

# ***THE IMPACT OF SYNCHROTRON RADIATION ON SCIENCE & SOCIETY IN THE DEVELOPING WORLD***

**Herman Winick**

**SLAC National Accelerator Laboratory**

**Winick@slac.stanford.edu**

*AfLS Workshop/Conference*

*ESRF, Grenoble*

*Nov. 16-20, 2015*

## ***Why a Synchrotron Radiation Facility in the Developing World?***

- World-class basic & applied research
- Train graduate students who will no longer have to go abroad
- Attract scientists working abroad to return (*reverse the brain drain*)
- Address local/regional issues/concerns  
biomedical, environmental, human heritage
- Promote development of high-tech industry (*capacity building*)
- Use scientific cooperation to promote peace & understanding between people from different traditions, religions, races, & political systems.

***Light sources operate in a democratic mode, open to all (women, minorities...)***

## ***Projects in the Developing? World***

**Light Sources in Construction or recently Started Operation**

***SESAME in the Middle East (starts research in 2016)***

***SOLARIS in Poland***

**Light Sources in Planning**

***African Light Source (AfLS), Iranian Light Source Facility (ILSF),  
Mexican Light Source (MLS), Turkish Light Source, Others??  
(Cuba)***

**Light Sources begun in developing countries decades ago, now in  
operation, with upgrades & new facilities in progress or planning**

***China, Brazil, India, Korea, Taiwan, Thailand...***

# ***LIGHT SOURCES AROUND THE WORLD***



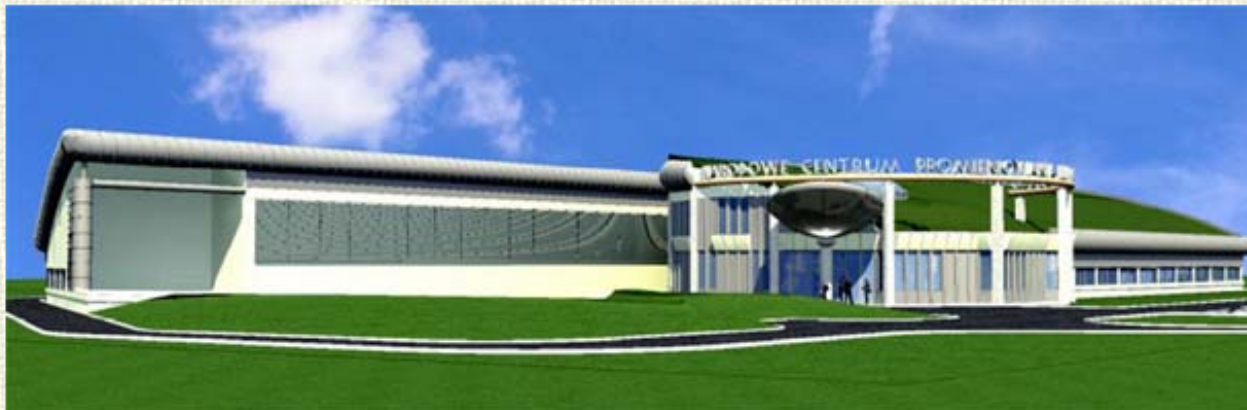


## The Rector of Jagiellonian University and the Minister of Science and Higher Education signed the contract for building the Synchrotron Centre

On 9th April the Minister of Science and Higher Education prof. Barbara Kudrycka and the Rector of Jagiellonian University prof. Karol Musiał signed in Collegium Maius the contract on realization of the project "National Centre of Electromagnetic Radiation for research aims (the stage I)" that is the Synchrotron Project.

This is unique and the very important investment for Polish science and our region, which gives the chance on new valuable research activity in many fields of science. Presently, Polish scientists, interested in applications of the synchrotron radiation, use foreign centres. Synchrotron in Cracow is a great chance for Poland, for region and for Jagiellonian University, which co-ordinates the Synchrotron Project. The facility will be built on a terrain of the University's III Campus. Its building will strengthen the position of Cracow on the scientific map of Europe and it will contribute to development of international co-operation.

### Camera-report



SOLARIS storage ring circumference: 95 m, electron energy: 0.7 - 1.5 GeV.  
Copy of MAX IV 1.5 GeV ring; First light achieved June, 2015

Witamy na stronie synchrotronu SOLARIS!

Narodowe Centrum Promieniowania Synchrotronowego SOLARIS buduje w Krakowie pierwszy w Polsce synchrotron. Synchrotron to nowoczesne multidyscyplinarne urządzenie badawcze, które otworzy nowe możliwości w wielu dziedzinach nauki takich jak: biologia, chemia, fizyka, inżynieria materiałowa, medycyna, farmakologia, geologia czy krystalografia.

Centrum SOLARIS będzie otwarte dla wszystkich grup badawczych z Polski, a także z zagranicy. Badania będą mogły się rozpocząć w 2016 roku.

-----  
Welcome to the website of synchrotron SOLARIS!

National Centre for Synchrotron Radiation SOLARIS builds in Krakow, Poland's first synchrotron. Synchrotron is a modern multidisciplinary research unit, which will open up new opportunities in many fields of science such as biology, chemistry, physics, materials engineering, medicine, pharmacology, geology or x-ray crystallography.

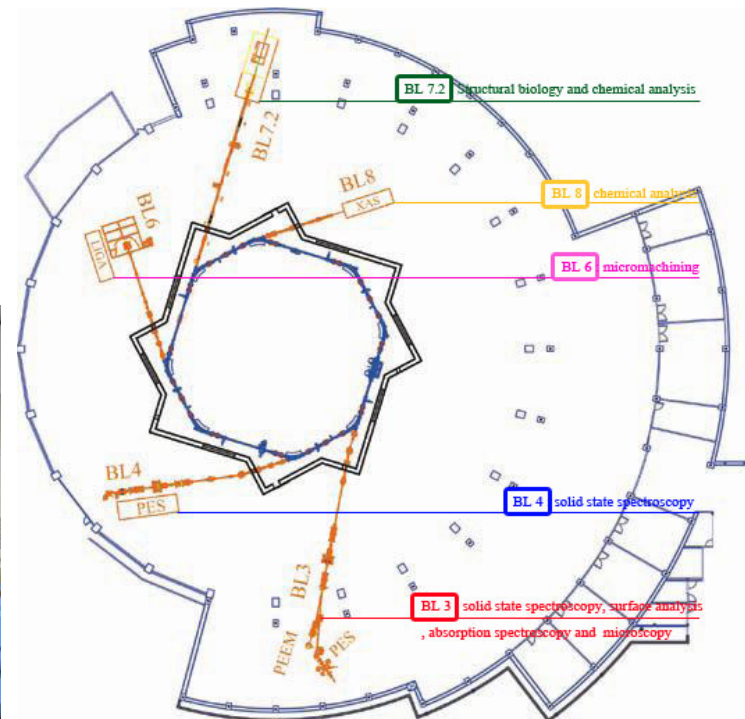
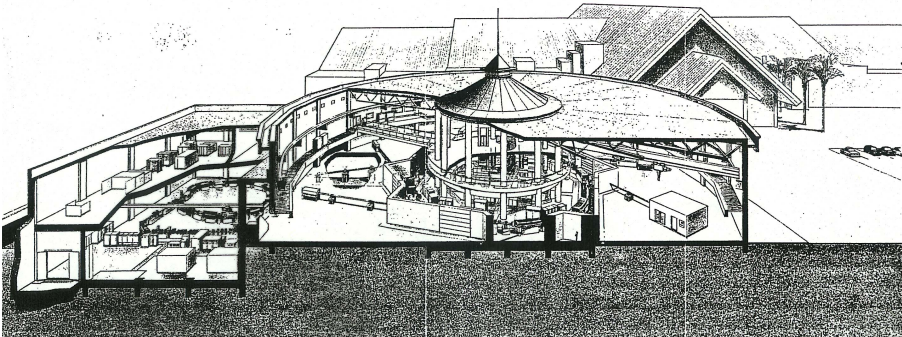
SOLARIS Centre will be open to all Polish research groups, as well as from abroad. The study will be able to start in 2016.



