The Abdus Salam
International Centre for Theoretical Physics

United Nations
Educational, Scientific and
Cultural Organization

IAEA
International Atomic Energy Agency

2031-4

Joint ICTP/IAEA School on Novel Synchrotron Radiation Applications

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Lightsources in Developing Member States

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Lightsources in Developing Member States

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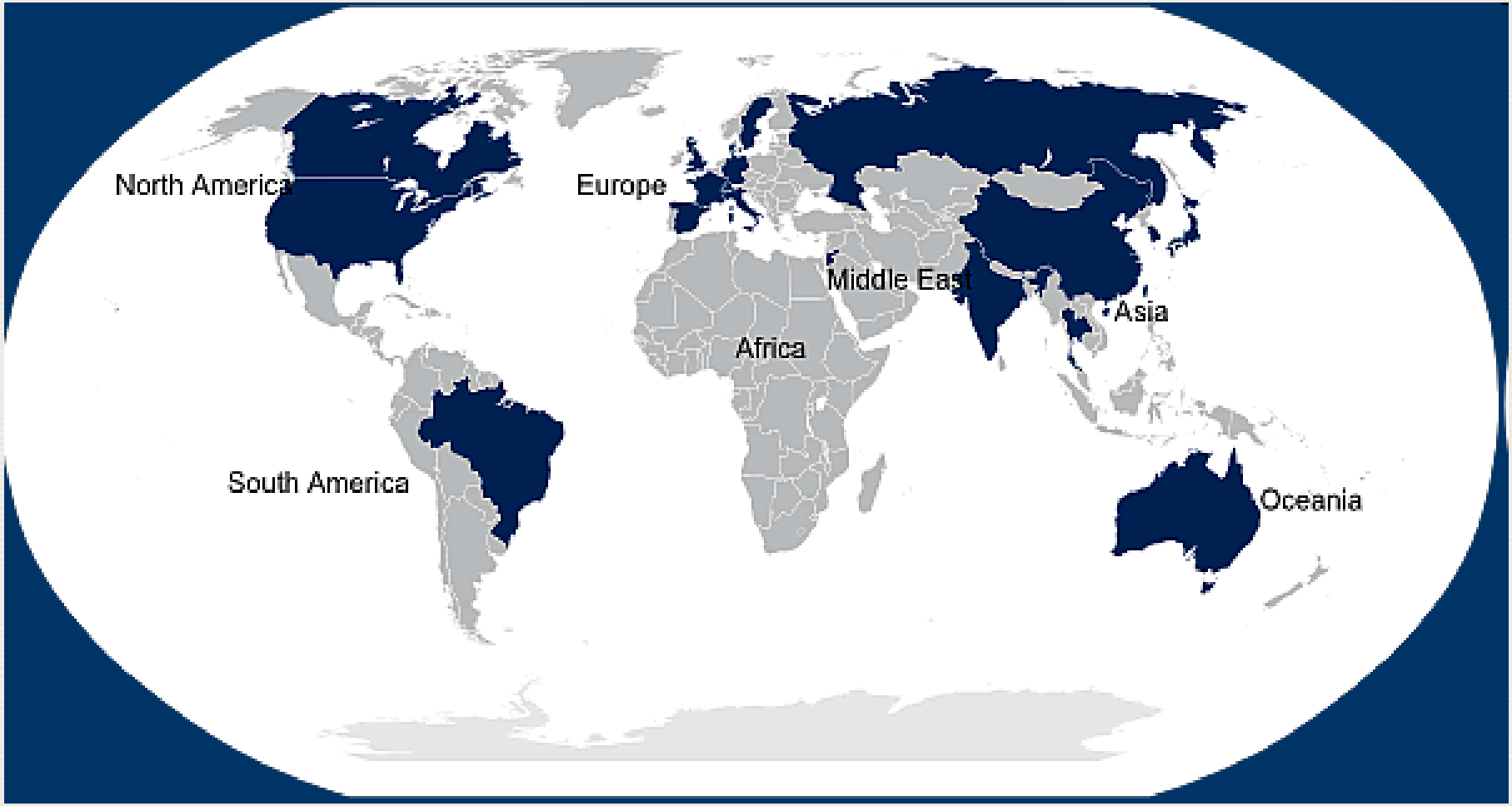
38 Lightsources over 20 Member States



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North America

Canada	Canadian Light Source (CLS)	Saskatoon
USA	Advanced Light Source (ALS)	Berkeley, California
	Advanced Photon Source (APS)	Argonne, Illinois
	Center for Advanced Microstructures and Devices (CAMD)	Baton Rouge
	Cornell High Energy Synchrotron Source (CHESS)	Ithaca, New York
	National Synchrotron Light Source (NSLS)	Brookhaven, New York
	Stanford Synchrotron Radiation Laboratory (SSRL)	Menlo Park, California
	Synchrotron Radiation Center (SRC)	Madison, Wisconsin
	Synchrotron Ultraviolet Radiation Facilty (SURF III), NIST	Gaithersburg, Maryland

