

# Science - a tool for bringing nations together - the example of SESAME

Sceptics: collaboration between scientists easy,  
but no influence on politics –**wrong**

1. Cooperation for large projects requires scientific, **administrative and political** efforts on “lower level” which irradiate into different and even highest government levels.  
Promotion of **human values** like rationality, honesty and tolerance  
*more efficient than production and exchanges of documents? (UN)*

## 2. Confidence building

from science up to politics (takes time, be patient)

Examples from my experience:

- **CERN-Dubna cooperation, only agreement between Western organisation and Soviet Union during ‘hottest’ cold war**
- **CERN – IHEP (Sovietunion) agreement in 1968**  
**became model for IHEP-USA agreement**  
**and later for model for USA- Soviet Union agreement (*Breshnev-Ford*)**
- **Disarmament meeting at Geneva in 1985**  
**when in deadlock private meeting at CERN unblocked it**
- **First scientists from PR China at DESY (Hamburg) 1978 (approval by Deng Ch.-P)**
- **Scientist from PR China and Taiwan**  
**at experiment of CERN 1984**
- **SESAME Middle East: Israel-Palestine-Iran**



# **SESAME**

## **History and Objectives**

**A dream becomes real**

**Coming back from SESAME Council meeting at Brussels**  
**Start of operation in December 2016**

**Herwig Schopper**  
**Funding President of Council**



**SESAME**

**S**ynchrotronlight for  
**E**xperimental  
**S**cience and  
**A**pplication in the  
**M**iddle  
**E**ast

*An International Center for Research and Advanced Technology  
for the Middle East and the Mediterranean Basin*

*Founded under the auspices of UNESCO according to CERN model*

*The first international organization in a Muslim country*

# Objectives of SESAME

*open many doors*

‘name chosen to express this’

Promote Science and Technology

(capacity building)

Bring nations together

‘Science for Peace’

Training

(scientists, technicians, administrators)

# ***How to achieve the objectives?***

- ❖ **Create a centre of excellence for interdisciplinary research with internationally **competitive** research facilities**  
**main principle: scientific excellence**
- ❖ **Promote international cooperation**  
**(to be successful first point is essential !)**
- ❖ **Scientific infrastructure to be used by scientists from the Member States (preferentially), but from all over the world, mixed international groups preferred**
- ❖ **Establish research programme in close cooperation with future users (no ‘white elephant’ !), users’ community (at CERN ~11000, SESAME already ~300 -> 1500)**
- ❖ **Training by workshops, schools, fellowships. research**
- ❖ **Involve scientists from the region working abroad, reverse brain drain**

# SESAME is child of CERN in several aspects

- First idea born at CERN
- Created following procedure of CERN: under UNESCO
- Convention of CERN ‘copied’
- Spirit of CERN: Open to all scientists of world,  
no discrimination
- Technical help of CERN (main ring)

# A short history of SESAME

*May be interesting lecture for future international projects*

**1997:** during a workshop for Middle East Scientific Cooperation organised by S.Fubini (theoretical physicist) of CERN proposal by H.Winick and G.-A.Voss to use components of BESSY I (to be closed down) at Berlin

S.Fubini asks H.Schopper (retired as Director-General of CERN) to take care

Suggestion to F.Mayor, DG UNESCO, to repeat CERN story

**June 1999:** F.Mayor, DG UNESCO, invites all governments of the region to a meeting at Paris

**Positive decision taken,  
Interim Council created  
with 12 members and 6 Observers (H.Schopper, President)**



# Formal establishment of SESAME by UNESCO as autonomous international laboratory

**UNESCO General Assembly** (about 180 countries)

**October 2001**

- asks Director General, K.Matsuura, to elaborate feasibility study and propose Statutes
- authorises **Executive Committee** to decide definitely (to save time)

**Mai 2002: unanimous Authorisation by Executive Committee**  
(about 50 countries) (including approval of Statutes)

**Procedure takes normally more than 4 years!!**

**”...model project for other regions....**

**Quintessential UNESCO project combining capacity building with vital peace-building through science.”**

# Declaration

**accepted by the Plenary Meeting of the Nobel Laureates  
at the PETRA IV on 19 June 2008**

We, the undersigned Nobel Laureates, commend the remarkable progress made in creating the SESAME Synchrotron Light Source. It will provide a major center for scientific research, with the ownership shared by many nations of the Middle East. Thereby, SESAME, as well as producing educational and economic benefits, will serve as a beacon, demonstrating how shared scientific initiatives can help light the way towards peace.



**Location decided after difficult negotiations**  
by secret vote of Interim Council

(proposals from 7 countries): **Jordan**

## **Conditions:**

- *all scientists from the world get access*
- *Site and building financed by host state*
- *Strong support by authorities*

