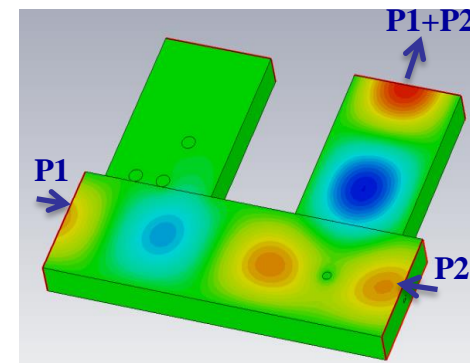
- 1) Design and implement the new version of cavity power couplers : 200 kW \rightarrow 300 kW / cavity
 - 2) Modify the waveguide network to combine the power from two amplifiers into one cavity
- \rightarrow Possibility of storing the full beam current using a single CM or 3 running cavities

« Magic Switch »

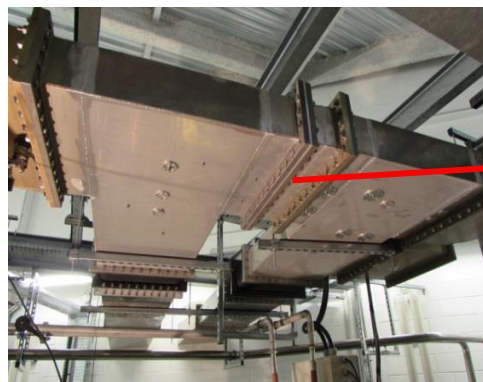


OR

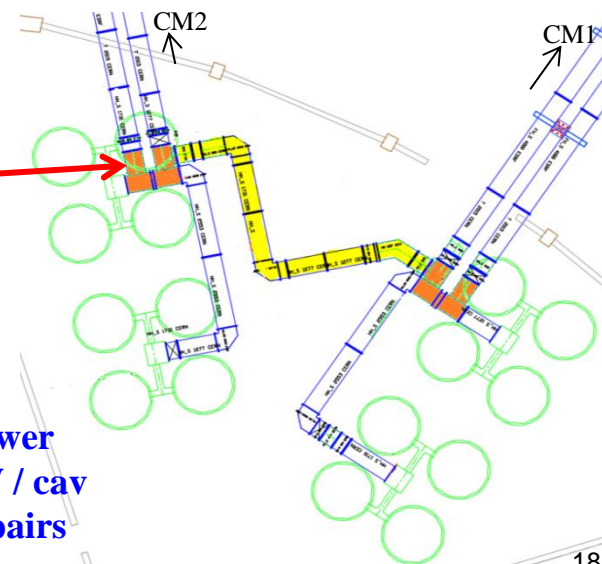
Depending on the post configuration

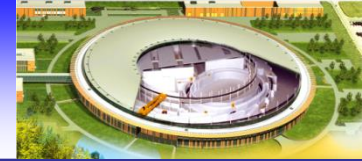


Connecting 2 Magic Switches



Wave guide network layout to power one or the other CM with 300 kW / cav from the 4 SSPA's, combined by pairs





Presently the SSPA is powering one 5-cell copper cavity which provides a V_{RF} of 1 MV

Standard operation : $P_{diss} (V_{RF} = 1 \text{ MV}) = 20 \text{ kW}$; $P_{beam} = 5 \text{ kW} \rightarrow P_{tot} = 25 \text{ kW}$



Upgrade plan : Increase V_{RF} from 1 MV up to 3 MV to achieve shorter bunch length with the objective of *improving the SR injection efficiency in low- α operation mode* by a factor of ~ 2 (presently limited by radiation safety reasons)

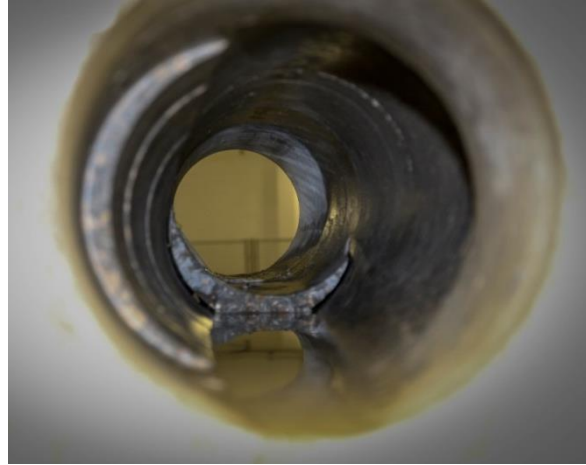


- Install our available spare cavity in the Bo ring and power it with 60 kW ($V_{RF} = 1.8 \text{ MV}$)
- → Build a new 60 kW - 352 MHz SSPA, identical to a standard tower of our SR amplifiers 10 dissipaters of 16 modules, using the 160 RF modules of 400 W with BLF574 transistors and their dc-dc converters, got back from the upgrade of these amplifiers
- Increase V_{RF} of the existing plant from 1 MV up to 1.2 MV → $P_{RF} \sim 30 \text{ kW}$ ($P_{beam} \sim 0$)
- There is space for the 2nd cavity in one straight section of the ring and for the SSPA with its LLRF & control (replica of the actual one) inside the Bo RF room → **Infrastructure work**
- **Additional benefits** : power savings & redundancy in all the other modes of operation



Project status : 60 kW SSPA completed → Cavity conditioning in test area in Nov. 2017
Infrastructure work ongoing → Installation & commissioning scheduled for early 2018

Booster preparation work for installing a second RF cavity



Hole in the shielded
BOO wall



New 30°C cooling circuit



Only the cavity is missing

Double V-Low beta SS (long BLs)