Europe

Denmark	Institute for Storage Ring Facilities (ISA, ASTRID)	Aarhus
England	Diamond, Rutherford Appleton Laboratory	Didcot
France	European Synchrotron Radiation Facility (ESRF)	Grenoble
France	SOLEIL Synchrotron	Saint-Aubin
Germany	ANKA Synchrotron Strahlungsquelle	Karlsruhe
Germany	BESSY	Berlin
Germany	Dortmund Electron Test Accelerator (DELTA)	Dortmund
Germany	(HASYLAB) at DESY	Hamburg
Italy	Elettra Synchrotron Light Source	Trieste
Italy	Daphne Light Laboratory	Frascati
Spain	ALBA Synchrotron Light Facilty	Vallés
Sweden	MAX-lab	Lund
Switzerland	Swiss Light Source (SLS)	Villigen

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Asia

China	Beijing Synchrotron Radiation Facility (BSRF)	Beijing
China	National Synchrotron Radiation Laboratory (NSRL)	Hefei
China	National Synchrotron Radiation Research Centre (NSRRC)	Hsinchu
China	Shanghai Synchrotron Radiation Facility, (SSRF)	Shangai
India	INDUS-1 and INDUS-2	Indore
Korea South	Pohang Accelerator Laboratory (PAL)	Kyungbuk
Russia	Siberian Synchrotron Radiation Centre (SSRC)	Novosibirsk
Thailand	National Synchrotron Research Centre (NSRC)	Nakhon Ratchasima
Singapore	Singapore Synchrotron Light Source (SSLS)	Singapore

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Australia and Japan

Australia	Australian Synchrotron	Melbourne
Japan	Photon Factory (PF) at KEK	Tsukuba
Japan	Super Photon Ring - 8 GeV (SPring8)	Nishi-Harima
Japan	UVSOR Facility	Okazaki
Japan	SX Light Source	Kashiwa

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Other Developing Member States

Brazil	Laboratório Nacional de Luz Síncrotron (LNLS)	São Paulo
Jordan	Sesame	Allan

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Brazilian Synchrotron Light Laboratory: LNLS

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Laboratorio Nacional de Luz Síncrotron

- Facility with a 1.37 GeV synchrotron and a molecular and structural biology centre.
- Open to the international community.
- Relatively low energy synchrotron machine.
- Most of the beamlines (10) operate in the 'hard' x-ray region (~10 keV), reflecting the demands of the Latin American community.
- 14 operating bending magnet beamlines.

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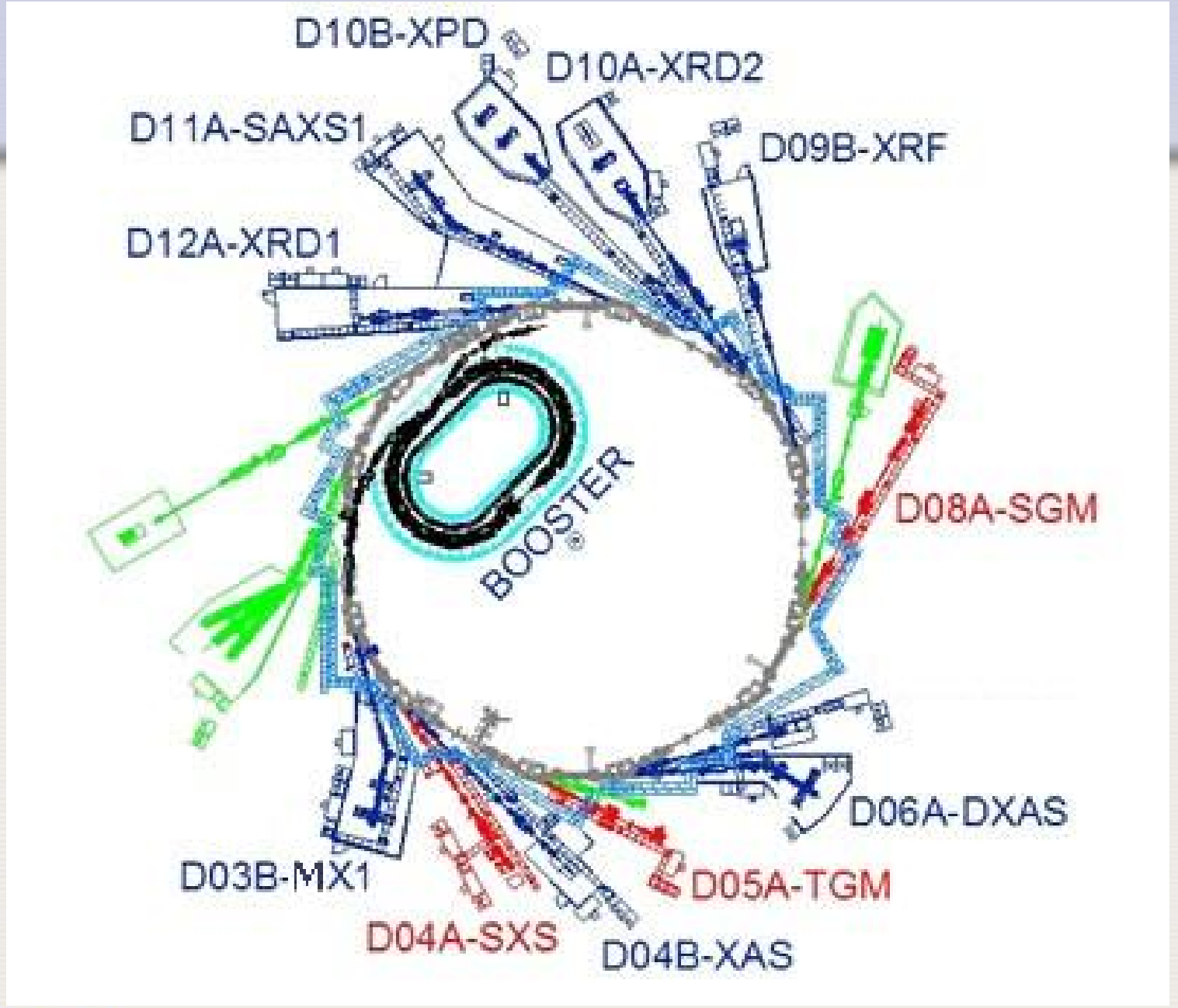
D10B-XPD
D10A-XRD2
D11A-SAXS1
D09B-XRF
D12A-XRD1
BOOSTER
D08A-SGM
D06A-DXAS
D03B-MX1
D05A-TGM
D04A-SXS
D04B-XAS

