A Light for Science

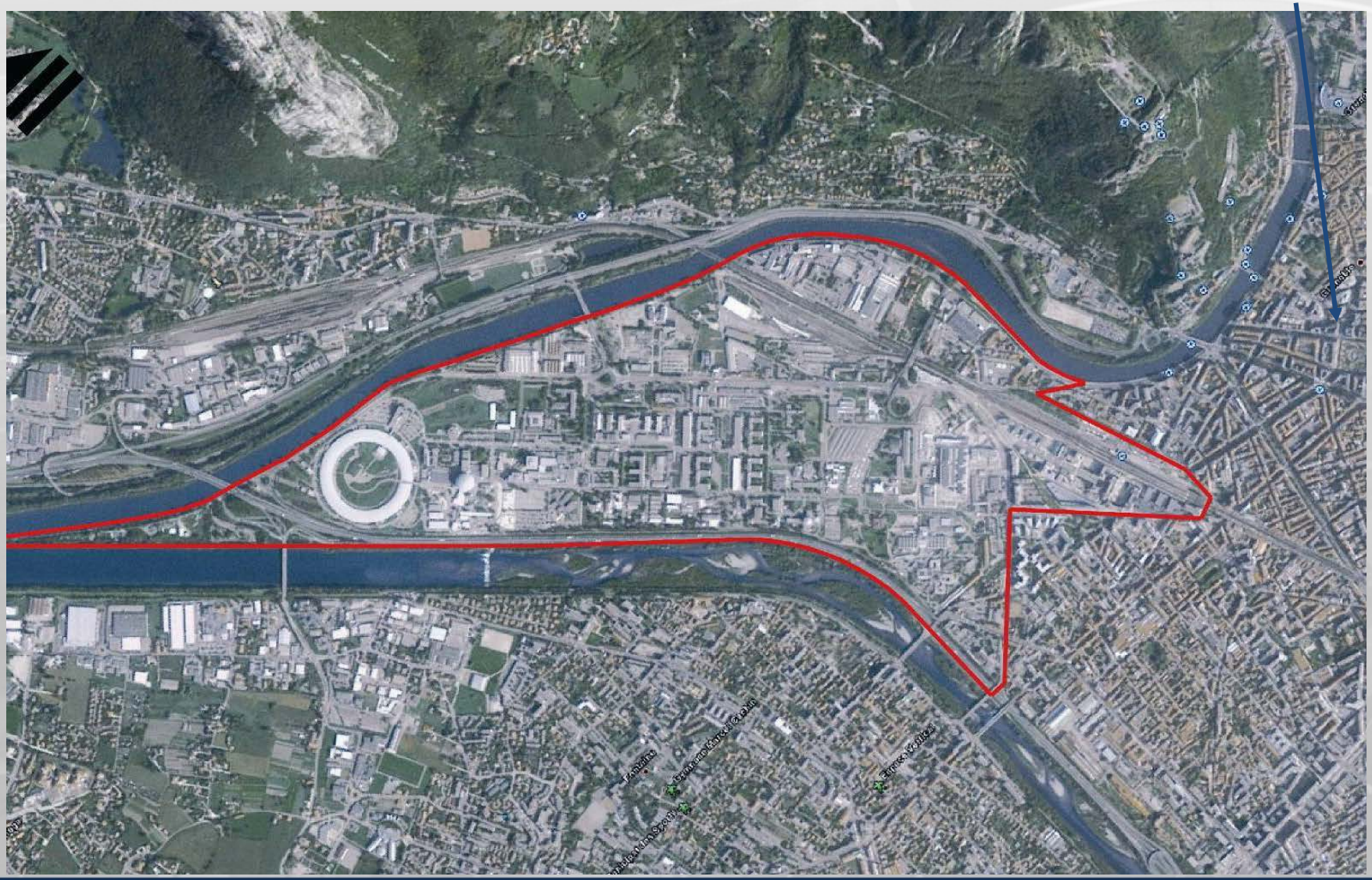
News from the ESRF

Francesco Sette

OUTLINE

- The Grenoble site and the GIANT initiative
- Operation and Upgrade Programme

The "Poligone Scientifique"



Large scale European laboratories

Academic partners

Research organisations

Local Authorities

GIANT Alliance

- Respond to societal challenges: health, information and energy
- Transcend barriers to create excellence
- Enhance international visibility and attractiveness
- Foster higher education, research and interest to industry
- Boost technological innovation
- Harmonize urban and scientific development

New buildings

Higher Education	53 000 m²
Research	95 000 m²
Industry	47 000 m²
Amenities	40 000 m²
Housing	57 000 m²
TOTAL	290 000 m²

Technological campuses

MINATEC	120 000 m²
Nanobio	50 000 m²
GreEn	110 000 m²

Ambitious objectives

GIANT

€1 285 million project investment over six years

€1 000 million annual operating budget

500 patents filed each year

10 000 researchers 7 000 industrial jobs

10 000 students 10 000 inhabitants

5 000 refereed publications each year

http://www.giant-grenoble.org/en/

GIANT

FORBES MAGAZINE (9-07-2013):
World's 15 Most Inventive Cities (Patent Intensity)

#1 - Eindhoven, Netherlands
#2 - San Diego, California
#3 - San Francisco, California
#4 - Malmo, Sweden
#5 - Grenoble, France
#6 - Stuttgart, Germany
#7 - Boston, Mass.
#8 - Stockholm, Sweden
#9 - Minneapolis, Minnesota
#10 - Munich, Germany
#11 - Mannheim, Germany
#12 - Goteborg, Sweden
#13 - Seattle, Washington
#14 - Copenhagen, Denmark
#15 - Raleigh, North Carolina

GRENOBLE:
Total Pop: 575,092
Pop. Density: 212
Patent applications: 358
Patent apps per 10k residents: 6.23

- Partnership between 20 countries

- Partnership between 20 countries
- Reliable and stable operation and service to our users
- Implementation of the UP Phase I

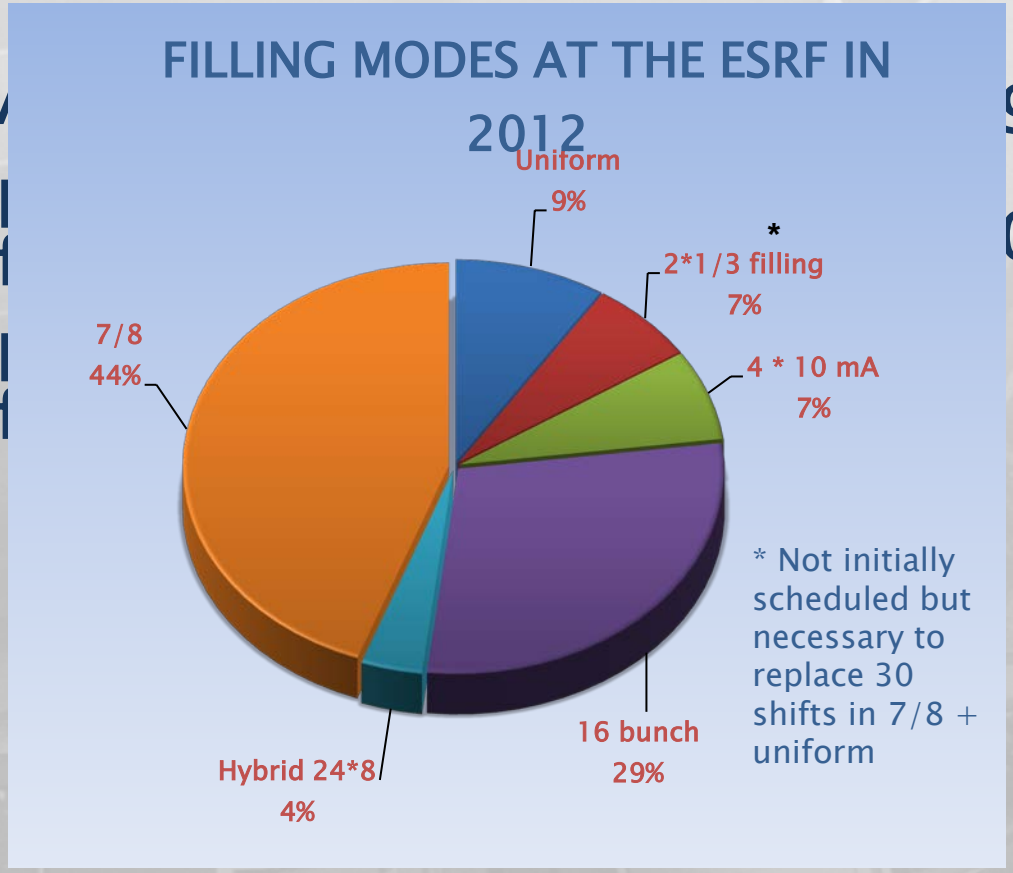
ESRF operates 43 beamlines:

