







2019 BEST WISHES FOR THE NEW YEAR

The Pan African Conference on Crystallography (PCCR2)

and

The African Light Source Conference (AfLS2)

The European Synchrotron Radiation Facility 30 years of Science

1 February 2019

F. Sette, Director General of the ESRF



The European Synchrotron | ESRE

CURIOSITY AND TECHNOLOGY DRIVEN RESEARCH ON CONDENSED AND LIVING MATTER DRIVES PROGRESS



Stone Age







Iron Age





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CURIOSITY AND TECHNOLOGY DRIVEN RESEARCH ON CONDENSED AND LIVING MATTER DRIVES PROGRESS





- How to evolve from TODAY'S ECONOMY to a new SUSTAINABLE ECONOMY?
- How to address CRITICAL GLOBAL CHALLENGES for a PEACEFUL and SUSTAINABLE WORLD for the next generation? RESOURCES ARE FINITE
- HEALTH, ENVIRONMENT, ENERGY, FOOD AND WATER SUPPLY, ARTIFICIAL INTELLIGENCE FOR A NEW GLOBAL SOCIAL PACT



Major synchrotrons in the world and a growing community

0 00 0 0 ESRF 1994 – The European Synchrotron **Radiation Facility – 6 GeV** SERVING THE LARGEST SCIENTIFIC ESR **COMMUNITY IN THE WORLD: 50** 000 TODAY AND GROWING FIRST THIRD-GENERATION **SYNCHROTRON**



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The European Synchrotron

Fundamental, applied and industrial research

Large variety of a applications for a common goal: link Function to Atomic Structure



1988 – 2018: 30 YEARS OF SCIENCE AT THE EUROPEAN SYNCHROTRON







- Come and see us in Grenoble
- Follow us on https://humans.esrf.fr

World Leader in Enabling Science



Nobel Prizes

10 000 scientific visits per year 44 beamlines



2000

publications per year 330 M€

over 2009-2022 2009-2022: delivery of a new portfolio of beamlines 2015-2022: construction of a new generation of synchrotron, EBS



Joining forces for One driving force:
Scientific Excellence Enable the best ↔ Get the best -

Serving the international community Serving humanity -



ESRF, 30 YEARS OF BIG SCIENCE AT THE HEART OF THE FRENCH ALPS, GRENOBLE, FRANCE



1977

1979

- 1975: A 1st meeting to consider the feasibility of producing hard X-rays with unprecedented high brilliance, was held under the auspices of the European Science Foundation (ESF).
- 1977: The ESF GA approved the report recommending a feasibility study for an advanced European synchrotron radiation laboratory. Set up of an *ad-hoc* Committee on Synchrotron Radiation and two sub-groups for Machine and Instrumentation.
- > 1979: The results of the feasibility study published in a four-volume report, the "Blue Book".





1977

- **1984**: Study Group published a report describing in detail the scientific goals, the Machine, the experimental facilities and the time schedule for construction, the "Green Book".
- 1985: France, Germany and the UK decided for Grenoble and signed the "Memorandum of Understanding", legal basis of the ESRF Foundation Phase. Italy and Spain joined early in 1986.
- **1987**: Publication of the Foundation Phase Report, "Red Book", prepared by the ESRF team, enabling the **start** of construction on 1 January 1988 and the basis for the ESRF Intergovernmental Convention.





Signature of the Intergovernmental Convention by 11 Countries

1991 The Netherlands joins the Intergovernmental Convention



ESRF

The European Synchrotron

HISTORY OF THE ESRF: IT TOOK 13 YEARS TO START CONSTRUCTION





First User Meeting – 1989

1992



28 February 1992:

> First electron beam in the ring and first X-ray beam in a beamline Design parameters reached – 100 mA stored current in the ring



HISTORY OF THE ESRF: IT TOOK 5 YEARS CONSTRUCTION TO GET THIS NEW GENERATION OF HARD X-RAYS



September 1994:

- Start of User Operation Mode with 15 l beamlines
- Storage ring current raised to 150 mA
- X-ray brilliance: 10¹⁹photons/mm²/mrad²/0.1%bw

1996:

- Storage ring current raised to 200 mA
- X-ray brilliance: 10²⁰ photons/mm²/mrad²/0.1%bw.







