

# Research and innovation infrastructures

**SESAME** : a model project for other regions

(Synchrotron-light for **E**xperimental **S**cience and **A**pplications in the **M**iddle **E**ast)

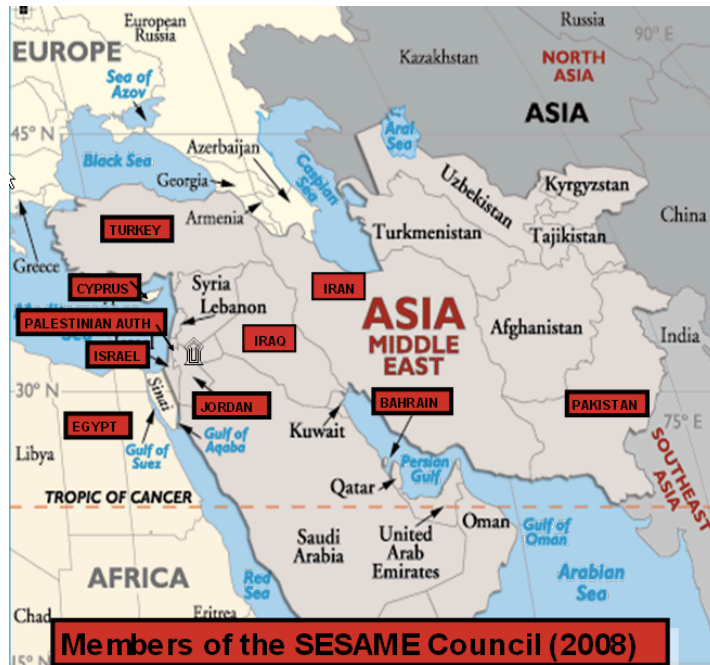
**Hany Helal**

Professor, Cairo University

Former Minister of Higher Education and Scientific Research, Egypt

Former Administrative Director, SESAME

**SESAME** is a third generation light-source under construction near Amman