# Synchrotron light in Thailand

## SIAM facility; gift by Japan of 1 GeV SOR-Tech facility

**An initiative by Takehiko Ishii**





**National Synchrotron Research Center (NSRC); Thailand**

# SESAME

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

*A Third Generation Light Source for the Middle East  
Modeled on CERN, Under the Auspices of UNESCO*

*A Collaboration of 9 Middle East countries  
On Track for startup in 2015/16*

*An example for other regions, e.g.*

*Sub-Saharan Africa*

*Central Asia*

*...*

# **SESAME (Synchrotron light for Experimental Science and Applications in the Middle East) is a *third generation* light-**

***under construction near Amman***

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

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



## **Purpose: to foster**

- science\* and technology in the Middle East and neighbouring countries

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

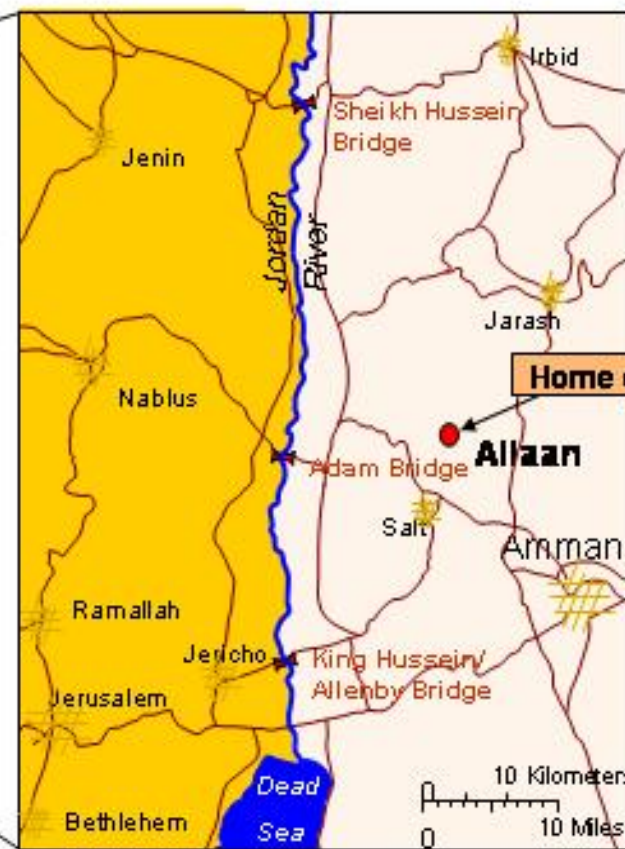
- cooperation across political divides

**UNESCO Executive Board** (2002) described SESAME as “a quintessential UNESCO project combining capacity building with vital peace-building through science” and “a model project for other regions”

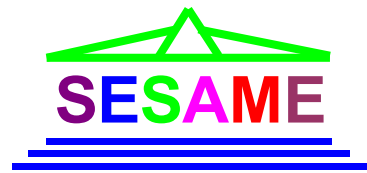




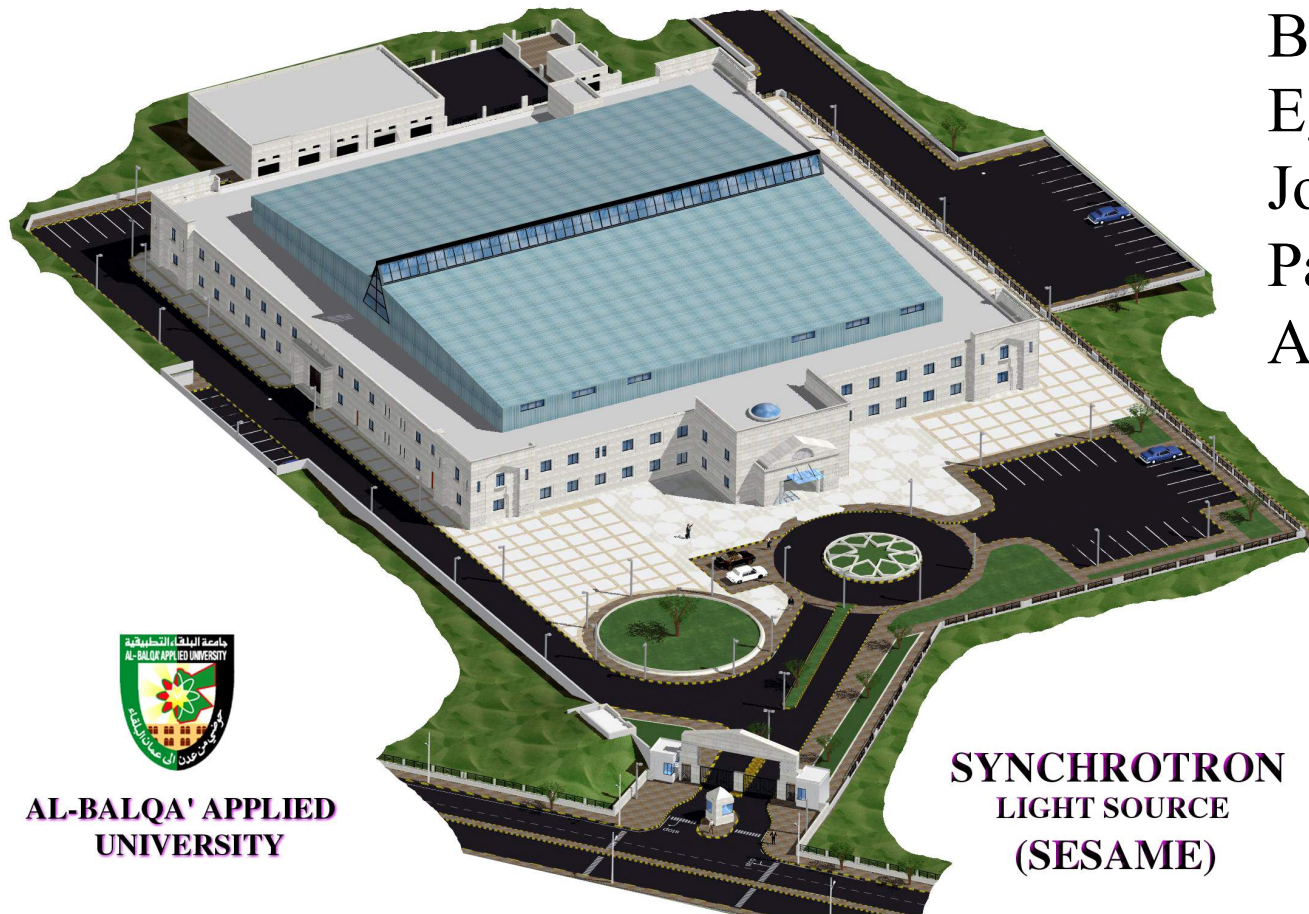
Gus Voss (1929-2013) watching the boat leave Hamburg harbor on its way to Aqaba, Jordan with BESSY I on board; June 7, 2002







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



Bahrain, Cyprus,  
Egypt, Iran, Israel,  
Jordan, Pakistan,  
Palestinian  
Authority, Turkey



AL-BALQA' APPLIED  
UNIVERSITY

**SYNCHROTRON**  
LIGHT SOURCE  
(SESAME)

[www.sesame.org.jo](http://www.sesame.org.jo)





*R. Sarraf*





***Nobel Laureates visit SESAME site in June, 2008***

**45 Laureates endorse SESAME “as a beacon, demonstrating how shared scientific initiatives can help light the way towards peace”.**





BESSY I 0.8 GeV Booster Synchrotron set up in SESAME building for “soft” inauguration on November 3, 2008

Mayor of Salt City in Jordan, Mr. Salameh, and Herman Winick





## ***ROOF COLLAPSE IN SNOWSTORM***

Jordan was hit by an unusual severe snow storm Dec 11 – 14, 2013. The SESAME experimental hall roof caved in due to heavy wind, rainfall and dense snow. Allan is located 680 m above sea level and typically snow falls occur for altitudes above 800 m in Jordan. Allan is characterized by rain fall. The last light snow seen in Allan was in winter 1992. The Jordanian code for buildings requires accounting for snow load of 75 Kg/square meter in such a location. The steel structure designer considered a load of 175 kg/square meter of snow. Due to the strong westerly winds, a heavy accumulation of snow and hail accumulated on the corrugated metal sandwich panel roof. This resulted in exceptionally heavy load and weak points in the middle of the structure that yielded under pressure. As a result the main truss bent in the middle and rested on the shielding wall, that acted as a support for the truss and metal frame structure. Fortunately, no one was hurt and no equipment was damaged.