Monitoring alignment
both IDs and photon
absorber
Double XBPM + new
imager

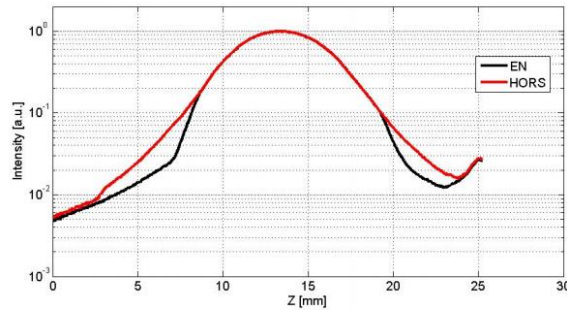
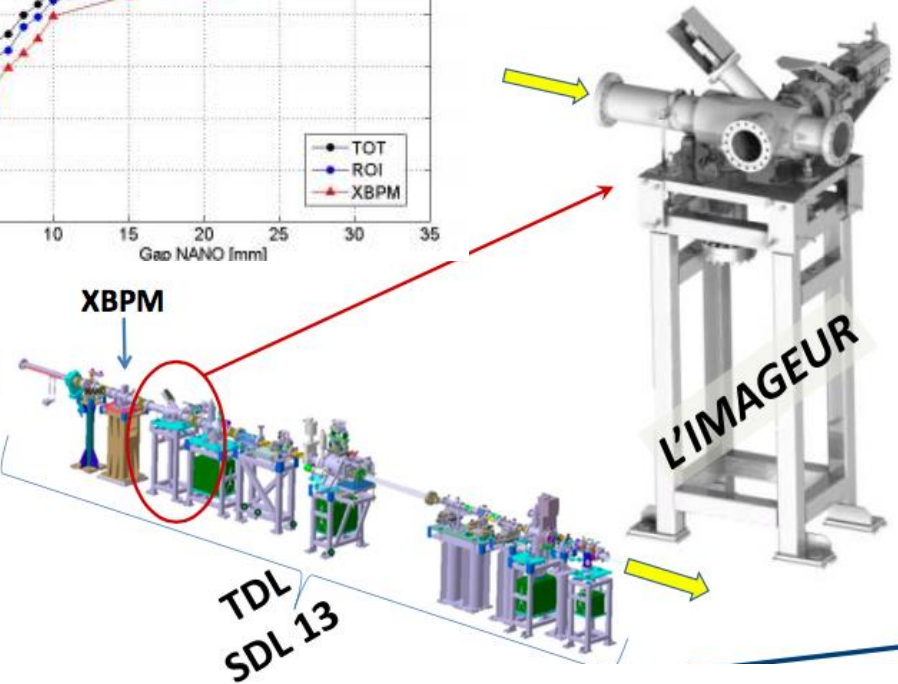
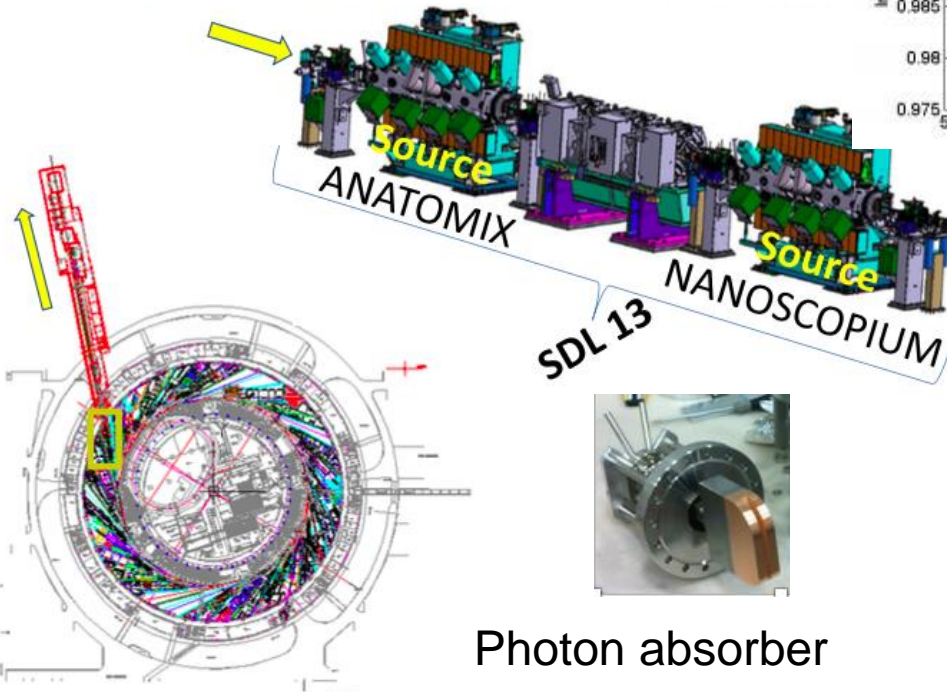
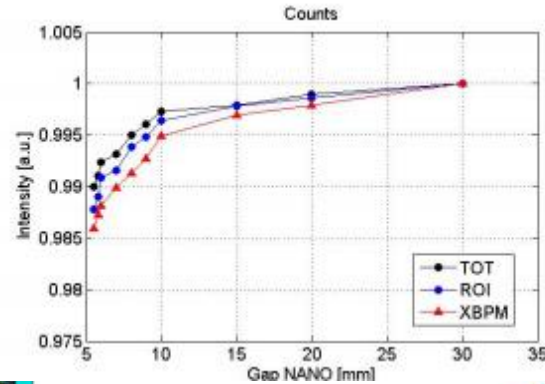


FIGURE 14 – Imager image with ABS HORS and EN. I=1
Data 25/08/2017.



Courtesy of M. Labat



Installed and commissioned in August 2017

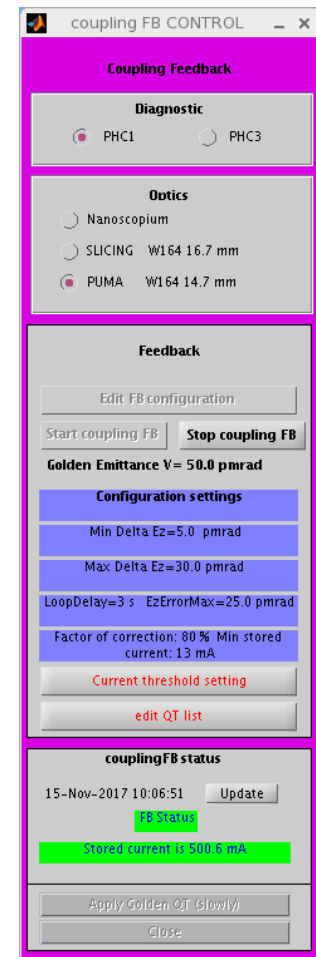
Vertical beam size stability

□ Global Feedback system:

2012: First operation, handling the variation of 32 skew quadrupoles (SQ) field and the monitoring of vertical beam size by means of a pinhole camera [scaling of a vertical dispersion wave every 3 seconds].

2017:

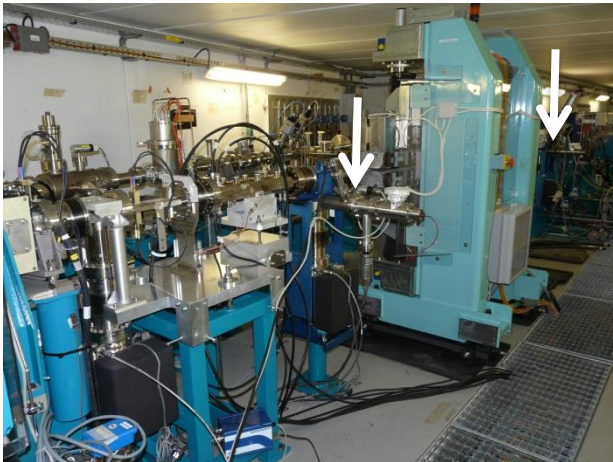
- Redundancy of the feedback on the second pinhole camera
- First successful test to change the actuator.
 - Goal:
 - Increase repetition rate of the global feedback
 - Avoid crossed talk of SQ field with machine skew gradient defaults.
 - Means:
 - The Transverse Feedback System should replace the SQ thanks to the modulation of a white noise.