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Laboratorio Nacional de Luz Síncrotron

- There are also four straight sections for insertion devices.
  - The first one: conventional wiggler for a MAD beamline dedicated to protein crystallography, which is now available to external users.
  - The second one: a home-made undulator, optimizing the flux in the soft x-ray region, the beamline for which is under construction.
  - The third one will be a superconducting wiggler for materials science applications (under construction).
  - The fourth and final device is under debate.

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Laboratorio Nacional de Luz Síncrotron

- Space saturation is approaching and is expected to be achieved in the next few years.
- Continuous qualitative and quantitative expansion of the synchrotron beamlines since the first year of operation (1997), the user community is growing rapidly, not only in Brazil but in the whole Latin America, which may push the demand for the construction of a new, higher energy machine in the next decade.
- LNLS is presently experiencing severe limitations on budget and human resources, which limits the expansion of the capabilities.

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SESAME

Synchrotron light for Experimental Science and Applications in the Middle East

International Center for Research and Advanced Technology

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- Work presented here is mostly taken from SESAME directors:
  - Professor Sir Chris Llewellyn Smith, Council President
  - Dr. K. Toukan, Director
  - Dr. H. Hoorani, Scientific Director
  - Dr. A. Nadji, Technical Director
  - as well as other members of the SESAME beamline coordination meeting
- IAEA is only involved in providing training and expert missions

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A Brief Early History of SESAME

1997: Proposal to use components of BESSY I as basis for new facility in the Middle East

June 1999: DG UNESCO ("Science for Peace"), invited all governments of the region to a meeting at Paris. Interim Council created with 12 members and 6 Observers; H. Schopper elected President

2000

- Site choice (candidates in Armenia, Egypt, Iran, Jordan, Oman, Palestinian Authority, Turkey)
- 18 scientists chosen to be trained at ANKA, Daresbury, Elettra, ESRF, LURE, MAXLAB, SLAC

2002

- Formal endorsement by UNESCO
- Decision that BESSY should be injector to new 2.5 GeV ring

6 January 2003 Ground breaking by King Abdullah II and DG of UNESCO

15 April 2004 Statutes ratified: official birth of SESAME

3 November 2008 Building opened by DG of UNESCO and Prince Ghazi Ben Mohammad. C Llewellyn Smith took over as President of Council

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SESAME

Synchrotron-Light for Experimental Science and Applications in the Middle East

Gus Voss (DESY) watching the boat leave Hamburg harbor on its way to Aqaba in Jordan with BESSY I on board; June 7, 2002

Winick - Schopper - Llewellyn Smith – Toukan

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SESAME *www.sesame.org.jo*

- ✓ World class synchrotron radiation laboratory of 3rd. generation for the region
- ✓ Interdisciplinary research
- ✓ Providing environment for collaborations as well as individual development
- ✓ Applications
- ✓ Technology
- ✓ An advanced facility for training
- ✓ Bringing nations together

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Location of SESAME

Within easy reach of Jordan, Israel, Palestinian Authority, Egypt.

Samples/equipment/people can in principle be transported by car.