**Members:** Bahrain, Cyprus, Egypt, Israel, Iran, Jordan, Pakistan, Palestinian Authority, Turkey

**Observers:** France, Germany, Greece, Italy, Japan, Kuwait, Russian Federation, Sweden, Switzerland, UK, USA

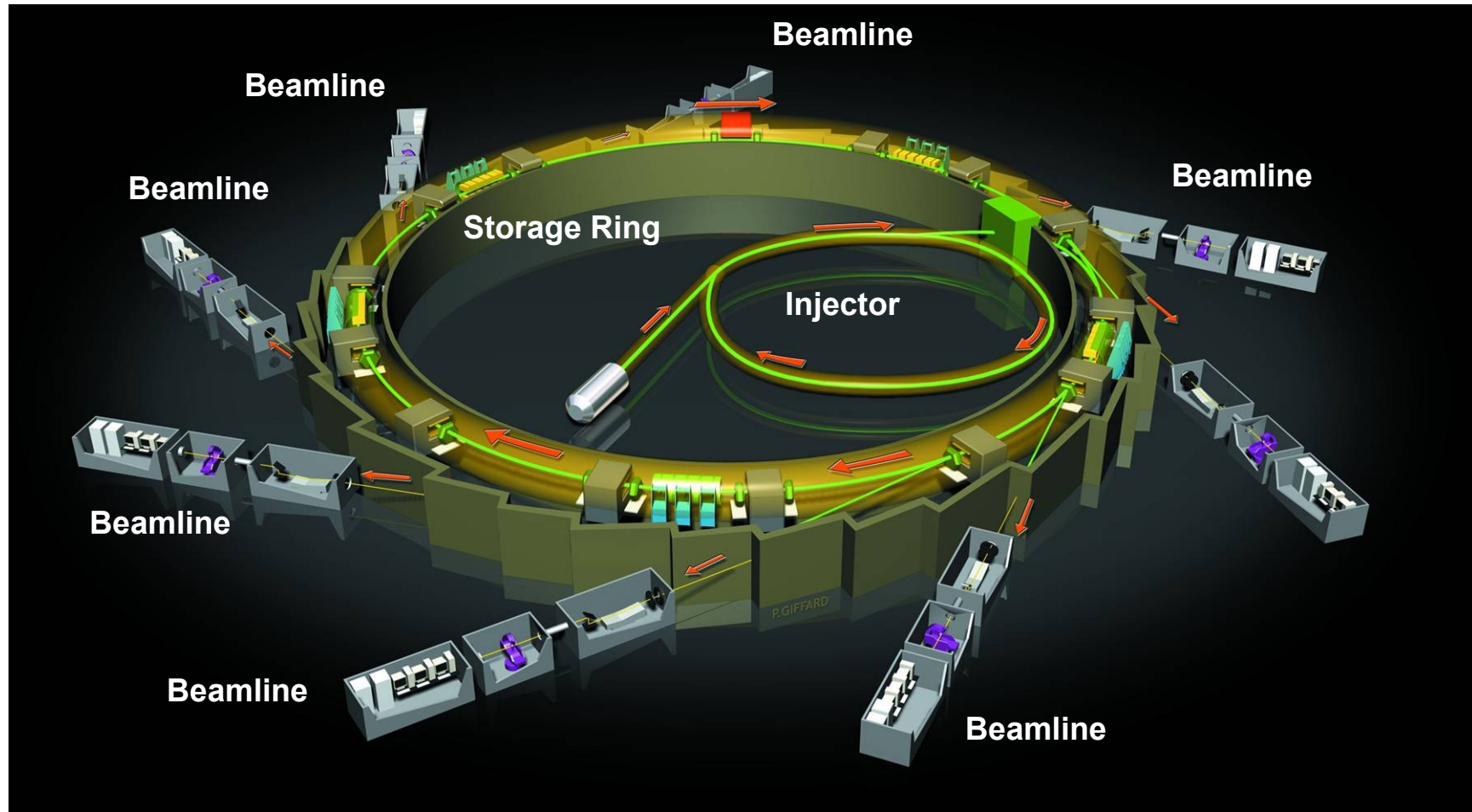
### **Purpose: to foster**

- science\* and technology in the Middle East (and prevent or reverse the brain drain).

\* from biology and medical sciences through materials science and physics to archaeology; endorsed by IUPAP, IUBMB, 45 Nobel Laureates, ..

