



**ESLS-RF**  
**EUROPEAN SYNCHROTRON**  
**LIGHT SOURCES**

# **WELCOME TO SOLEIL**

Amor Nadji  
On behalf of Synchrotron SOLEIL

- **SOLEIL is the French synchrotron light source, both a large scale facility and a research laboratory.**
- **Shareholding of the French public centers CNRS and CEA, SOLEIL is at the service of the international scientific community and industry.**



**72 %**

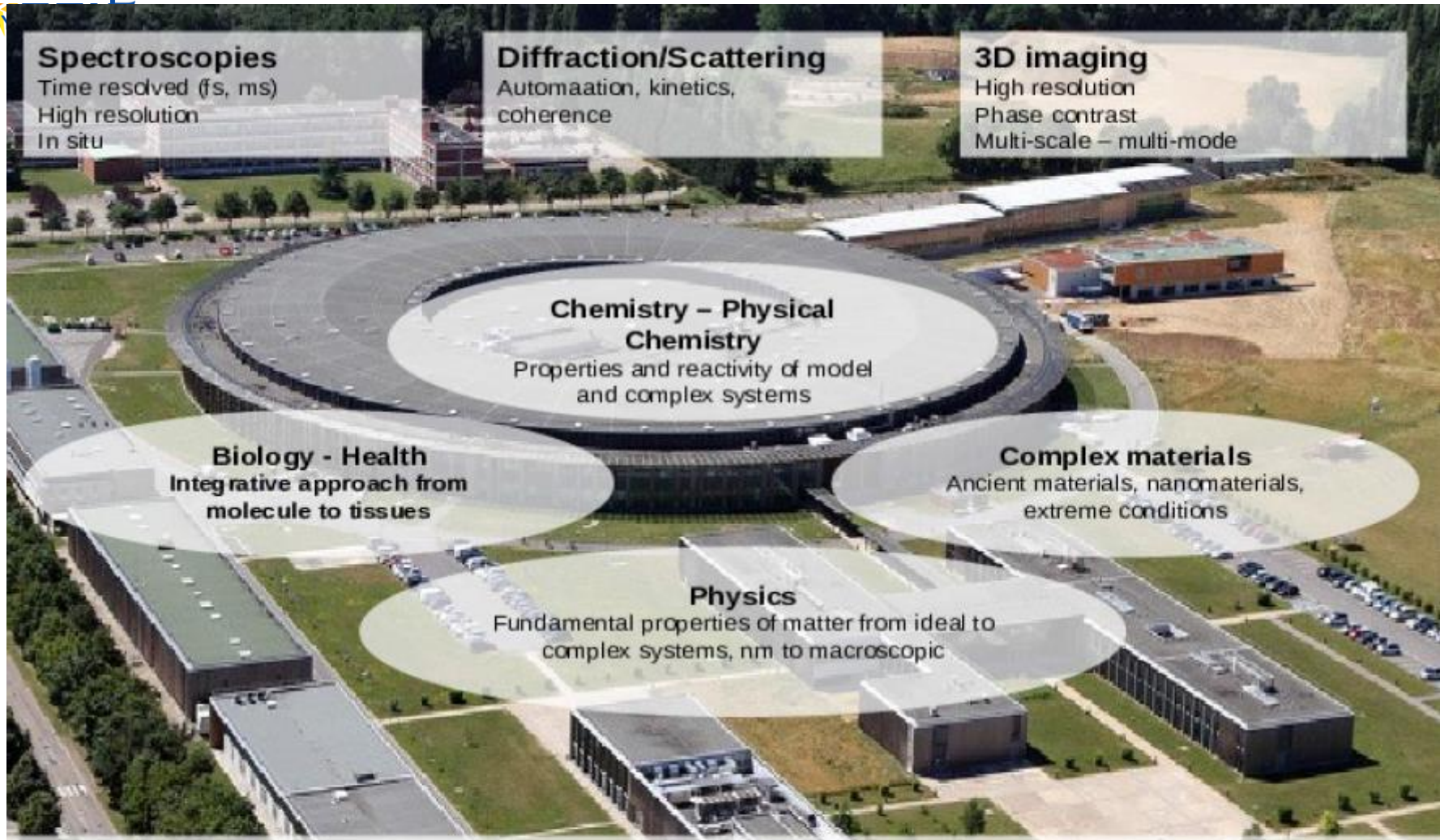


**28 %**

- **350 permanent staff.**
- **Functioning budget per year : ~ 55 M€.**



# Scientific Strategy



## Spectroscopies

Time resolved (fs, ms)  
High resolution  
In situ

## Diffraction/Scattering

Automation, kinetics,  
coherence

## 3D imaging

High resolution  
Phase contrast  
Multi-scale – multi-mode

## Chemistry – Physical Chemistry

Properties and reactivity of model  
and complex systems

**Biology - Health**  
Integrative approach from  
molecule to tissues

**Complex materials**  
Ancient materials, nanomaterials,  
extreme conditions