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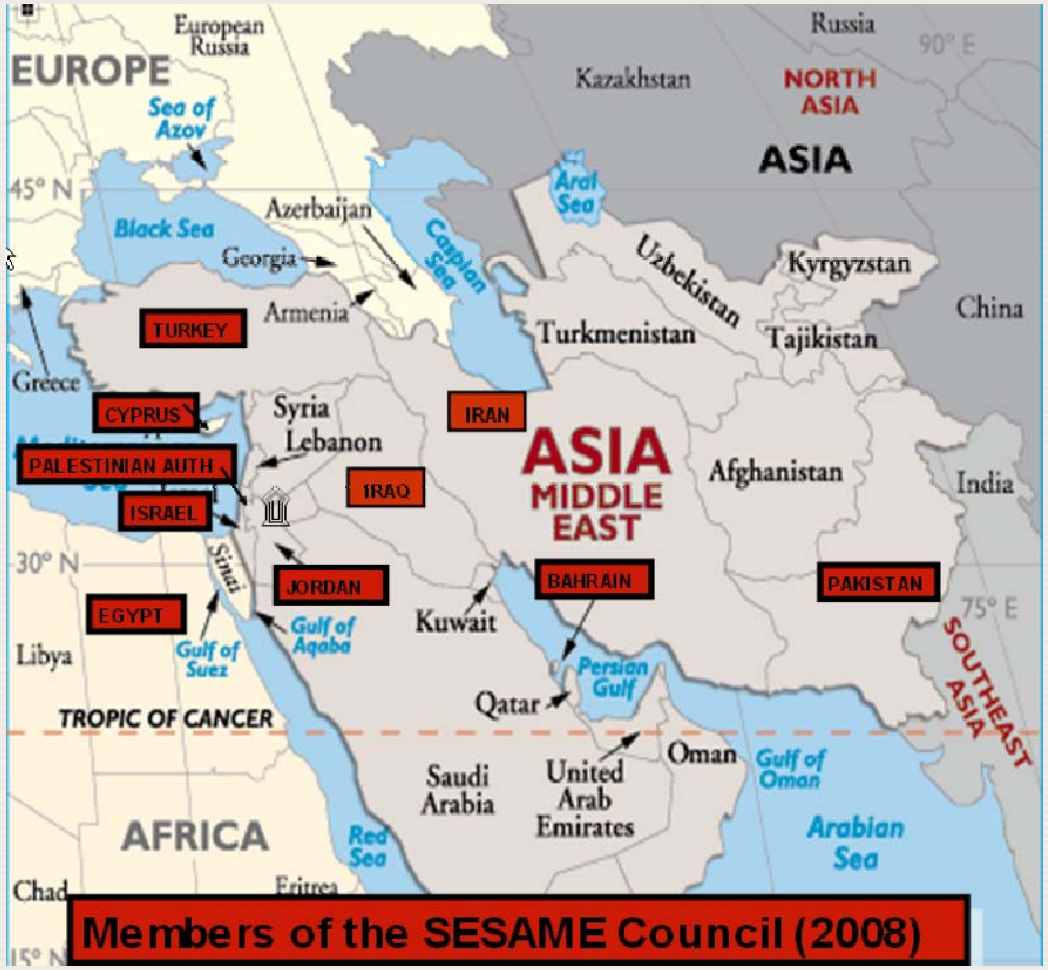
Member Countries



- Bahrain, Cyprus, Egypt, Israel, Iran, Jordan, Pakistan, Palestinian Authority, Turkey.
- Pending: Iraq

Observer Countries

France, Greece, Germany, Italy, Japan, Kuwait, Russian Federation, Sweden, UK and USA.