## Members

- BAHRAIN
- Cyprus
- EGYPT
- Iran
- ISRAEL
- JORDAN
- PAKISTAN
- PALESTINIAN  
AUTHORITY
- TURKEY

## Observers

France  
EU  
Germany  
Greece  
Italy  
Japan  
Kuwait  
Portugal  
Russia  
Sweden  
Switzerland  
UK  
USA

## Governing Body

**Council is  
Modelled on  
CERN Council**

**Each Member one vote**

**Two delegates**





***Japan Society for the Promotion of Science (JSPS)***  
***JSPS-SESAME-Sabanci Univ. School; Turkey, March 1-5, 2010***



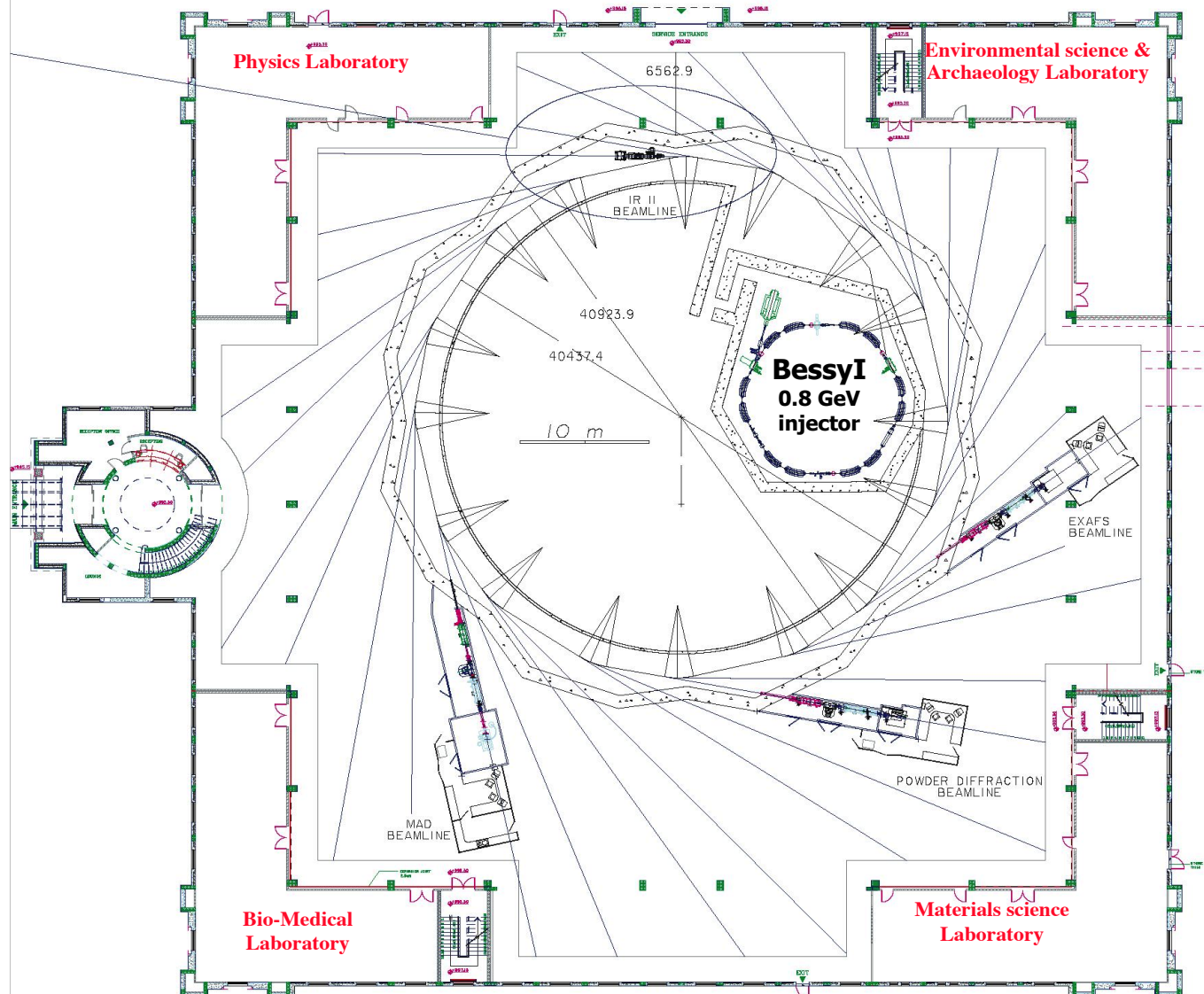


Hands-on Session at ***SESAME-JSPS*** School for Synchrotron Sciences; Cairo, Egypt; Nov. 17-23, 2008