**Physics**  
Fundamental properties of matter from ideal to  
complex systems, nm to macroscopic

## Platforms

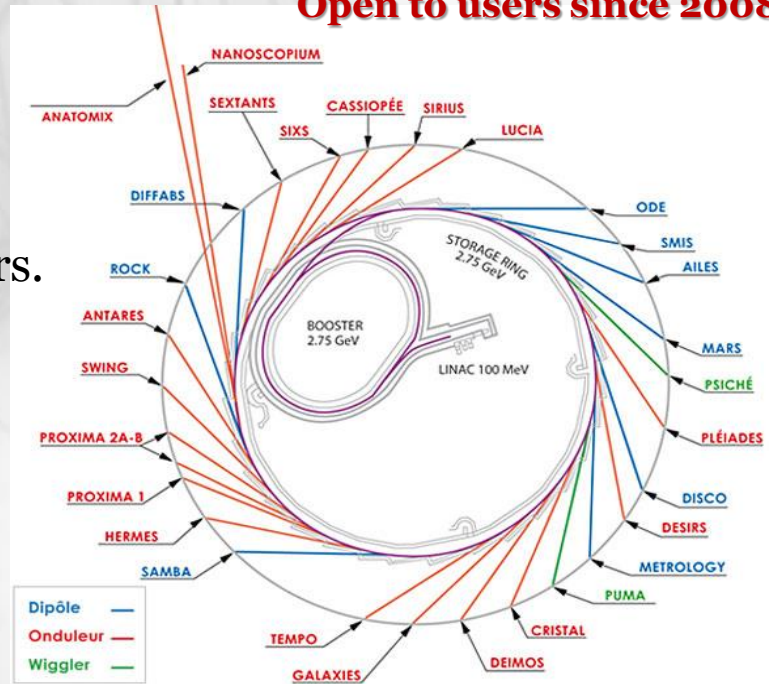
*Medium-long term projects, support and complementary instrumentations, interfaces R&D*

**Ancient materials:**  
**IPANEMA**

**Environmental  
sciences**

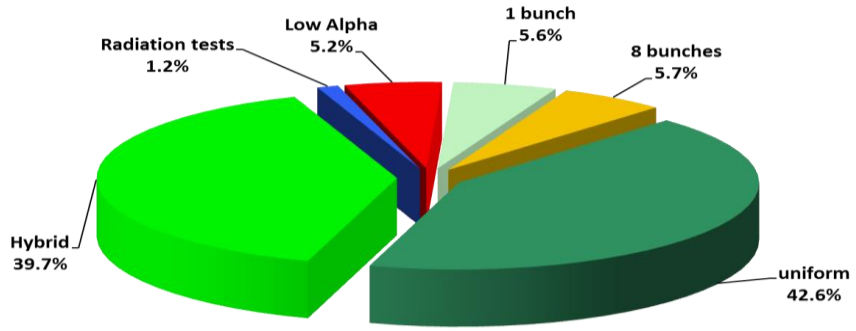
**Biology-health**

- 29 beamlines operational in 2018.
- > 42000 users visits since 2008.
- > 600 articles published yearly.
- Machine availability > 98% and MTBF > 90 hours.



Mode of operation Bunch fill. patterns	User Operation in 2018	Ultimate performance achieved
Multibunch (M2)	500 mA	500 mA
Hybrid/camshaft mode (M)	425 mA + 5 mA	425 mA + 10 mA
8 bunches (8)	100 mA	110 mA
1 bunch (S)	16 mA	20 mA
Low- $\alpha$ : Hybrid mode (L)	4.7 ps RMS for 65 $\mu$ A	< 3.2 ps RMS for 15 $\mu$ A

- ~ 5000 hours of photon beam for user operation.



Top up injection in all modes

Broadband spectrum:  
9 orders of magnitude from far IR to hard X-rays.

