Status of SESAME Project

A. NADJI

On Behalf of SESAME Team

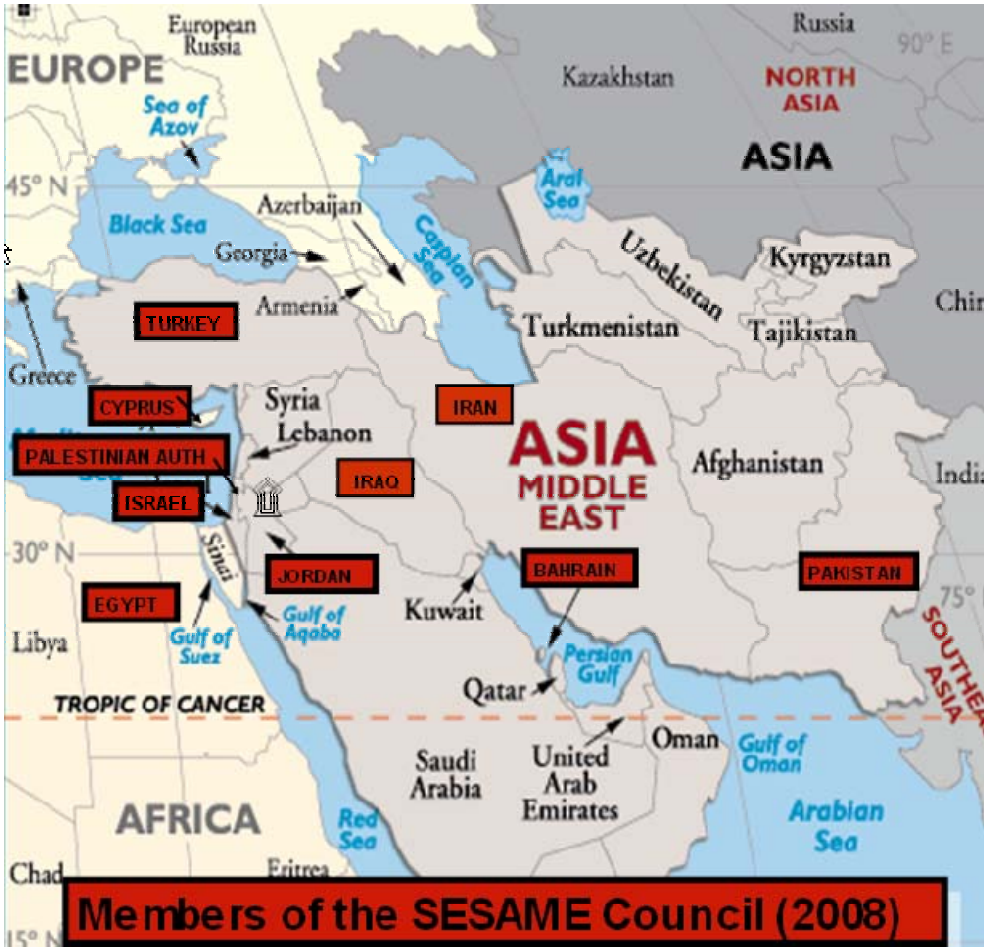
What is SESAME?

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

is the first international 3rd generation synchrotron light source

in the Middle East region,

under construction near Amman (Jordan)



Members:
Bahrain, Cyprus, Egypt, Israel, Iran, Jordan, Pakistan, Palestinian Authority, Turkey.
Pending (?): Iraq

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

Purpose: **Foster excellent science and technology in the Middle East (and prevent or reverse the brain drain).**

+ Build bridges between diverse societies, and contribute to a culture of peace through international collaboration in science.

Very Brief History of SESAME

- **1997: proposal by Prof Herman Winick (SLAC) and Prof G.-A. Voss (DESY):**

➔ *rebuild old 0.8 GeV BESSY I in the Middle East, as basis for a new international organization, modeled on CERN, under umbrella of* ***UNESCO.***

- **2002: Shipment of BESSY I to Jordan**

- **2002: decision to build a new 2.5 GeV ring** (BESSY I as injector)

➔ *world* ***competitive*** *device*

- **2003: Ground breaking Ceremony**

➔ *foundation of* ***SESAME***

- **2008: Completion of the building**

Gus Voss (DESY) regardant le bateau quittant le port de Hambourg et en direction d'Aqaba (Jordanie) avec BESSY I à bord, le 7 Juin 2002.

SESAME GROUND BREAKING CEREMONY - 6 JANUARY 2003

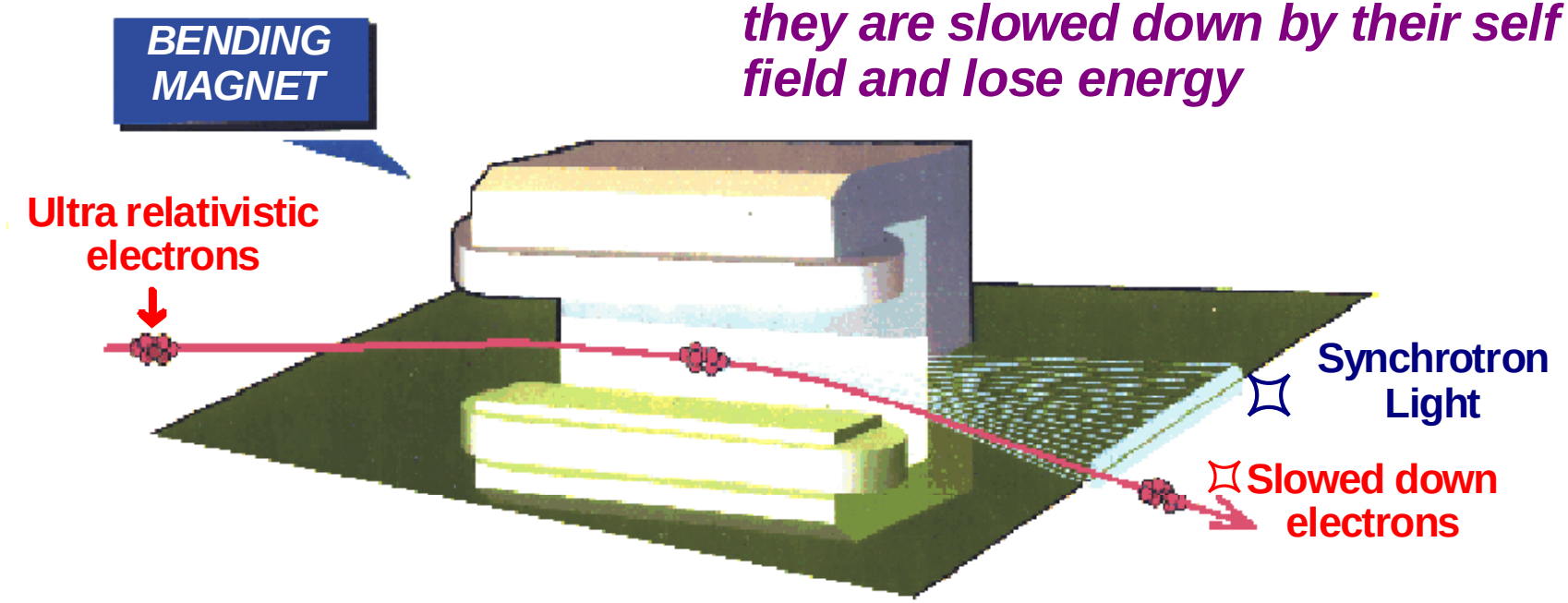
SESAME building, financed by Jordan

Opening of the SESAME building
3 November 2008


R.Sarraf 3-11-2008

Ultra relativistic electrons can be deviated by the constant magnetic field of bending magnets in which their trajectory is an arc of circle

Due to the bending of their trajectory, they are slowed down by their self field and lose energy