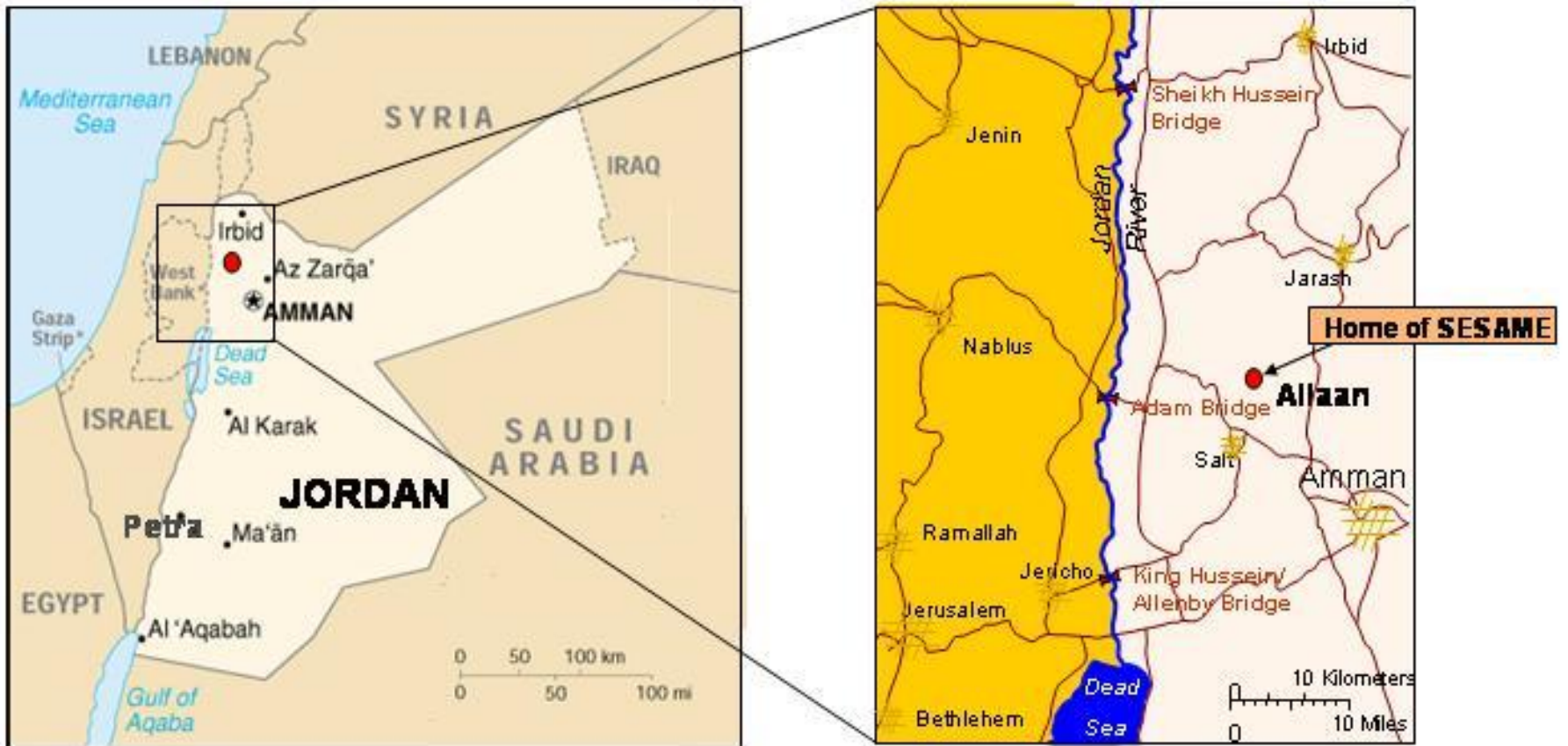
**Host country has special obligations**

(Host State agreement,  
privileges immunity, tax free, etc, like CERN)

**Strong support by H.M. King Abdullah II**



**H.Schopper, UNESCO-ADG Iaccarino, H.M. Abdullah, Prince Ghazi**



**SESAME location in Allaan, Jordan**



# SESAME's Members in 2016



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

**Iraq has asked for Membership,  
other countries are welcome  
(Ratification by parliaments!)**

# Groundbreaking SESAME Building January 2003



*Yusef Allan*

**UNESCO DG Matsuura and H.M.King Abdullah II unveiling marble plate,**





First users' meeting, January 2003 at Amman  
Financed mainly by Japan



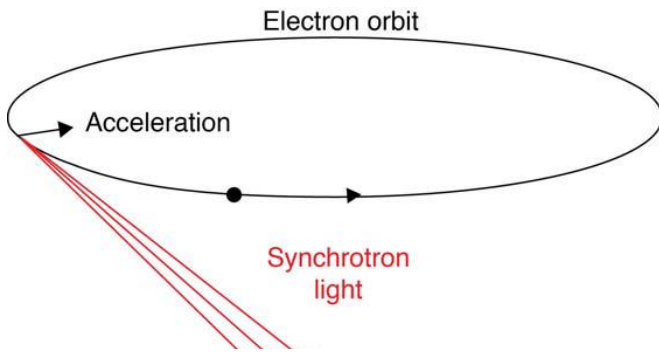


Completion of building 2008

# What is the SESAME Facility ?

- Extremely strong **light source** of synchrotron radiation
- **What is synchrotron radiation?**
- **Three minutes of physics!**

# SYNCHROTRON RADIATION (SR)



At high velocities electrons in a curved orbit emit SR tangential to the orbit.

**Electromagnetic radiation (light)**

Wavelength range from **infrared** to **visible** to X-rays.