07/11/2018 17:48:29

Function Mode: **TOP-UP**

Filling Mode: **4/4**

Lifetime: **15.64 h**

Integrated Current: **20751.6 A.h**

Average Pressure: **4.5e-10 mbar**

Delivery Since: **Tue Nov 6 07:00**

End Of Beam: **Nov-12 07:00**

Remaining Time: **109:11:32**

Bending Magnet	Insertion Devices
ODE	I02_C
MARS	DESIRS
DISCO	DEIMOS
METRO	109_L
SAMBA	PX2
ROCK	ANATOMIX
DIFFABS	SIXS
	LUCIA
	CASSIOPEE
	SIRIUS
	PSICHE
	PUMA
	GALAXIES
	HERMES
	SWING
	ANTARES
	NANOSCOPIUM
	SEXTANTS
	SMIS
	AILES

Orbit(RMS): 53.9  $\mu$ m, 73.8  $\mu$ m

Emittance: 4.49 nm.rad, 38.2 pm.rad

Tune: 0.1655, 0.2371

Shift Lignes

Wed Nov 7 07:01



# SOLEIL Lattice and Some Parameters

Rather small Circumference: **354 m**

16 cells

High ratio of free straight sections (~45%)

24 straight sections

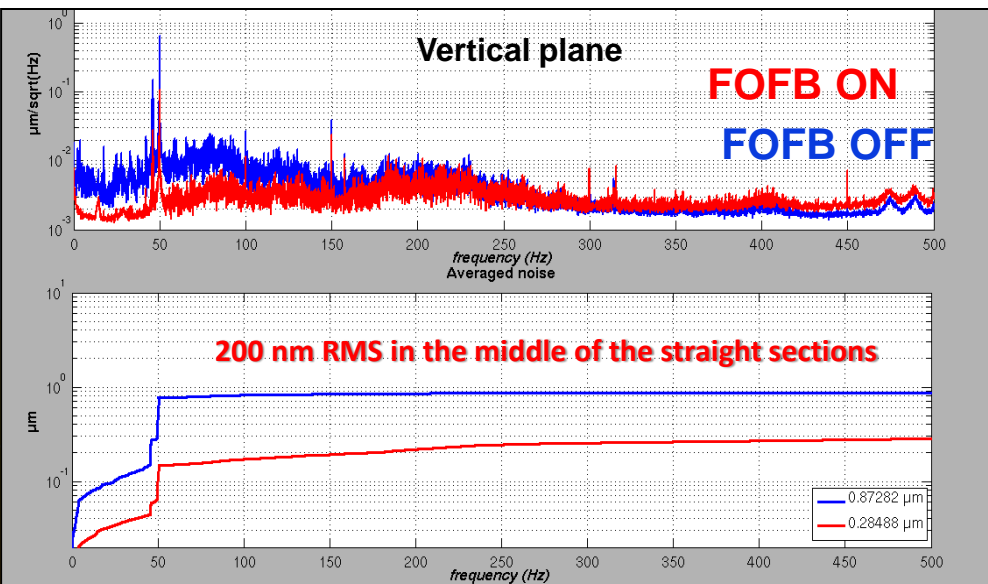
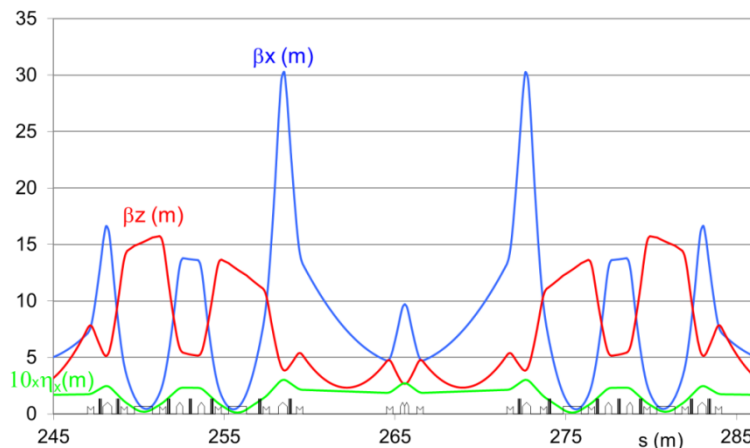
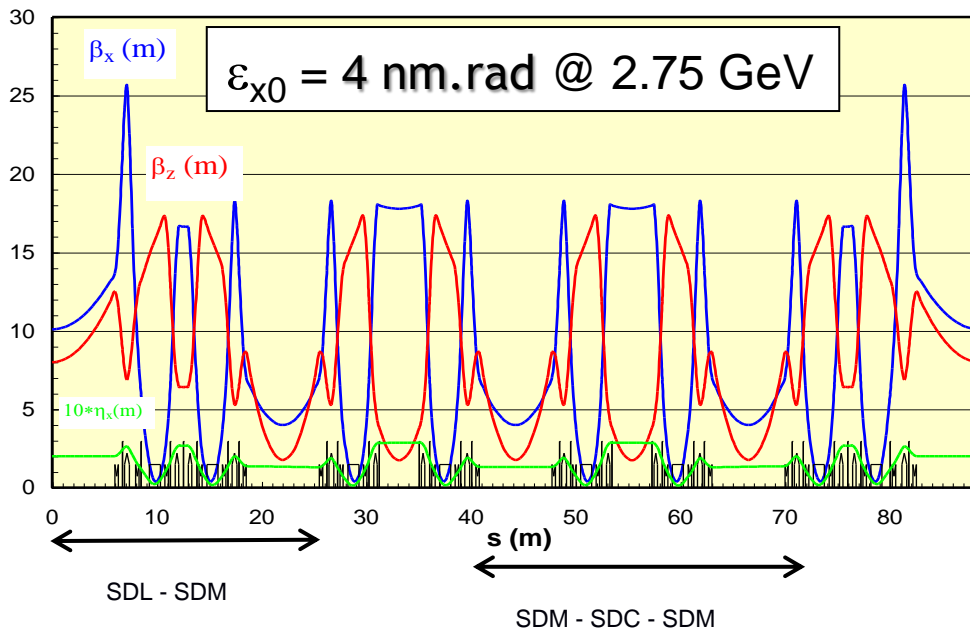
4 x 12 m