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Techniques of Light Sources

SPECTROSCOPY	SCATTERING	IMAGING	DYNAMICS
Energy = E	Momentum p=mv	Position	Time

SPECTROSCOPY

1. Low-Energy
2. Soft X-ray
3. Hard X-ray
4. Optics
5. Calibration
6. Metrology

SCATTERING

1. Hard X-ray Diffraction
2. Macromolecular Crystallography
3. Hard X-ray
4. Soft X-ray

IMAGING

1. Hard X-ray
2. Soft X-ray
3. Infrared
4. Lithography

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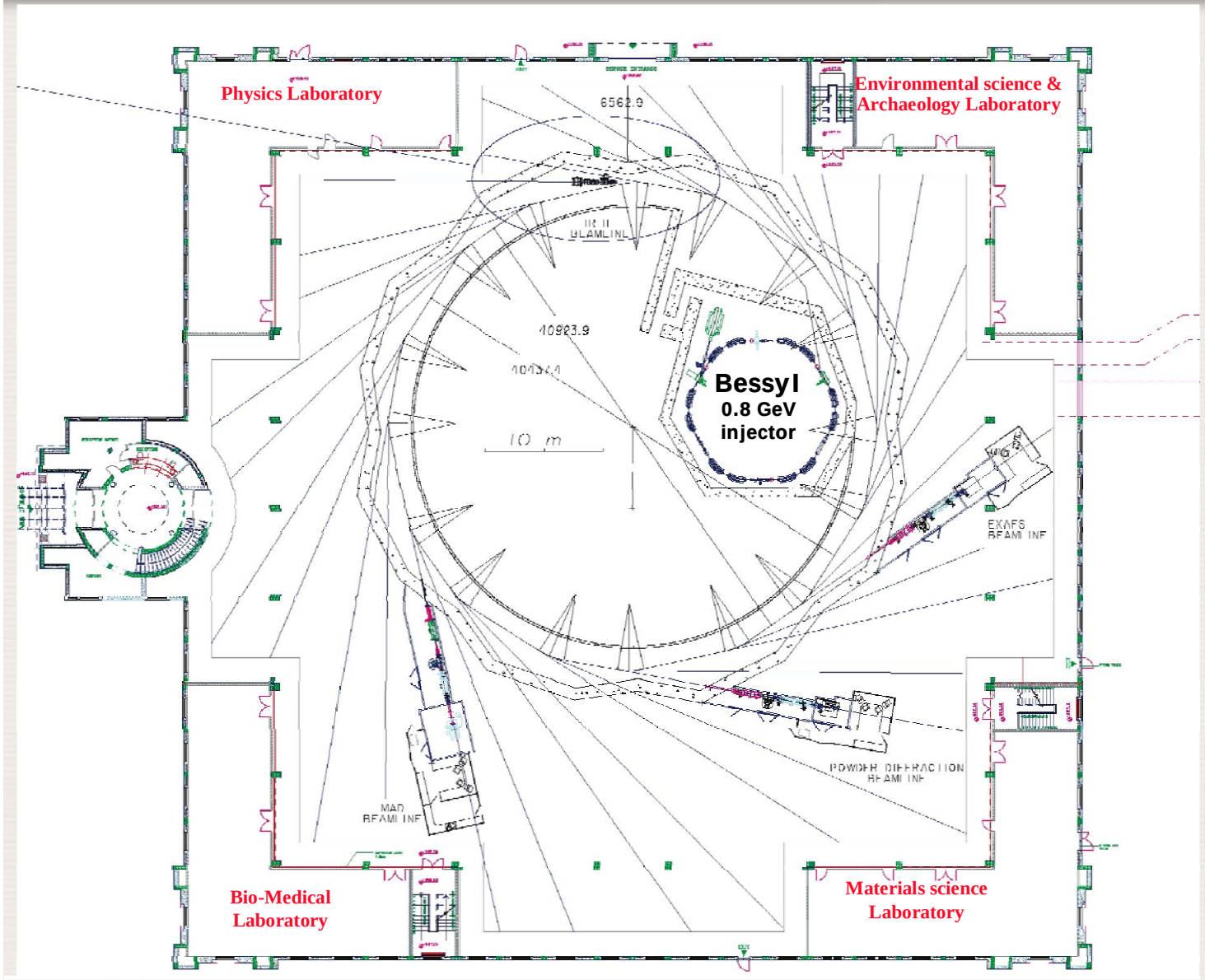
Experimental Hall Layout



Ring Status

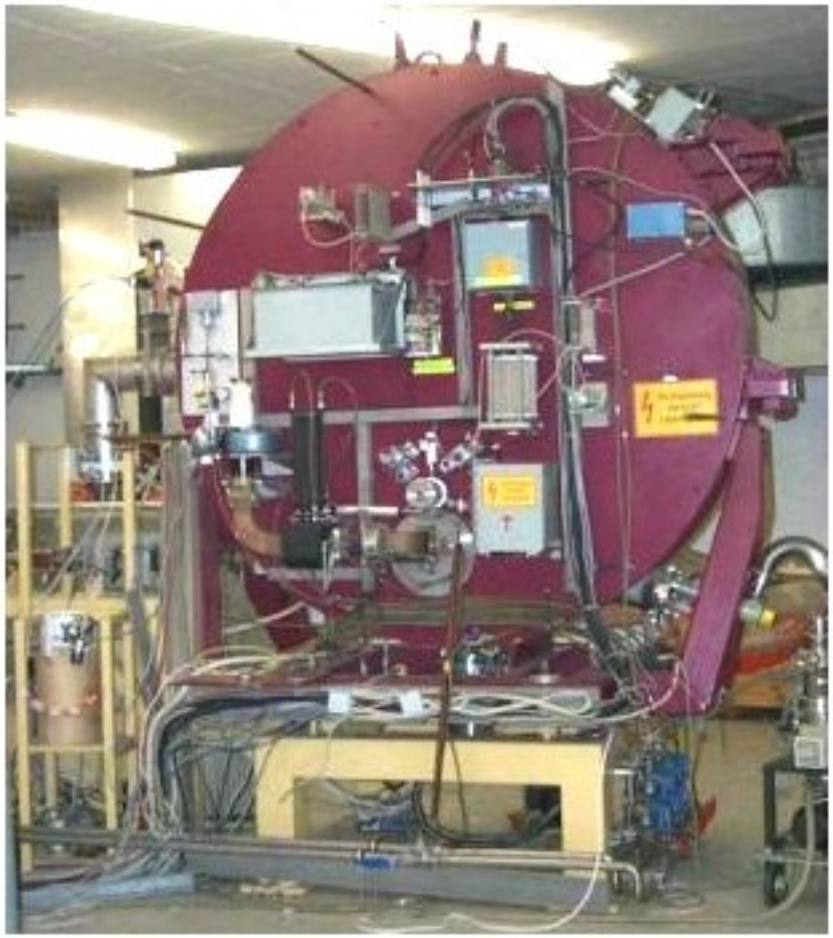
BESSY I microtron and the transfer line to the Booster are installed.