**Extremely high intensities and special properties (polarization)**

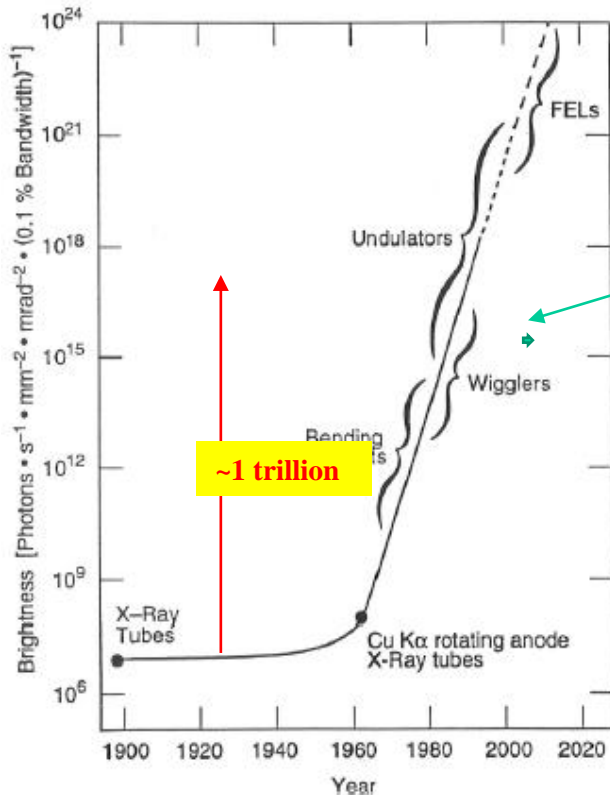
**SESAME: 3<sup>rd</sup> generation sources**

(more than 60 in world);

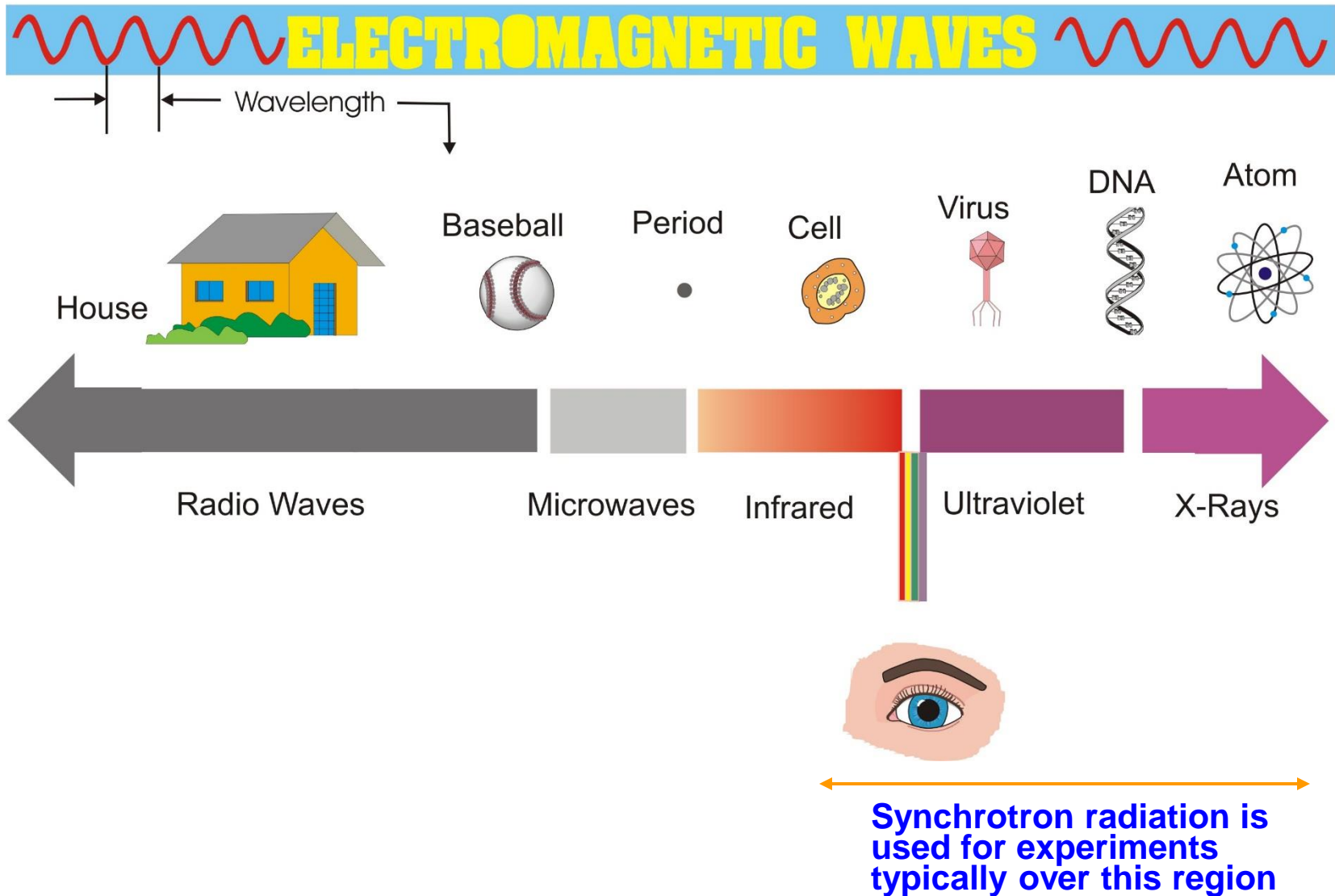
**Insertion devices in straight sections, wigglers and undulators,**