ESRF

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- 1998 Portugal
- 1999 Check Republic
- 1999 Israel
- 1999 Slovakia
- 2000 Hungary
- 2002 Austria
- 2004 Poland





- 1998 Portugal
- 1999 Check Republic
- 1999 Israel
- 1999 Slovakia
- 2000 Hungary
- 2002 Austria
- 2004 Poland
- 2013 South Africa





• 2014 – Russia

New Member Country With 6% of ESRF shares





- 1998 Portugal
- 1999 Check Republic
- 1999 Israel
- 1999 Slovakia
- 2000 Hungary
- 2002 Austria
- 2004 Poland
- 2013 South Africa
- 2017 India



22 PARTNER COUNTRIES

13 Member Countries:	
France	27.5 %
Germany	24.0 %
Italy	13.2 %
United Kingdom	10.5 %
Russia	6.0 %
Benesync	5.8 %
(Belgium, The Netherland	ds)
Nordsync	5.0 %
(Denmark, Finland, Norw	ay, Sweden)
Spain	4.0 %
Switzerland	4.0 %
10 Associate Countries:	
Austria	1.75 %
Israel	1.75 %
Centralsync	1.05 %
(Czech Republic, Hungary	, Slovakia)
Poland	1.00 %
Portugal	1.00 %
India	0.66 %
South Africa	0.30 %

ESRF Grenoble France

- Access based on scientific excellence
- 11 Beamtime allocation panels made of international experts in charge of peerreviewing proposals for 44 beamlines
 Travel and local costs refunded to users

• Staff: ~ 700

- Partner Countries contributions: ~ 85 M€/year
- Annual Operation Budget: ~100 M€



STATISTICS ON SCIENTIFIC USE OF THE ESRF

3000

Beamtime Proposal and Experimental Session Statistics



In 2017:

- Number of proposals submitted: 2544
- ✓ Number of proposals receiving beamtime in 2017 : 1022
- ✓ Number of User visits: 7 068
- ✓ Number of Experimental Sessions in 2017: 1907
- Beamtime delivered:
 - 132 624 hours (~15 years/year)



Number of ESRF Publications 1994-2018



Until 9 January 2019 The European Synchrotron

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Number of ESRF Publications 1994-2018



ESRF

EPN SCIENCE CAMPUS : A UNIQUE SITE FOR RESEARCH AND INNOVATION







• +500 scientists in the Campus

3 European Organisations and the IBS – a
 French Institute for Structural Biology –
 working together to welcome users from all over the world



ESR

Collaboration

ESRF – EMBL - IBS

FOR SCIENC

EMBL



Most powerful research reactor and synchrotron source worldwide at 400 m from each other **ESRF FOR THE NEXT GENERATIONS: HERCULES PROGRAMME**

HERCULES

European School

22%

HERCULES UNIQUENESS relies on a careful balance between **lectures** from internationally well known experts **and practical work at cutting edge experimental setups**, in neutron and synchrotron radiation large facilities

VNIVERSITÉ Grenoble Alpes 2000 participants since 1991 Senelux France Germany United Kingdom Italy Nordic countries

Spain

Other countries

PAUL SCHERRER INSTITUT



⇒~75 participants/session





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ESRF FOR THE NEXT GENERATIONS: UNDERGRADUATE STUDENT SUMMER PROGRAMME

"All the I'm at ti Viktor R Age 25 Participa Universit Viktor is

"It's exciting working so close to the synchrotron. I've been given the chance to really understand the everyday life of what it's like to be a scientist in an international research facility". Eleonora Polini Participant on the ESRF/ILL International Student Summer Programme Age 21 Universita di Roma La Sapienza, Italy Eleonora is studying the behaviour of MAPbI3, a hybrid perovskite, using X-ray diffraction under high pressure. ESRF-ILL International Undergraduate Student Summer Programme

- Increase visibility and
 attractiveness of ESRF and ILL
 among undergraduate
 students
- ~170 applications
- 20 students from 10-15 countries



ESRF FOR THE NEXT GENERATIONS: SYNCHROTRON AT SCHOOL PROGRAMME

Science made by an for the youngsters



- A partnership of ESRF and Académie de Grenoble
- ~1 500 high school students every year
 - High schools with scientific and technical specializations
- A day of full scientific immersion, with scientific experiments carried out
- Schools from <u>all over</u> the world are welcome





MINISTÈRE DE L'ÉDUCATION NATIONALE

SYNCHROT

@SCHC

MINISTÈRE DE L'ENSEIGNEMENT SUPÉRIEUR ET DE LA RECHERCHE





ESRF FOR THE NEXT GENERATIONS: SYNCHROTRON AT SCHOOL PROGRAMME



Lycée Loiselet from Bourgoin-Jallieu – France: 5 000th student at Synchrotron@School 29 January 2019





X-ray science and tomorrow's challenges

Challenges and Objectives of Storage Ring and XFEL sources:

Explore from the extremely fast: TIME RESOLVED SCIENCE DOWN TO THE FEMTO-SECOND

- Explore from the extremely small:
 SPACE RESOLVED SCIENCE DOWN TO THE NANO-WORLD
- New tools to investigate condensed and living matter, bridging gaps and complementing optical and electron microscopies
- News tools to address pressing technological, health and environmental challenges facing Society.