- 30 PUBLIC Beamlines
- 13 CRG Beamlines (Teams from Members' Countries)

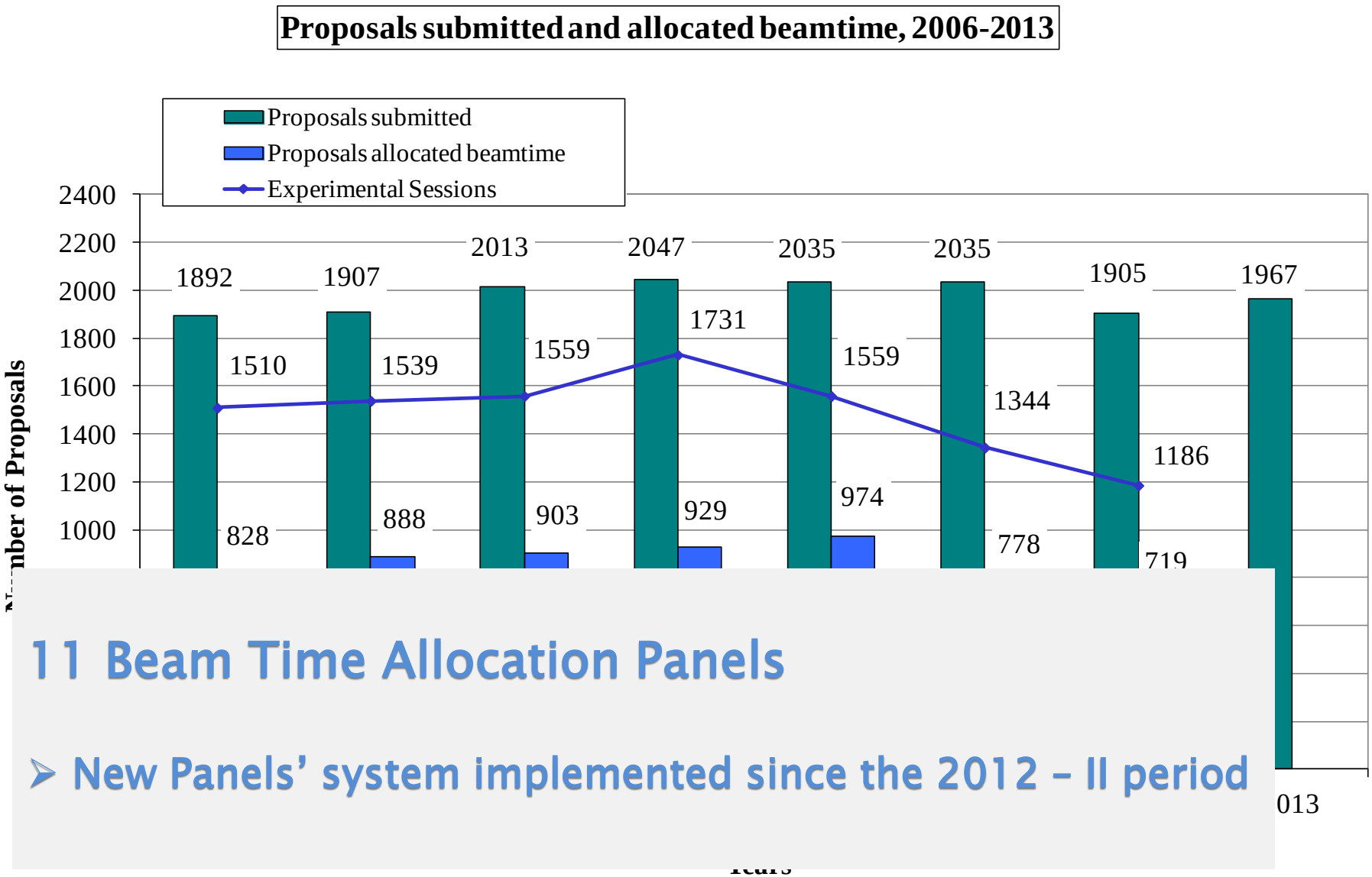
Machine Statistics for 2010–2013 at the ESRF

(Accelerators shutdown 12–2011 to May 2012)