12 x 7 m

8 x 3.6 m

Very compact magnetic structure

Very stable beam



One long straight section (**SDL13**, accommodating 2 long beamlines) has been modified.



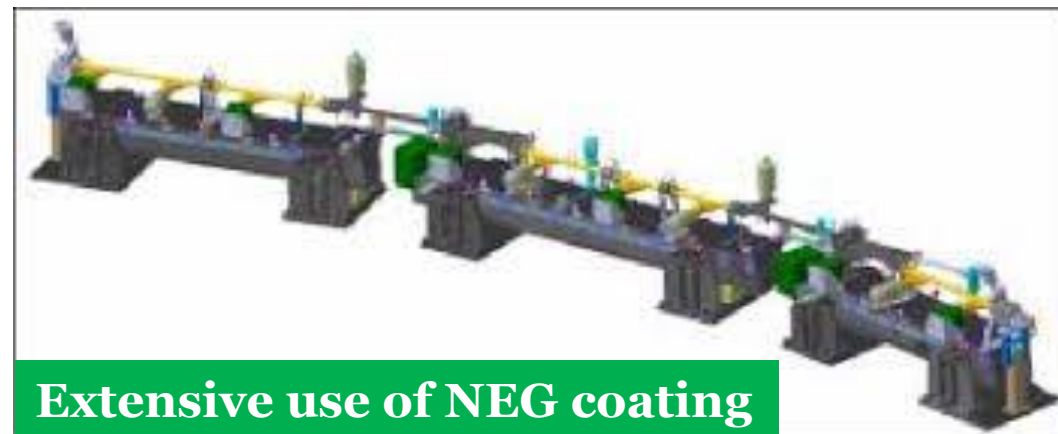
## 352 Superconducting RF cavity



## RF Solid State Amplifiers



## Diverse Insertion Devices



Extensive use of NEG coating



ERC Grant (M.E. Couprie)

