Progress Report
of
SESAME Project

A. NADJI

On Behalf of SESAME Team
What is SESAME?

SESAME (Synchrotron-light for Experimental Science and Applications in the Middle East)

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

-v- 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
SESAME GROUND BREAKING CEREMONY - 6 JANUARY 2003

A. Nadji, IPAC10, Kyoto, 23 – 28 May 2010
SESAME building, financed by Jordan

Opening of the SESAME building
3 November 2008
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
Status of the BOOSTER
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
Holes of 1 to 3 cm in length were discovered in two dipole chambers. Up to now, the reason is unknown.

Welding using silver, under Argon shield, gave a good result.

No visible hole in all the other chambers (helium leak detector). Nevertheless, it is essential to understand the reason of the presence of these holes before the installation of the Booster. Inspection is underway.

Brazing by DIN 8513 LAG40 CD
Booster’s pulsed Injection and Extraction system tests

Successfully tested
Injection kicker tests results

220 A

4 us
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.
BPM sets Response initial tests assembly (Down left), and High frequency termination/50Ω preparation (Down right) at the electric Lab.
Booster Dipole Magnet Power Supply

Under manufacture at Bruker (France)
Booster Quadrupoles Power Supplies
Under manufacture at Bruker (France)
Status of the STORAGE RING
STORAGE RING OPTICS

SESAME FULL PERIOD OPTICAL FUNCTIONS Qx=7.23 - Qz=5.19

"BETAZ" u 1:2
"BETAX" u 1:2
"ETAX*10" u 1:2

(m)

(meters)
Radiation from Bending Magnets, Wigglers and Undulators

FLUX

Photon energy (KeV)
Photons / sec / 0.1% BW

In-Vacuum (6mm gap) Undulator, 25mm
Wiggler, 3.5T, 60mm
Wiggler, 2.5T, 120mm
Undulator, 40mm
Bending, 2.5GeV
Radiation from Bending Magnets, Wigglers and Undulators

BRILLIANCE

Photon energy (KeV) vs. Photons/s/mm²·mrad²·0.1BW

- In-Vacuum (6mm gap) Undulator, 25mm
- Undulator, 40mm
- Wiggler, 3.5T, 60mm
- Wiggler, 2.5T, 120mm
- Bending, 2.5GeV

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Example of the Bending Magnet

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

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3D Mechanical Engineering Design
Crotch absorber

Arc vacuum chamber
RADIATION SHIELDING WALL CONSTRUCTION

Microtron and its racks
A Proposal for the Installation of the Solid State Amplifiers of the Storage Ring RF System
Fitting out of the Service Area (to scale)
Survey & Alignment Network
# Phase 1 Beamlines

<table>
<thead>
<tr>
<th>No.</th>
<th>Beamline</th>
<th>Energy Range</th>
<th>Source Type</th>
<th>Donation</th>
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</thead>
<tbody>
<tr>
<td>2.</td>
<td>XAFS/XRF</td>
<td>3 – 30 keV</td>
<td>Bending Magnet</td>
<td>Daresbury DL – 4.1 &amp; 4.2</td>
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<tr>
<td>3.</td>
<td>Infra-red Spectro-microscopy</td>
<td>0.01 – 1 eV</td>
<td>Bending Magnet</td>
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<tr>
<td>4.</td>
<td>Soft X-ray, Vacuum Ultra Violet (VUV)</td>
<td>0.05 – 2 keV</td>
<td>Elliptically Polarizing Undulator</td>
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<tr>
<td>5.</td>
<td>Small and Wide Angle X-ray Scattering (SAXS/WAXS)</td>
<td>8 – 12 keV</td>
<td>Bending Magnet</td>
<td>Daresbury DL – 16.1</td>
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<tr>
<td>7.</td>
<td>Extreme Ultraviolet (EUV)</td>
<td>10 – 200 eV</td>
<td>Bending Magnet</td>
<td>LURE</td>
</tr>
</tbody>
</table>
Location of PHASE 1 Beamlines

D03 (IR)

D07 (Protein Crystallography)

D09 (XAFS/XRF)

I07, I08, I11, D10, D12

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Major tasks for the **Storage Ring** until the start of the commissioning

<table>
<thead>
<tr>
<th>Storage Ring</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
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<tr>
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<td>6</td>
<td>9</td>
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<td>Diagnostics</td>
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<td>RF system</td>
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<td>Pulsed</td>
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<td>Magnets</td>
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<td>Cooling System</td>
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<td>Radiation Monitors</td>
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<td>Insertion Devices</td>
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<td>Front Ends</td>
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<td>Commissioning with Beam</td>
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A. Nadji, IPAC10, Kyoto, 23 – 28 May 2010
## Cost of Completing Construction

<table>
<thead>
<tr>
<th>Item</th>
<th>Budget Without options</th>
<th>Budget With options</th>
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<tbody>
<tr>
<td>Microtron + Booster + Storage Ring (M€)</td>
<td>15.340</td>
<td>17.940</td>
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<tr>
<td>Infrastructure (M€)</td>
<td>3.160</td>
<td>3.160</td>
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<tr>
<td>Contingency (10%) (M€)</td>
<td>1.850</td>
<td>2.110</td>
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<tr>
<td>Total in M€</td>
<td>20.350</td>
<td>23.210</td>
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<tr>
<td>Total in MUS$</td>
<td>30.525</td>
<td>34.815</td>
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### SESAME Technical Staff

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

Signature of the Collaboration between SESAME and SOLEIL (France) (October 23, 2007)
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 shielding wall is under construction.

- 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 your help.