	2010	2011	2012	2013
A		98.91	98.58	98.58
I		07.80	60.00	60.00
I		1.18	0.85	0.85



~84 % of Beamtime available for Timing Exps



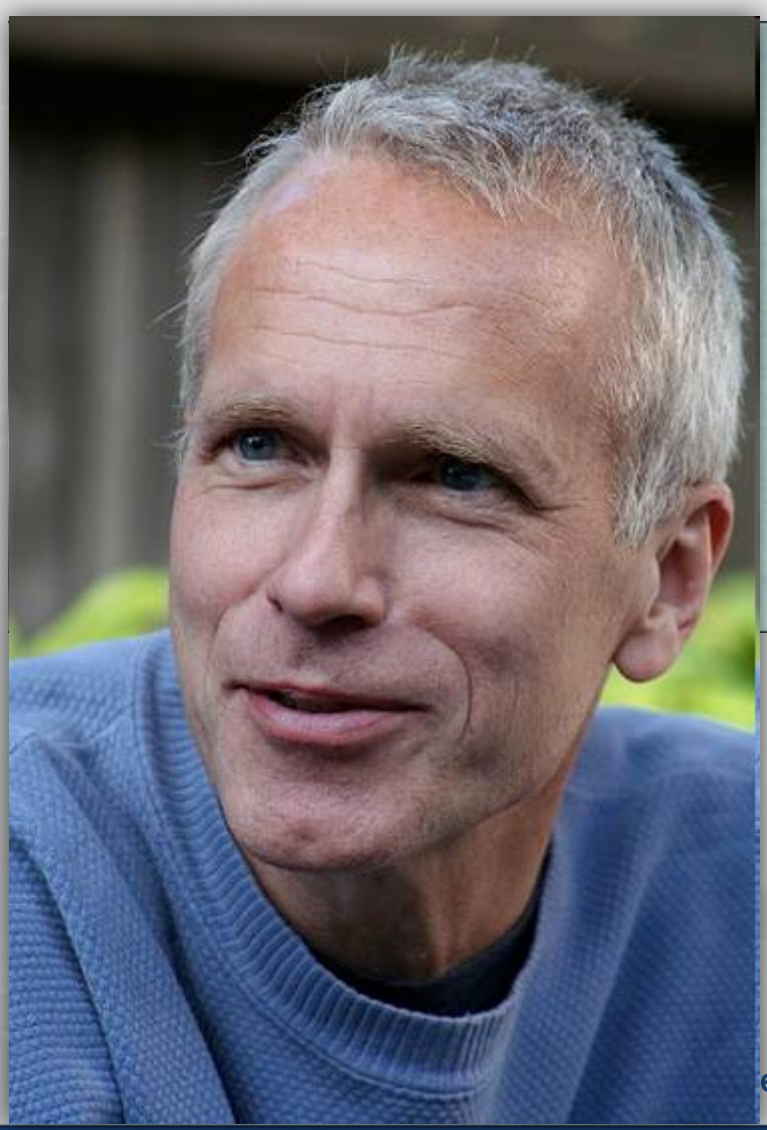
11 Beam Time Allocation Panels

- New Panels' system implemented since the 2012 – II period

ESRF TODAY

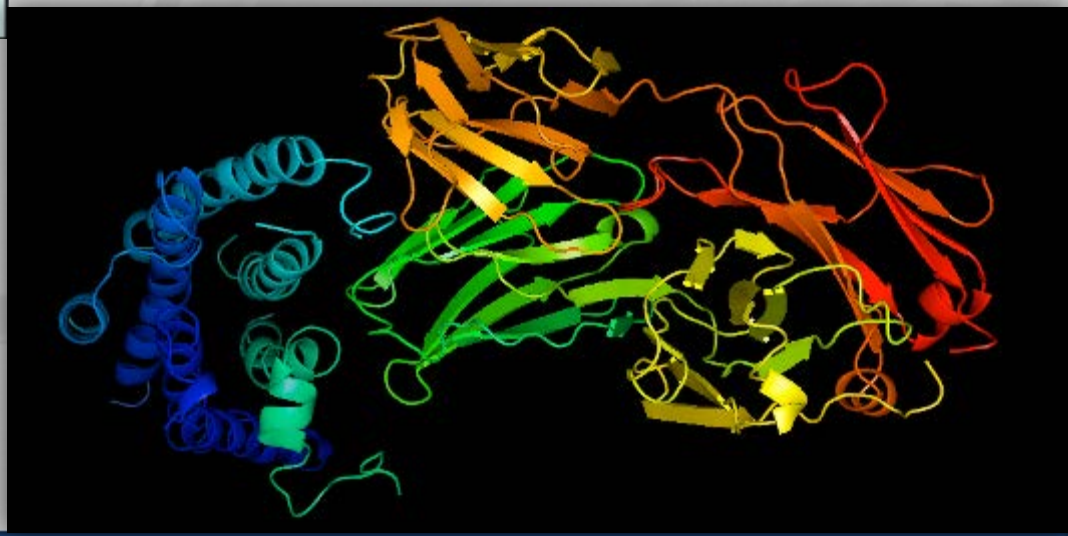
- Partnership between 20 countries
- Reliable and stable operation and service to our users
- Implementation of the UP Phase I
- Scientific productivity

G-Protein Coupled Receptors



800 different proteins controlling body functions and drug transit across membrane

Brian Kobilka (Stanford)
Chemistry Nobel Prize 2012
ESRF user (ID13) 2005 – 2007



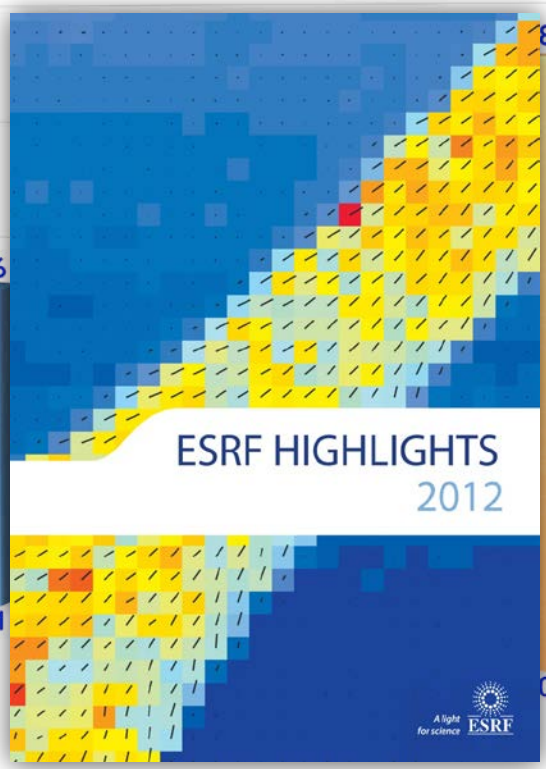
Scientific Impact

User Facility

- 11,000 PIs between 2009 and 2012
- ~1900 publications per year

Publications in peer-reviewed journals

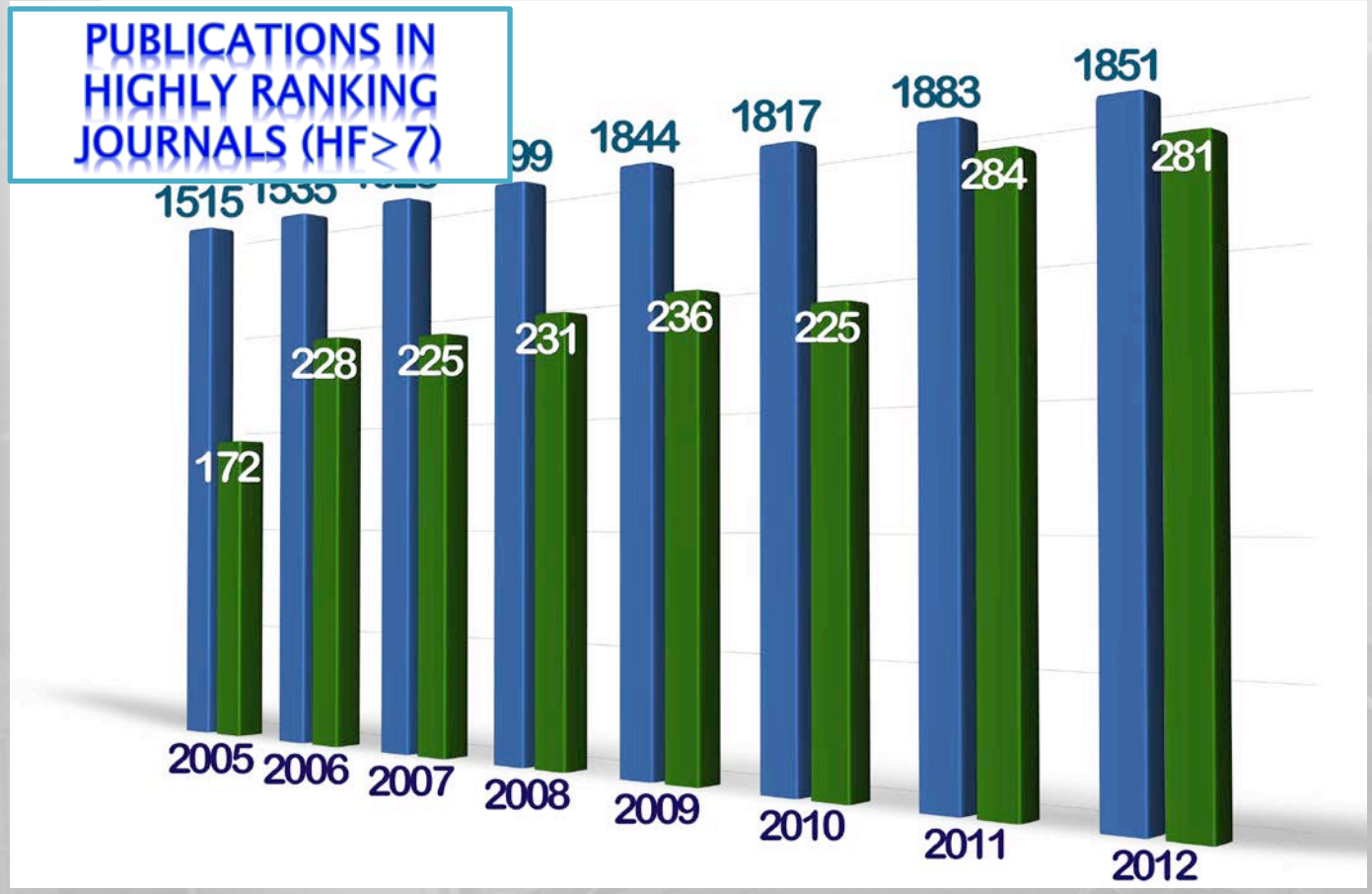
21525 PAPERS IN THE 1994-2012 PERIOD!