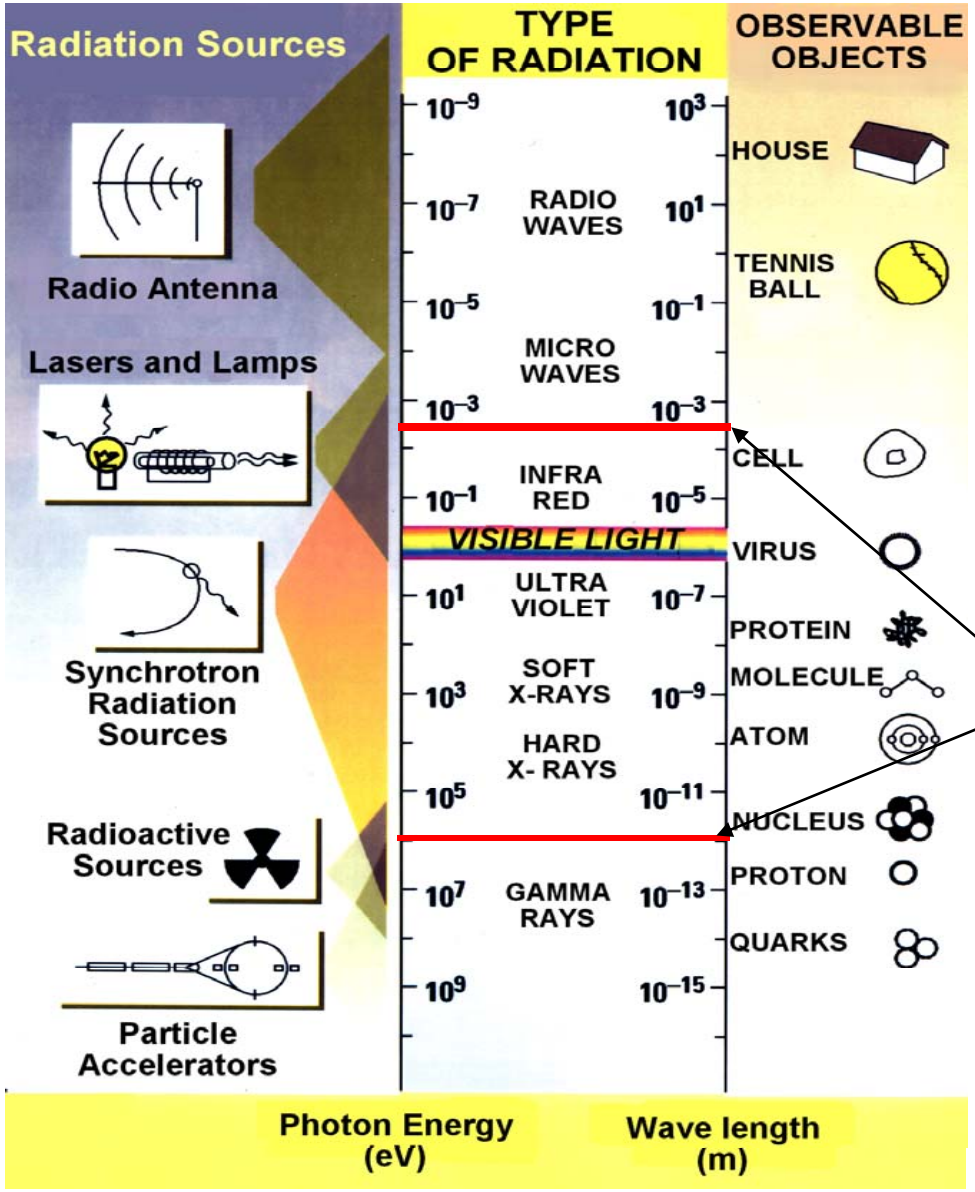


They emit photons in a direction tangent to their trajectory

This is synchrotron radiation

Such conditions are met in electron storage rings

Energies and wavelengths associated with Electromagnetic Waves

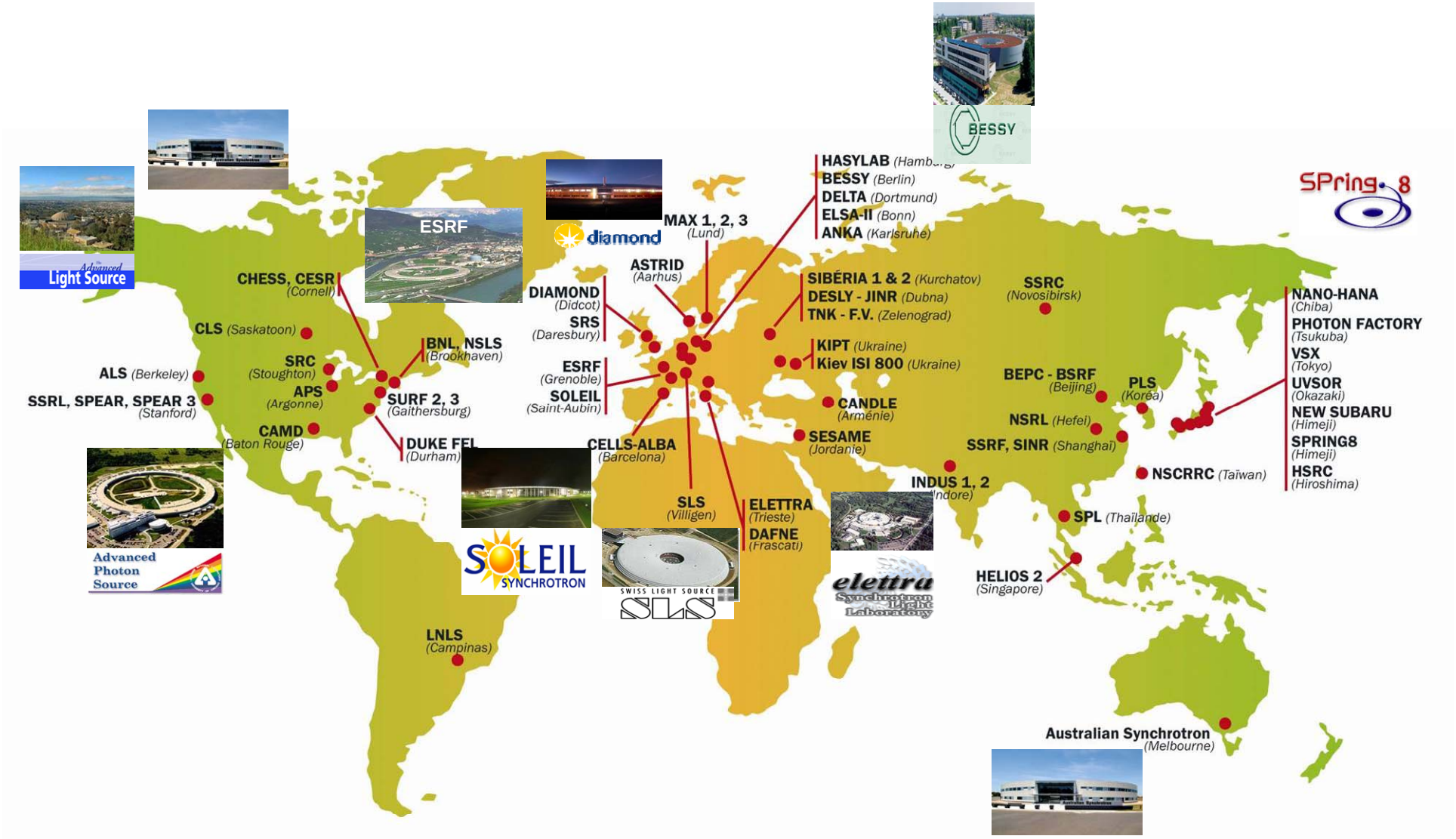


Synchrotron Radiation Sources can cover a wide range of electromagnetic waves

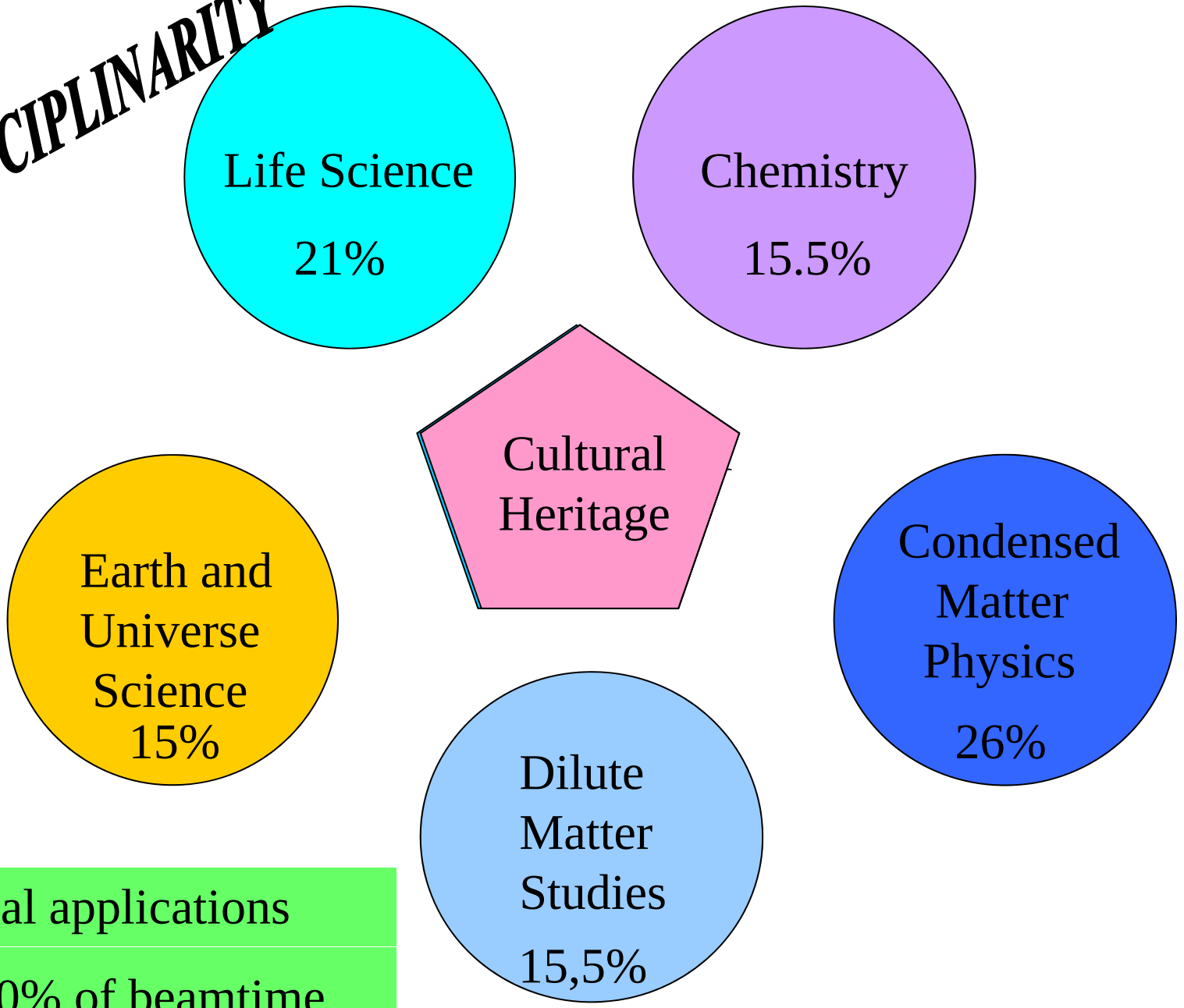
From far infra red to hard X-rays

The shorter the wavelength, the smaller the details than can be resolved.

Synchrotron Radiation in the World



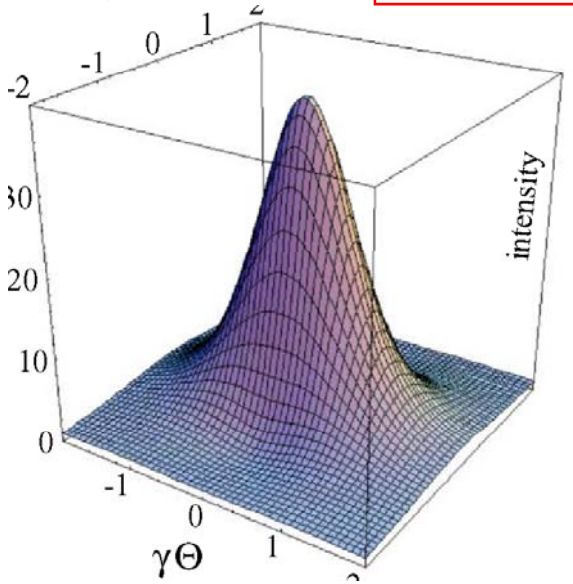
PLURIDISCIPLINARITY



Industrial applications

Up to 10% of beamtime

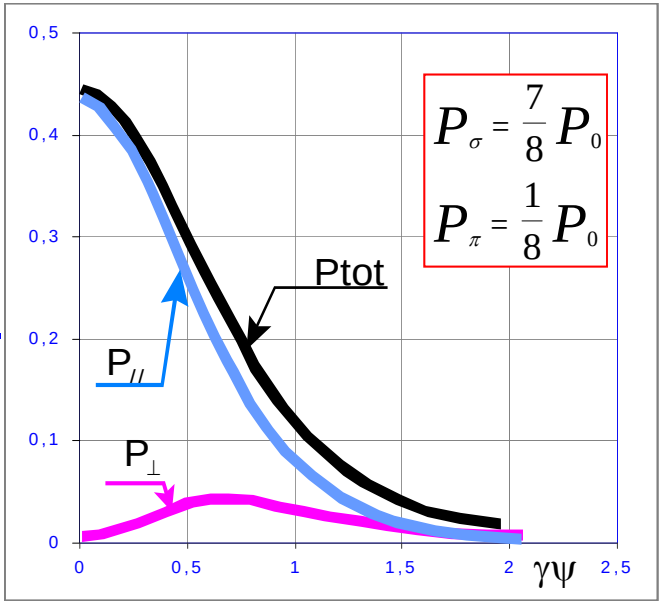
Properties of Synchrotron Radiation



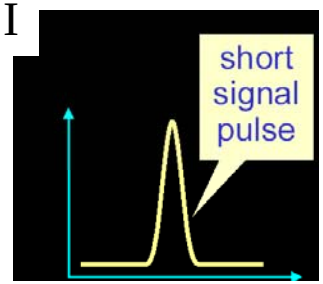
➢ **emitted in a narrow cone :**

$$\theta = \frac{mc^2}{E} = \frac{1}{\gamma}$$

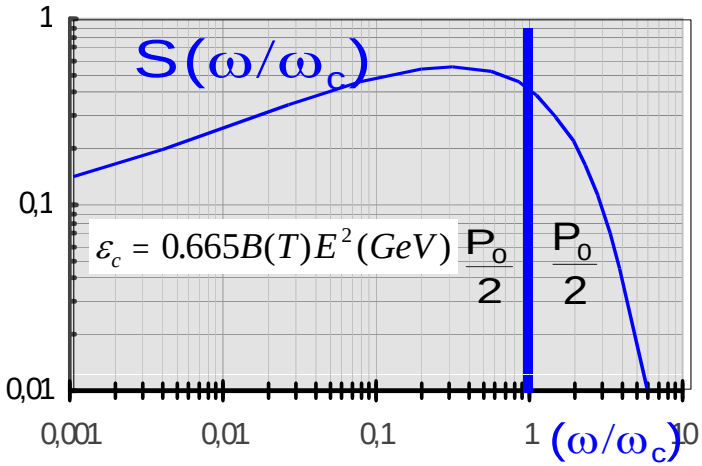
➢ **polarised :**



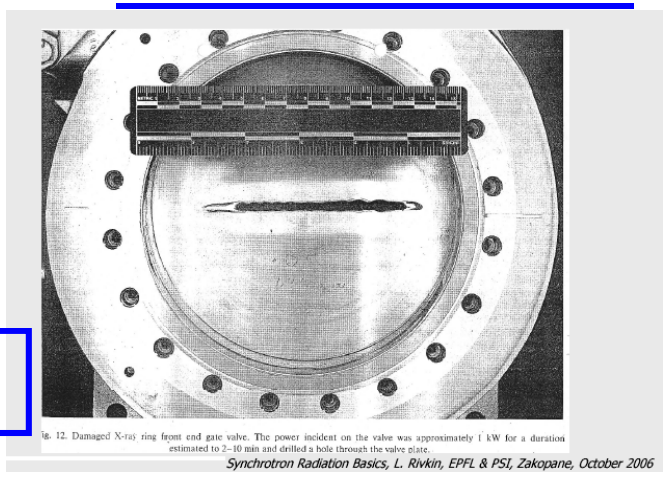
➢ **pulsed-time structure:**



➢ **broad spectrum:**



➢ **Power is all too real!**



$$P_{rad} \alpha E^2 B^2$$

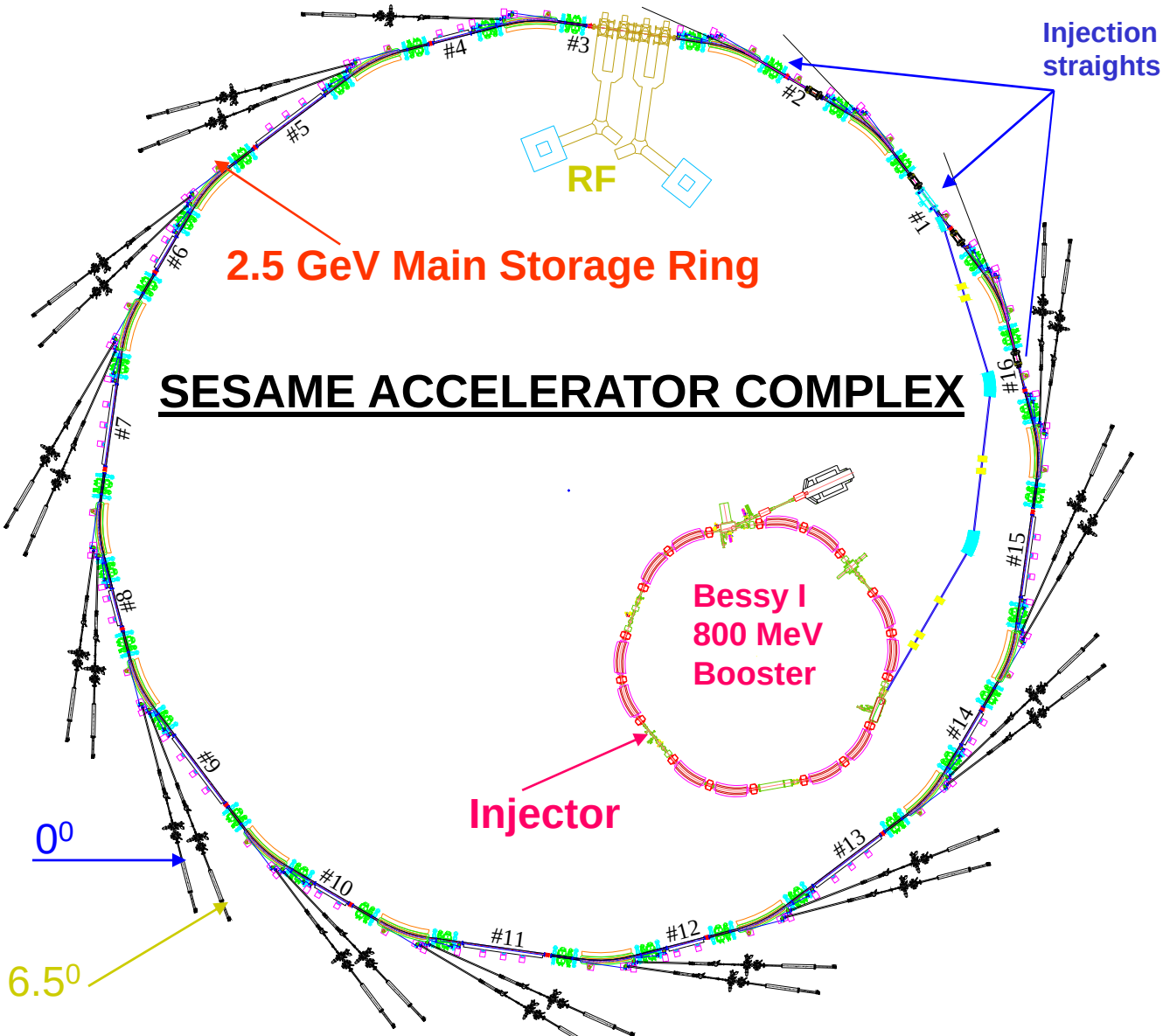
Synchrotron Radiation Basics, L. Rivkin, EPFL & PSI, Zakopane, October 2006