# ***SESAME; in construction in Jordan***

***[www.sesame.org.jo](http://www.sesame.org.jo)***



**2.5 GeV**

**400 mA**

**C = 133 m**

**Emitt; 26 nm**

**12 spaces for  
wigglers or  
undulators**

**16 bend magnet  
lines**

**Beam lines up to  
36 m long**

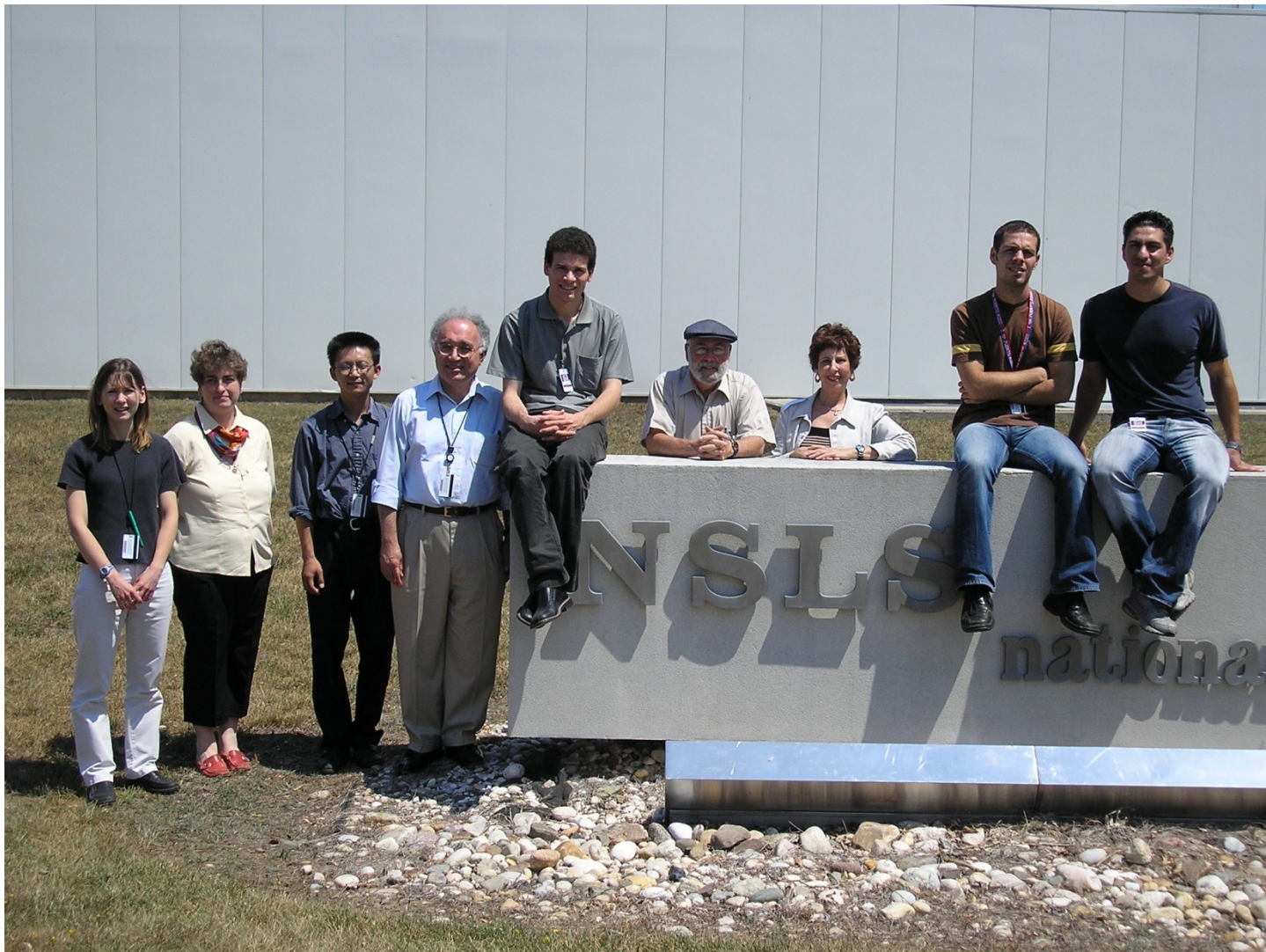
**Operational in  
2016**



Three SESAME Trainees, Taiwan Light Source Directors C. T. Chen and Keng Liang, plus other NSRRC staff

Seated Left to Right; Tasaddaq Ali Khan (Quaid-i-Azam University; Islamabad, Pakistan); C. T. Chen; Fatemeh Elmi (Tarbiat Modarres University; Tehran, Iran); Ozen Ozen (Hacettepe University; Ankara, Turkey). Keng Liang is standing, second from the right.





**Israeli-Arab students from Ben-Gurion University at NSLS (Brookhaven Lab) for one month, summer 2005. Funded by the US Department of Energy**

Lisa Miller, Vivian Stojanoff, Zhong Zhong, Avraham Dilmanian, *Mahmoud Simri*, Herman Winick, Brenda Laster, *Ebrahim Mahajna*, *Sami Khoury-Salameh*





**2011 SSRL-XAS Summer School Class** Photo by Natalie Cramar



# Microtron PreInjector at SESAME

## Accelerated beam, April 2009





# Tests of the MICROTRON Subsystems



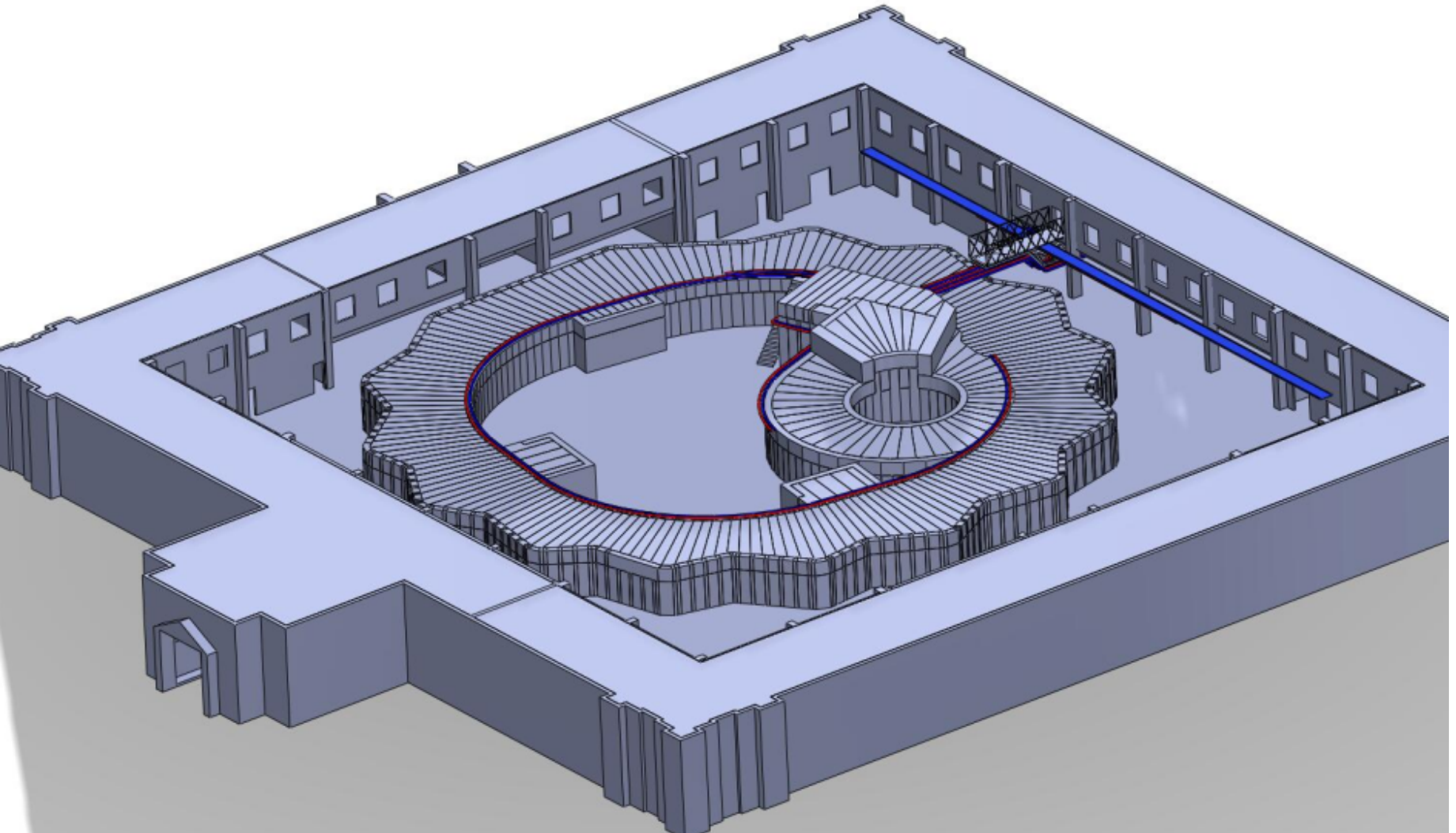
Amor NADJI



- ***Dr. Hamed Tarawneh***
- Student at SESAME Accelerator School in 2000
- Sent by SESAME to Lund for additional training
- PhD in Accelerator Physics at Lund Univ; Advisor is Prof. Mikael Eriksson
- Thesis Topic is Multi Bend Achromat (MBA)
- Back to SESAME
- Then to Berkeley
- Now at MAX IV



# 3D View of the New Shielding







***Shielding complete for SESAME injector and storage ring; May 2011***

# SESAME Scientific Collaborations

## Human Histone Deacetylases are flexible enzymes: insights from solution structural analysis of human apo-histone deacetylase 8 (HDAC8 )

Authors:

Tzvia Selzer<sup>1</sup>, Brian Vash<sup>2</sup>, Said Ali<sup>3</sup>, Rotem Sertchook<sup>1</sup>, Guenter Grossmann<sup>4</sup>, Peter Atadja<sup>2</sup>, Travis Stams<sup>2</sup>, Dalia Cohen<sup>2</sup>, and Irit Sagi<sup>1\*</sup>