Scientific Impact

Scientific Excellence

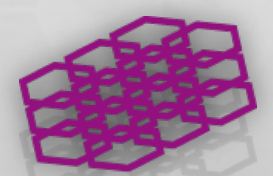
- ~30 Nature and Science papers in 2012
- 4 Nobel Prize winners among users



ESRF Upgrade Programme

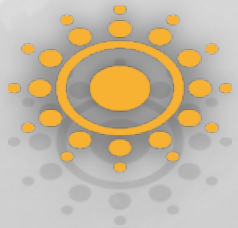
X-ray *nano*-beams routinely available for new science

Advanced materials



Health & life sciences

Energy research



ESRF Upgrade Programme

- Phase I (2009–2015) – Implementation
- Phase II (2015–2020) – Preparation

ESRF Upgrade Programme
Phase I (2009–2015) – Implementation

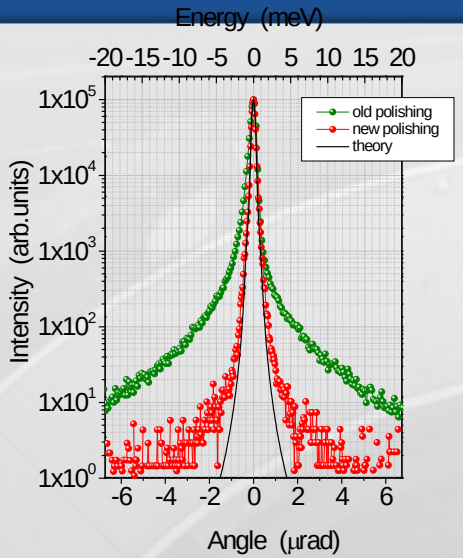
- New (8) and renewed (~7) beamlines
- Enabling technologies
- New Premises *(Belledonne and Chartreuse)*
- Accelerator and source

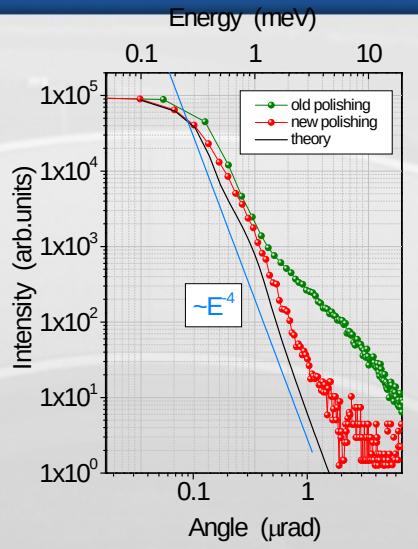
8 NEW AND 7 FULLY REFURBISHED BEAMLINES

AVERAGE IMPROVEMENT: ~x 5000

❖ X-ray Optics

- Improvement of Si crystal polishing process for high energy resolution applications

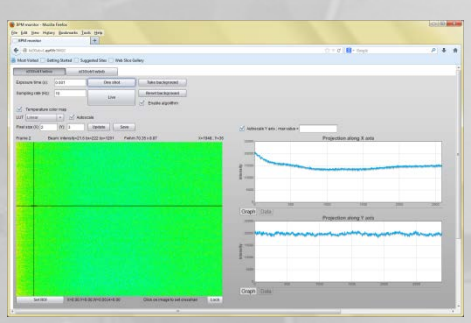


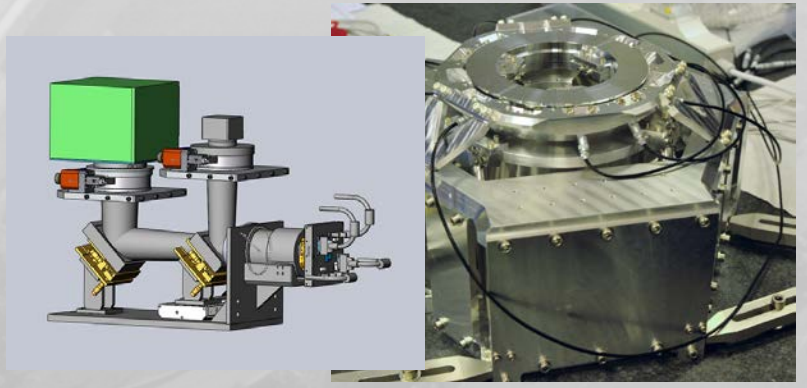


❖ Mechanical engineering:

opto-mechanical and *nano*-positioning systems design and assembly

❖X-Ray Detectors & Electronics

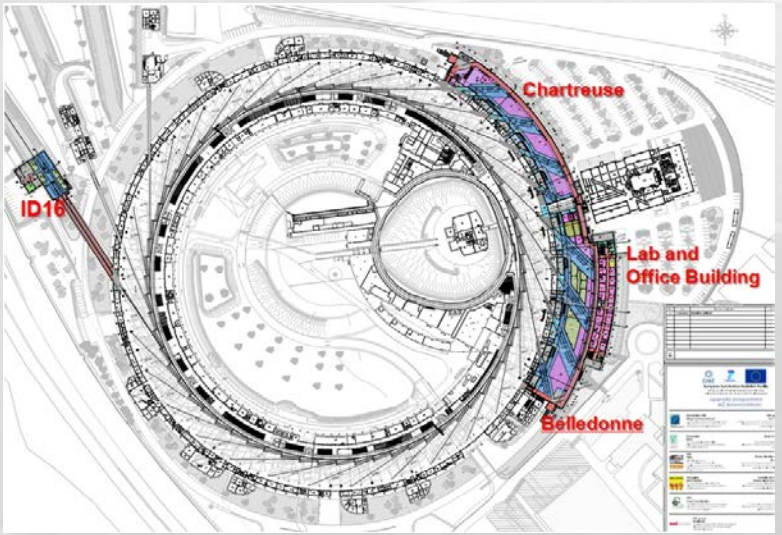




Nano positioning sample stage for UPBL 4 NI

❖Software Developments for UPBLs, BLs and Accelerator control

EX2



- Daily temperature variation of +/-0.5 C within *EX2*
- 2 people on the Golden Slab (GS) : *Uz*<1.5 μm at 3 m
- *Uz*<2 μm and *Θ*<200 nrad every where on GS except edges
- Crane loaded up to 2 000 Kg: *Uz*<1.5 μm GS
- No amplification of the background noise (dynamic): *Uz*<1.5 μm

Thermal fluctuations of the hall
Mechanical behaviour under load
Dynamical response of the slab
Effects of crane and wind

Slab shrinkage and bending during curing
Natural ground bed properties
Planning – coordination – cost