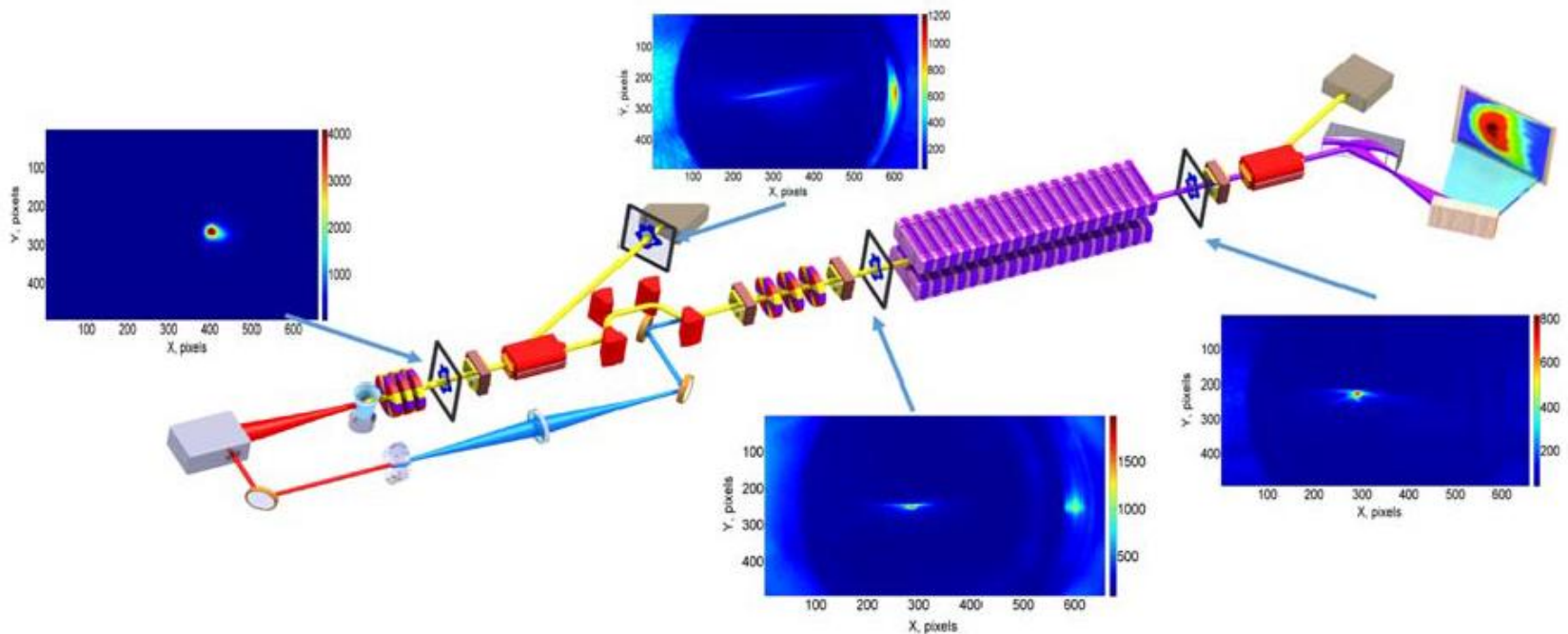


Figure 1: First transport of the LPA electron beam in the COXINEL beamline.

Aims at demonstrating Free Electron Laser amplification with present LWFA performances Using an existing TW laser.