1. Dept of Structural Biology, the Weizmann Inst. of Science, **Rehovot, Israel.**

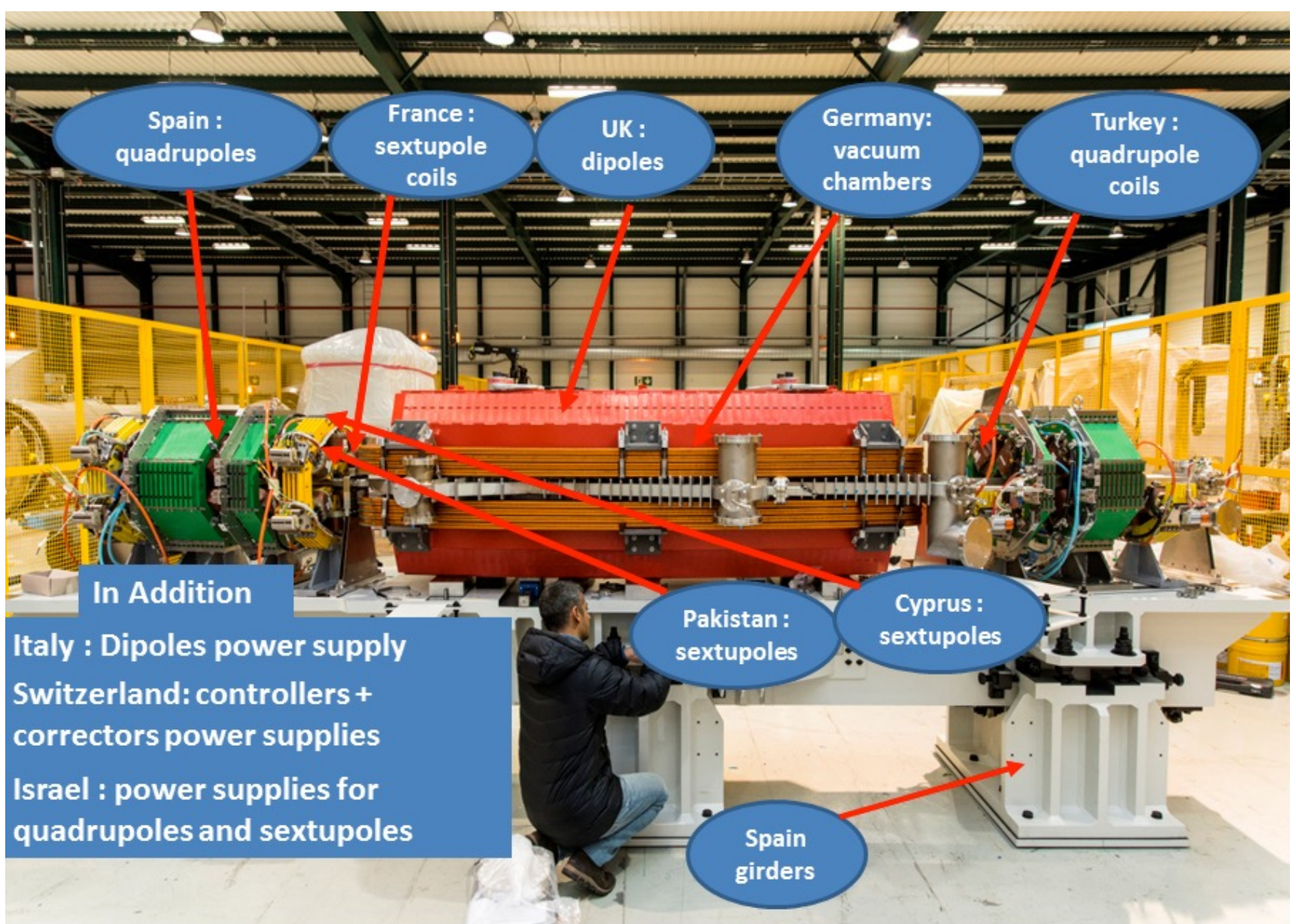
2. Novartis Institutes for Biomedical Research, **Cambridge, MA USA.**

3. Department of Biophysics, **Cairo University, Giza, Egypt.**

4. Molecular Biophysics Group, CCLRC **Daresbury Lab, Warrington, UK**

*\*Corresponding author*

Ph: 972 8 9342130    Fax: 972 8 9344154    [irit.sagi@weizmann.ac.il](mailto:irit.sagi@weizmann.ac.il)



First of 16 cells of the SESAME storage ring, assembled for testing at CERN in March, 2015 in a collaboration between CERN and SESAME Members/Observers.

# ***SESAME Summary***

- Delay due to roof collapse in heavy snowstorm (December, 2013)
- Now on track for start of operation in 2016 with 2 Beam Lines
- EU has joined as an Observer; 5M Euro contribution to CERN for Magnets  
*2M Euro from Italy*
- Next President of the SESAME Council is Rolf Heuer, outgoing Director of CERN
- Heuer succeeds previous Council Presidents who were also Directors of CERN  
*(Herwig Schopper and Sir Chris Llewellyn-Smith)*
- Capital funding from SESAME Member countries to complete new 2.5 GeV storage ring, first beam lines *(Egypt, Iran, Israel, Jordan, Turkey)*



# Conclusions

## *There are challenges*

Stable financial support; attracting new members from the Gulf and the Mahgreb (**new members very welcome**); compensating differences in the human and financial resources of the members; solving problems involving travel restrictions; remaining funding for provision of full energy and current, hostel, adaptation/upgrading of full suite of Phase 1 beamlines,....

## ***But an enormous amount has been achieved \****

*\* thanks especially to HM King Abdullah II, Director Toukan, UNESCO, IAEA, JSPS, those who have donated equipment,...*

***SESAME is working politically and technically, and the training program is building capacity in the region***

***The voluntary contributions (agreed March 2012) constitute a major step forward and make it possible for SESAME to come into operation in 2016***

# **ANOTHER WORLD?**

**“As a string theorist, I work on parallel universes. I was always curious about what a parallel universe was like, and now I know. I’m living in one when I go to *SESAME* meetings”**

***Eliezer Rabinovici; Hebrew University and Israeli representative to the SESAME Council***

***SESAME is Happening!!***

***[www.sesame.org.jo](http://www.sesame.org.jo)***



**5<sup>th</sup> Users' Meeting of the Mexican Light Source;  
104 participants, August, 2015**

# Short History of Mexican Light Source

- 2006-2007 Conacyt Megaprojects
    - 1st Mexican Workshop on accelerator Physics
    - Fund limited proposal —> 2nd Generation Light Source
  - 2010-2011 Conacyt Committee on Accelerator Projects —> Thematic Networks (Red FAE)
    - Synchrotron LS & Hadrotherapy Facility
    - Visit to ALBA —> 2nd MWAP —> 3rd Gen LS
    - 1st Mexican Users Meeting
    - 1st Mexican Particle Accelerator School
  - Morelos Government—>Fomix Project (Conacyt & Sicyt Morelos)
    - Strategic Project & Business Plan to Build a Synchrotron in Morelos
- Instituto de Física - UNAM coordinates the project: UNAM, UAM, Univ. of Guanajuato.



# Mayan Pigments

Pigments produced by the Mayas, show colors of various hues, ranging from a purple to a greenish blue



Mayan Pigments are extremely stable: it can resist the attack of boiling, concentrated nitric acid, alkali and organic solvents.



MAYAN  
PIGMENTS INC.