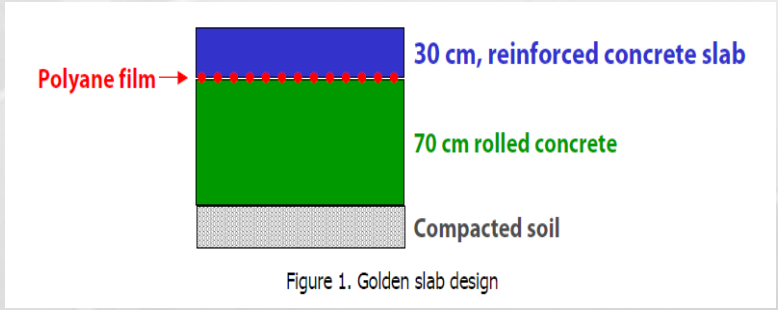
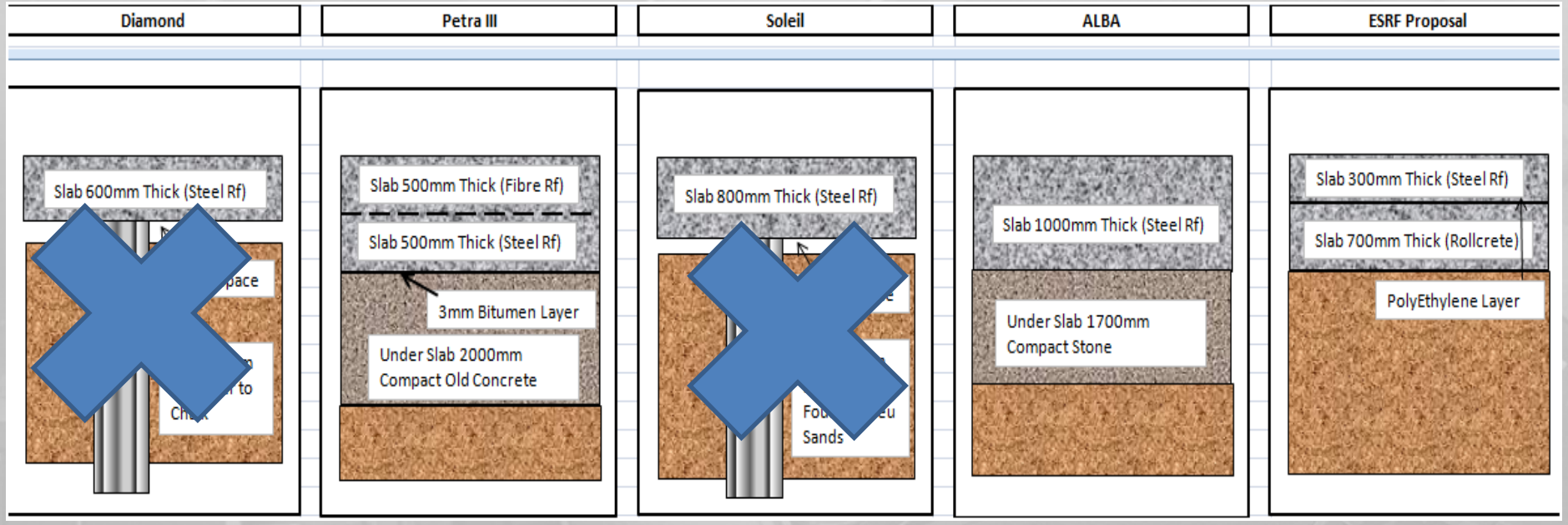


Figure 1. Golden slab design



UP PI: Experimental hall Extension (EX2)

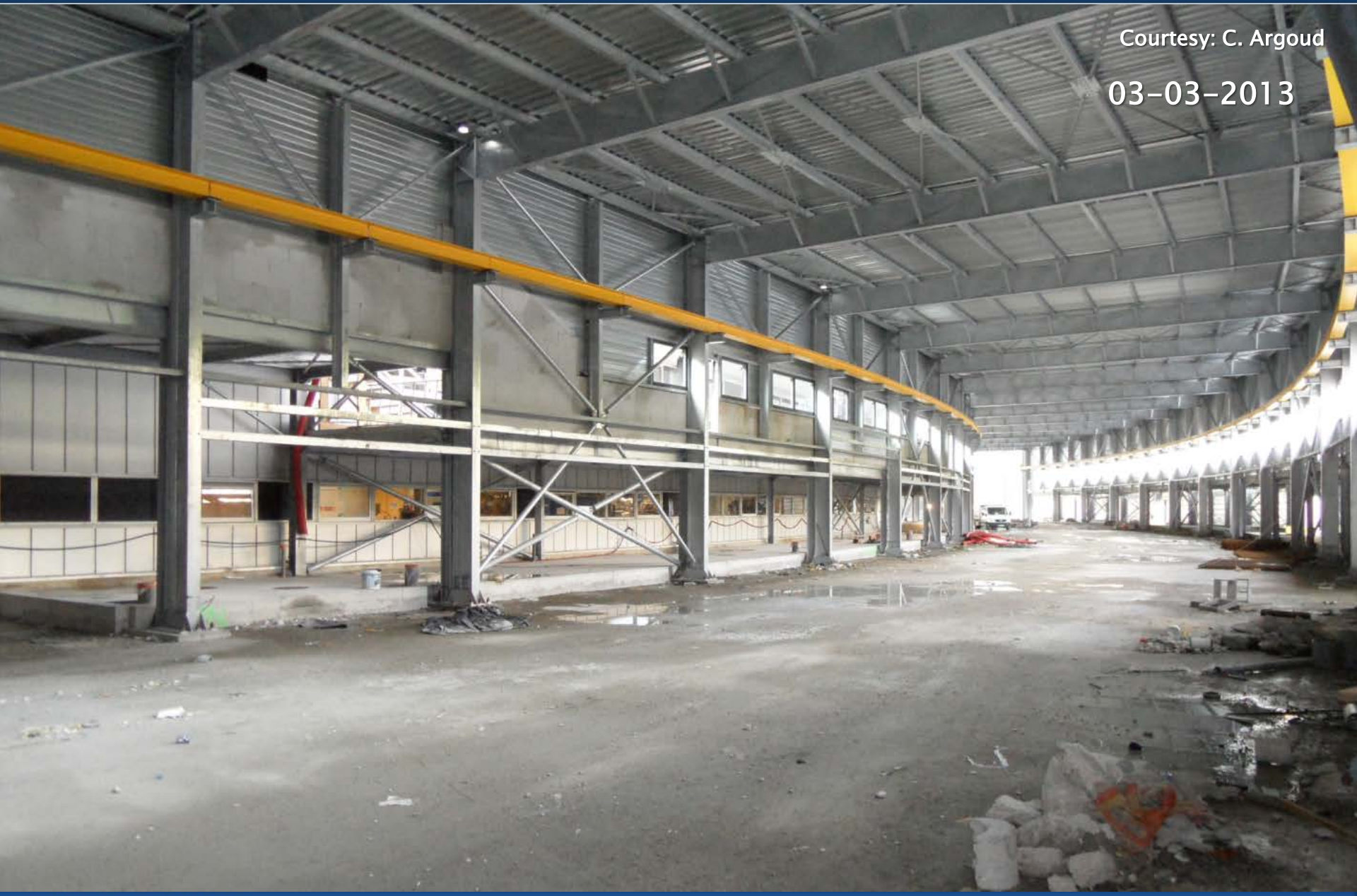
Courtesy: C. Argoud

14-02-2012

UP PI: Experimental hall Extension (EX2)

UP PI: Experimental hall Extension (EX2)

UP PI: Chartreuse Hall Extension



UP PI: Golden Slab (EX2)

UP PI: Golden Slab Pouring (EX2)

UP PI: Golden Slab Polishing (EX2)

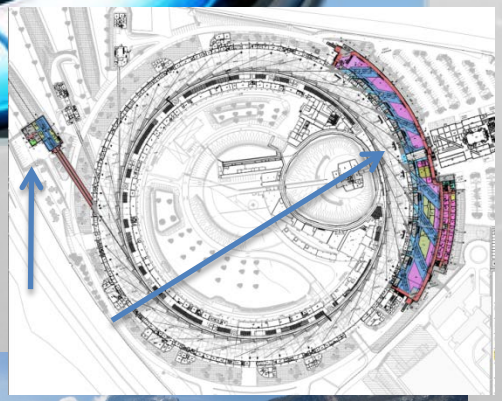
UP PI: Chartreuse Hall today (EX2)