**4<sup>th</sup> generation sources;**

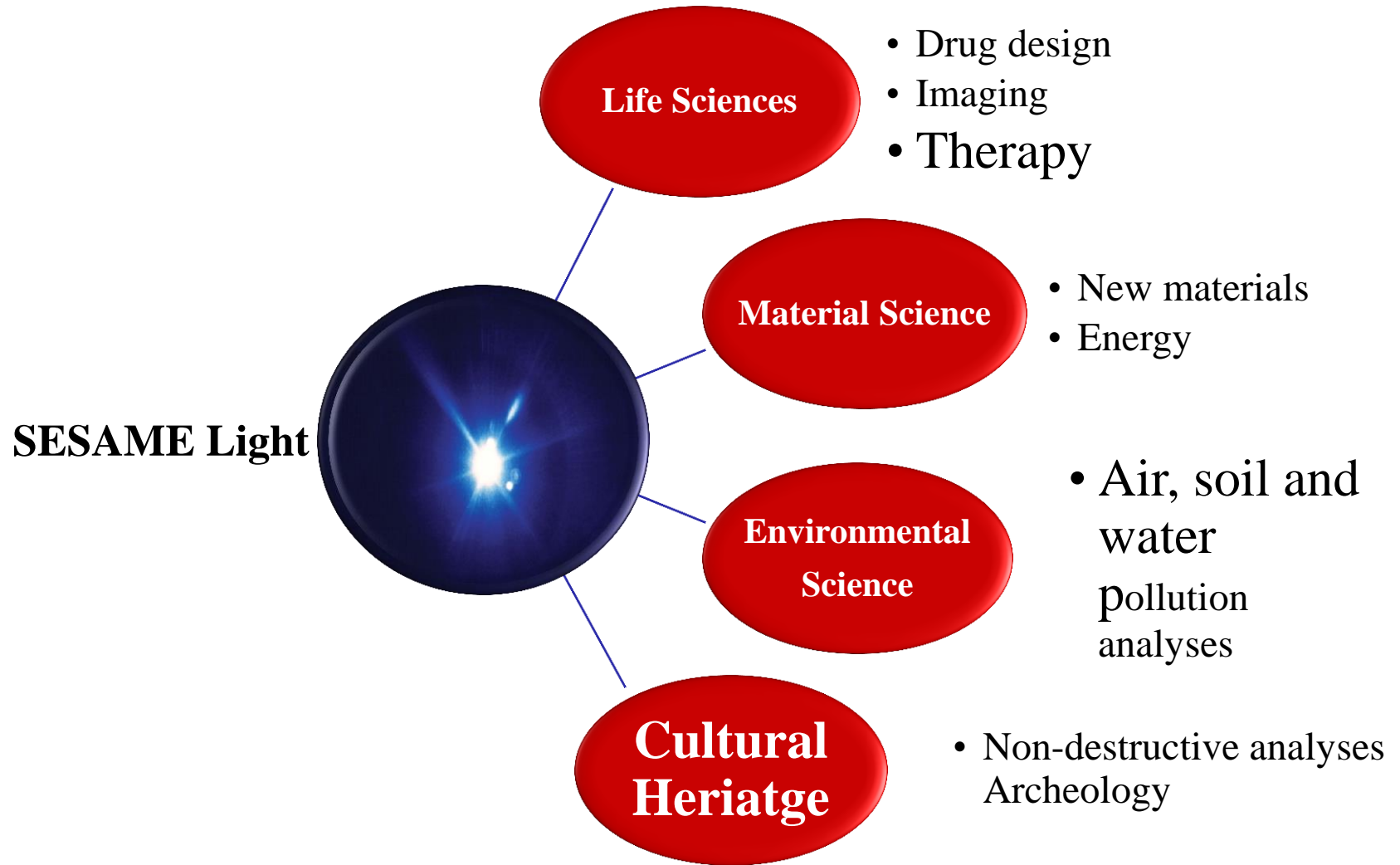
(a few in the world) free electron lasers



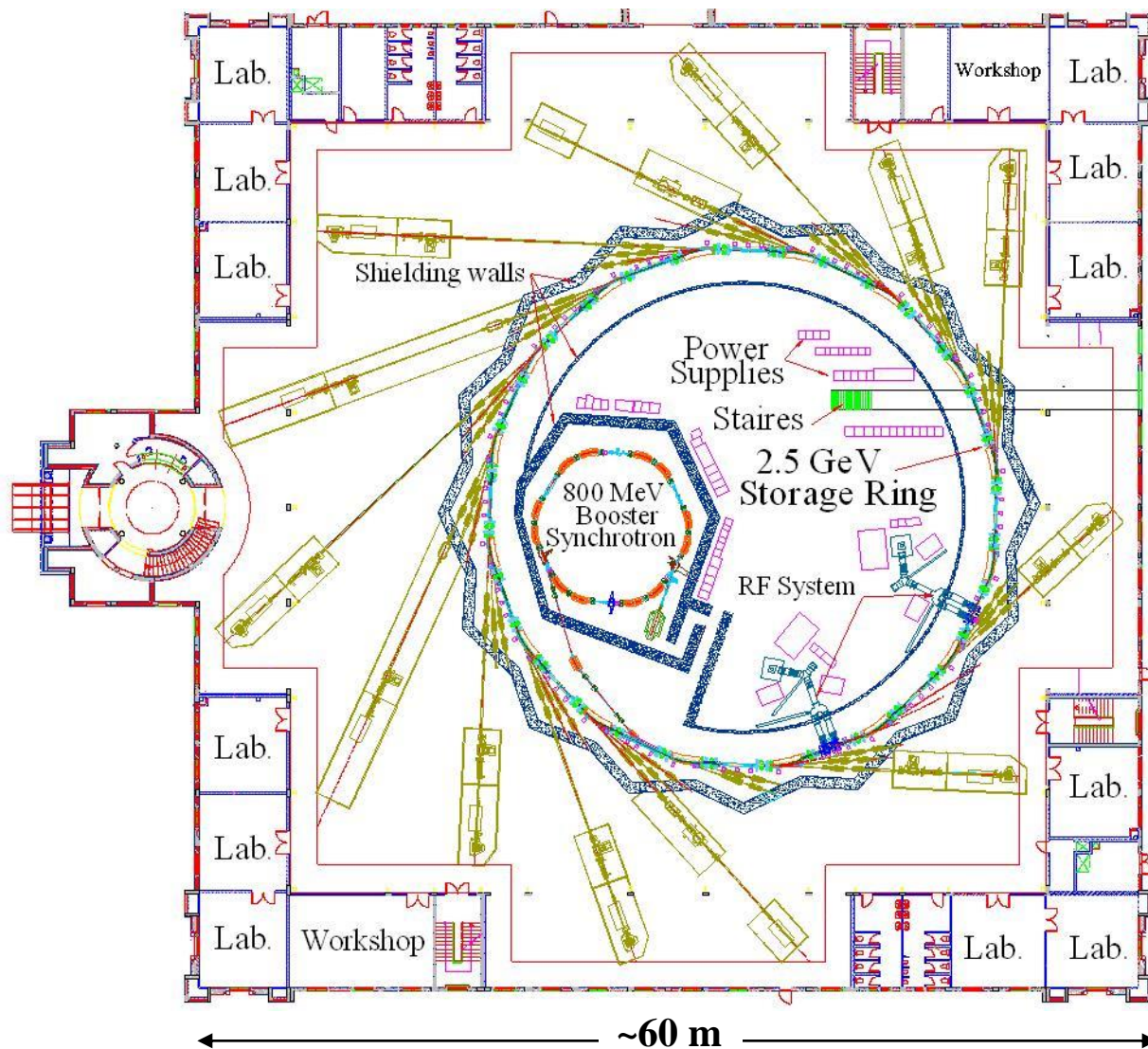
# Electromagnetic Radiation - How It Relates to the World We Know