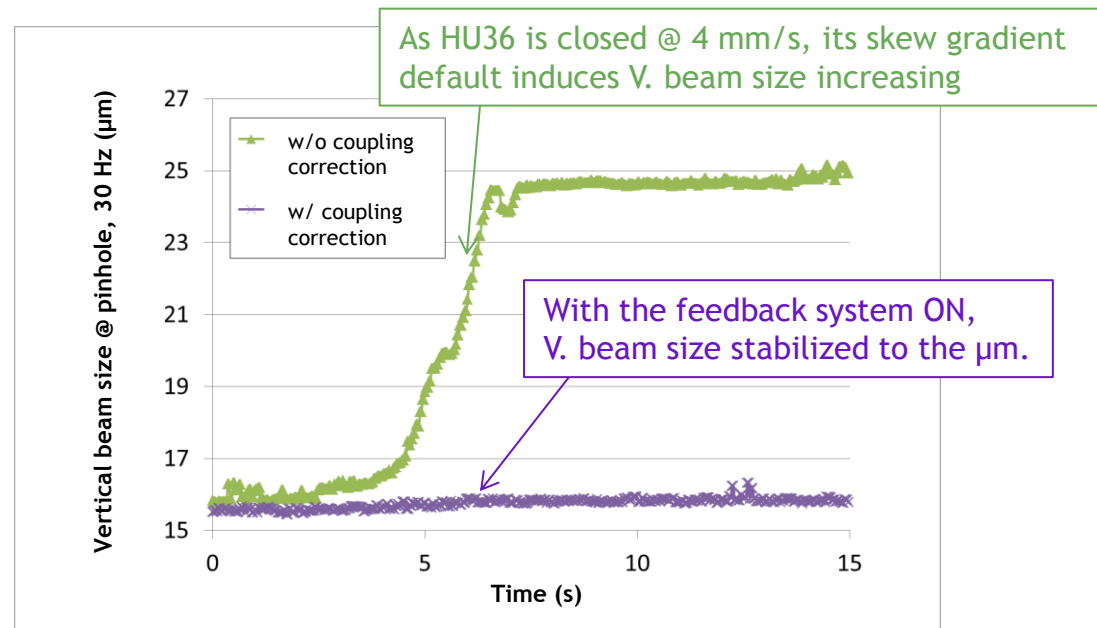
Coupling Feedback System interface

Vertical beam size stability

- ❑ Local feedforward system (1 system for 1 undulator)
 - to be installed on the 2 IDs that perturb the electron beam beyond specifications ($\pm 2\%$ on beam sizes for 8 hours).
- **2016:** First system for HU36, with gap varying @ 4 mm/s. Effective frequency around 60 Hz [Profibus]
- **2017:** On-going correction for the 10 m long electromagnetic HU640 [analog control to follow fast switching of the main field @ 1500 A/s]



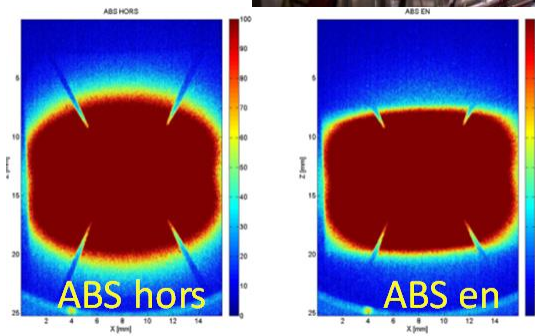
Installation of 2 new in air skew quadrupole correctors around the undulator HU36 and its command control 60 Hz.



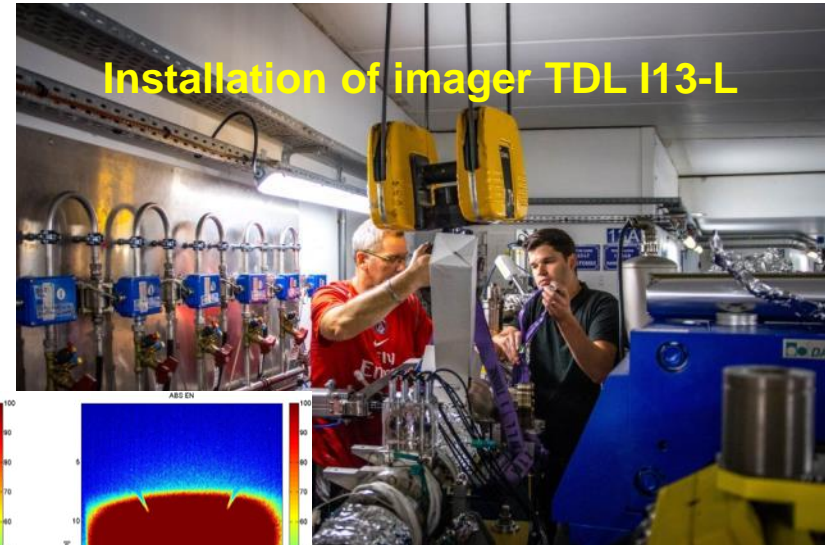
Test of the new coupling feedforward system, applied to the fast varying HU36 undulator.

Coupling control

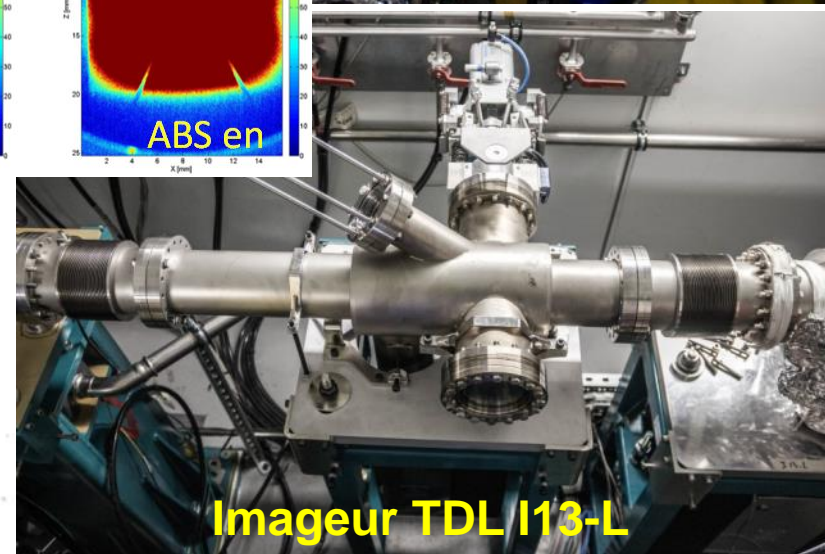
- ID induced control
- Slow coupling FFWD for a Apple-II commissioned
- Slow coupling for HU640 ID