SESAME FACILITY

Main Ring Parameters:

Energy = 2.5 GeV
Circumference = 133.2 m
Emitt. = 26.0 nm.rad
16 Straights sections
{8 x 4.44 m + 8 x 2.38 m}
Up to 28 Beamlines:
12 Insertion Devices
16 Dipole ports with

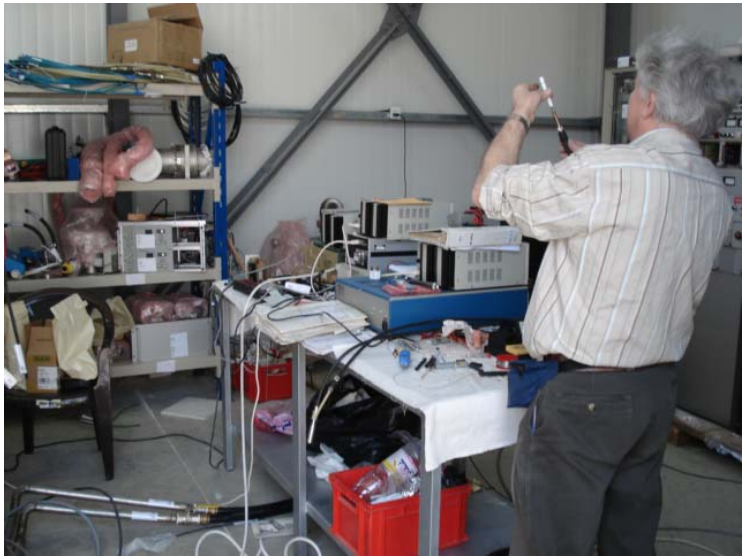
Beamlines
length range from
21 m – 36.7 m



Status of the MICROTRON

MICROTRON Subsystems Tests in the Hanger

(April – June 2008)



MICROTRON Installation in the SESAME Experimental Hall

25/08/2008

The *MICROTRON* System installed and tested

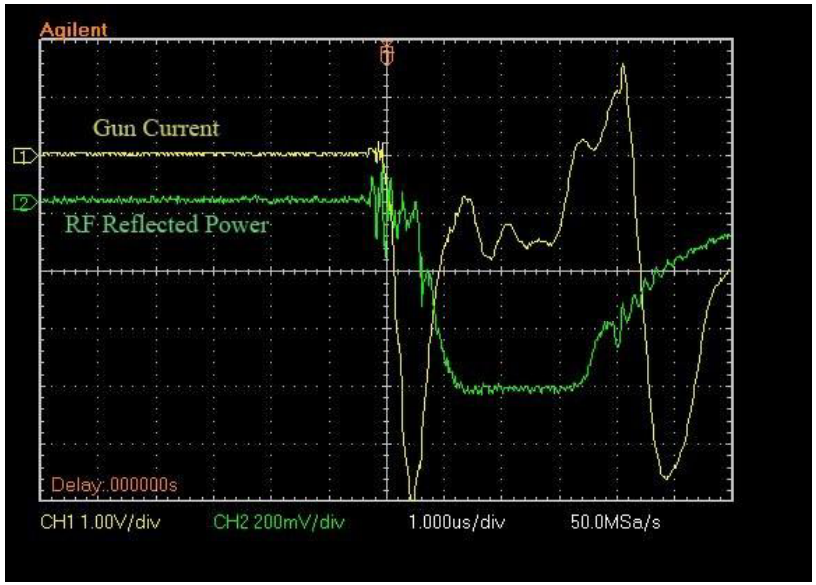
at BESSY (1998)

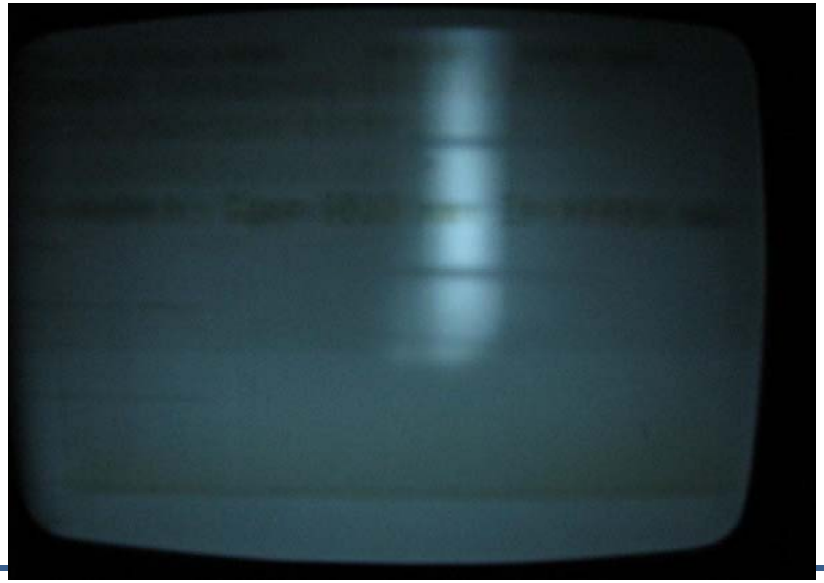
at SESAME (end 2008)

Temporary Shielding for *MICROTRON* Operation

FIRST SESAME MICROTRON BEAM

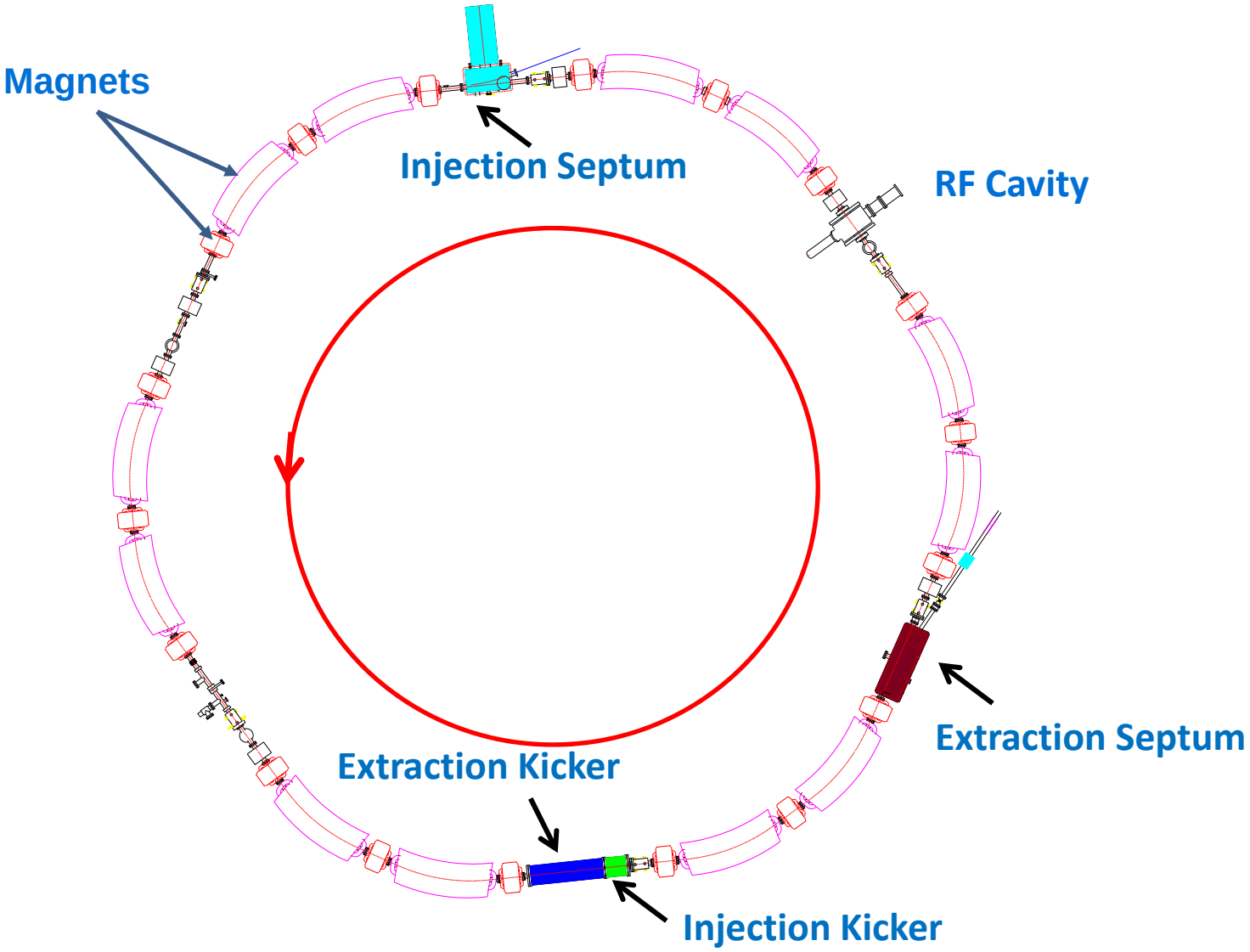
JULY, 14th, 2009 (00:35)