# SESAME's SCIENCE







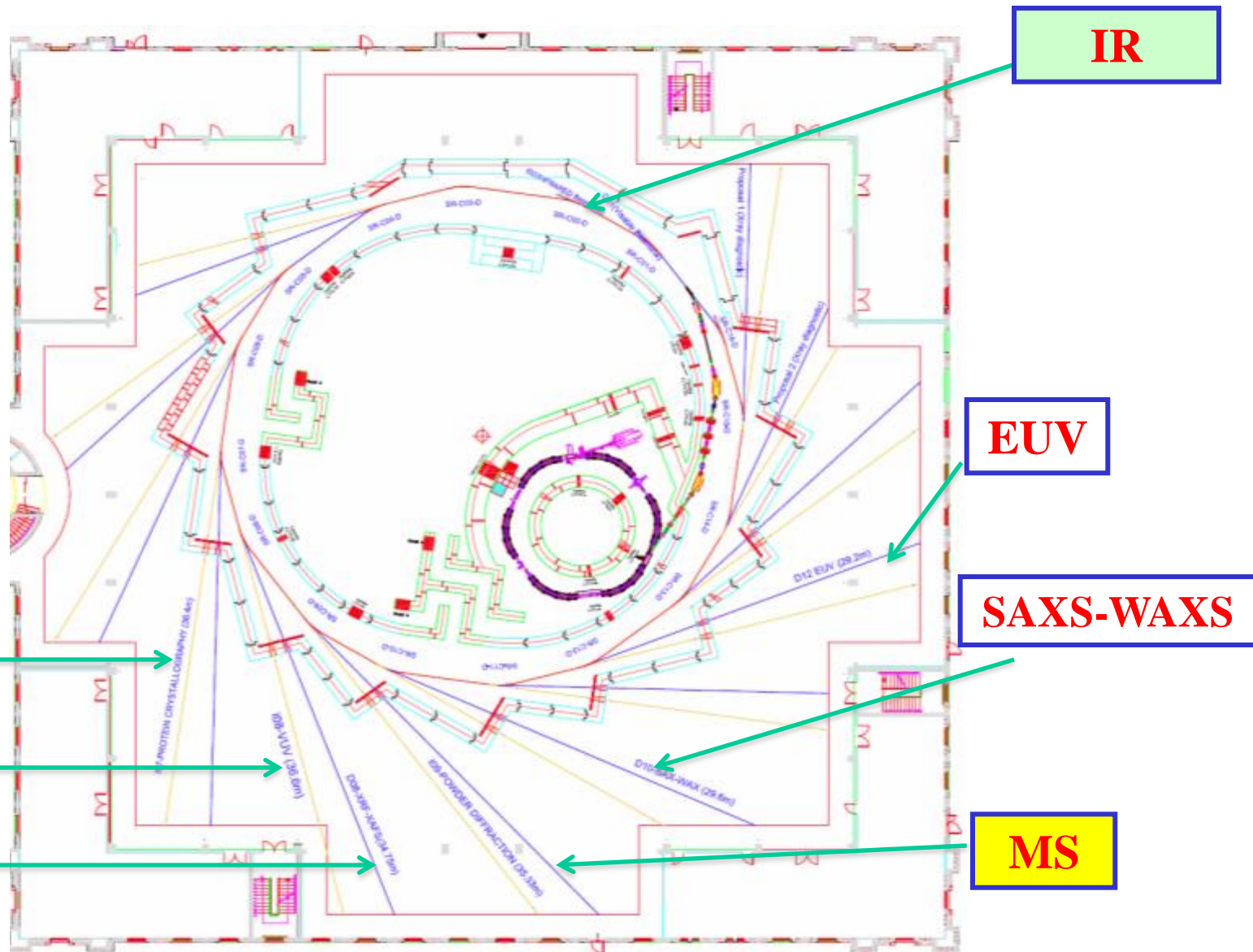
Energy	2.5 GeV
Current	400 mA
Circumference	128.4m
Emittance (horiz)	26.4 nm-rad
Possible IDs	13
ID Length	2.75 m

e <sup>-</sup> Beam Size in Straight Sections	
$\sigma_x/\sigma_y$	700 $\mu$ m/35 $\mu$ m
Critical Energy	5.9 KeV
e <sup>-</sup> Energy Spread	0.1%
Bending Mag. Field	1.425 T