EX2

New Premises

Chartreuse Extension

Belledonne Extension and LOB



UP Phase I: the Accelerator's Complex

- Upgrade of the X ray source in terms of availability, stability, capacity and brilliance

- Study possibilities for a new lattice
  - ➔ Increasing the source brilliance
  - ➔ ….. and coherence

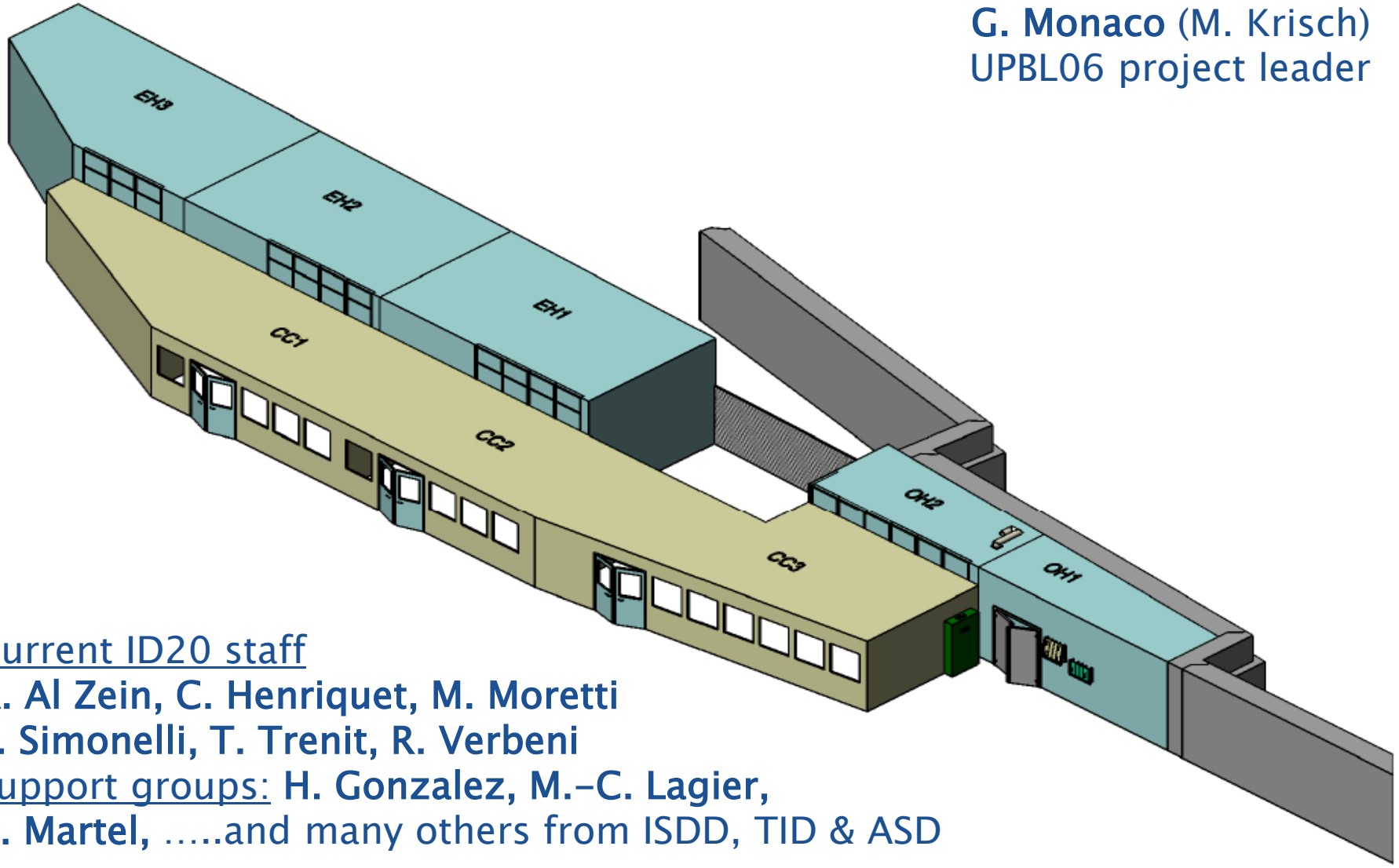
Science at the ESRF

UPBL6

Inelastic X-ray Scattering

UPBL06 @ ID20
Hard X-ray Inelastic Scattering

G. Monaco (M. Krisch)
UPBL06 project leader

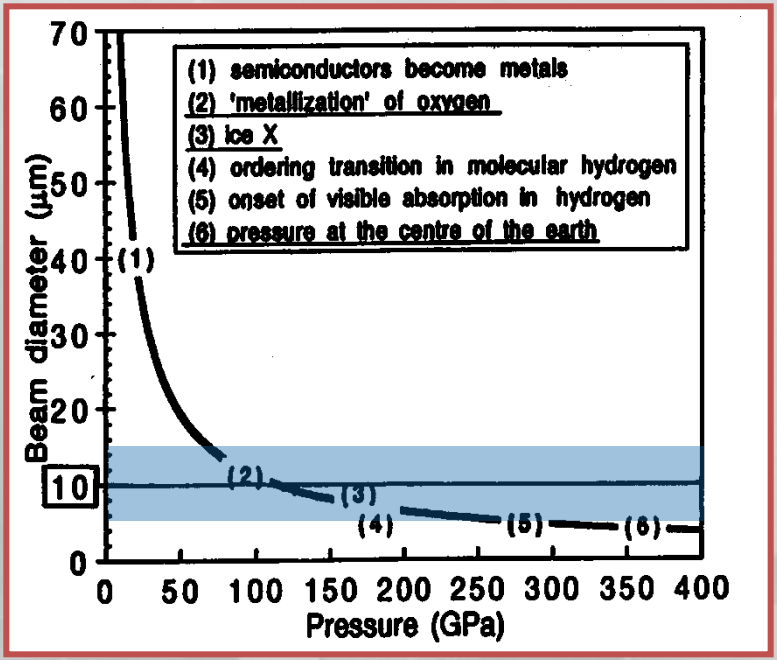


Current ID20 staff
A. Al Zein, C. Henriquet, M. Moretti
L. Simonelli, T. Trenit, R. Verbeni
Support groups: **H. Gonzalez, M.-C. Lagier,**
K. Martel, …..and many others from ISDD, TID & ASD

ID20 targets

1. Focal spot size ~ 10 μm for HP and high resolving power
2. Energy range 5-20 keV
3. Large solid-angle spectrometers

1



2

- Access to higher-Z samples facilitated
- Compatibility with complex sample environment
- Compton scattering spectrum at higher energies
- Higher momentum transfers
- Reduced radiation damage in sensitive samples