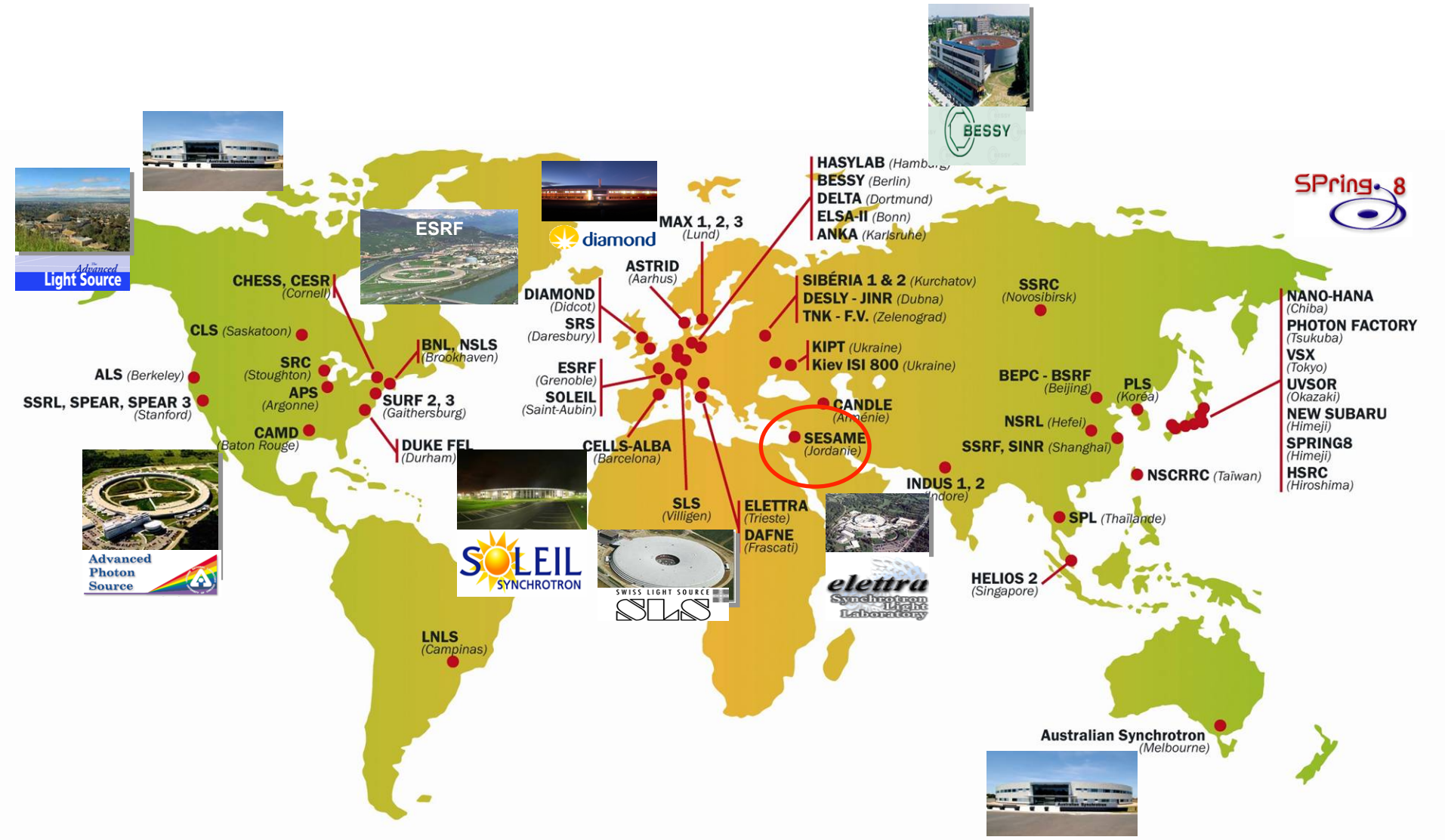
- cooperation across political divides and build bridges between diverse societies, and contribute to a culture of peace through international collaboration in science.

# A Synchrotron Light Source



**All beamlines get beam simultaneously**

# Synchrotron Radiation in the World



There are ~ 60  
synchrotrons in  
world

None in the Middle  
East


**SESAME** building, financed by Jordan and  
designed by civil engineers from Al-Balqa'  
Applied University, Jordan

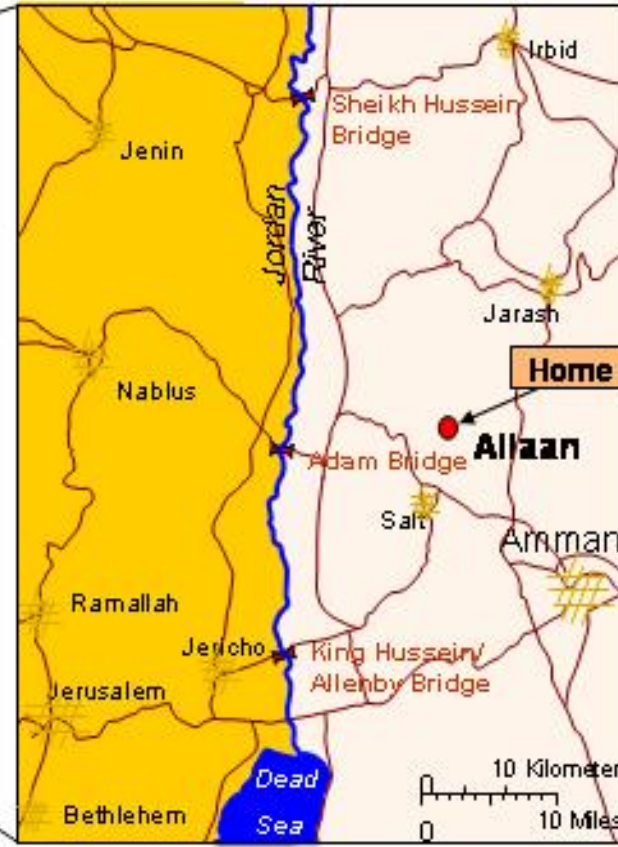


Building can be used for high-level Arab-  
Israeli and Middle East Scientific meetings