The first girders of the Booster are installed (with some bending magnets).

Injector System of BESSY I will be used unchanged for SESAME

Worth several million $

Booster Synchrotron at BESSYI in Berlin



Microtron 20 MeV

Microtron Installed at SESAME

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Components of BESSY1 installed

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SESAME Beamlines

- SESAME has the capacity for ~28 beamlines:

  Straight Sections = 16 (8 long 4.44 m, 8 short 2.38 m):
  Beamline Length 21 - 36.7 m

  Photon energies from IR to soft x-rays to hard x-rays

- Mission for beamline development is to ensure appropriate capabilities to:
  - meet needs of very diverse user community (novice to experienced in many different areas of science),
  - develop state-of-the-art user-friendly capabilities,
  - provide user support for carrying out outstanding science,
  - has clear and transparent policy that provide equal opportunities for access of beam times

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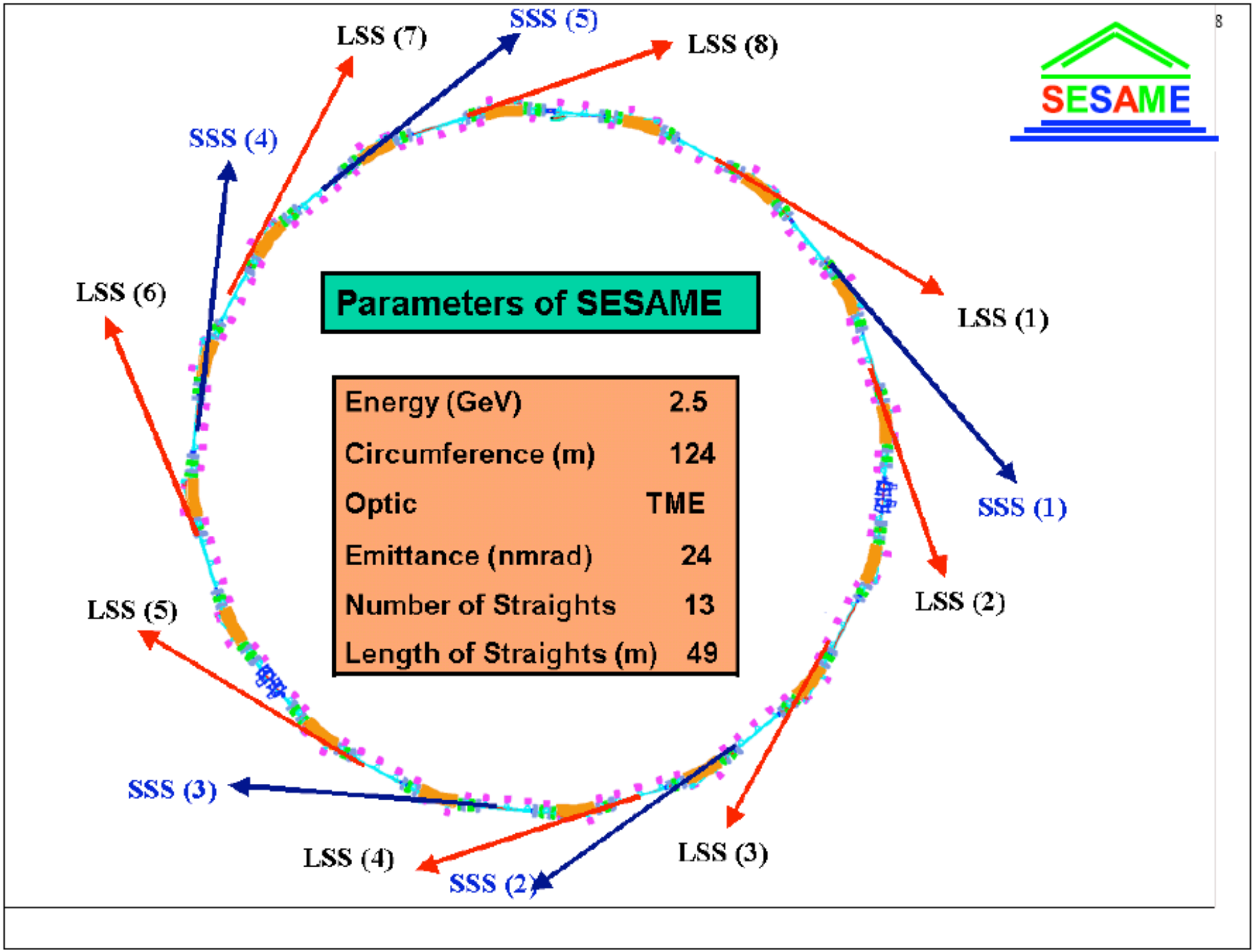
LSS (7)
SSS (5)
LSS (8)
SSS (4)
LSS (6)
LSS (1)
SSS (1)
LSS (2)
LSS (5)
SSS (3)
LSS (4)
LSS (3)
SSS (2)
Parameters of SESAME
Energy (GeV) 2.5
Circumference (m) 124
Optic TME
Emittance (nmrad) 24
Number of Straights 13
Length of Straights (m) 49
SESAME