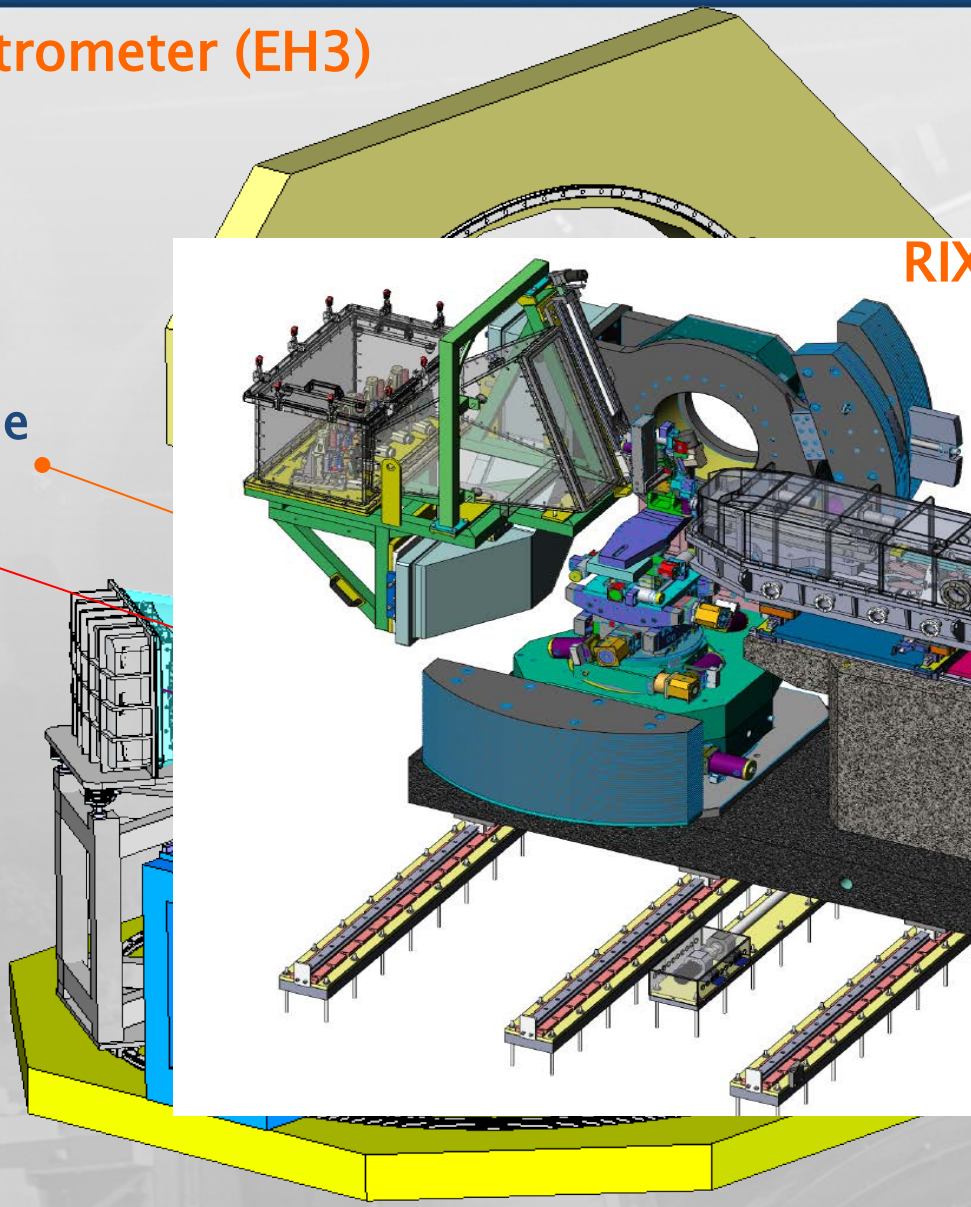
3

- X-ray Raman experiments
- Non-resonant and resonant IXS measurements of low-energy excitations

⇓

Access to systems & problems out of reach today

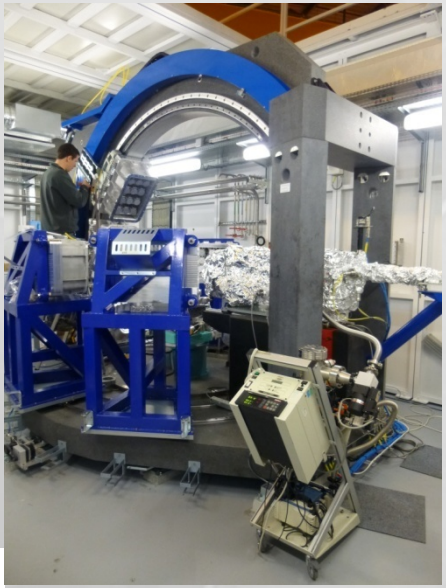
NIXS spectrometer (EH3)



RIXS spectrometer (EH2)

NIXS Spectrometer (EH3) ……almost there!!!!

Transfer line to EH3
KB system in place



Cabling in progress

72 crystal analysers ready to go!

First spectra three days ago!

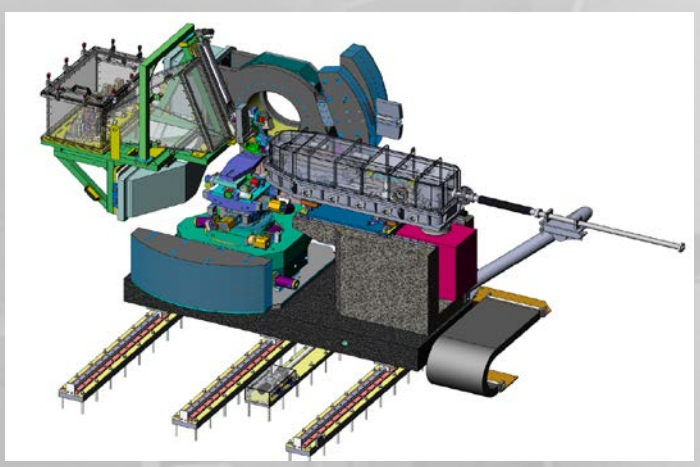
Spin wave dispersion in $CaIrO_3$ by means of Ir L_3 edge RIXS