## ***AZUL MAYA***

***An Ancient Hybrid Organic/Inorganic  
Material***

***Russell R. Chianelli***

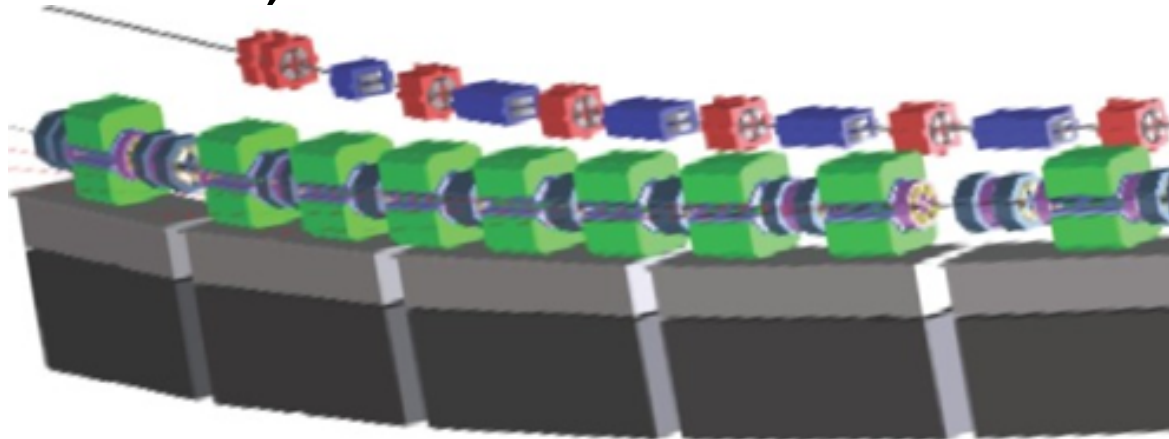
**Materials Research and Technology Institute -UTEP**

**“Art Institute of Chicago/Northwestern University  
Seminar series in Conservation Science:  
“Nanotechnology for research and art conservation ”**

**October 28, 2010**

# Mexican Light Source: Lattice Conceptual Design

- The Multiple bend achromat cells (MBA, D. Einfeld 1993) and Diffraction Limited Light Sources are being considered in a scheme suggested by R. Hettel, R. Bartolini & F. Pérez (II MWAP, 2014, Huatulco)
- 3x3x3= 300 m circumference, 300 pm emittance, 3 GeV
- DBA - ALBA, Spain
- 5BA - Sirius, Brazil
- 7BA - MAX IV, Sweden
- 9BA - ALS II, USA





# **Launch of the Interim Steering Committee for the African Light Source**

Launched electronically on the  
16<sup>th</sup> August 2014  
Coinciding with the ASP2014 Forum  
Day

# Interim Steering Committee for the African Light Source

***African Light Source Workshop*** to be held on November 16-20, at European Synchrotron Radiation Facility (ESRF) Grenoble, France.

- Participants will be African scientists, students who have worked at Light Sources, Policy Makers, and friends of Africa who support the vision for an African Light Source.
- Discussions on the Roadmap for Africa
- Election and Founding of the new, fully mandated Steering Committee for the African Light Source

# Initial members of the Interim Steering Committee of the African Light Source

These members nominated following communications sent to all available mailing lists and records of interested parties.

Sekazi Mtingwa	MIT, USA	
Simon Connell	UJ, SA	
Tshepo Ntsoana	Necsa, SA	
Jonathan Dorfan	OIST, Japan	
Mohammad S. Yousef	Cairo University, Egypt	
Tarek Hussein	Cairo University, Egypt	
Kennedy Reed	LLNL, USA	
Brian Masara	SAIP, SA (Zimbabwean)	
Ken Evans-Lutterodt	BNL, USA	
Sverker Werin	MAX IV, Sweden	
Francesco Sette / ESRF representative	ESRF, Europe	
Ahamadou Wague	Universite Cheikh AntaDiop Senegal	
Krystle J. McLaughlin	Lehigh University, USA	
Herman Winick	SSRL/SLAC	
,		



# THE THIRD BIENNIAL AFRICAN SCHOOL OF FUNDAMENTAL PHYSICS AND ITS APPLICATIONS

Cheikh Anta Diop University  
Dakar, Senegal  
August 3-23, 2014



**Applications:** [wsp2014-registration@cern.ch](http://wsp2014-registration@cern.ch)  
**Deadline:** Open for application from Dec 18th,  
2013 to March 31st, 2014. Full support for  
selected students. Provide a CV, transcripts,  
letter of motivation and one recommendation  
letter with your **Online Application**.  
**Contact:** [wsp2014-ec@cern.ch](mailto:wsp2014-ec@cern.ch)  
**Website:** [www.africanchoolofphysics.org](http://www.africanchoolofphysics.org)

## Physics Topics:

- Theoretical Physics
- Experimental Physics
- Applied Physics
- Monte Carlo Generators
- Detector Simulation
- Diagnostics and Instrumentation
- Data Analysis
- Grid and Computing



## International Organizing Committee:

B. Acharya (ICTP, King's College London),  
K. Assamagan (BNL), G. Darve (ESS),  
S. Muanza (CPFM), J. Ellis (King's College London)

## Local Organizing Committee:

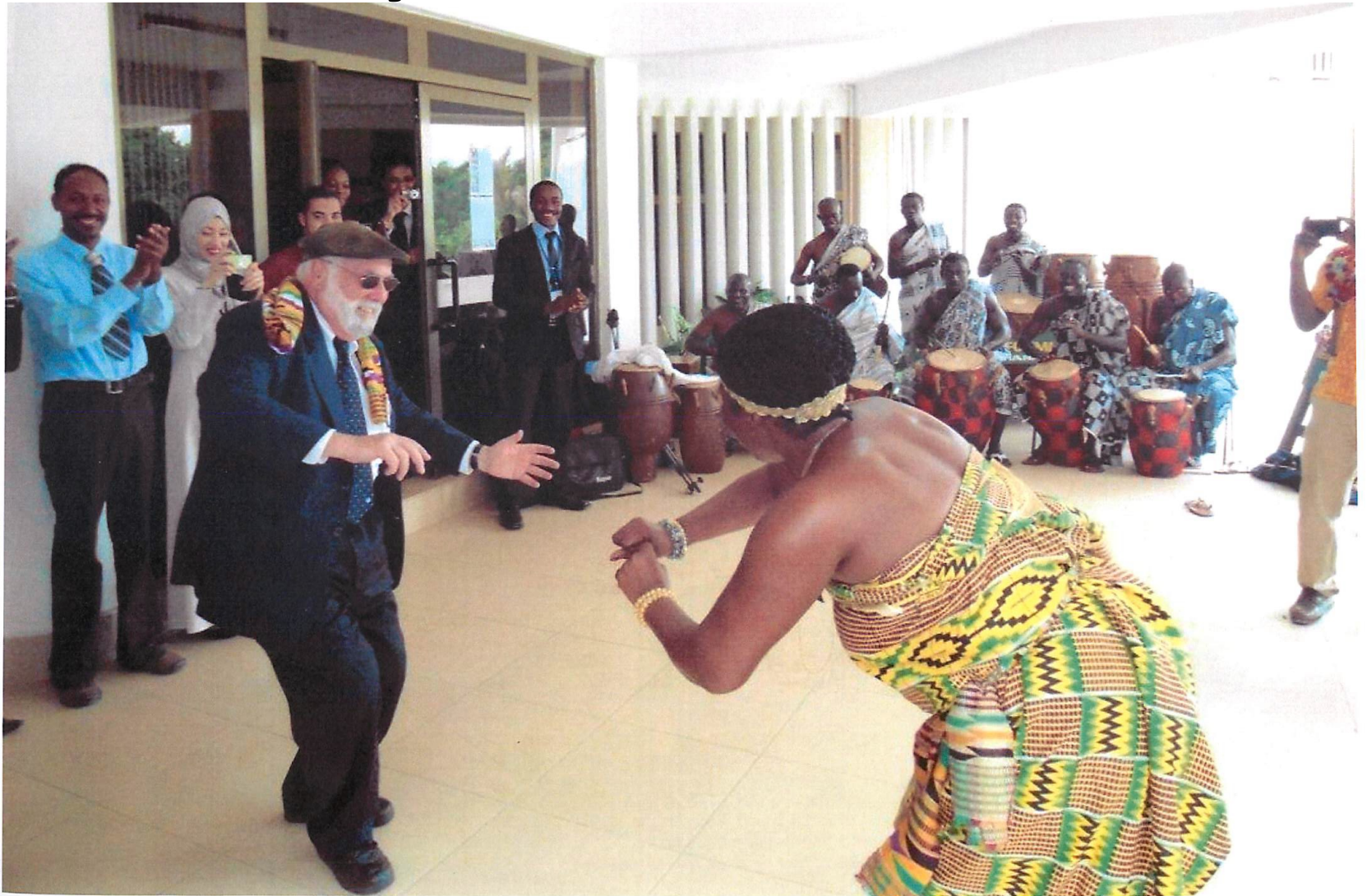
O. Ke (ICNP), S. B. L. Amor (UGA), M. Diaye  
(ICAU), N. Diaye-Faye (ICAU), B. Faye (ANES-  
Seydine), M. Faye (ICAU), Y. Gning (ICAU), R. K.  
Guysa (ICAU), D. Kabor (IASU), A. Ndiaye (UGN),  
A. Ndiaye (AIB), C. Thiamdouna (ICAU), A. Wague  
(UGA)