New fast skew quadrupole corrector of H640 coupling --- FFWD under commissioning



Installation of imager TDL I13-L



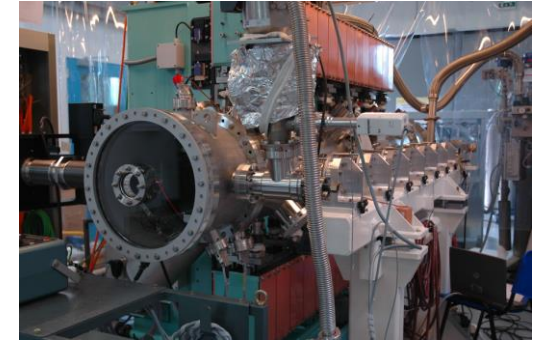
Imageur TDL I13-L

Cryogenic undulator developments at SOLEIL

First PrFeB cryogenic undulator built at SOLEIL:
U18 CPMU n°1 (2 m long) installed on Nanoscopium beamline

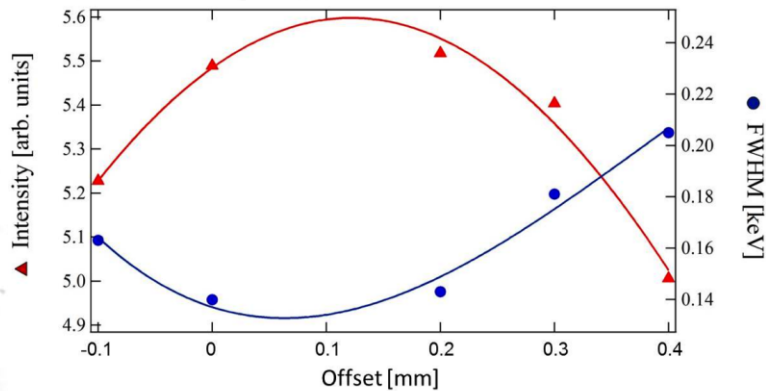
C. Benabderrahmane et al, Nucl. Instr. Meth. A A 669 (2012) 1-6

Nd₂Fe₁₄B and Pr₂Fe₁₄B magnets characterisation and modelling for cryogenic permanent magnet undulator applications, C. Benabderrahmane, P. Berteaud, M. Valléau, C. Kitegi, K. Tavakoli, N. Béchu, A. Mary, J. M. Filhol, M. E. Couprie, Nuclear Instruments and Methods in Physics research A 669 (2012) 1-6

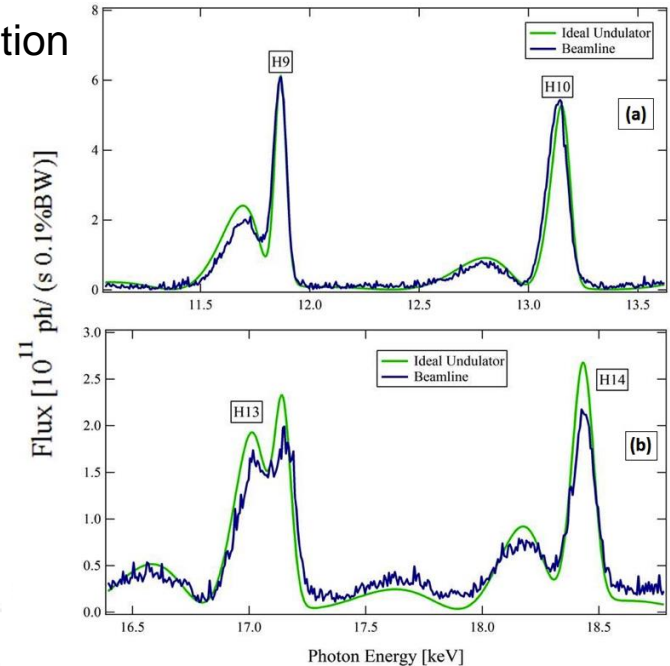


Photon beam characterization

Photon beam-based alignment



→ U18 offset adjusted by 100 μm

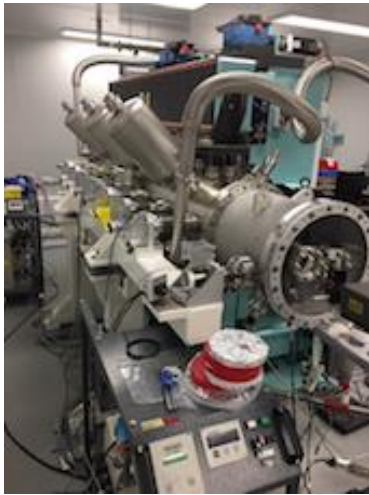


Measured spectra compared with simulation of an ideal undulator

Cryogenic undulator developments at SOLEIL

Second PrFeB cryogenic undulator built at SOLEIL:
U18 CPMU n°2, 2 m long, with half poles

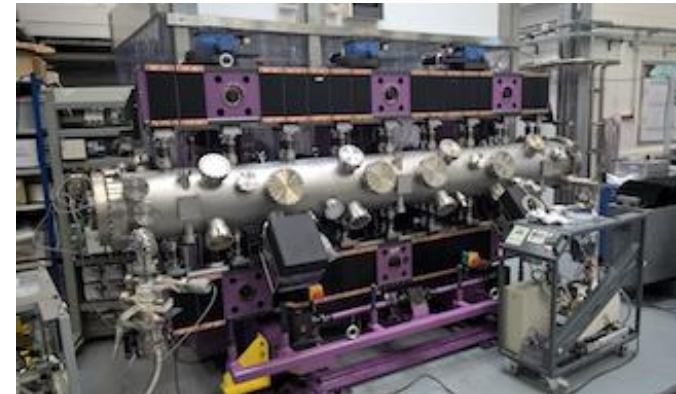
Installed on COXINEL test experiment
(→ A. Loulergue's presentation tomorrow)