- International collaboration is obvious way for countries with limited science budgets to build synchrotron-light sources
- Broad programme makes synchrotron ideal facilities for building scientific capacity
- **SESAME** will be a user facility: scientists will typically go to SESAME two or three times a year for a week or two to carry out experiments, in collaboration with scientists from other institutions/countries

# Very Brief History of SESAME

- **Original idea (1997)** - rebuild old 0.8 GeV Berlin Synchrotron (BESSY 1) in the Middle East, as basis for a new international organisation, modelled on CERN, under umbrella of UNESCO
- **1999 - (Interim) Council established**; followed by international advisory committees
- **2002 - decision to build a new 2.5 GeV ring** (still using BESSY booster)  
 *competitive 3<sup>rd</sup> generation device*
- Ground breaking (2003); **completion of building (2008)**
- **Vigorous training programme and growing potential user community**
- **First experiments in 2015**, *assuming* funding for main ring + building and adapting/upgrading beamlines can be found



# Training Programme

One of the essential objectives of SESAME

- Users meetings, Workshops, Individual training (visits, Fellowships, ...)

- Funding from

International organisations:

**IAEA, UNESCO**, ICTP, ESRF

External National organisations & synchrotron labs in: Brazil, France, Germany, Italy, Japan, Portugal, Spain, Sweden, Switzerland, Taiwan, UK, USA (DoE)

Organisations in Members: Cyprus, Egypt, Iran, Israel, Jordan, Turkey

Scientific bodies: APS + EPS + IOP + DPG + ACS

Companies: Gentech, Ox Diffraction, PANanalytical, Jordanian Phosphate Mining CO.

Foundations: Canon, Lounsbery

Link SCEEM project












# Training Programme

- ❖ **Workshops and schools in the different domains of the field : structural molecular biology, accelerator science, material science,...**
- ❖ **Training in several world-class synchrotron laboratories : ALBA, ESRF, PF, SLS, SOLEIL, SSRF,...**
- ❖ **Annual user's meetings since 2002 : 250 participants last year**
- ❖ **Visits of experts at SESAME**
- ❖ **Today more than 25 people are working as engineers, technicians or scientists at SESAME ([www.sesame.org.jo](http://www.sesame.org.jo)).**

# Tentative Agenda

Program	2010				2011				2012				2013				2014				2015			
	T 1	T 2	T 3	T 4	T 1	T 2	T 3	T 4	T 1	T 2	T 3	T 4	T 1	T 2	T 3	T 4	T 1	T 2	T 3	T 4	T 1	T 2	T 3	T 4
<b>End of the shielding (complete)</b>																								
<b>Installation + Test of the Booster Subsystems</b>																								
<b>Commissioning of the Microtron at 22.5 MeV (reached)</b>																								
<b>Commissioning of the Booster</b>																								
<b>Storage Ring call for tender + Manufacturing</b>																								
<b>Installation + Tests</b>																								
<b>Commissioning of the Storage Ring</b>																								

## SESAME GROUND BREAKING CEREMONY - 6 JANUARY 2003





Zehra Sayers

Heman Winick

Dincer Ulku

Javad Rahigi

**3<sup>rd</sup> SESAME User Meeting**  
**October 11-13, 2004, Antalya, Turkey**  
**9<sup>th</sup> Users' meeting in Amman November 2011**



## **SESAME Accelerator Group, August 14, 2007**

**First row left to right: Yara Zreikat, Mechanical Designer (Jordan), Adel Amro, Vacuum Assistant Engineer (Jordan), Adli Hamad, Radiation Officer (Jordan)**

**Second row Left to Right: Darweesh Foudeh, RF Engineer (Jordan), Firas Makahleh, Mechanical Engineer (Jordan), Mohammad Alnajdawi, Mechanical Designer (Jordan), Maher Shehab, Mechanical Engineer (Jordan), Hamed Tarawneh, Accelerator Physicist (Jordan), Maher Attal, Accelerator Physicist (Palestine), Ahed Aladwan, Control Engineer (Jordan), Arash Kaftoosian, RF Engineer (Iran) Seadat Varnasseri, Diagnostics Engineer (Iran)**