**Future  
Outlay of  
SESAME**

**Parameters: 2.5 GeV ring with 13 possible insertion device beam lines. Beam lines can also come from the 16 bend magnets.**

# SESAME HALL & PHASE 1 BEAMLIN



**SESAME Beamlines Chosen by Users**

# SESAME EXPERIMENTAL HALL

May 2012





# ORGANIZATIONAL STRUCTURE OF SESAME

## Permanent Council

*Delegates of member countries and UNESCO*

Each one vote

## Directorate

*Director: K. Toukan (former Jordanian Minister)*

*Technical Director: E. Huttel (German)*

*Scientific Director: G. Paolucci, (Italian)*

*Administrative Director: Y. Khalil (Egyptian)*

Concentrate on  
scientific  
objectives,  
keep politics  
out as much as  
possible

## International Advisory Committees

*Scientific: Z. Sayers (Turkey)*

*Beamlines: Z. Hussain (USA)*

*Training: J. Rahighi (Iran)*

*Technical: A. Wrulich (Switzerland)*

Staff:  
about 40,  
to increase  
to 60

# SESAME SCIENTIFIC COMMUNITY



# Financial Strategy

- **Unusual strategy had to be adopted, risky**
- **Operating budget by Members rising from \$ 0.5 million to \$ 5 million/year**
- **Investment**
  - **site, building, infrastructure: Jordan**
  - **machine: donation Germany, Italy, France, UK, USA**  
funds requested for main ring from EC, (\$ 12 mill.),  
voluntary contributions by large members (5 mill each)
  - **beamlines by Members and donations from Daresbury, LURE, SLAC, others**  
**First generation of beamlines exists, users took responsibility!!**
  - **Emergency funds: Jordan to avoid delays (roof, electricity)**

- **Major financial problems solved but:**  
Budget increase to value at full operation  
Delayed payments by Members (Iran sanctions, Cyprus crisis)  
Total project worth about 100 million \$
- **The region gets a jewel by help from outside**
- **Special problem: energy**  
was originally very cheap (gas),  
now about 40% of operation cost  
**solution:** sun panels will be installed  
to provide more energy than needed by SESAME  
(land space secured)

# SESAME TIME SCHEDULE

<b>First idea</b>	<b>1997</b>
<b>Interim Council</b>	<b>1999</b>
<b>Establishment as intergovernmental organization by UNESCO</b>	<b>2003</b>
<b>Building finished (incredibly fast!)</b>	<b>Nov2008</b>
<b>Start operation</b>	<b>December 2016</b>
<i><b>Inauguration ceremony</b></i>	<i><b>20 May 2017</b></i>

**A rather short time schedule  
even compared with a national project**

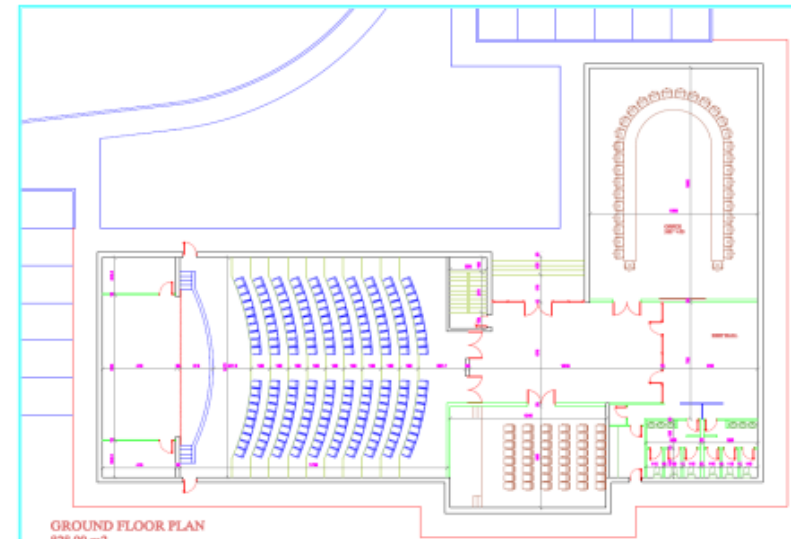
# The future

SESAME is planning to build a guest house for users

**Construction will start in 2016 !**

This will be followed by a  
**Conference Centre:**

If SESAME operation allows,  
**SESAME will be able to house meetings on other topics (food, water, archaeology, ...) in secure/easily accessible surroundings**



**Dream:**

**this will lead to other joint facilities & collaborations**

## Conclusions:

Large projects carried out by international scientific organisations establish links between the scientific community and the realm of politics with benefits for both sides:

- Large international projects can be created
- Science helps to bring nations together

In time where relations between some nations are characterised by **hatred and violence** it is gratifying that CERN and SESAME bring together politicians and scientists to work peacefully together

**Small light in dark times**

**Thank you**



## Collaborative projects with scientists from the Middle East:

- FTIR analysis of breast cancer from Iranian patients: collaboration from Tehran University, **Iran**.
- FTIR analysis of bacterial and marine micronutrients: Collaboration from the University of **Pakistan**
- Study effects of pharmaceutical products on different skin layers by of infrared spectromicroscopy: collaboration the university of Jordan, **Jordan**.
- Effect of environmental pollution on the edible, medicinal and aromatic plants grown in Jordan: faculty of pharmacy, university of Jordan, **Jordan**.
- Investigation on diamond like carbon deposited on Si wafer using the FTIR microscope equipped with a grazing angle objective: collaboration with Ministry of Science & Technology. Baghdad, **Iraq**.
- FTIR analysis on organic samples, which have promising pharmaceutical applications, combinatory analysis using powder diffraction: collaboration with Physics Division, National Research Center Cairo, **Egypt**.