Third PrFeB cryogenic undulator built at SOLEIL:
U18 CPMU n°3, 2 m long

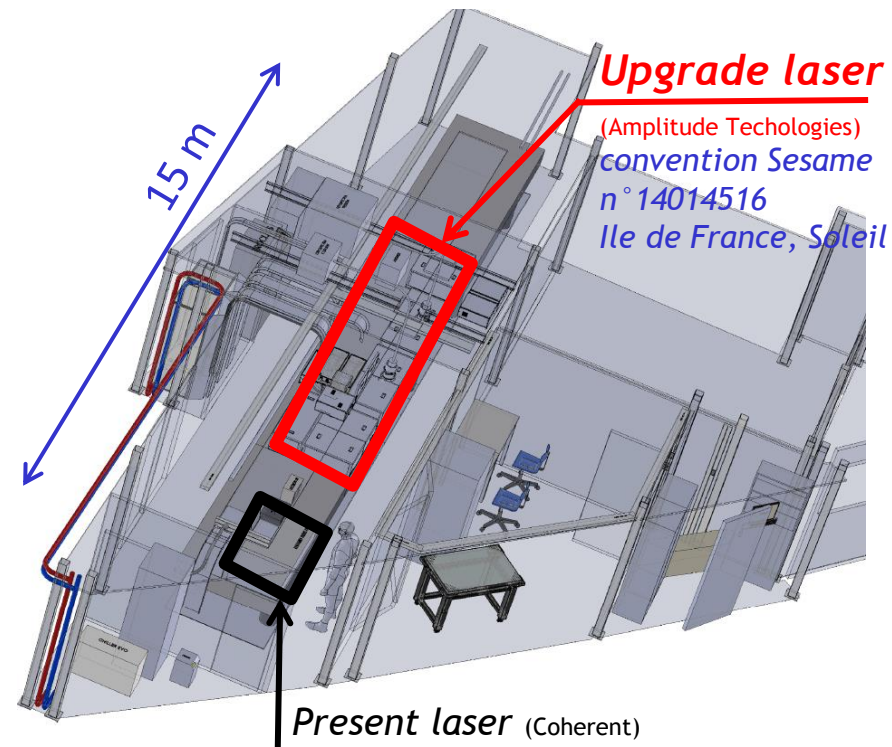
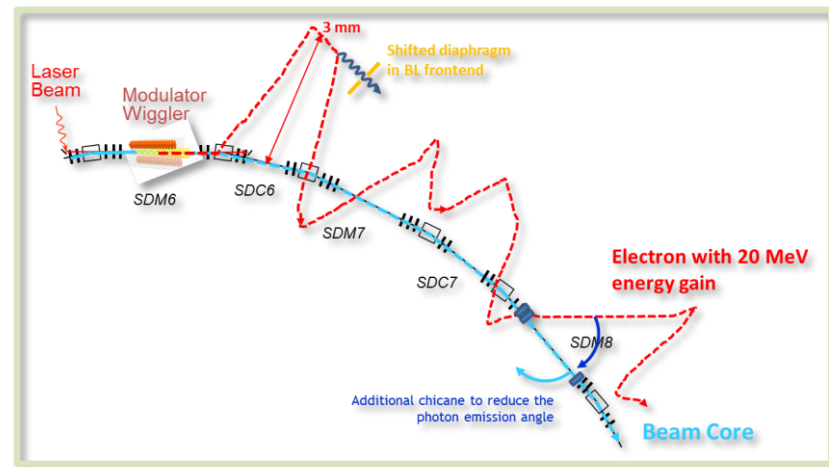
To be installed on Anatomix Beamline Dec 2017
Phase error at 77 K below 3°

U15 PrFeB 3 m cryogenic undulator prototype
(SOLEIL / MAX IV collaboration)
Measured modules



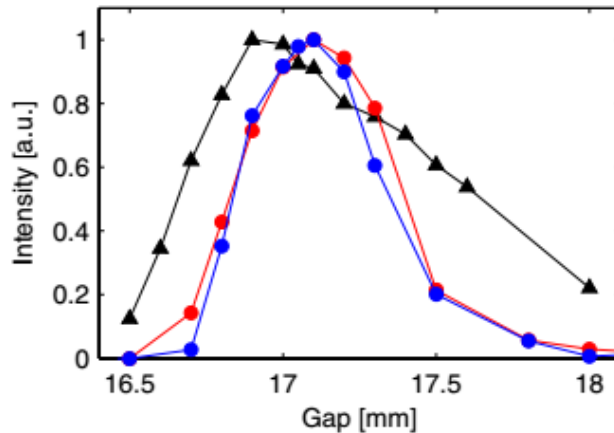
Femtosing progress

- ❑ Five weeks of operation from June 2016 to Feb. 2017
- ❑ Since Feb. 2017, Upgrade of the laser:
 - Shutdown of the femto-slicing operation
 - Present laser: 25 fs, 5 mJ/pulse @ 1 kHz
 - **+ Upgrade laser: 40 fs**
 - 6.5 mJ/pulse @ 5 kHz**
 - 5 mJ/pulse @ 8 kHz**
 - 4 mJ/pulse @ 10 kHz**
- ✓ Factory Acceptance test mid April 2018
- ✓ Site Acceptance test Autumn 2018
- ✓ Commissioning with the upgrade laser Spring 2019
- ❑ Installation of a THz diagnostic in the SR tunnel in August 2018
- ❑ Operation resumption with external users foreseen in Call for Proposal #2 2019



Femto-slicing operation

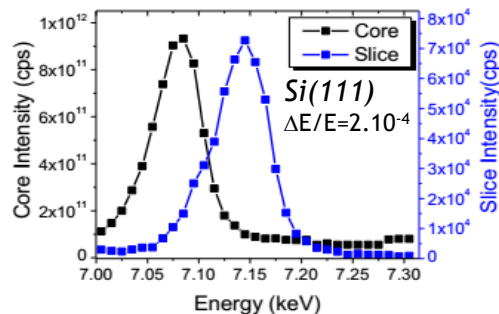
- For the first time in a Femto-slicing scheme, two beamlines are simultaneously benefiting from sub-ps pulses



- ▲ THz intensity on AILES beamline
- Slice photon flux on CRISTAL beamline
- Slice photon flux on TEMPO beamline

Simultaneous record of 3 signals versus the gap of the wiggler modulator: from bolometer on the THz beamline, and from detector on hard and soft X-ray beamlines.

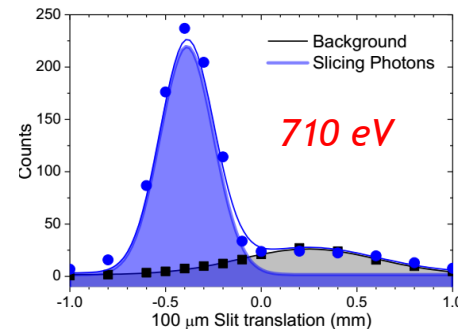
Hard X-ray beamline CRISTAL



Energy separation of core and slicing photons (7.1 keV).

- ✓ Evidence of photon **short bunch length < 140 fs FWHM** @ CRISTAL
- ✓ Setting up of a new multilayer monochromator Ni/B₄C → Flux : 1000 ph/pulse in $\Delta E/E = 1\%$

Soft X-ray beamline TEMPO



Spatial separation of core and slicing photons.

- ✓ First photons measured @ TEMPO in December 2016.