## International Advisory Committee:

E. Auye (CNRS-IN2P3), V. Brelton (CNRS-IN2P3), S. Connell  
(UJ), H. Bachacou (CEA), T. Ekelof (UJ), L. Elouadmiri  
(UNAF), E. G. Ferreira (LX), H. Gordon (IN), J. Gouveia  
(UCL), N. Holikamp (SLAC), J. Huston (MSU), Y. K. Kim  
(Chicago), G. Margaritondo (ETH), B. Malaescu (IAF),  
H. Montgomery (UNAF), B. Mueller (BNL), E. Quevedo  
(CTP), V. Rivesse (J. of Paris-Sud XI), L. Rivkin (PSI), G.  
Tasamala (CERN), T. Viokey (Wisc), R. Voss (CERN), Z.  
Vitek (Wisc), H.B. White JR (FNL), J. Yu (UT)



# ***At the African School on Fundamental Physics; Ghana, 2012***





# ***Putting up African Light Source Poster at SRI 2015 in New York***





# *Final Poster*



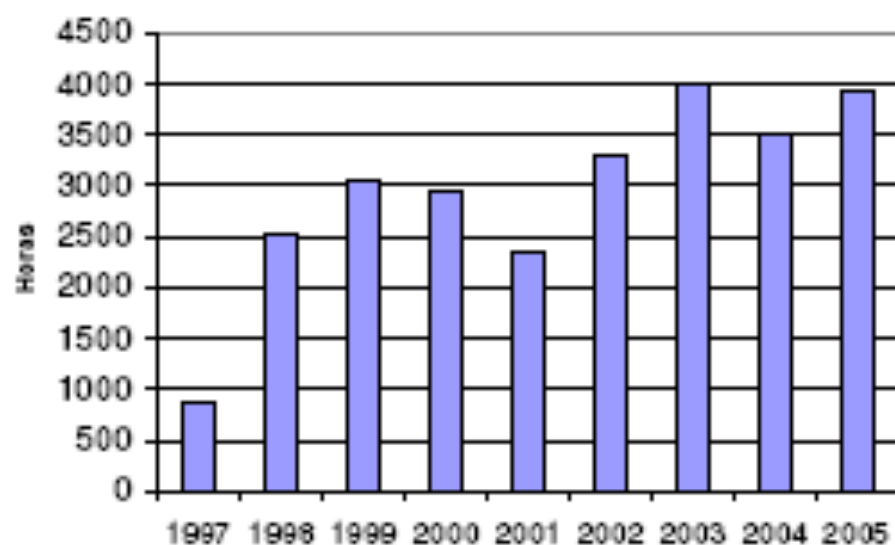
***Particularly relevant to consideration of new light sources in developing regions is the successful experience with Light Sources in **Brazil, Korea, Taiwan*****

- Began consideration of national light source in 1980s
- Began operation in 1990s
- Since then each has trained hundreds of PhDs locally
- Attracted dozens of mid-career diaspora scientists to return
- World class research on a broad range of science & technology
- Including local biomedical, environmental, human heritage issues/concerns
- Attracted other scientific institutes to locate at light source site
- Growth of User community
- Demand for higher performance light sources
- **Governments approve funding (>\$300M) for advanced facilities**

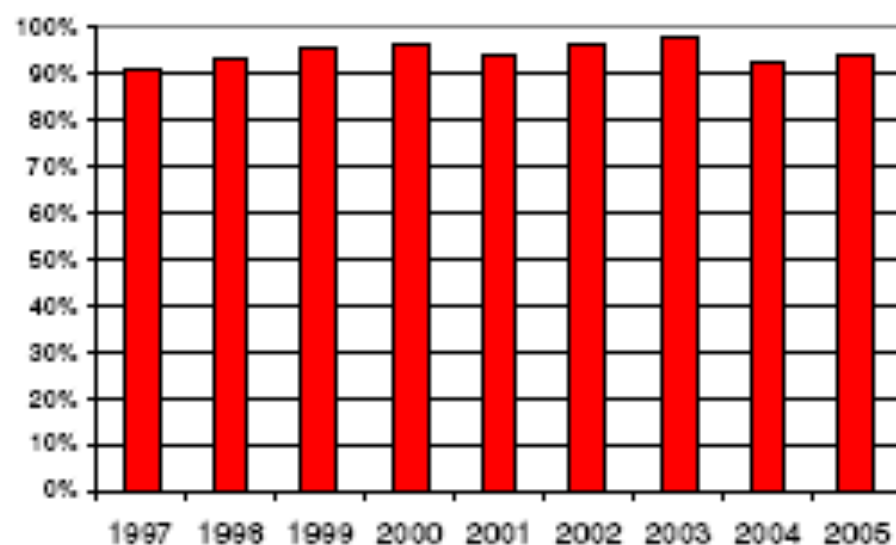


# Light Source Operation

User Beam Time



Availability







# Interaction of LNLS with Local Industry

- Providing technological solutions (development).
- Providing access to sophisticated equipment.
- Joint development.

- Industrial Automation.
- Catalysis (chemical industry).
- Quantum Computing (electronics industry).
- Welding Technologies (oil industry, chemical industry)