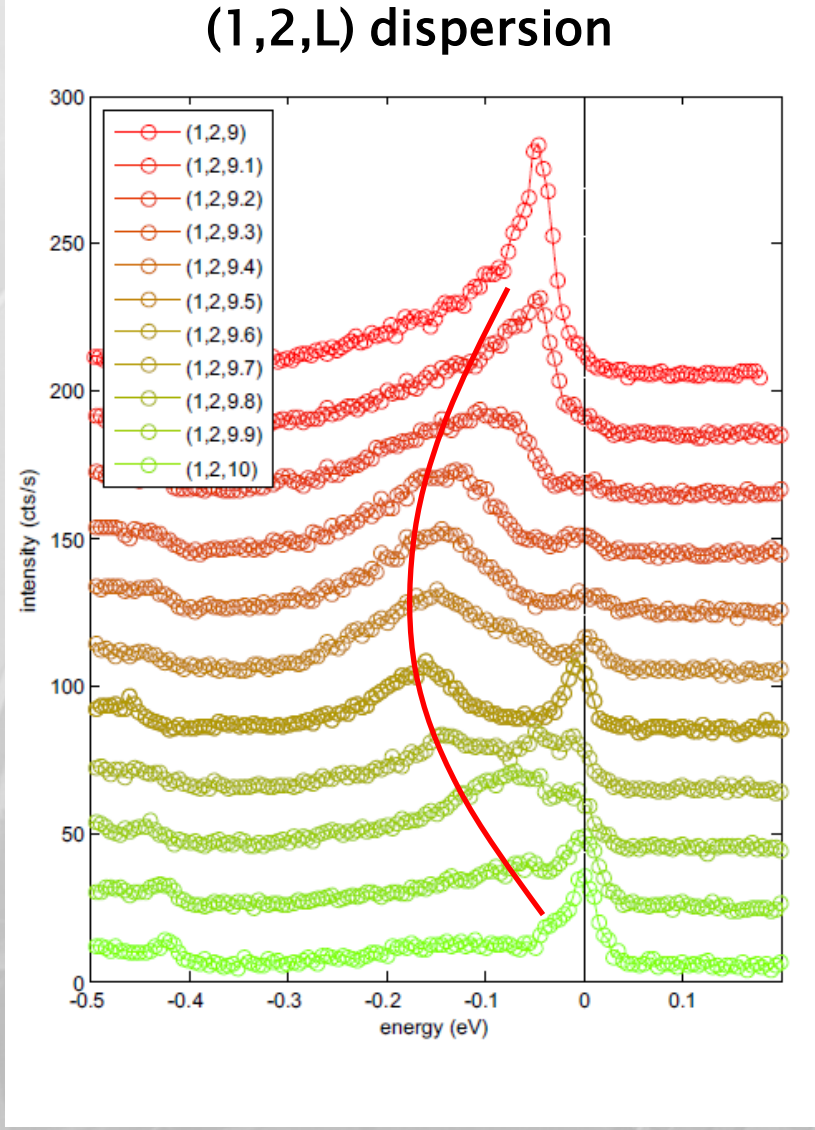
E_{in} = 11.215 keV

Si(111)+Si(844) monochromators
ΔE_{in} = 15 meV

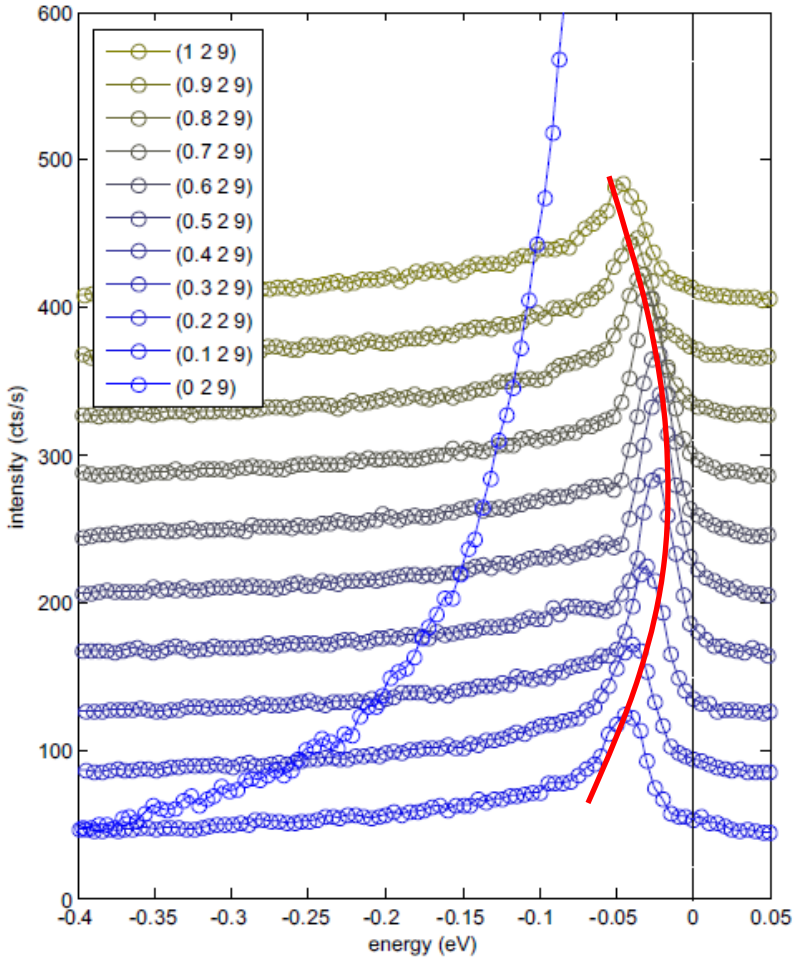
Si(844) diced analysers
ΔE_{tot} = 25 meV

Courtesy M. Moretti and ID20 Team



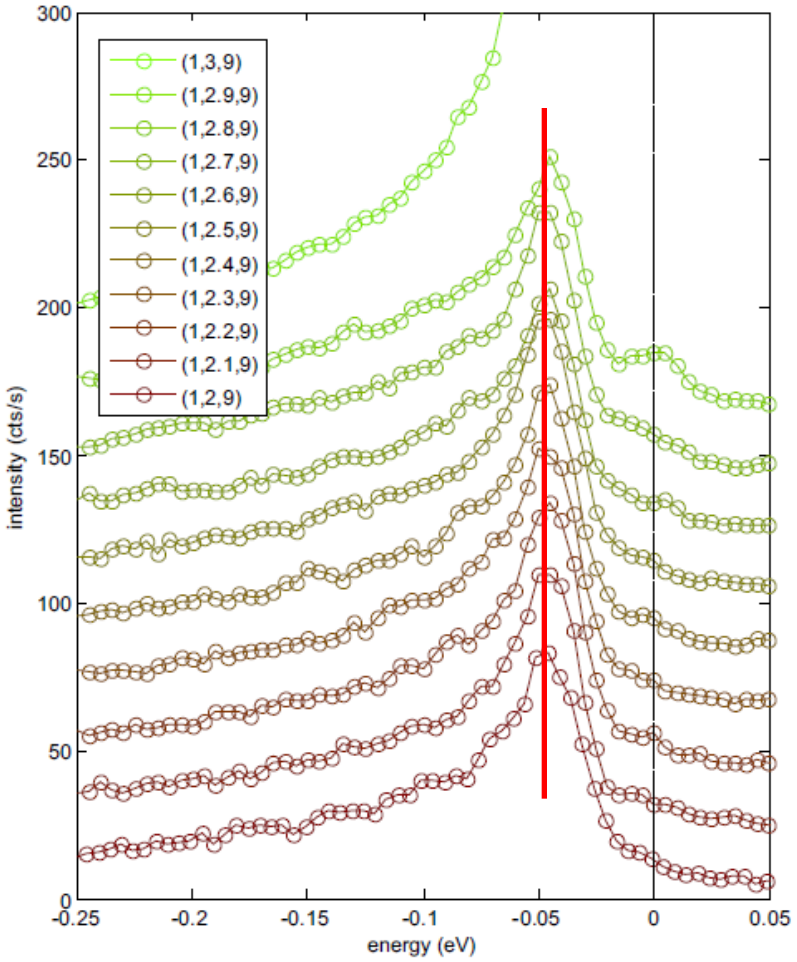


(H,2,9) dispersion



Courtesy M. Moretti and ID20 Team

(1,K,9) dispersion



Courtesy M. Moretti and ID20 Team

ESRF Upgrade Programme

Phase II (2015–2020) – Preparation

White Paper – November 2012
Technical Design Study – June 2014

- Accelerator and Source
- Four new Beamlines
- Enabling technologies
- New Premises *(new Vercors building extension)*

New Lattice: ESRF "Holy Grail"

DESIGN OF A NEW LOW-HORIZONTAL-EMITTANCE LATTICE

(from 4 *nm* to ~0.1 *nm*)

- Brightness and coherent fraction increases *(x30 or more)*
- Substantial total power reduction on beamlines optics
- Power density increase on beamlines up to a factor of ~2

AND:

- ✓ *Maintain the present location of existing ID and BM beamlines*
- ✓ *Preserve multi-bunch (200 mA) and timing modes operation flexibility*
- ✓ *Keep the present injector complex*
- ✓ *Continue to use, as much as possible, the existing hardware (~90%)*
- ✓ *Minimize operation costs, particularly wall-plug power (>20%)*
- ✓ *Limit the downtime for installation and commissioning to about one year*

New Lattice: ESRF "Holy Grail" Upgrade

Next Steps

➢ **Preparation of the Technical Design Study Report by June 2014**

- ✓ *Science Case: developed with the SAC and the ESRF Users*
- ✓ *New Storage Ring Lattice: preparation work reviewed with the APAC*
- ✓ *Project Management, Organization and implementation*
- ✓ *Baseline funding model to finance the UP Phase II*

- ❖ ***Launch UP Phase II implementation on 1 January 2015***
- ❖ ***Start operation of the new ring end of 2019 after a ~12 months' shutdown***

New Lattice: ESRF "Holy Grail" Upgrade

- Opportunity to enter into a new era of X-ray Science
- Routine availability of intense X-ray *nano*-beams with a qualitatively new level of coherent fraction
- Couple microscopy and 3D imaging with *nano*-meter spatial resolution to diffraction, scattering and spectroscopy methods
- New " eye" on *meso*-scopic investigations in condensed matter, materials and life sciences

Thank you for your attention!

A Light for Science

ESRF