THOMX

Compton Back Scattering X-ray source

Electron : 1 bunch, 1 nC, 20 to 70 MeV max
Rep = 20 MHz in a ring

Laser : 1 pulse, 10 – 30 mJ max
Rep = 40 MHz in FP cavity

X-Flux : up to 90 keV
up to 10^{13} Photon/s



Status

All installation should end by mid-2018

Commissioning start mid-2018
Linac then Ring

First photon by end of 2018

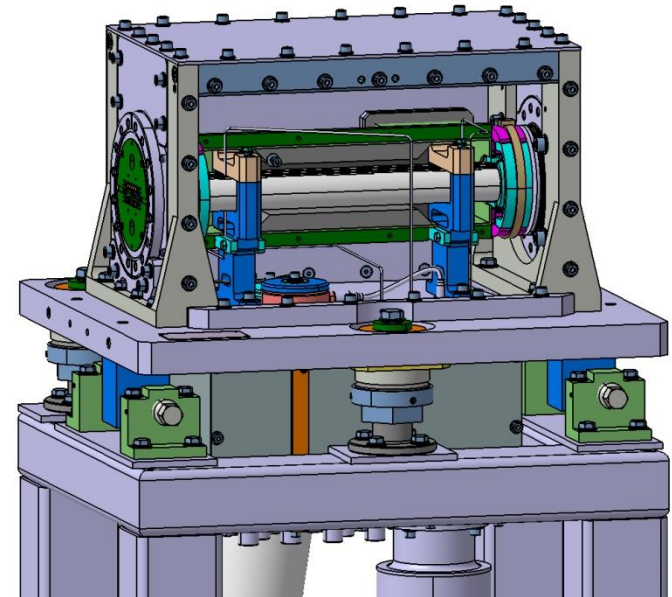
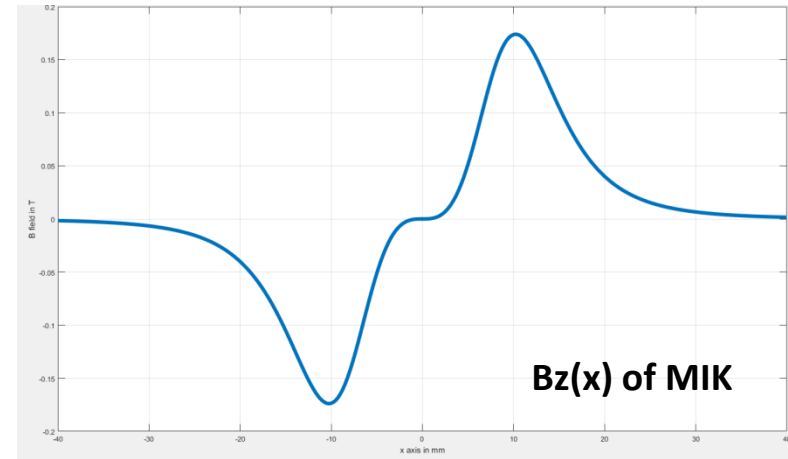
Installation started
from August 2017



MAX-IV – SOLEIL Multipole Injection Kicker (MIK) project

Summarized overview

- **A single short magnet (400 mm) that allows transparent Top-Up injection** in the next generation of storage rings, in lieu of traditional 4 kicker bump injection scheme.
- **Aim of project is to design and build such magnets and its pulsed power supplies** for MAX-IV 3 GeV ring and SOLEIL 2.75 GeV ring. Budget : 774 k€.
- **For MAX-IV 3 GeV ring: integrated field of deflection is 11.7 mTm (ie 1.17 mrad).** Peak current in magnet coils : 7700 A under 14 kV.
- **The final design is inspired from the octupole-like non linear kicker of Bessy II, with the main points:**
 - Vacuum chamber is made of pure monocrystalline sapphire with internal 1 μm titanium coating.
 - Magnet coils are embedded in the sapphire chamber which requires extremely tight machining tolerances to achieve excellent quality of the zero field region at center.
 - High voltage on very compact magnet led to detailed engineering of insulators.
 - Extensive work on the pulsed power supplies to minimize voltage constraints on magnet while delivering fast current pulses.

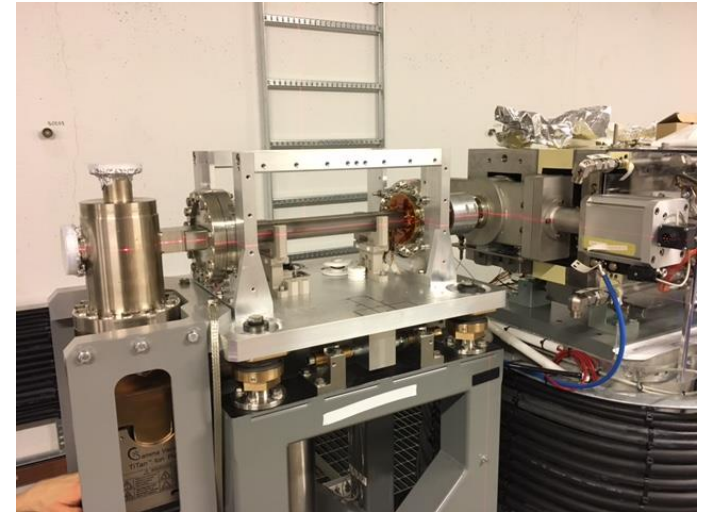


3D view of the complete MIK magnet

MAX-IV – SOLEIL Multipole Injection Kicker (MIK) project

Timeline : 2012 – 2017/18

- **Early 2012 - Mid 2014:** Preliminary designs of MIK magnets and high voltage pulsed power supplies to meet the extensive specifications of both machines. Prototyping on feasibility of embedded conductors in vacuum chamber.
- **Mid 2014 - April 2015:** Detailed designs of all subsystems (magnet & vacuum chamber, mechanics, pulser, control system, high voltage power supplies, etc..). ***Numerous call for tenders followed.***
- **May 2015 – Dec. 2016:** delivery of all subcomponents required to build a first complete system (vacuum chamber with magnet, mechanics, pulser, controls cabinets).
- **2017: assembly of a first complete prototype of MIK magnet.** The assembly of the magnets & other subcomponents is done at SOLEIL by skilled technicians.
- **July 2017:** magnetic measurement of the prototype magnet, after complete electrical testing.
- **August 2017:** installation on MAX-IV 3 GeV ring of a complete MIK system. **Commissioning with beam should happen in Dec. 2017 and early 2018.**
- **2018:** end of assembly of 4 definitive MIK magnets and installation on MAX-IV & SOLEIL rings for routine operation.