**Opening of the SESAME Building by the DG of UNESCO and his Royal Highness Prince Ghazi Ben Mohammad, 3 November 2008**



# Microtron (injector to BESSY 1) at SESAME, November 2008



**Components of BESSY 1, which will form the booster accelerator that injects electrons into SESAME, temporarily 'installed' for the opening ceremony, November 2008**





# Shielding under construction November 2010



# Shielding Completed, May 2011



**Microtron installed in final position  
+ ring in which booster is being installed  
May 2011**



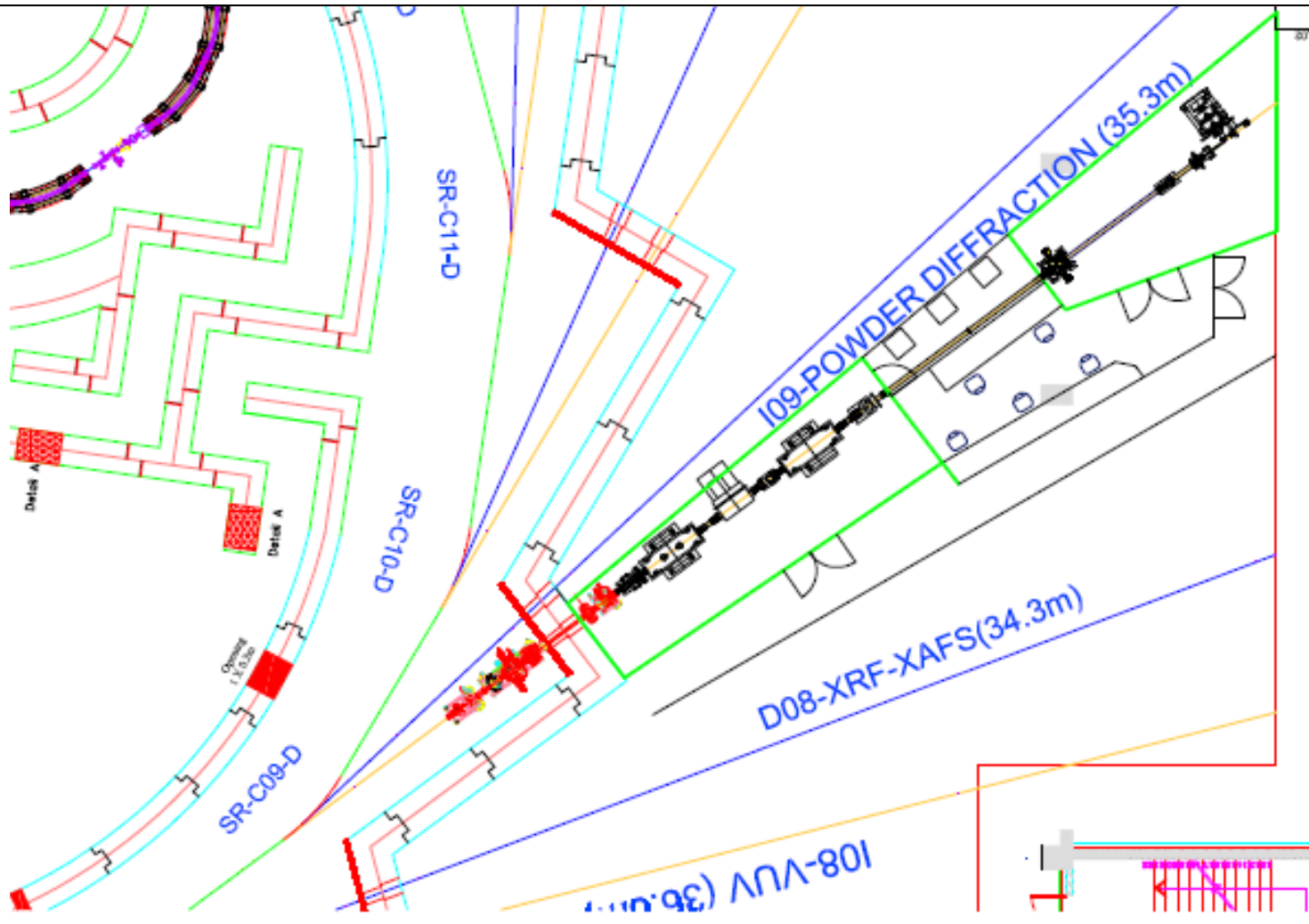
## Booster Magnets Being Installed on the Girders (May 2012)