Phase I Beamlines

No.	Beamline	Energy Range	Source Type	Research Area
1.	**Mad Protein Crystallography**	4 - 14 keV	In-vacuum Undulator	Biology
2.	**Soft X-ray - VUV**	0.05 - 2 keV	Elliptically Polarizing	Atomic Molecular
3.	**SAXS/WAXS**	8 - 12 keV	Undulator	Material Science
4.	**XAFS/XRF**	3 - 30 keV	2.0 Tesla MPW	Material, Arch.
5.	**Powder Diffraction**	3 - 25 keV	2.1 Tesla MPW	Material, Arch., Env.
6.	**IR Spectro-microscopy**	0.01 - 1 eV	Bending Magnet	Material, Arch., Env.
7.	**VuV Spectroscopy**	5 - 250 eV	Bending Magnet	Atomic Molecular

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Phase I Beamlines at SESAME & Other

SESAME: Phase I

1) PX (und)
2) Soft x-ray (EPU)
3) SAXS/WAXS
4) EXAFS/XRF (Wiggler)
5) Powder Diff (Wiggler)
6) IR (BM)
7) AMO (und)

NSLS-II

1) Inelastic
2) Nanoprobe
3) Soft Coherent
4) Hard Coherent
5) EXAFS
6) Powder

A(ustralian)SP

1) IR
2) PX (BM)
3) Soft (undulator)
4) EXAFS (wiggler)
5) Powder (BM)

C(anadian)LS

1) far-IR
2) UV (PEEM+XAS)
3) Soft (STXM)
4) Soft (PEEM+XAS)
5) EXAFS

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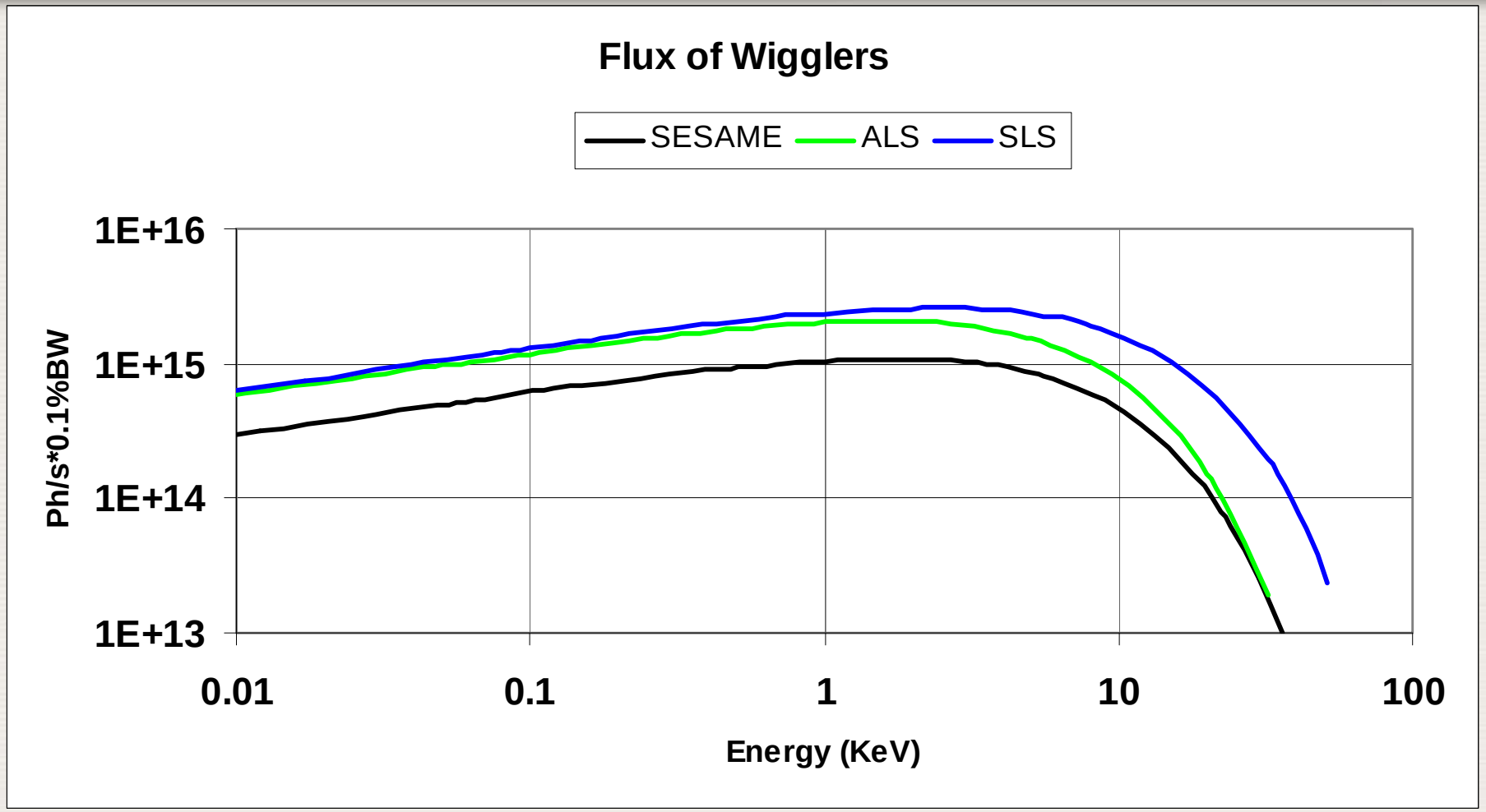
Comparison of SR from wigglers of SESAME, ALS and SLS