Status of the BOOSTER

Tests of Booster Equipment



Booster's Magnets Hydraulic tests

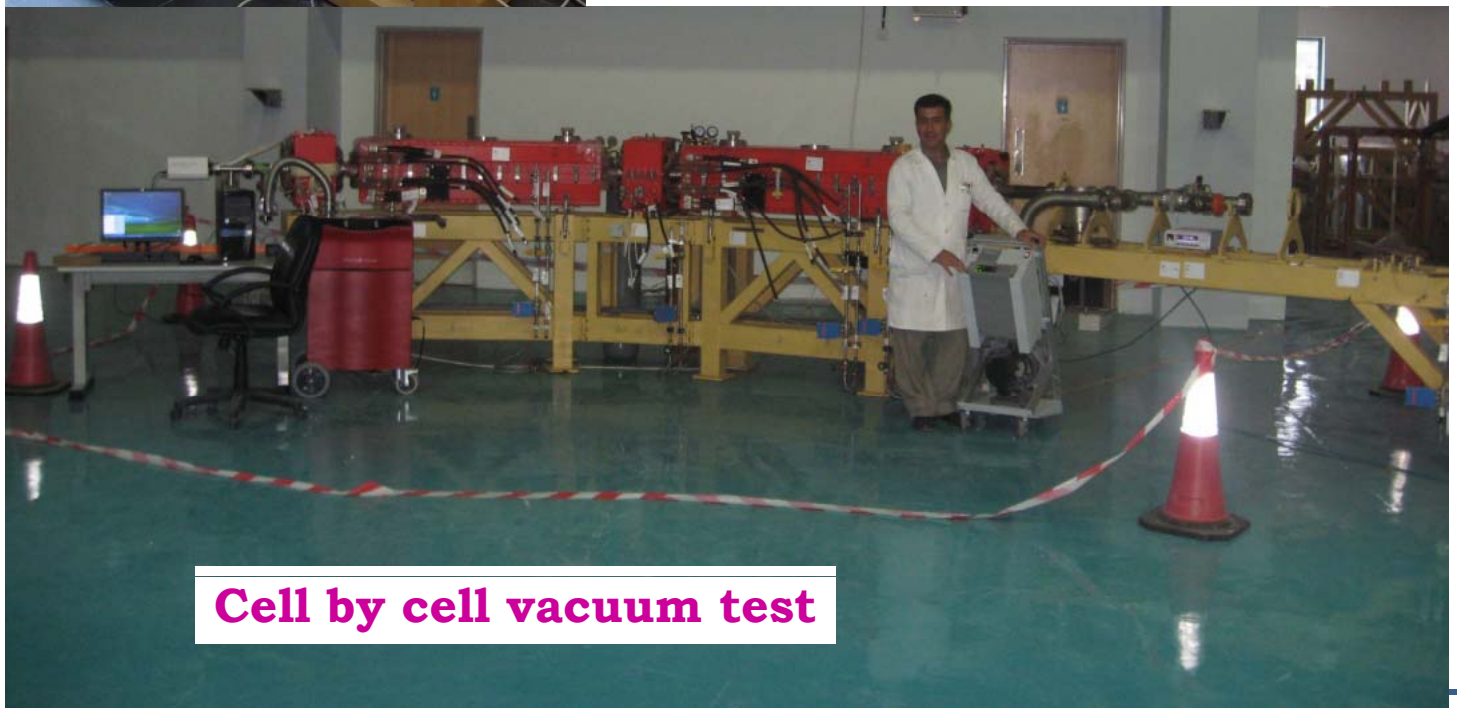
Hydraulic Cell Assembly

Water Magnet Cleaning

Flow Switch Test

Booster Vacuum Tests

In-vacuum injection Septum is being tested inside the lab

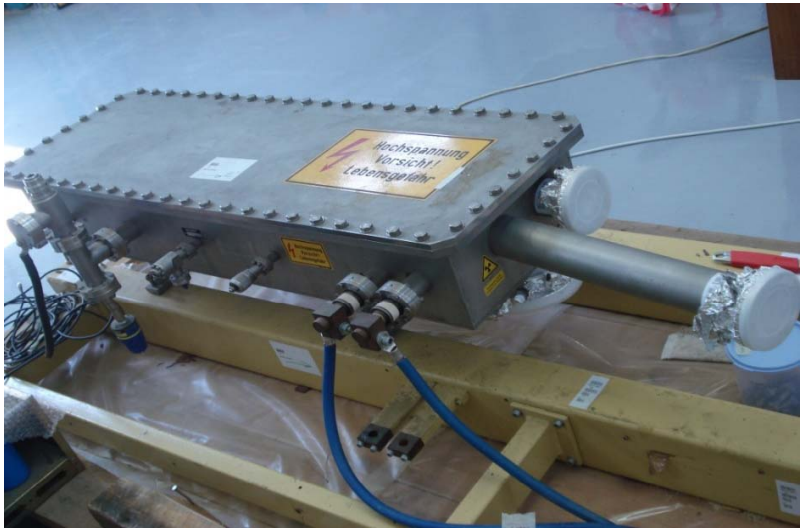


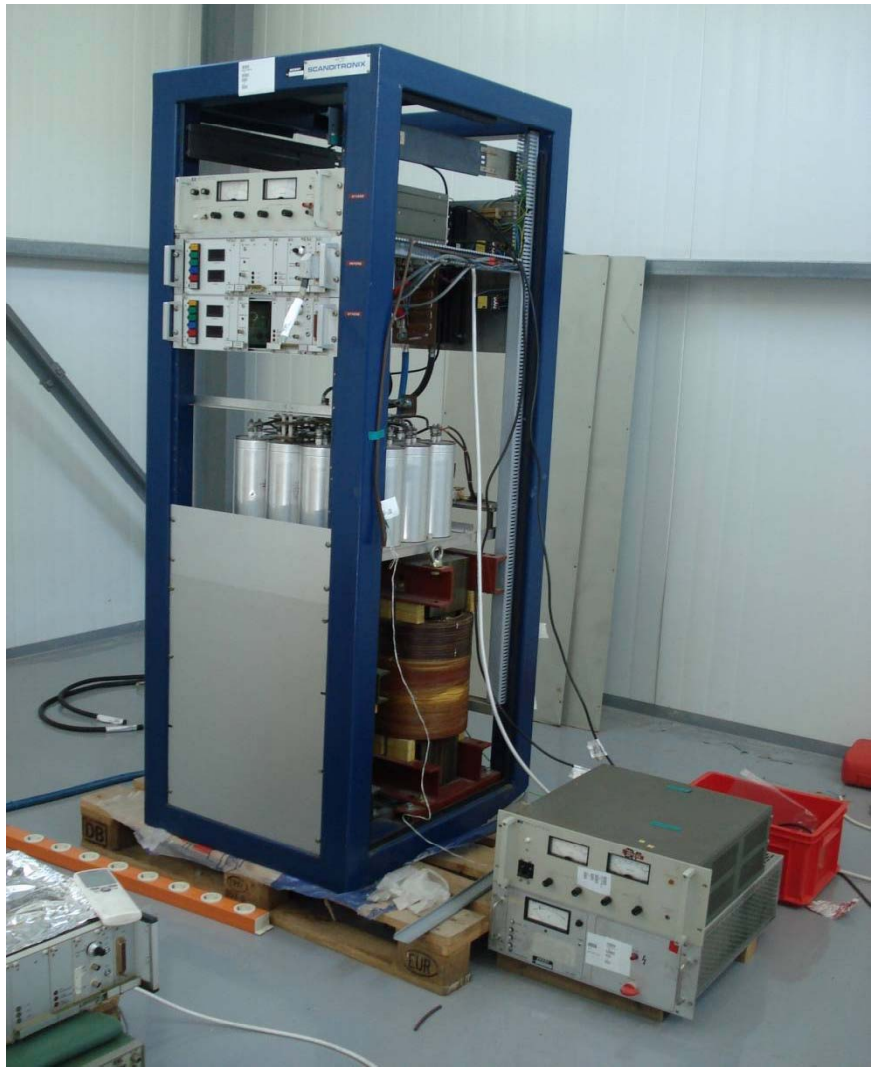
Cell by cell vacuum test

The whole Booster's Vacuum Tests

Booster's pulsed Injection and Extraction system tests

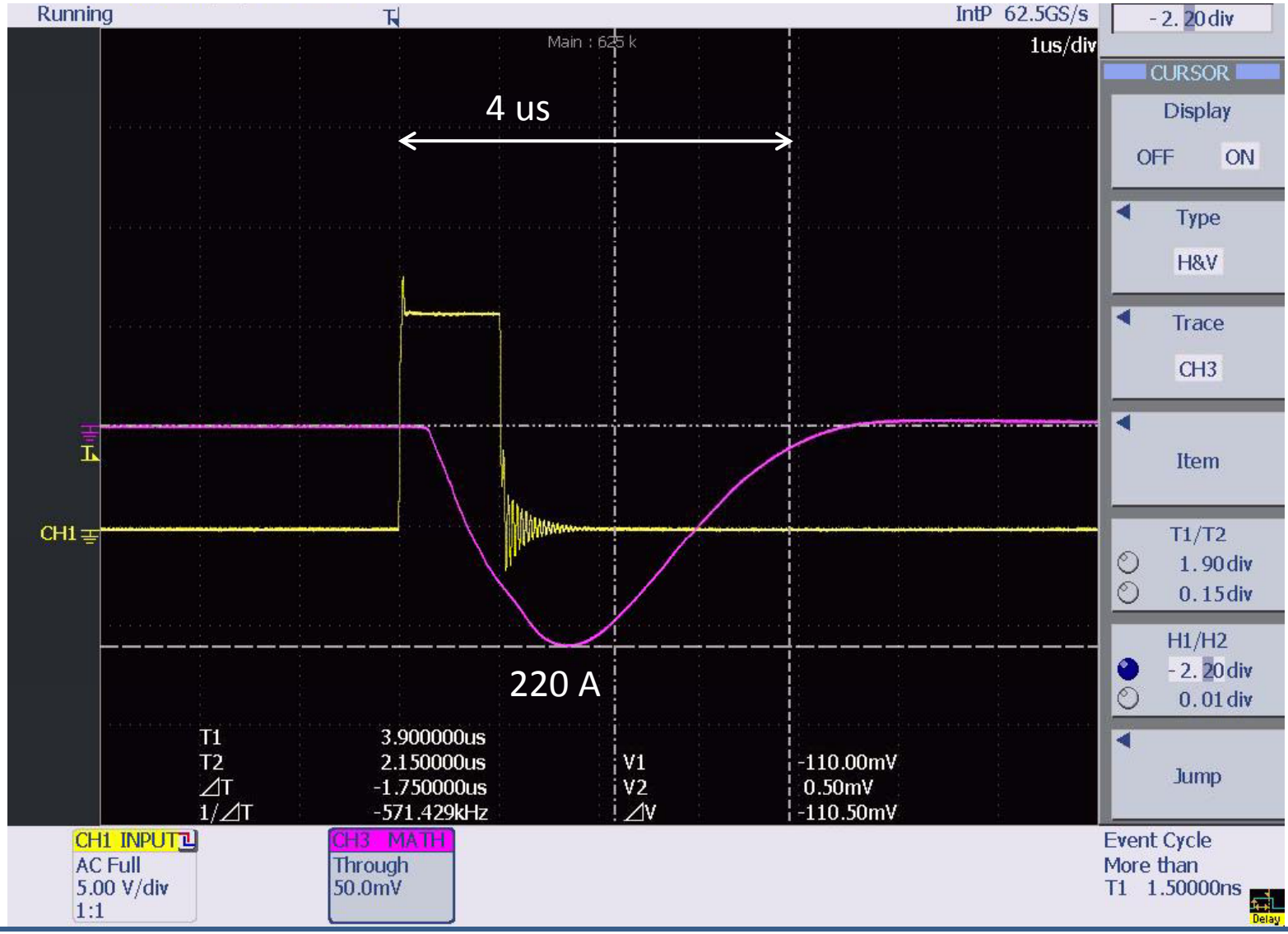
Successfully tested





Booster's pulsed Injection and Extraction system tests

Injection kicker tests results

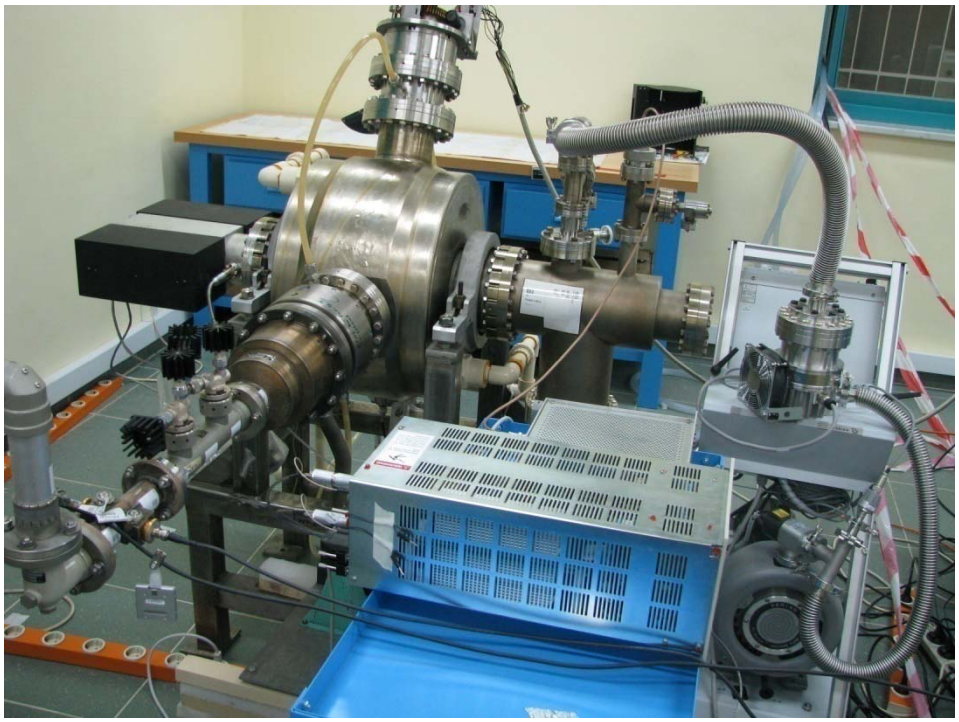


Booster RF System

- The Booster RF system **is complete** and ready to be installed in the Booster tunnel.

- All the subsystems have been tested and connected, including Cavity, LLRF, solid-state transmitter, interlocks and RF control system.

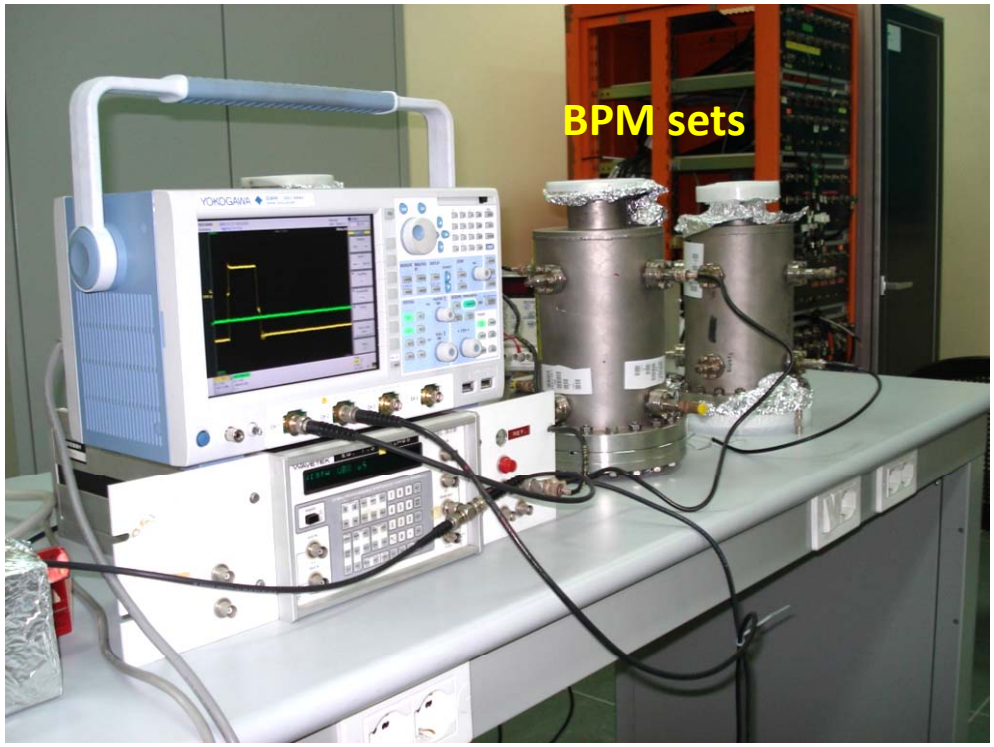
Booster RF system



Booster RF Cavity during commissioning

Booster Beam Diagnostics Tests Preparation

BPM sets Response initial tests assembly (Down left), and High frequency termination/50Ω preparation (Down right) at the electric Lab.