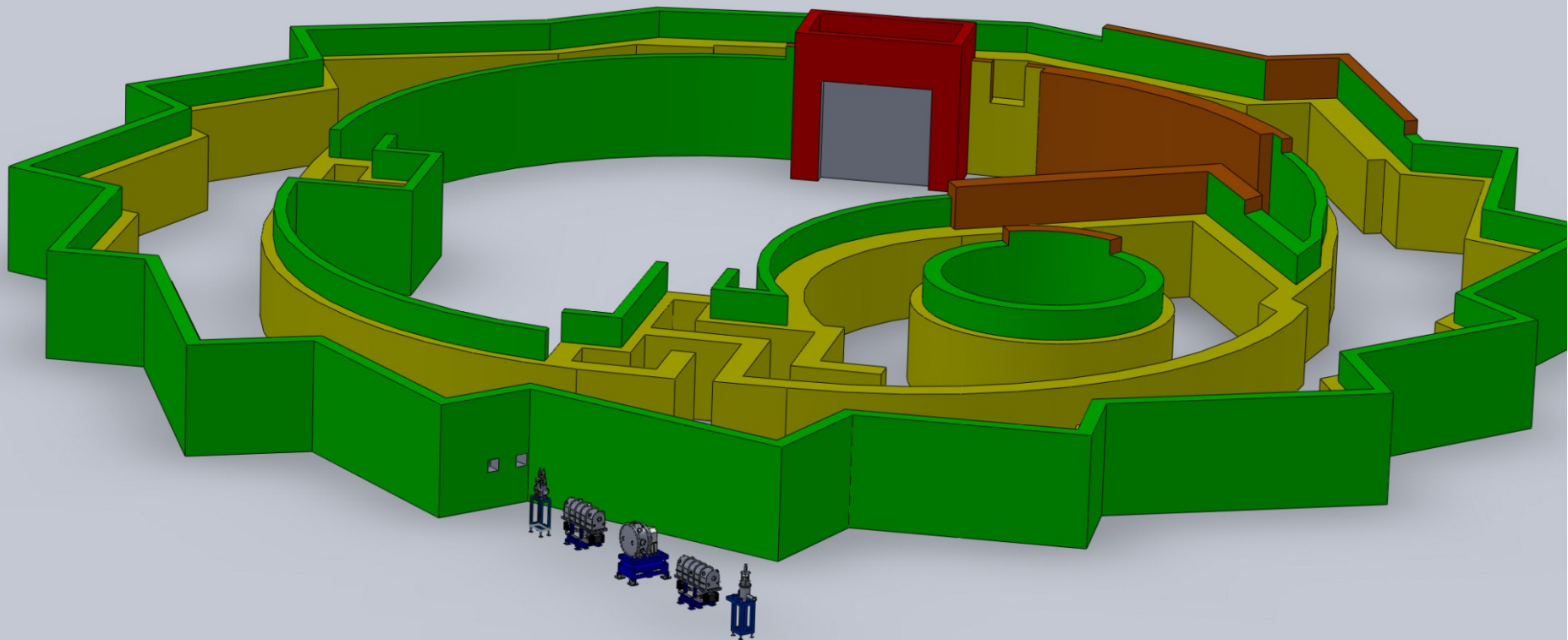


# Design of Powder Diffraction Beamline