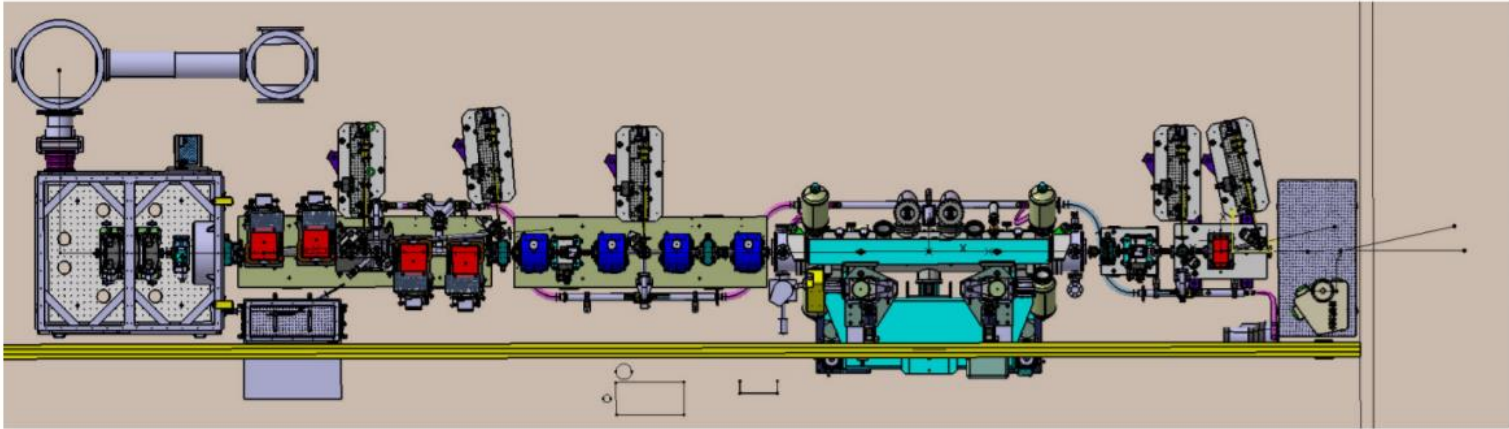


MIK magnet installed on 3 GeV ring at MAX-IV



MIK pulsed power supply, control cabinets and high voltage charging power supplies at MAX-IV.

Project COXINEL: FEL amplification using Laser Plasma Acceleration



Goals :

- Demonstrate an appropriate transport to the undulator, and FEL amplification at 200 nm and later at 40 nm using undulators from SOLEIL
- Investigate and control (theory/experiments) FEL performance

M. E. Couprie et al. J. Physics B : At., Mol. Opt. Phys. (2014) 234001

A. Loulergue et al., New J. Phys. 17 (2015) 023028 (2015)

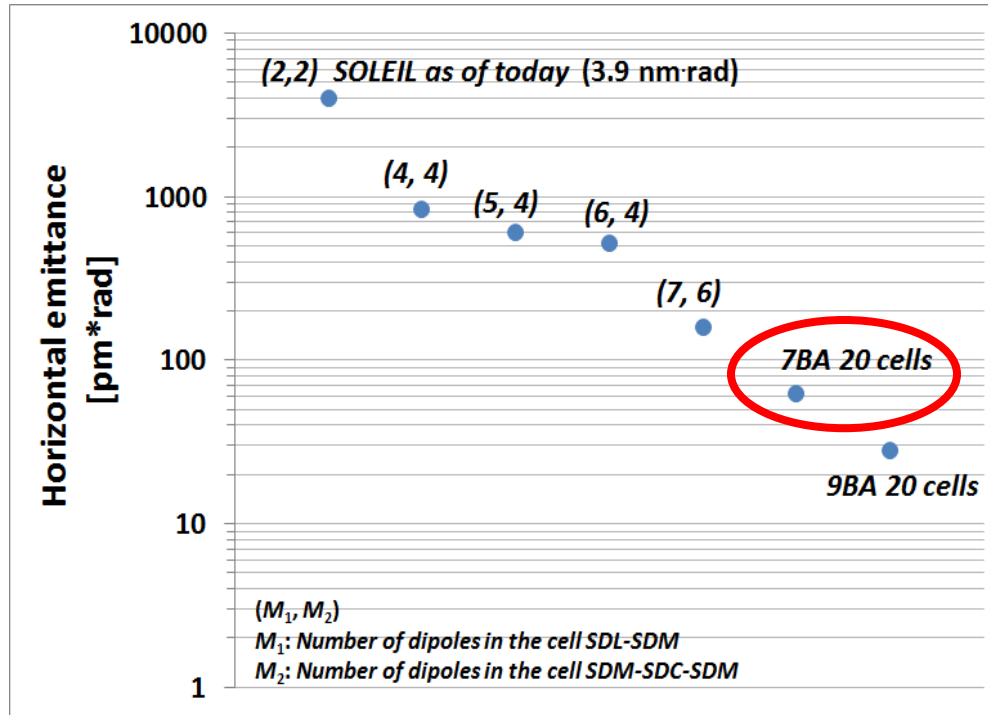
M. E. Couprie et al., Plasma Physics and Controlled Fusion, Volume 58, Number 3 (2016)

⇒ **A dedicated talk by A. Loulergue (SOLEIL) tomorrow**

Upgrade SOLEIL

Dramatically enhanced photon beam brilliance and coherent flux to beamline experiments as compared to the present machine are aimed by respecting the following conditions:

- Reduce by more than a factor 30 or 40 the horizontal electron beam emittance (in the order of 100 pm.rad).
- Reuse of the existing tunnel and its radiation shielding wall.
- Maintain the existing insertion device source points.
- Keep a storage ring energy that covers a very broad photon energy range.
- Preserve a current of 500 mA in multibunch operation.
- Preserve time structure and time resolved operations.
- Reuse of the injector complex: linac and booster.
- Reuse much of the technical infrastructure.
- Limit downtime to a maximum of two years.
- Minimize operation costs, in particular the wall-plug-power.
- Preserve Infra-Red (IR) beamlines.
- Provide alternative radiation sources for the existing bending magnet based beamlines.



Evolution of lattice studies carried out for the SOLEIL upgrade



An optimized solution having 7BA 20 cells defined as the **baseline lattice**

⇒ Dedicated talks on

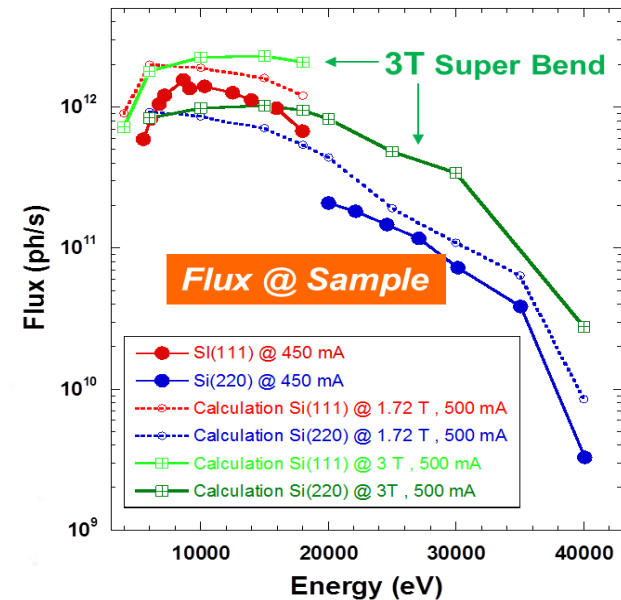
- Lattice studies, by A. Loulergue
- Studies of longitudinal on-axis injection scheme, by myself tomorrow

2018 roadmap (1)