A new paradigm for beamlines and source:

European X-ray Free Electron Laser ESRF Upgrade Programme PHASE I and ESRF-EBS





New, better science

ESRF EBS: AN AMBITIOUS NEW STANDARD FOR SYNCHROTRON STORAGE RINGS

ESFR

European Commission



Purple

January

Book

2008

ESRF UPGRADE PHASE I 180 M€ (2009-2015): ESFRI ROADMAP 2006-2016 ESFRI LANDMARK (2016) In time – within the budget

- 19 new beamlines specialised on nano-science
- Study for a revolutionary storage ring

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

- The 1st high-energy fourthgeneration synchrotron
- 4 new flagship beamlines
- Detectors, Instrumentation and Data As A Service



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The European Synchrotron

Orange

January

Book

2015

ESRF Extremely Brilliant Source The 1st high-energy 4th-generation synchrotron light source



Pantaleo Raimondi wins the Gersch Budker IPAC17 Prize

For his invention of the "Hybrid Multi Bend Achromat" (HMBA) lattice, which has become the design basis of most future "fourth generation" synchrotron sources in the world





ESRF-EBS

EBS STORAGE RING: CONSTRUCTION PROGRAMME





AN EXTREMELY BRILLIANT SOURCE (EBS) FOR THE NEXT GENERATION OF RESEARCH IN LIFE AND MATERIAL SCIENCES

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EBS storage ring implementation schedule and beamlines restart



20 October	2017
10 December	2018
8 November	2019
2 December	2019
March	2020
25 August	2020

Start girder assembly (12 months) End of USM and Start of Shutdown (20 months) Dismantling (3 months) and Installation (8 months) Tunnel closed Accelerator commissioning (4 months) Beamlines and Accelerator commissioning (5 months)

Back to USM



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LAST BEAM AT 8 AM ON MONDAY 10 DECEMBER 2018







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ASSEMBLY AND INSTALLATION OF THE NEW EBS STORAGE RING IN THE ESRF STORAGE RING TUNNEL





- All of the 129 girders of the new storage ring have been assembled and are ready to be mounted in the storage ring tunnel
- The old storage ring is now being disassembled and the tunnel refurbished





THE EXTREMELY BRILLIANT SOURCE: A QUANTUM LEAP IN RESEARCH







EBS will enable scientists to write a new chapter in X-ray science by providing new tools for the investigation of materials and living matter



Construction of 4 flagships beamlines: ESRF Council on 26-27 June 2017

- EBSL1 Beamline for Coherent X-rays Dynamics and Imaging Applications
- EBSL2 Beamline for Hard X-ray Diffraction Microscopy
- EBSL3 Beamline for High throughput Large Field Phase-contrast Tomography
- EBSL8 Beamline for Serial Macromolecular Crystallography

New and better science unveiling the secrets of nature

Down to the single atom

Detect new phenomena

Go to extreme conditions

Higher throughput and faster dynamics

The European Synchrotron



ESRF EBS IN THE INTERNATIONAL CONTEXT



THE ESRF USERS CONTRIBUTION TO MODERN SYNCHROTRON SCIENCE

TO CITE A FEW:

- a) Successful scientific programme at the ESRF: the First 3rd Generation Light Source entirely based on IDs
- b) Development of X-ray key techniques (often pre-natal or at their infancy at second generation sources): XRD, XAS, IXS, RIXS, XMCD, XES, XPCS with many microscopy and imaging derivations and developments
- c) X-ray Protein Crystallography with IDs: first time at the ESRF, 2009 Nobel Prize in Chemistry (RIBOSOME)
- d) X-ray Protein Crystallography with IDs and microfocus : first time at the ESRF, and 2012 Nobel Prize in chemistry (GPCRs)
- e) Far-reaching and comprehensive Industrial Programme using synchrotron light: first time at the ESRF
- f) X-ray science at Extreme Conditions Programme (P at Mbars and T at 5 000 K): first time at the ESRF
- g) X-ray Phase contrast 3D-imaging and microscopy: first time at the ESRF
- h) Hard X-ray techniques for material science and Paleontology (Diffraction, Imaging and Time resolved): first time at the ESRF









ESRF: World Leader in Synchrotron Science and Applications ESRF USERS create value for Humanity by constructing International Cooperation for the Advancement of Science ESRF Partners join forces to:

- Enable Excellence in Science
 - ✓ Powerful and efficient user's programme
 - ✓ DRIVE the NEXT STEP in SYNCHROTRON SCIENCE
- Develop new technology and instrumentation
- Serve needs of industry and innovative applications
- Attract, train and educate the next generation of scientists, engineers and technicians
- Create value by offering international collaboration opportunities to scientists and engineers from all over the world and from many different disciplines

ESRF: World Leader in Synchrotron Science and Applications ESRF welcomes cooperation and association with Countries from Africa in the context of building up the African Light Source

- <image>
- Is not only a budget matter: too expensive for a single country!
 Best science is enabled creating a world-hub where everybody feels home and contributes
 - ESRF, as CERN for high-energy physics, establishes world leadership in synchrotron science, education and with an inclusive policy open to the world largest scientific community – ~50 000 individuals today and constantly growing



As long as the World needs Synchrotron Light, the ESRF will provide the BEST source, beamlines and support to the world largest science community

Thanks for your attention! @esrfsynchrotron