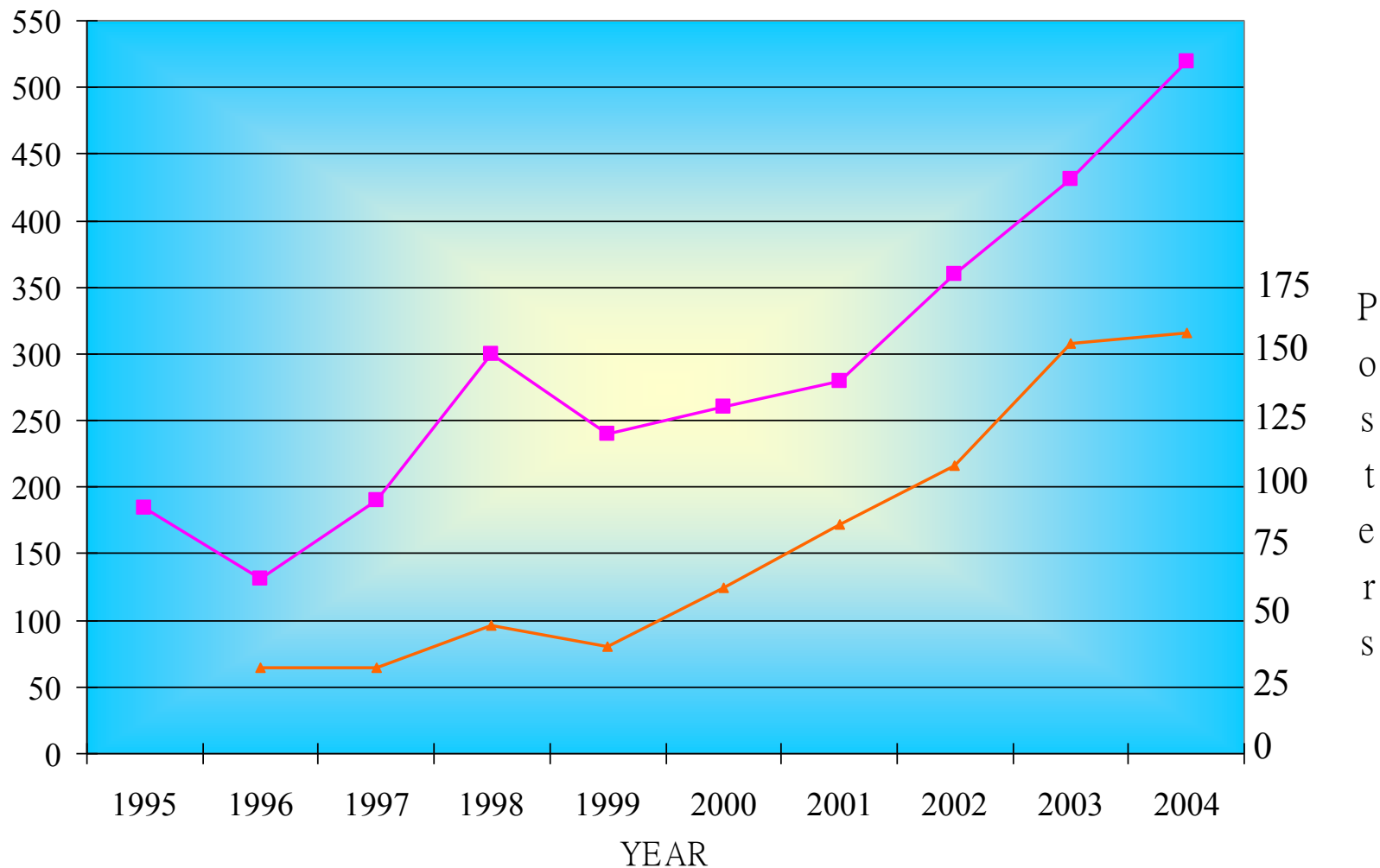
# Conclusions

- LNLS is a success story: it delivered what it promised.
- Apart from the technical and scientific results, perhaps the most important impact was the successful implementation of the **National Open Multi-User Facility Concept**.

*Existing National Labs must be consolidated and new ones created in order to structure promising areas...*

*From: Física para o Brasil, Pensando o Futuro. SBF 2003.*

# Attendance at Annual Users Meeting for Taiwan Light Source





## **SOME FACTS ABOUT THE TAIWAN LIGHT SOURCE (2007)**

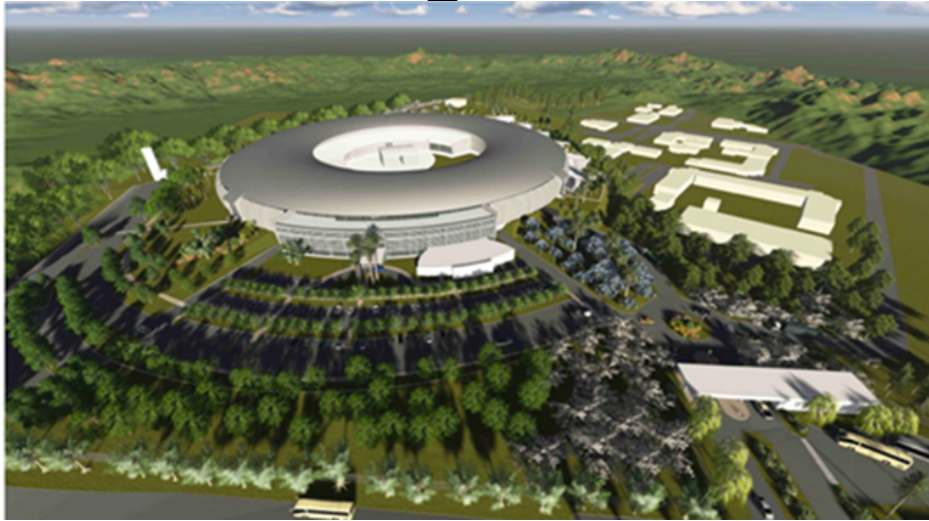
- **NSRRC has produced more than 140 PhDs. More than 25 Taiwanese scientists returned to Taiwan due to the light source.**
- **Taiwan companies have developed capabilities to design, fabricate, and measure many technical components of a light source. (from Keng Liang)**
- **The previous Director of NSRRC, *Chien-Te Chen*, was born in Taiwan. He was the leader of a major Bell Labs research group which used synchrotron radiation to study the electronic properties of materials by the photoemission technique. Under his leadership, Bell Labs built a beam line for these studies at the National Synchrotron Light Source (NSLS) at Brookhaven National Laboratory. In the 1990's he returned to Taiwan as Director of the NSRRC. As part of the deal to bring him back to Taiwan, the government paid to have his beam line at NSLS sent to Taiwan where it was installed at the NSRRC.**
- **The second Director (Jan. 1, 06) of NSRRC, *Keng Liang*, was born in Taiwan, received a PhD at Stanford University in the 1960's after which he worked for the EXXON corporation for about 30 years. His main research activity was the use of synchrotron radiation for studies relevant to the interests of EXXON (materials, catalysis, etc.). In the 1990's he returned to Taiwan to become Deputy Director of the NSRRC.**



***Taiwan Light Source Users' Meeting***



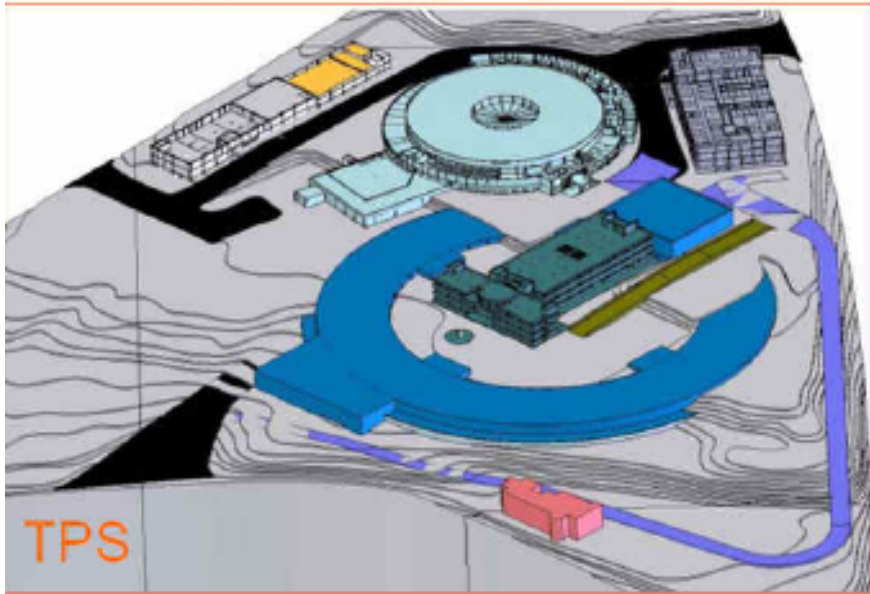
# New Light Sources in Brazil, Korea, Taiwan



***SIRIUS, Brazil***



***Pohang Light Source, Korea***



***Taiwan Photon Source***

***All are Upgrades or replacements of 1980s light sources. All are 3 GeV, and very low emittance***





TENTH MEETING OF THE TECHNICAL REVIEW COMMITTEE OF THE SYNCHROTRON RADIATION RESEARCH CENTER  
Meeting held on December 9-11, 1991 at Hsinchu, Taiwan, Republic of China





Zhen Zhongfeng

Mark L. Gong

Michael

Amir Nadji

Michael Eich

M. D. L. P.

Max Corns

Richard Walker

M. D. L. P.

Max Corns

Adrian Wiedemann

Kenneth Oide

Masamune Kobayashi

Bob Deltos



# Anton Chekov

***"There is no national science, just as there is no national multiplication table. Science that is national is not science."***



End of Presentation  
Thank you