- Installation new cryogenic U18 in double V low-beta SS
 - Both long BLs to receive users by end of July (2x 5.5 mm IVUs)
 - New 4 magnet chicane (reliability, redundancy)
- Femtosecond upgrade
 - Building a THz Beamline (SR tunnel)
 - Diagnostics for maintaining Femtoslicing interaction (Sem2 2018)
 - New laser for both Soft and hard X-ray BLs
- Continuous improvement for the operation
 - Spare power supplies for SR sextupole PS and dipole LT2
 - Operating at 500 mA with a single cryomodule, and degraded modes for user beam.
 - Upgrade TFB (SPRing-8 processor)
 - Fast coupling FWD for a mechanical and a fast switch electromagnetic IDs

2018 roadmap (2)

- Installation of second 5 cell Cu cavity in Booster
 - Low-alpha mode:
 - Possibility to increase injection efficiency from 15-20% to 30-35% by shortening BOO bunches
 - Open the possibility to increase the number of BLs in this mode by overcoming the radiation safety limitation
 - Redundancy for user operation
- Project study for replacing a 1.71 T bending dipole with a super)-bend of 3T
 - Increasing flux in 14-43 keV domain
 - Choice of technology (electromagnet or Permanent Magnet)



2018 Beam Calendar

janv 2018	févr 2018	mars 2018	avr 2018	mai 2018	juin 2018	juil 2018	août 2018	sept 2018	oct 2018	nov 2018	déc 2018	janv 2019	févr 2019
lun 01	jeu 01	jeu 01	dim 01	mar 01	ven 01	dim 01	mer 01	sam 01	lun 01	jeu 01	sam 01	mar 01	ven 01
mar 02	ven 02	ven 02	lun 02	mer 02	sam 02	lun 02	jeu 02	dim 02	mar 02	ven 02	dim 02	mer 02	sam 02
mer 03	sam 03	sam 03	mer 03	jeu 03	dim 03	mar 03	ven 03	lun 03	mer 03	sam 03	lun 03	jeu 03	dim 03
jeu 04	dim 04	dim 04	mer 04	ven 04	lun 04	mer 04	sam 04	mar 04	jeu 04	dim 04	S S S	mar 04	lun 04
ven 05	lun 05	lun 05	jeu 05	sam 05	mar 05	jeu 05	dim 05	mer 05	ven 05	lun 05	mer 05	sam 05	mar 05
sam 06	mar 06	mar 06	ven 06	dim 06	mer 06	ven 06	lun 06	jeu 06	sam 06	mar 06	jeu 06	dim 06	mer 06
dim 07	mer 07	mer 07	sam 07	lun 07	jeu 07	sam 07	mar 07	ven 07	dim 07	mer 07	ven 07	jeu 07	mer 07
lun 08	jeu 08	jeu 08	dim 08	mar 08	ven 08	dim 08	mer 08	sam 08	lun 08	jeu 08	sam 08	mar 08	ven 08
mar 09	ven 09	ven 09	lun 09	mer 09	sam 09	lun 09	jeu 09	dim 09	mar 09	ven 09	dim 09	mer 09	sam 09
mer 10	sam 10	sam 10	mar 10	jeu 10	dim 10	mar 10	ven 10	lun 10	mer 10	sam 10	lun 10	jeu 10	dim 10
jeu 11	dim 11	dim 11	mer 11	ven 11	lun 11	mer 11	sam 11	mar 11	jeu 11	dim 11	mar 11	ven 11	lun 11
ven 12	lun 12	lun 12	jeu 12	sam 12	mar 12	jeu 12	dim 12	mer 12	ven 12	lun 12	mer 12	sam 12	mar 12
sam 13	mar 13	mar 13	ven 13	dim 13	mer 13	ven 13	lun 13	jeu 13	sam 13	mar 13	jeu 13	dim 13	mer 13
dim 14	mer 14	mer 14	sam 14	lun 14	jeu 14	sam 14	mar 14	ven 14	dim 14	mer 14	ven 14	lun 14	jeu 14
lun 15	jeu 15	jeu 15	dim 15	mar 15	ven 15	dim 15	mer 15	sam 15	lun 15	jeu 15	sam 15	mar 15	ven 15
mar 16	ven 16	ven 16	lun 16	mer 16	sam 16	lun 16	jeu 16	dim 16	mar 16	ven 16	dim 16	mer 16	sam 16
mer 17	sam 17	sam 17	mar 17	jeu 17	dim 17	mar 17	ven 17	lun 17	mer 17	sam 17	lun 17	jeu 17	dim 17
jeu 18	dim 18	dim 18	mer 18	ven 18	lun 18	mer 18	sam 18	mar 18	jeu 18	dim 18	mar 18	ven 18	lun 18
ven 19	lun 19	lun 19	jeu 19	sam 19	mar 19	jeu 19	dim 19	mer 19	ven 19	lun 19	mer 19	sam 19	mar 19
sam 20	mar 20	mar 20	ven 20	dim 20	mer 20	ven 20	lun 20	jeu 20	sam 20	mar 20	jeu 20	dim 20	mer 20
dim 21	mer 21	mer 21	sam 21	lun 21	jeu 21	sam 21	mar 21	ven 21	dim 21	mer 21	ven 21	lun 21	jeu 21
lun 22	jeu 22	jeu 22	dim 22	mar 22	ven 22	dim 22	mer 22	sam 22	lun 22	jeu 22	sam 22	mar 22	ven 22
mar 23	ven 23	ven 23	lun 23	mer 23	sam 23	lun 23	jeu 23	dim 23	mar 23	ven 23	dim 23	mer 23	sam 23
mer 24	sam 24	sam 24	mar 24	jeu 24	dim 24	mar 24	ven 24	lun 24	mer 24	sam 24	lun 24	jeu 24	dim 24
jeu 25	dim 25	dim 25	mer 25	ven 25	lun 25	mer 25	sam 25	mar 25	jeu 25	dim 25	mar 25	ven 25	lun 25
ven 26	lun 26	lun 26	jeu 26	sam 26	mar 26	jeu 26	dim 26	mer 26	ven 26	lun 26	mer 26	sam 26	mar 26
sam 27	mar 27	mar 27	ven 27	dim 27	mer 27	ven 27	lun 27	jeu 27	sam 27	mar 27	jeu 27	dim 27	mer 27
dim 28	mer 28	mer 28	sam 28	lun 28	jeu 28	sam 28	mar 28	ven 28	dim 28	mer 28	ven 28	lun 28	jeu 28
lun 29	jeu 29	jeu 29	dim 29	mar 29	ven 29	dim 29	mer 29	sam 29	lun 29	jeu 29	sam 29	mar 29	ven 29
mar 30	mer 30	mer 30	lun 30	mer 30	sam 30	lun 30	jeu 30	dim 30	mar 30	ven 30	dim 30	mer 30	lun 30
mer 31	M M M	M M M	M M M	jeu 31	M M M	mar 31	ven 31	A A A	mer 31	S S S	lun 31	jeu 31	M M M