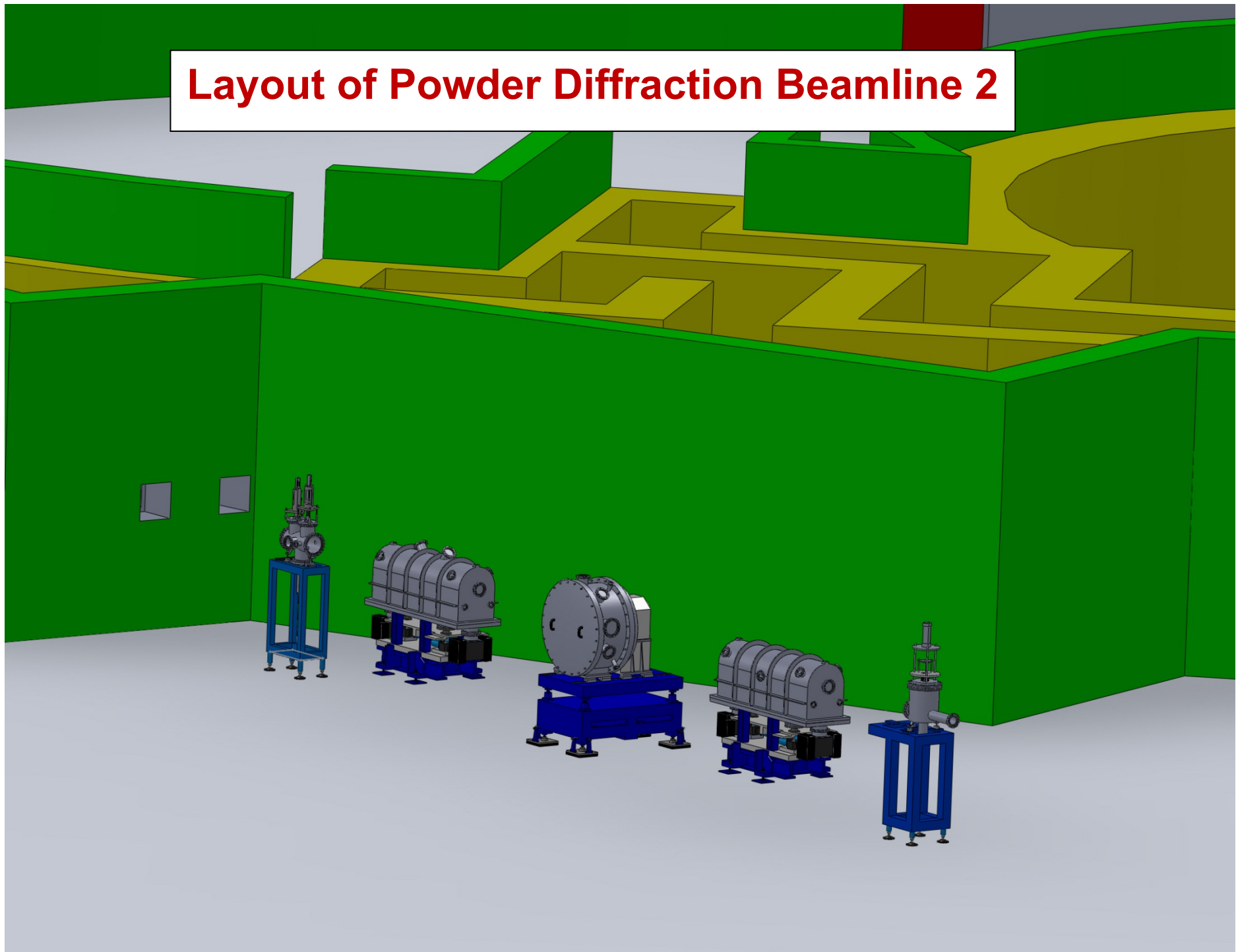
Made by a team for scientists & engineers from Turkey  
+ SESAME staff