Thus at 10keV there is little difference between ALS and SESAME

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Collaboration or “Parentage”

- SESAME will be assisted by international laboratories who have built 3rd generation synchrotron radiation sources
- Signing of agreement with **SOLEIL**: Since 2007
  Pulsed Magnets, Power Supplies, Building Infrastructure, Alignment, …
- Approval by **ESRF** Directorate for
  Calculation of the Shielding, Radiation Monitors Distribution, PSS
- Collaboration with **ALBA** is being arranged
  Bending Magnet Measurement, IOTs and LLE-RF, Personnel Exchange
- Collaboration with **SLS** is in progress
  Vacuum and Control Systems

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SESAME Construction Schedule

ACTIVITY	START DATE	END DATE
Machine Detailed Design	Jan 2005	Dec 2007
Component Procurement		
Call for tender for all the Subsystem	Feb 2008	Jul 2009
Contracts for all the Subsystem	May 2008	Nov 2010
Prototypes Construction and Acceptance	May 2008	Jul 2009
Subsystem construction	May 2008	Apr 2011
Installation		
Installation of Microtron and Booster in the new building	Mar 2008	April 2009
Commissioning of Microtron and Booster	May 2009	Jul 2010
Floor preparation, Utilities and Main Ring installation	Jun 2008	Dec 2011
Commissioning of Main Ring	Dec 2011	Jul 2012
Beamlines commissioning	2012	----------

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Technical Team

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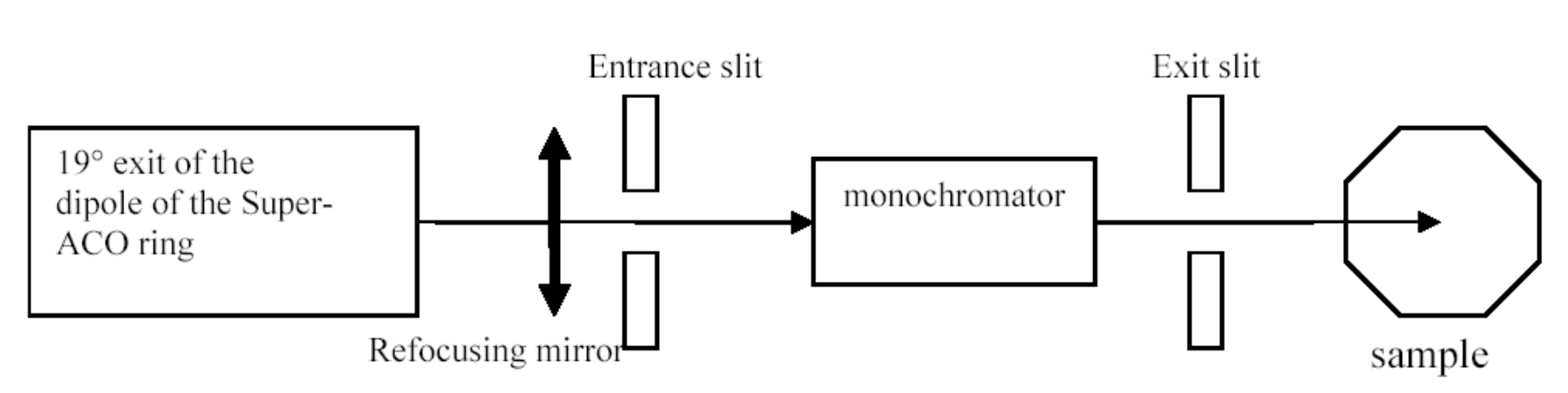
Beamline 7, VUV Spectroscopy



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IAEA activities towards SESAME

- 4 x 6 months Beamline scientist fellowships per year. IAEA Technical Officer participates to evaluation panel. Restricted to IAEA & SESAME Member States fellows.
- 4 x 1 months technical trainings per year. Restricted to SESAME staff.
- Expert missions
- Lecturers at users' meetings

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Lightsources around the world

Lightsources.org

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Thank you