Démonstrateur  $10^{13}$  ph/s

~ 90 keV @ 70 MeV

100 m<sup>2</sup>

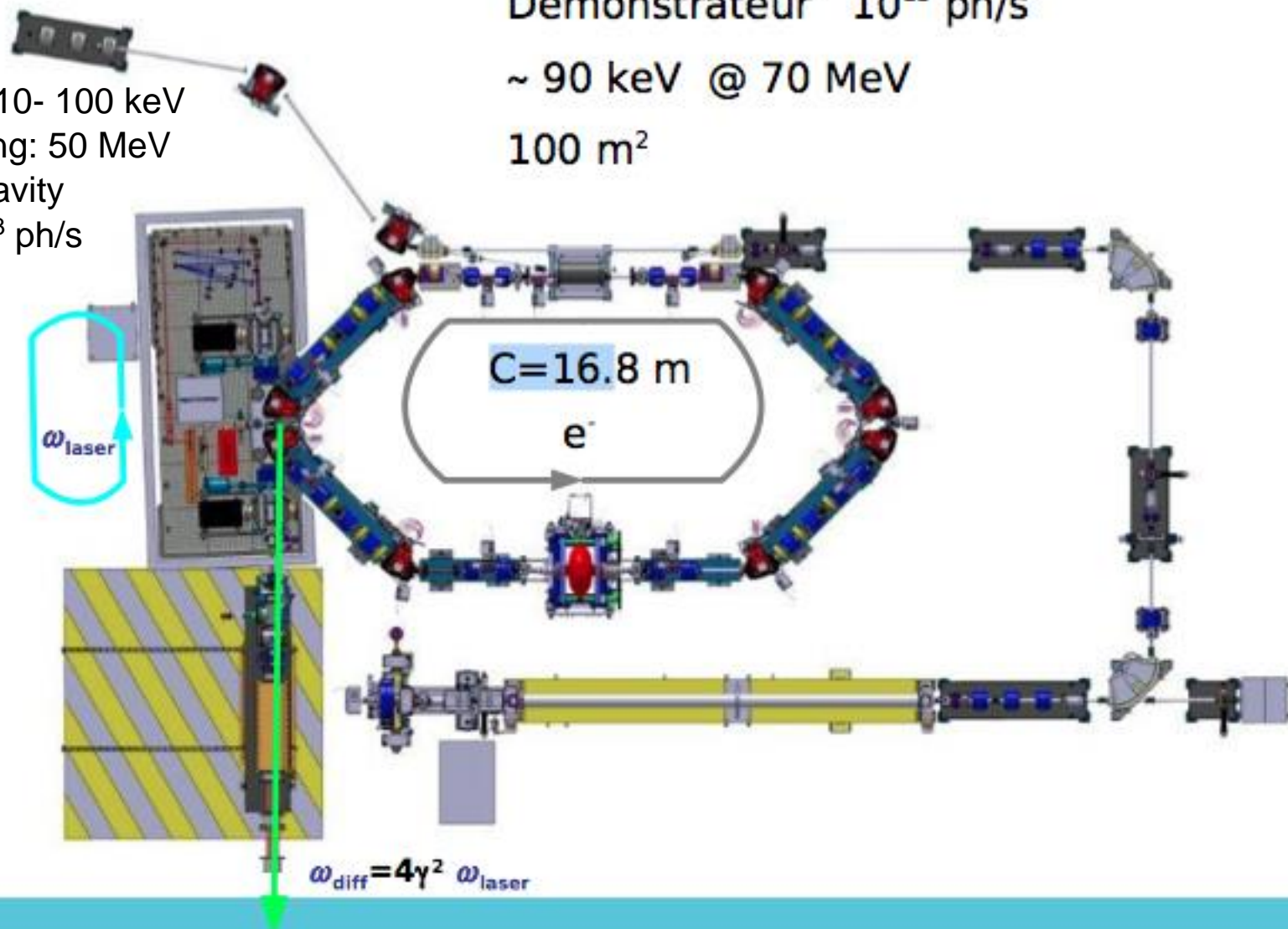
**Principle:**

X Compton : 10- 100 keV

Low energy ring: 50 MeV

Fabry-Pérot cavity

Flux:  $10^{12}$ - $10^{13}$  ph/s

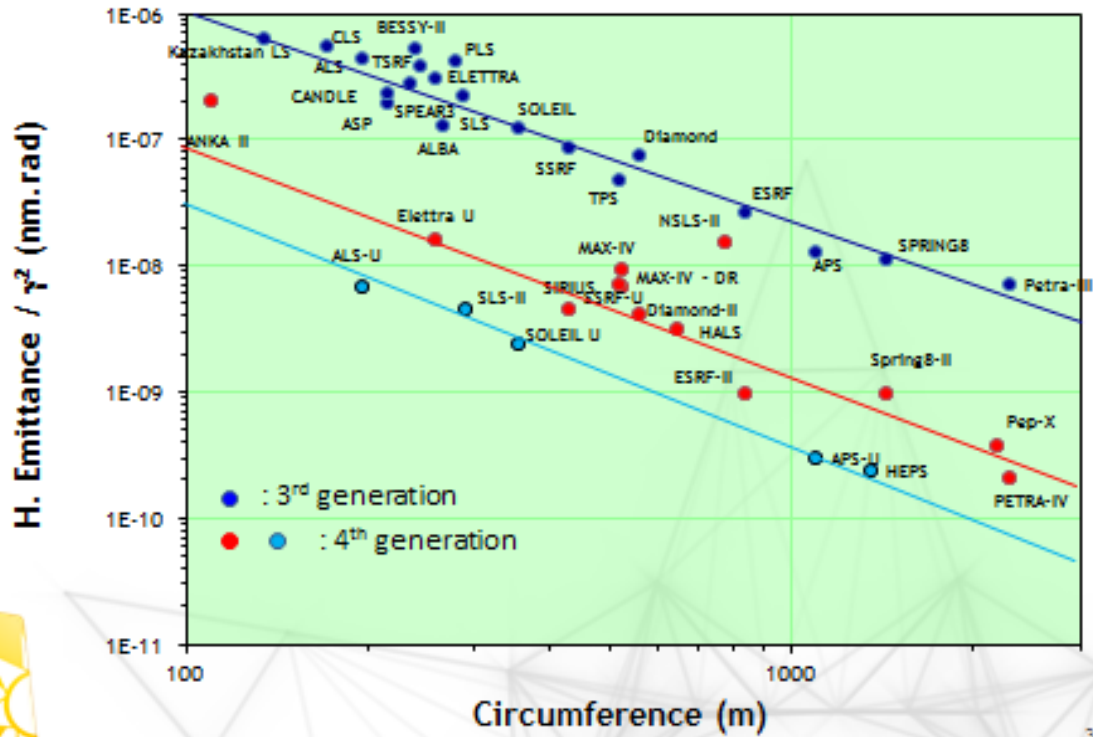


**Under construction at LAL (ORSAY)**



# Towards 4<sup>th</sup> Generation Storage Ring

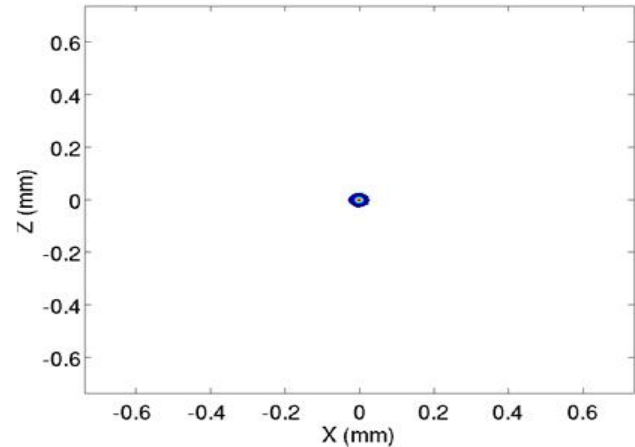
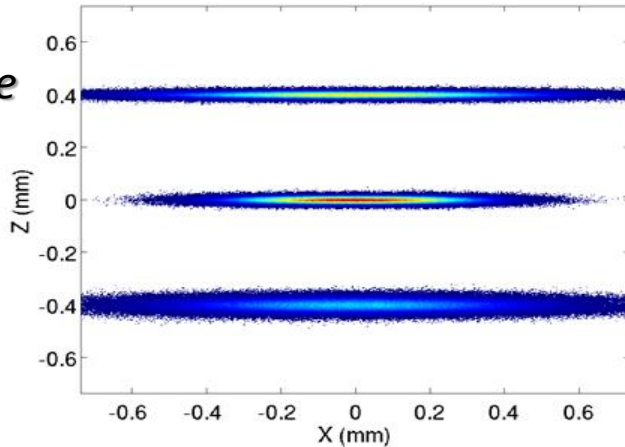
Evolution of the emittance



Adapted from R. Bartolini

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Evolution of the beam size



# Timeline for the proposed upgrade

Date	Phase
Dec. 2016	Council meeting, presentation of the first proposal for an upgrade.
2017 - 2019	Discussions regarding the definition of the project (beamlines and storage ring); definition of objectives. Baseline Lattice defined.
2018 - 2019	Continuation of discussions and prototyping to assess feasibility of key options.
2019	<b>Decision to launch a Conceptual Design Report (CDR).</b>
2019-2020	CDR based on preliminary studies and prototyping.
2020	<b>Decision to launch a Technical Design Report (TDR).</b>
2020-2022	Technical Design Report.
2022	<b>Decision to start the project.</b>
2022-2025	Reconstruction of storage ring and beamlines.
2026	Restart of user operation.

- **RF** system used to compensate the energy loss of the particles due to synchrotron radiation.
- **RF** system for bunch lengthening
- **RF** system for bunch shortening
- **RF** system for injection
- **RF** system as a feedforward to cope with the transient beam loading.
- Development of **RF** Undulator-Based Insertion Devices for Storage Rings
- **RF optimization is a strong function of storage ring performance priorities.**





# I wish you a successful Workshop

and

# Enjoy your stay in PARIS