# Layout of Powder Diffraction Beamline 1



## Layout of Powder Diffraction Beamline 2





# Some SESAME People, including Users of Day One Beamlines



Mohammad Yous



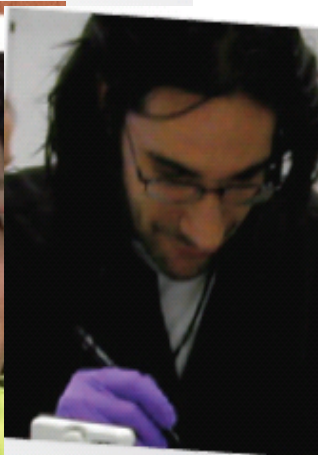
Sumera Javeed



Maher At



Irit Sagi



Vasilis Promponas



Mukhles Sowwan

# Day-One Beamlines

No	Beamline	Energy Range	Source Type	Comments
1.	Protein Crystallography	4-14 keV	Wiggler (ALS) (?)	<ul style="list-style-type: none"> <li>•Daresbury 14.1/2</li> <li>•New Double Crystal Mono, liq N2 cooled</li> <li>•New Hutch</li> </ul>
2.	X-ray Absorption Fine Structure/X-ray Fluorescence(XAFS/XRF)	3-30 keV	Bending Magnet	<ul style="list-style-type: none"> <li>•Helmholtz-Zentrum Dresden-Rossendorf/ESRF</li> <li>•New focussing optics</li> <li>•New Hutch</li> </ul>
3.	Infrared Spectro-microscopy	0.01-1 eV	Bending Magnet	<ul style="list-style-type: none"> <li>•Mod to storage vacuum chamber</li> <li>•New beamline</li> </ul>

## Remaining Phase I Beamlines

No	Beamline	Energy Range	Source Type	Comments
4	Powder Diffraction	3-25 keV	2.1 Tesla MPW (SLS)	SLS XO4SA
5	Small- and Wide-Angle X-ray Scattering	8-12 keV	Bending Magnet	Daresbury 14.2
6	Extreme Ultraviolet	10-200 eV	Bending Magnet	Daresbury 4.1 & Lure
7	Soft X-rays	0.05-2 keV	Elliptically Polarizing Undulator	New BL

Beamlines chosen by the users community.

# Funding So Far

**Capital investments\* + value of donated equipment\*\* + supporting operational budget\*\*\* ~ \$55M**

\* From Jordan (land, building and cash), EU (€3.2M),...

\*\* From Germany, UK, ...

\*\*\* From Members

**New main ring** not foreseen initially, and not budgeted by Members. Funding being sought for this and for adapting/upgrading the donated beamlines - **see below**

**Extensive Training Programme**: funded by outside donors (see below) – over \$3.0 M spent; annual value rising towards \$1M

# Donated Equipment

- **From Germany**
  - BESSY 1
- **From LURE, France**
  - Beamline, undulator, ...
- **From SLS, Switzerland**
  - Beamline, wiggler
- **From Daresbury Lab & University of Liverpool, UK**
  - Five beamlines, value if new over €20M
- **From SLAC, Stanford University, USA**
  - Undulator,...
- **From ALS, Berkeley, USA**
  - Wiggler
- **From Elettra, Italy**
  - Cavities
    - **From ESRF/Helmholtz (Germany)**
      - Rossendorf beamline

# Funding Needed 2010-14

- **To complete storage ring etc: \$27.5M**  
Certain non-essential items will be added later
- **To provide three day-one beamlines** (two using components donated by Daresbury + one new) **+ computing: \$6.1M**  
Four more Phase 1 beamlines will be added later
- **Ancillary buildings and security: \$1.2M**  
Would like to add conference centre and other buildings later

**Total Capital funding needed 2011-14: \$34.8 M**

- **Operational funding needed 2011-14: \$(21-24)M** – to be provided by Members

[With investments so far + donations (~ \$55M) → total cost to bring SESAME into operation, with three day-one beamlines, starting from a green field ~ \$110M

- in line with the cost of other recently constructed light-sources]

# Possible Sources of Funding

- **Members** – must pay **operational/personnel costs** + make a substantial contribution to the **capital funding**:
- At a meeting in Amman on 8 March 2012, representatives of four SESAME Members (Iran, Israel, Jordan and Turkey) agreed to make voluntary contributions of US\$5 million each towards the construction of SESAME over the four years 2012-15.
- **EU** (already contributed ~ \$4M)
- **EU** will probably provide €5 million to support construction of the main ring, which will be done jointly by CERN and SESAME. Last week during the Council meeting a CERN-SESAME protocol was signed which specifies the work to be done.
- **US**
- **FP7/Euromed** (preparing bid)
- **Foundations**
- **European Investment Bank**, which is prepared in principle to make a loan - this would be a last resort

**Thank you**