# SESAME is intergovernmental organization

## Members of SESAME

- BAHRAIN
- CYPRUS
- EGYPT
- IRAN
- ISRAEL
- JORDAN
- PAKISTAN
- PALESTINIAN  
AUTHORITY
- TURKEY

## Observers

France  
Germany  
Greece  
Italy  
Japan\*  
Kuwait  
Portugal  
Russia  
Sweden  
UK  
USA

## Governing Body Council

Each Member one vote

SESAME Statutes are  
'copy' of CERN Convention

**Iraq: request to become Member**

**Other countries have expressed interest and are welcome**

# *Lessons learned from SESAME*

## **Great differences between Muslim countries**

- ❖ regarding the interest in science and giving support to it
- ❖ ‘Poor countries’ much more open to education and research than oil-rich countries
- ❖ Different approaches to improve the situation
  - some countries are well advanced  
(**Pakistan, Egypt, Iran, Turkey**)
  - some are aware of the problem and make big effort (**Jordan**)
  - others show very little interest to revive golden epoch of science,  
(**Emirates, Oman....**)
- ❖ **Restricted solidarity among Arab countries**
  - e.g. no patronage for Palestine

# National Science Policy

- ❖ **Priority is given to short-term national problems**  
(infrastructure, roads, water)  
mercantile mentality prevails, promote activities with short return (tourisms)
- ❖ **Funding of R&D is completely unsatisfactory,**  
is necessary for long-term development (unemployment),  
*should spend a very small amount of available funds  
for long term development*
- ❖ **Learn how to establish priorities** and introduce evaluation.  
mechanisms for decision taking and priority setting are missing
- ❖ **Lack of cooperation inside individual countries**  
*encourage establishment of national networks*



Strong support by President Arafat  
**But which name for Palestine in Convention ?**

## 4. Help individuals (dissidents)

who have of political, racial or religious problems

*Authoritative governments want to keep face*

*Scientific arguments may help*

### ➤ Orlov

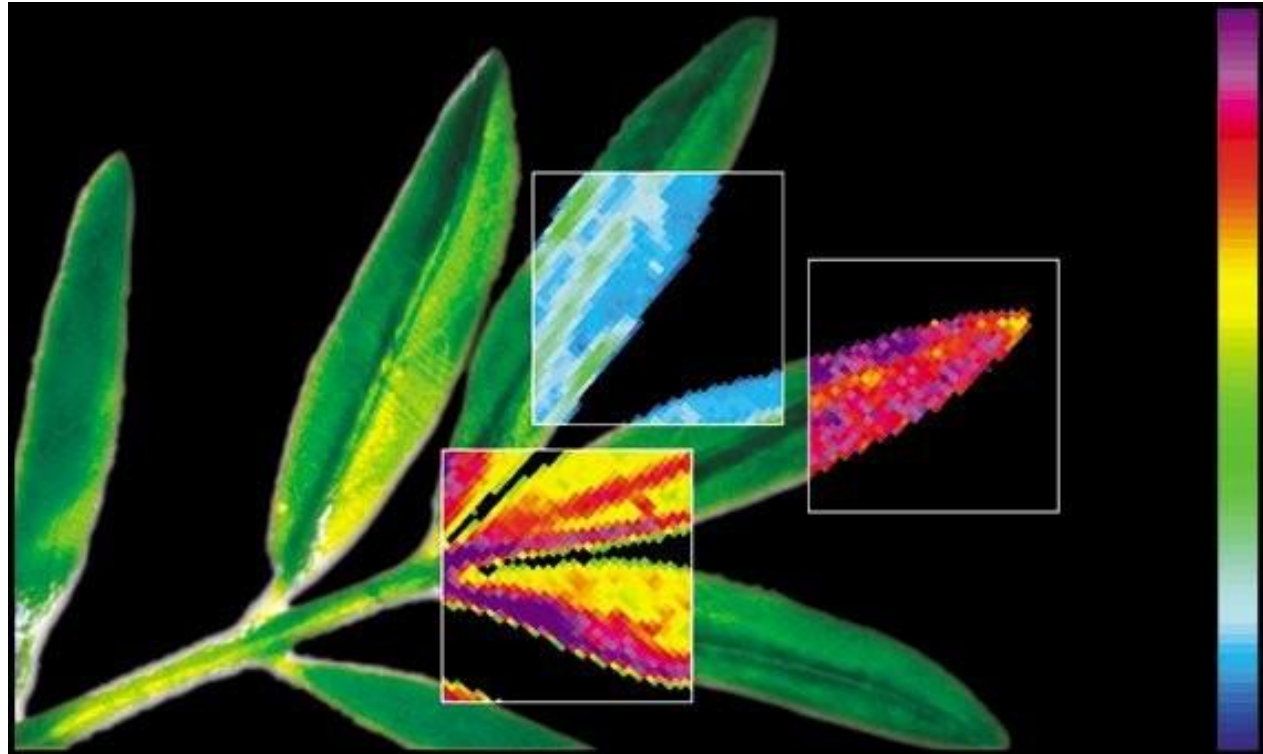
(from Soviet Union to CERN, talk to Minister Petrosyansk)

### ➤ Okun

(in SPC of CERN, not allowed to come, talk to his director, Chuvilov)

### ➤ Hadizadeh

(arrested in Iran, letter to Minister and Chatami, could come to SESAME meetings, now in USA)



### **X-rays Illuminate Selenium in Plants.**

Synchrotron X-rays are used to study how plants absorb and transform toxic materials and guide development of new strategies for environmental remediation. Biotransformation of selenium in *Astragalus bisulcatus* (“locoweed”) is studied using synchrotron X-rays. Spatial locations and absolute concentrations of different selenium chemical species can be studied to understand how plants absorb and transform toxic materials..