Booster New Power Supplies (arrived at SESAME on September 27th 2010)

Dipole Magnet Power Supply

FQ Power Supplies

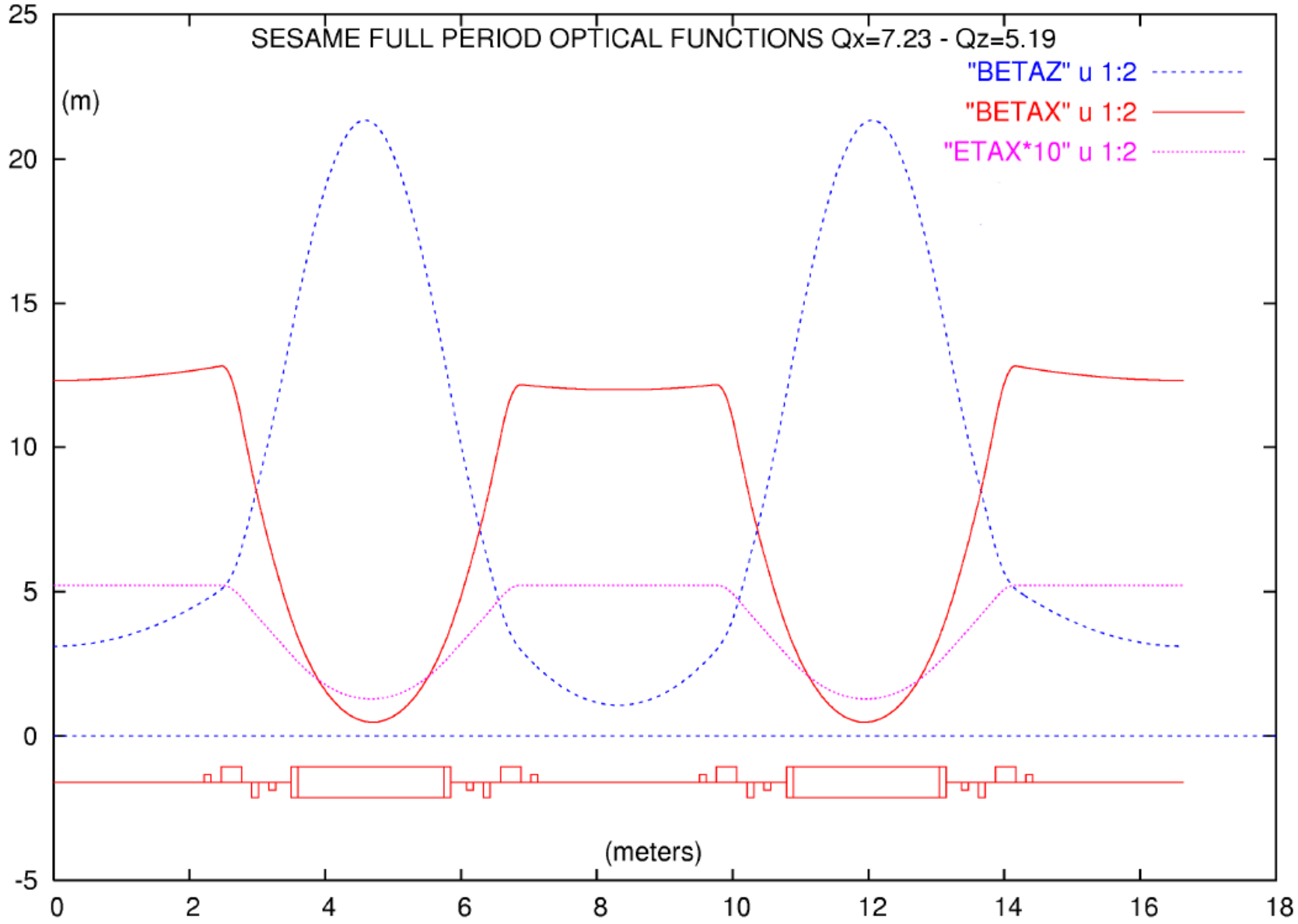
DQ Power Supplies

Update of the Major tasks for the *Booster*

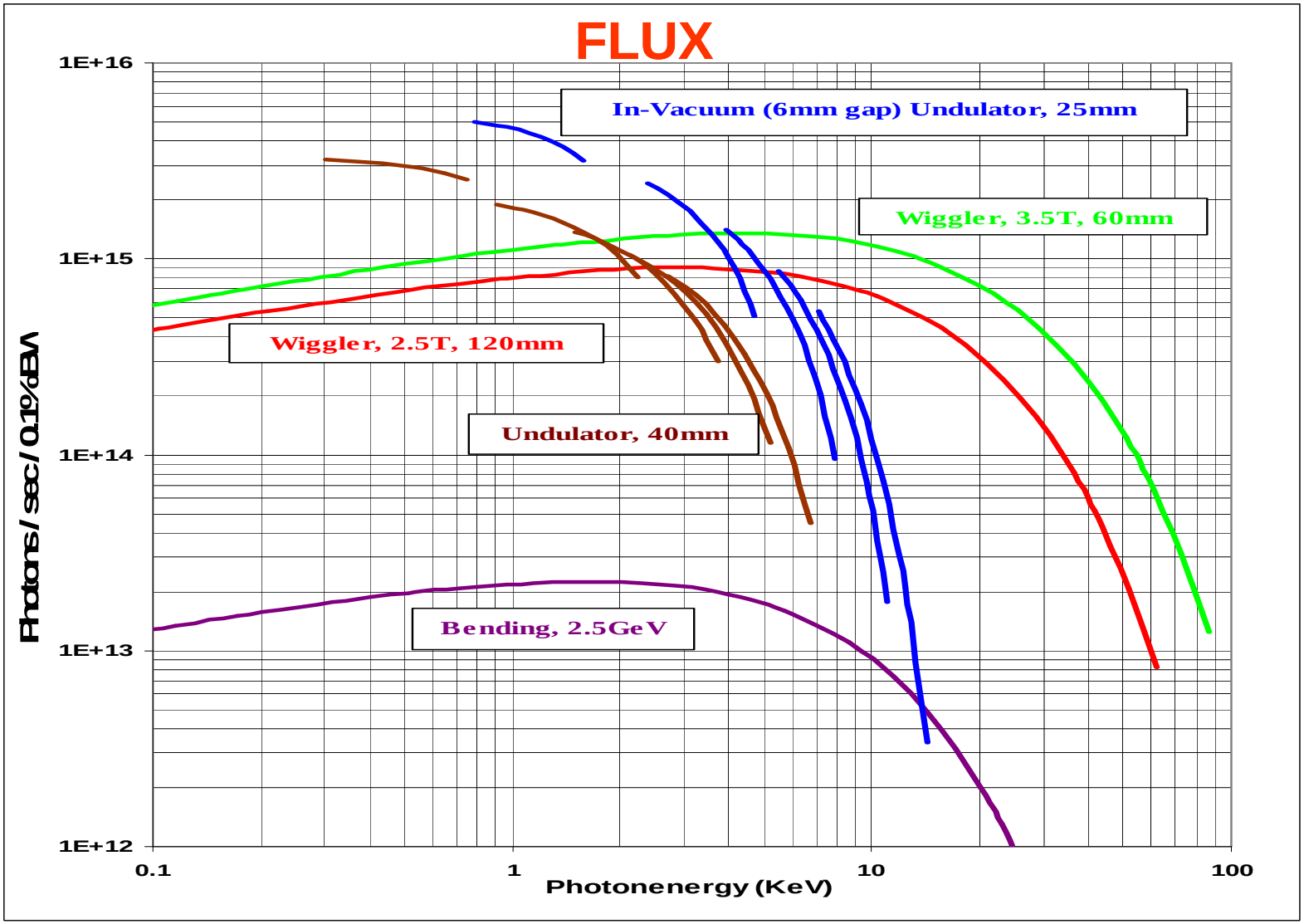
BOOSTER	2009	2010			2011		
		Jan. – Apr.	May-Aug.	Sept.-Dec.	Jan. – Apr.	May-Aug	Sept.-Dec
Shielding							
Timing System	Specification						
Control System			Specification				
Radiation Monitors & PSS				Specification			
Water piping distribution & Cabling							
Installation							
Commissioning							

Status of the STORAGE RING

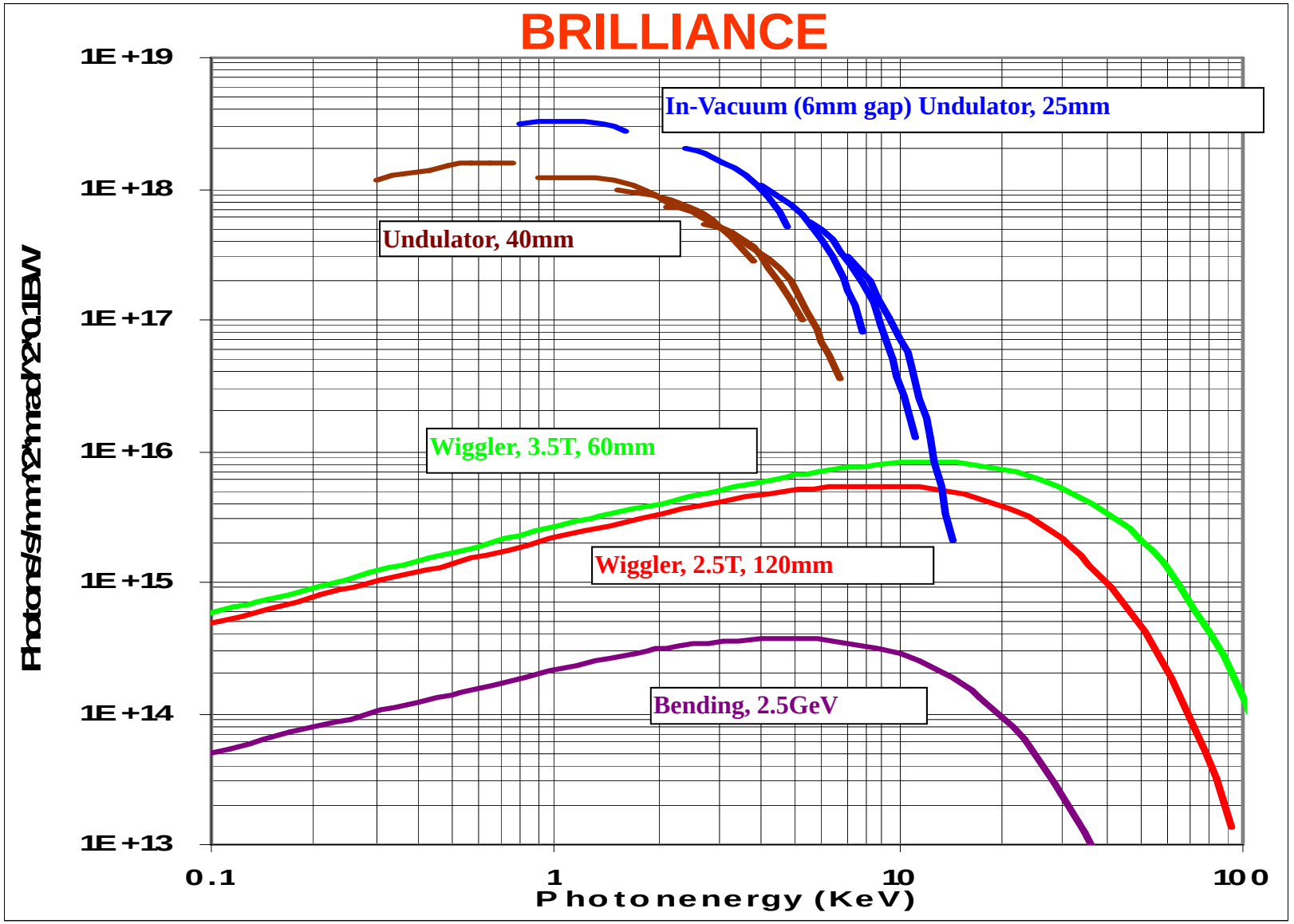
STORAGE RING OPTICS



Radiation from Bending Magnets, Wigglers and Undulators

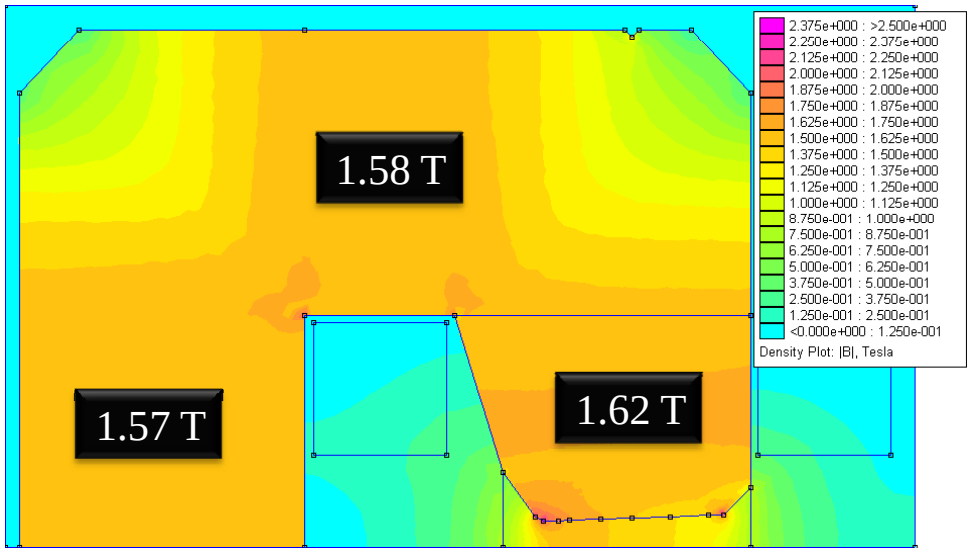


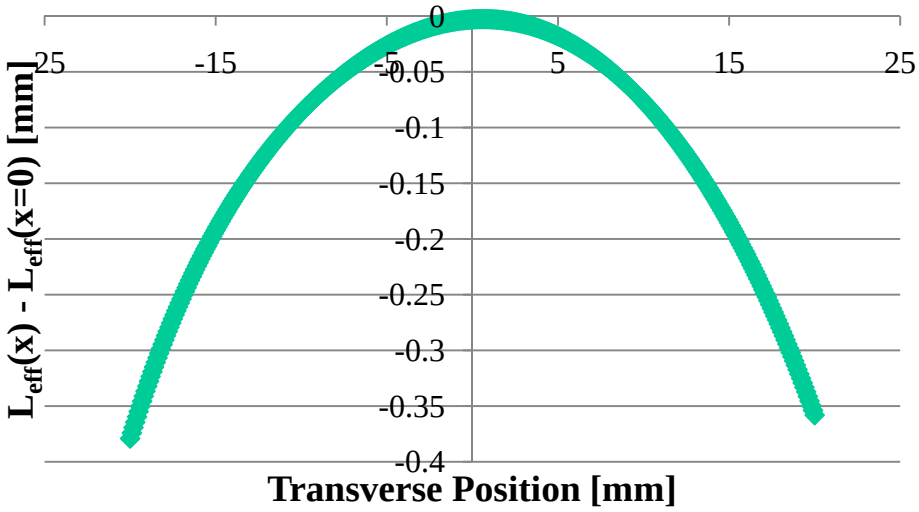
Radiation from Bending Magnets, Wigglers and Undulators

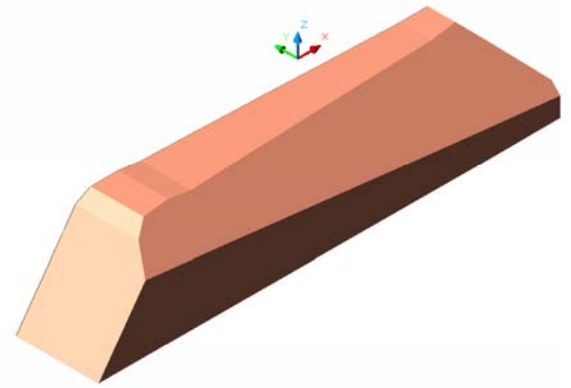


Magnetic Design Complete

Example of the Bending Magnet

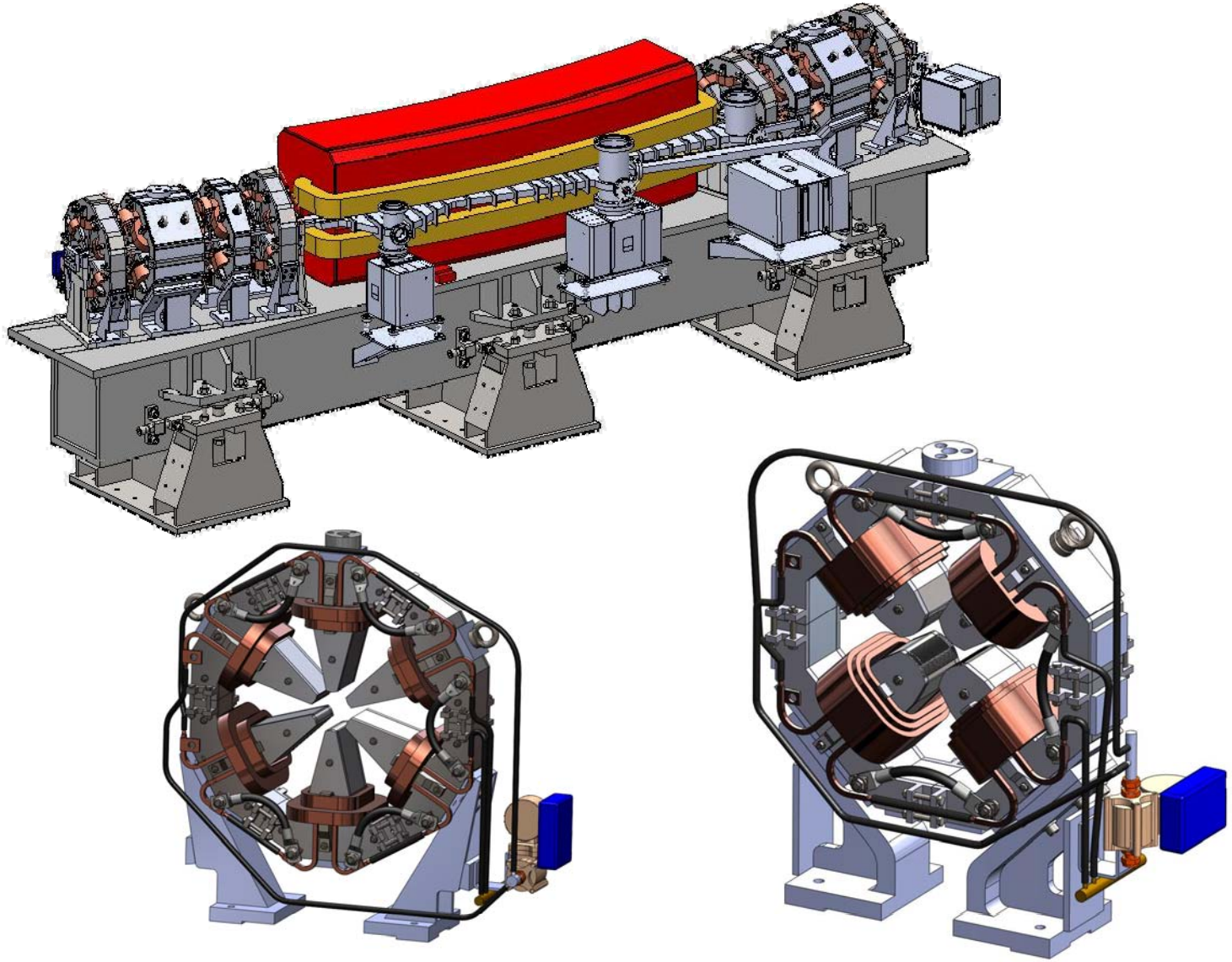






End-chamfer to achieve the same effective magnetic length along the transversal position.

3D Mechanical Engineering Design



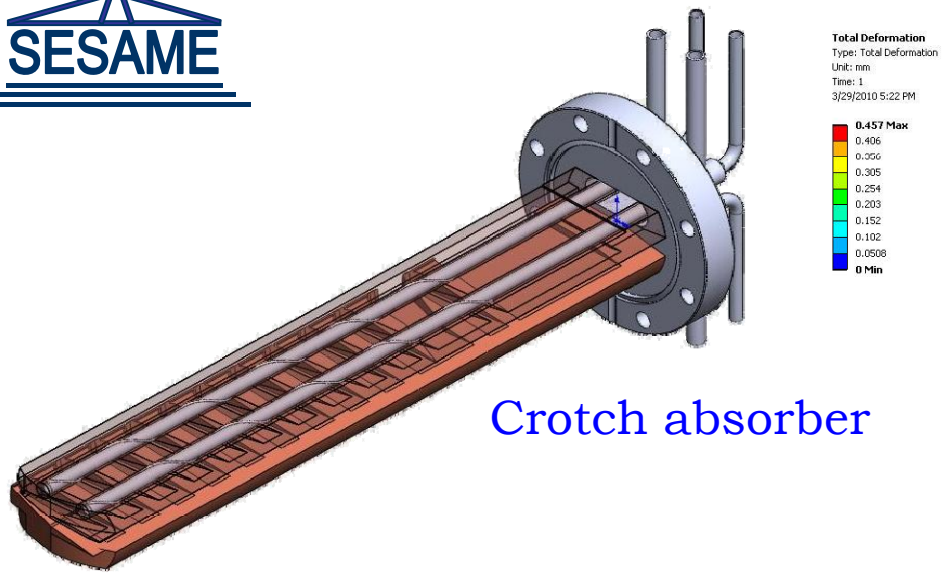
Collaboration with CERN

- Proposal for the supply of the SESAME **Main Ring magnet system** by a CERN-EU joint venture

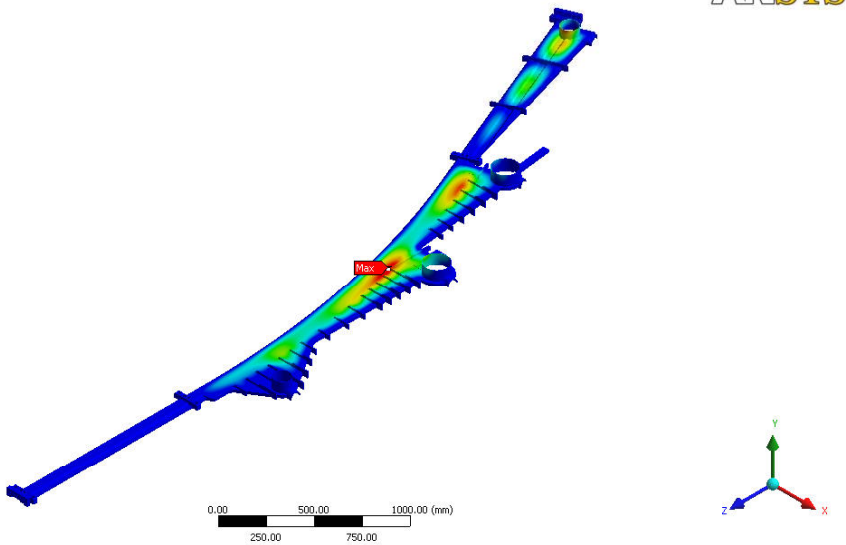
- Work packages and sharing of responsibilities for the proposed initiative

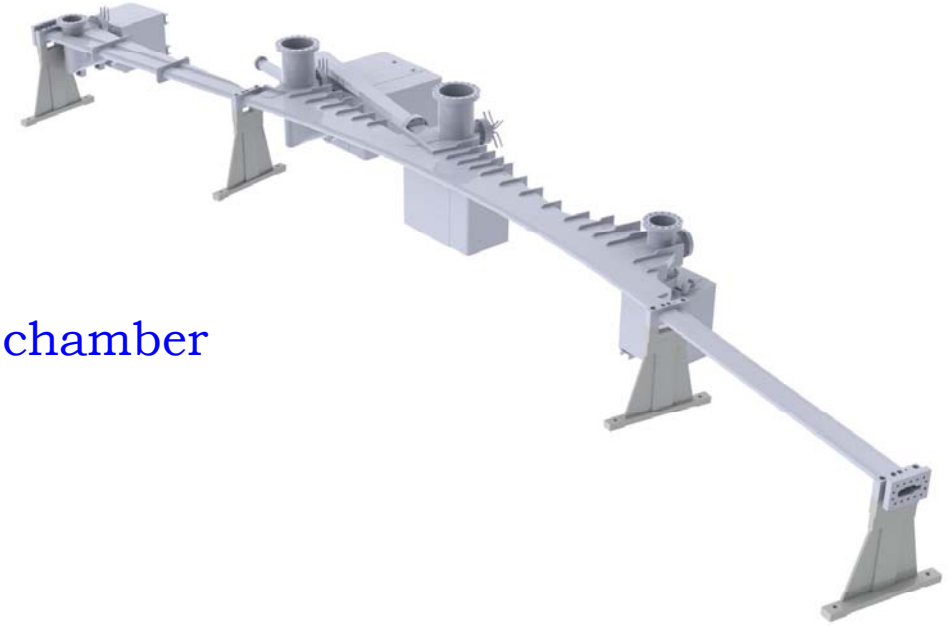
- SESAME takes full responsibility for the specifications and the acceptance of the equipment. The specifications must be agreed with CERN and its subcontractors, where applicable.