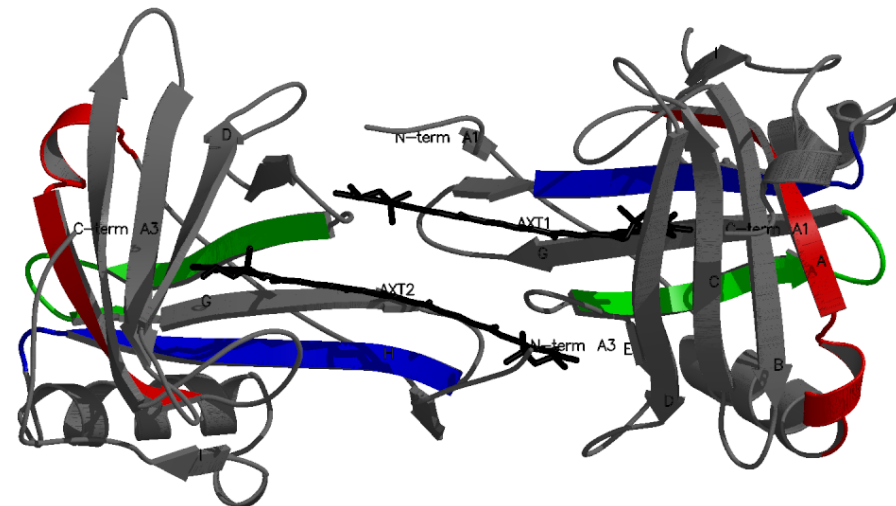




## *Why does lobster change colour when cooked?*

The slate blue colour of the lobster is due to the interactions of a Pigment (astaxanthin) with its binding protein crustacyanin. Upon cooking Crustacyanin is denatured and the pigment is released regaining its Red-orange colour.

Use of tunable X-rays from a synchrotron source allowed determination of the structure of the complex to develop an insight into The processes involved.



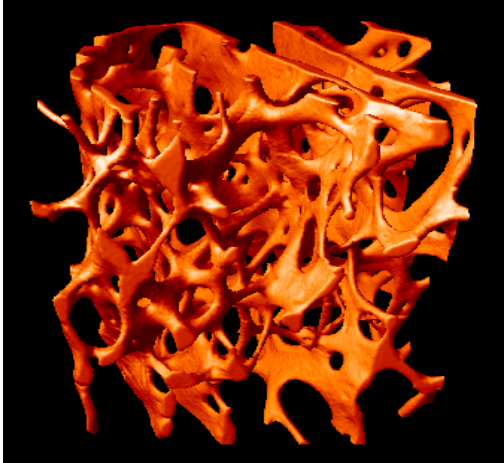




Egypt and Syria (7<sup>th</sup> -8<sup>th</sup> AD)

# Osteoporosis Research

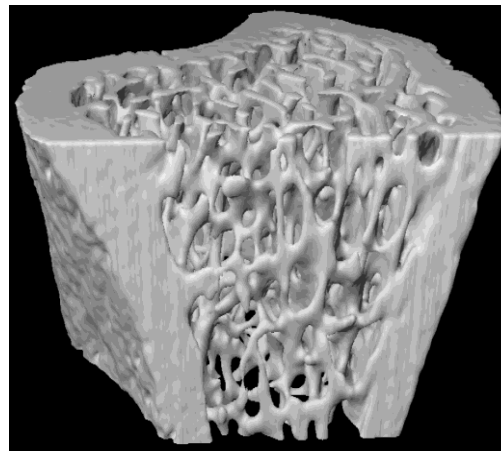
## - Understanding Loss of Bone Mass



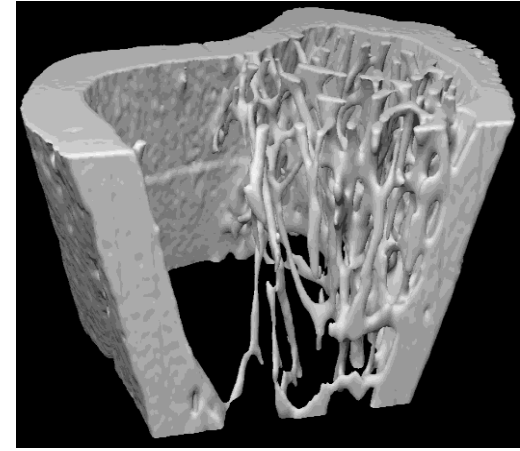
X-ray tomograph of trabecular bone in the human femoral neck taken with synchrotron radiation by LLNL scientists using synchrotron radiation at SSRL

*Osteoporosis is a major public health problem*

- 1.3 million osteoporotic fractures each year
- 50% of women over 70 have had at least one fracture
- a disease which strikes without warning
- responsible for more deaths than breast cancer



*before and*



*after estrogen loss*

**Estrogen deficiency can be visualized in living beings using non-invasive x-ray synchrotron tomography imaging.** The image above is from a rat taken under sedation.