- **Magnet review 6, 7th December 2010 at SESAME**



Crotch absorber





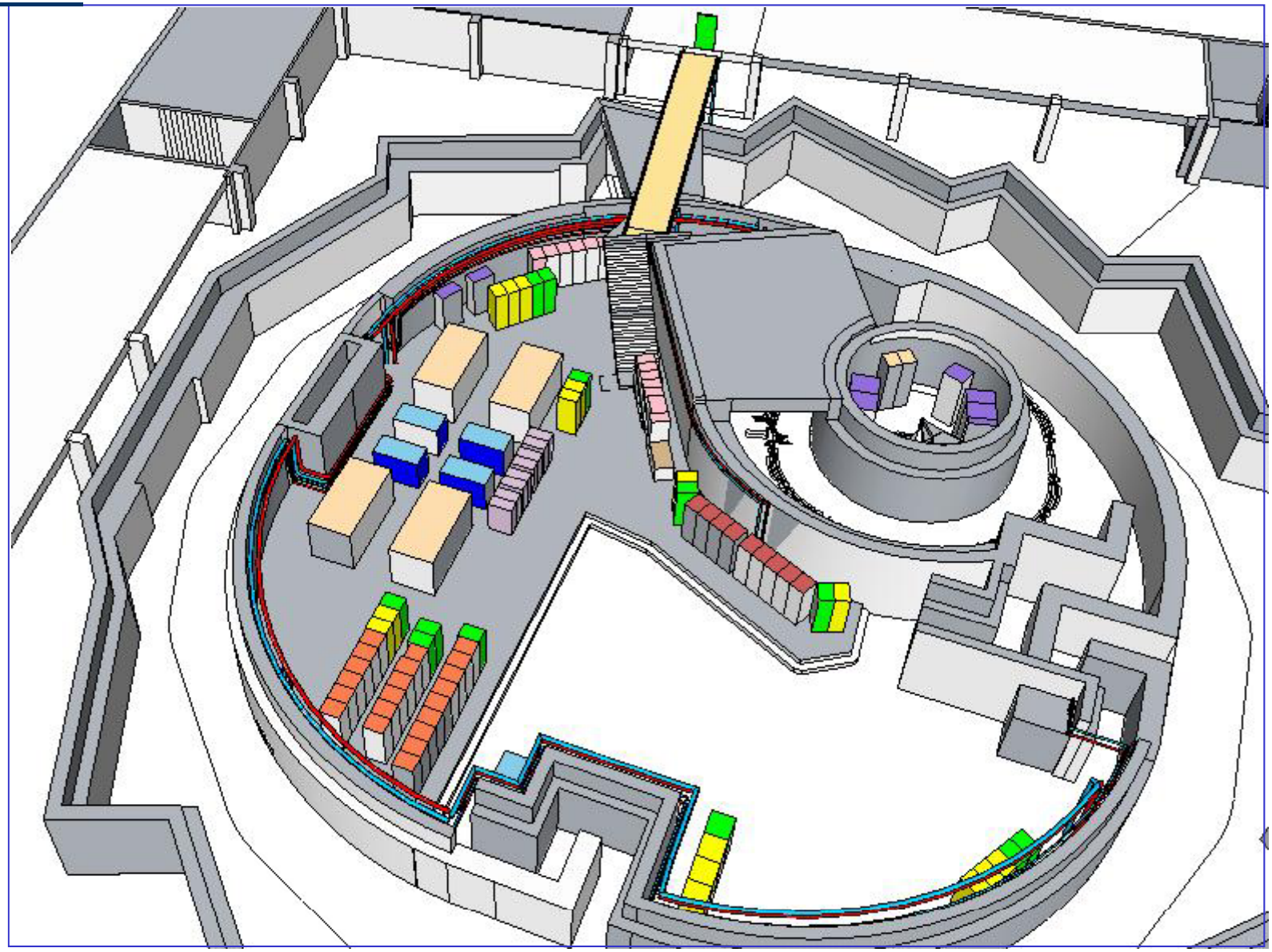
Arc vacuum chamber

RADIATION SCHIELDING WALL CONSTRUCTION

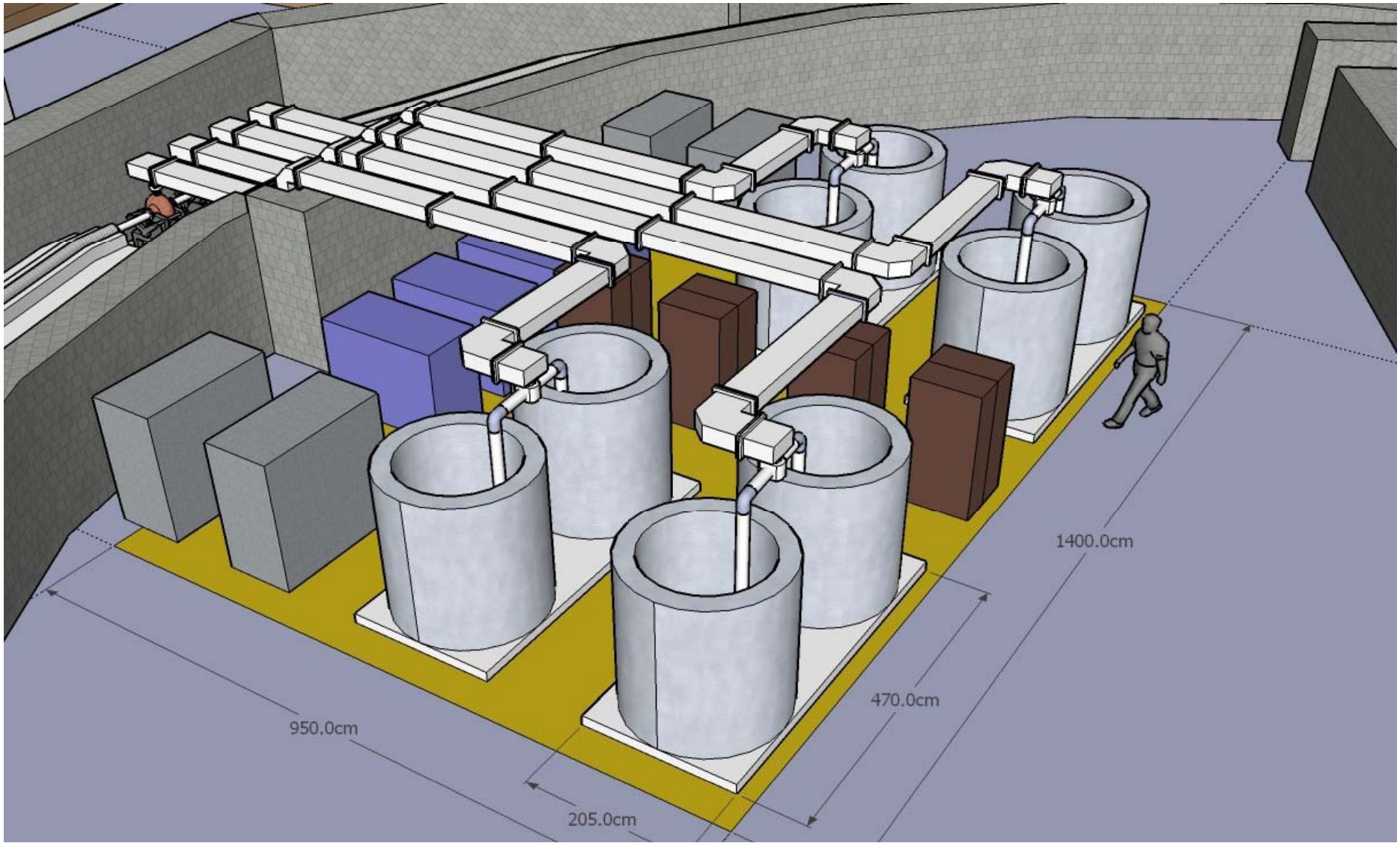

SESAME


SESAME

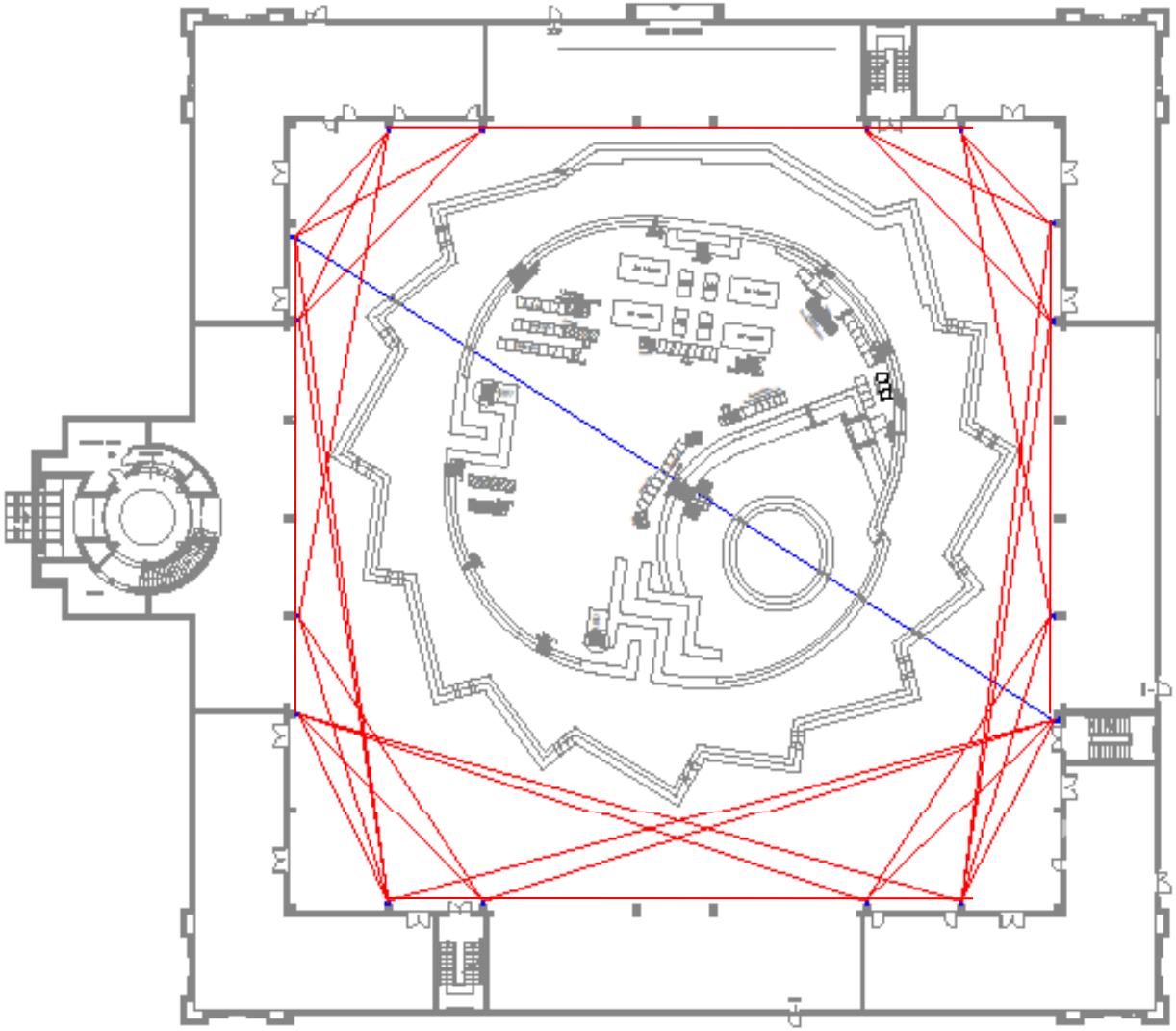
Fitting out of the Service Area (to scale)



A Proposal for the Installation of the Solid State Amplifiers of the Storage Ring RF System



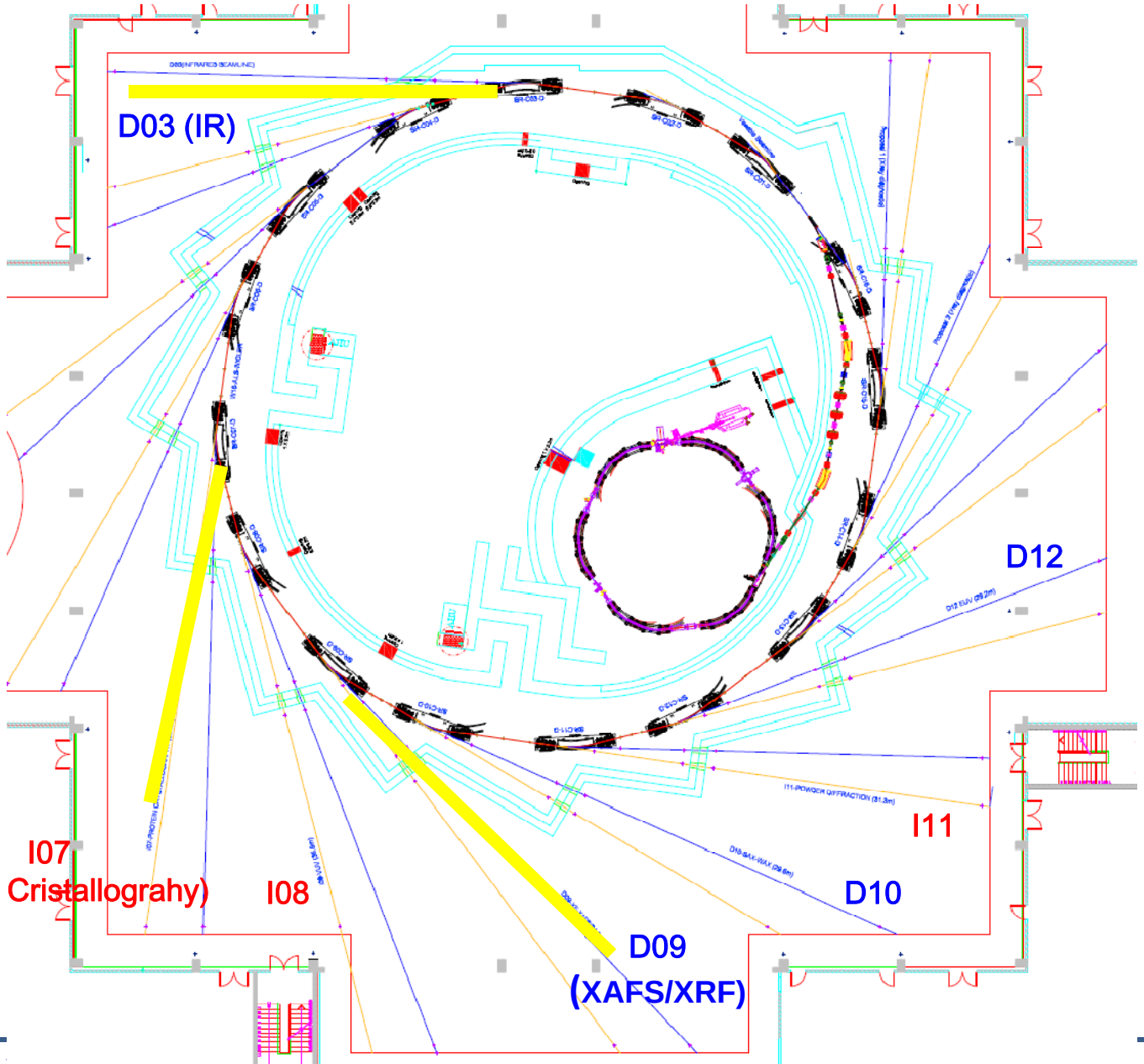
Survey & Alignment Network



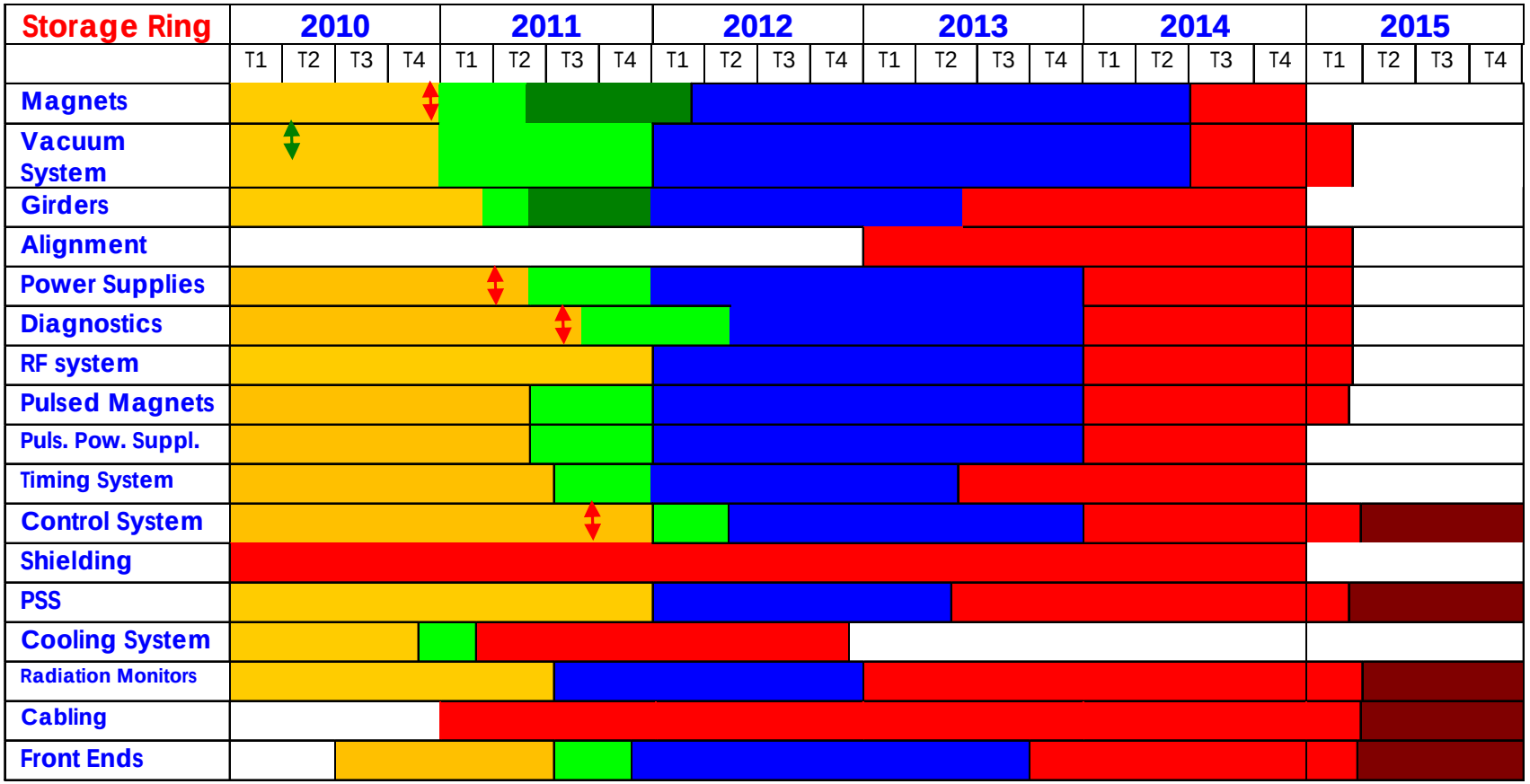
PHASE 1 BEAMLINES

No.	Beamline	Energy Range	Source Type	Donation
1.	**Protein Crystallography**	**4 – 14 keV**	**Wiggler (ALS)**	**Daresbury DL – 14.1 & 14.2**
2.	**XAFS/XRF**	**3 – 30 keV**	**Bending Magnet**	**Daresbury DL – 4.1 & 4.2**
3.	**Infra-red Spectro-microscopy**	**0.01 – 1 eV**	**Bending Magnet**	-
4.	Soft X-ray, Vacuum Ultra Violet (VUV)	0.05 – 2 keV	Elliptically Polarizing Undulator	-
5.	Small and Wide Angle X-ray Scattering (SAXS/WAXS)	8 – 12 keV	Bending Magnet	**Daresbury DL – 16.1**
6.	Powder Diffraction	3 – 25 keV	Multi-pole Wiggler	**SLS**
7.	Extreme Ultraviolet (EUV)	10 – 200 eV	Bending Magnet	**LURE**

Location of PHASE 1 Beamlines



Major tasks for the *Storage Ring*



: Design phase

: production and acceptance

: Call for tender

: Installation before starting the Storage Ring

: Prototype

: Installation after starting the Storage Ring

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
End of the shielding																								
Installation + Test of the Booster Subsystems																								
Commissioning of the Microtron at 22.5 MeV																								
Commissioning of the Booster																								
Storage Ring call for tender + Manufacturing																								
Installation + Tests																								
Commissioning of the Storage Ring																								

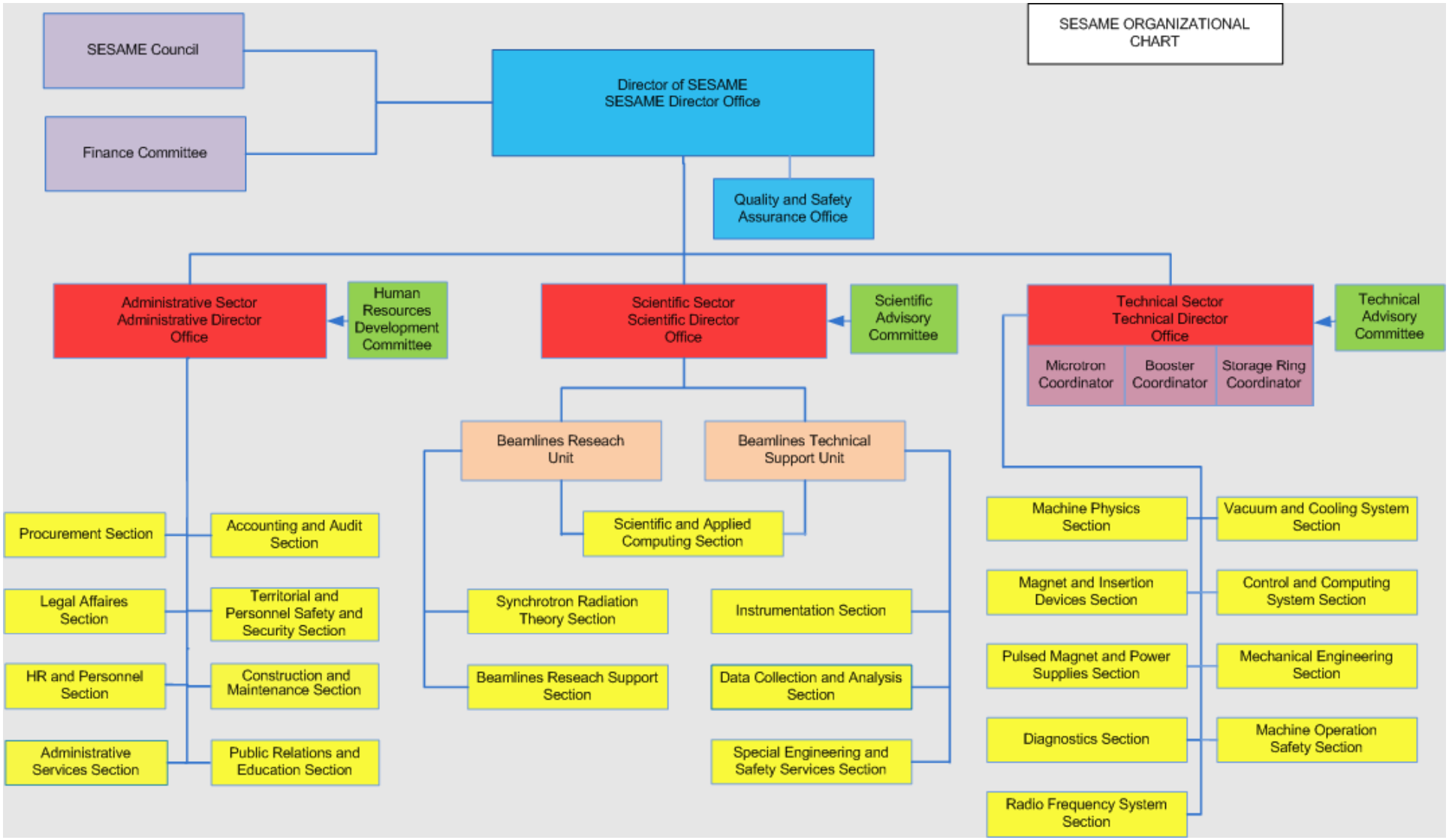
Cost of Completing Construction

Item	Budget Without options	Budget With options
Microtron + Booster + Storage Ring (M€)	**15.340**	**17.940**
Infrastructure (M€)	**3.160**	**3.160**
Contingency (10%) (M€)	**1.850**	**2.110**
Total in M€	**20.350**	**23.210**
Total in MUS$	**30.525**	**34.815**

SESAME Technical Staff

	Name	Field of Activity	Nat.	Hir. Date
1	Maher Attal	Acc. Physics.	Palestine	Jan 2004
2	Firas Makahleh	Cooling and Vacuum	Jordan	Jun 2004
3	Seadat Varnasseri	Diagnostics & Puls. Magnets & Power Supplies	Iran	Jul 2004
4	Adel Amro	Vacuum & Service Area	Jordan	Jul 2004
5	Maher Shehab	Mech. Engineering	Jordan	Feb 2005
6	Darweesh Foudeh	RF & Electronics	Jordan	June 2007
7	Arash Kaftoosian	RF	Iran	Oct 2005
8	Hamed Tarawneh	Acc. Physics/ Magnet	Jordan	Mar. 2006
9	Moh'd. Alnajdawi	Mechanical Engineering	Jordan	June 2007
10	Salman Matalgah	Computing and Network	Jordan	Sept. 2007
11	Saed Abu Ghannam	Control System	Palestine	August 2010
12	Adli Hamad	Radiation Safety	Jordan	June 2007
13	Thaer Abu Haniah	Alignment & Survey	Jordan	Nov. 2007
14	Tasadaq Ali Khan	RF & Control	Pakistan	Nov. 2007
15	Saed Budair	Vacuum	Jordan	July 2008
16	Muayed Sbahi	Electrical & Cabling	Jordan	August 2008

SESAME Organizational Structure



There are challenges…

- **Construction budget not secure**
- **Need of stable financial support**
- **Increasing the number of member countries in the Gulf as well as in the Maghreb**
- **Compensating the differences in the human and financial resources of the member countries**
- **Solutions to some practical problems involving travel restrictions in the region**

Construction Funds (spent)

- **1.2 M€ from EU – Jordan**

  Electronic, RF, Control and Vacuum **labs**
  Mechanical workshop
  Refurbishment of the Microtron

- **500 kJD from Ministry Of Higher Education- Jordan**

  Network infrastructure

- **3.1M US$ from Jordan Royal Court**

  Alignment tools and network
  Radiation shielding wall construction
  Complement for the network
  Bridge and cable trays

Training Programme

One of the essential objectives of SESAME

- **Funded by IAEA, other organisations around the world, and numerous synchrotron laboratories which provide training opportunities : ALBA, ESRF, PF, SLS, SOLEIL,…**

- **Many workshops, users' meetings: + schools supported by JSPS**

- **Travel support from APS-EPS-IoP-DPG, ICTP and Canon Foundation (UK)**

Recent Staff trips

- Firas Makahleh, Maher Shehab and Amor Nadji (6 & 7 /04) to ALBA for the vacuum review meeting. Financed by IAEA.
- Hamed Tarawneh (19/09 to 24/09) to CERN to discuss the Storage Ring magnets (cross check our magnetic design with OPERA 3D). Financed by SESAME.
- Saed Abu Ghannam (4/10 to 26/10) newly hired control system engineer to CLS to be trained in accelerator control systems. Financed by CLS.
- Maher Attal and Adli Hamad (24/10 to 24/11) to ALBA to participate to the commissioning of the Storage Ring. Financed by IAEA.
- Mohammad Najdawi (21/10 to 21/12) and Saed Budair (21/10 to 22/11) to SLS for the dismantlement of the Material Science Beamline and to be trained on the Front Ends design. Financed by PSI.

CONCLUSION

- **The Microtron has been successfully commissioned with beam at low energy.**
- **All the existing Booster subsystems have been tested and new Booster magnets power supplies are being manufactured. More investigation are made for the vacuum chambers.**
- **The concrete part of the shielding wall is complete.**
- **The design of the Storage Ring equipment is finalised and technical specifications are ready for call for tender.**

We have come this far, we have to believe we will get there

We will keep the faith but we need help.