HiRadMat - Brief Overview
HiRadMat facility – Scientific Scope

- HiRadMat is a facility designed, to study the impact of **intense pulsed beams** on materials
  - Thermal management (heating)
    - material damage even below the melting point
    - material vaporization (extreme conditions)
  - Radiation damage to materials
  - Thermal shock - beam induced pressure waves

- It will serve as test bed, important for the design validation of **LHC near beam components** before installation in the ring
  - An alternative to ad-hoc pirate installations for such tests as done so far

- **Targeted users:** LHC collimators, R&D on materials, high-power targety, test of vacuum components (beam windows, coating), others?
HiRadMat - Location

HiRadMat shares the same extraction from SPS as the TI2 line to LHC.
The experimental area will be upstream the old T9 target for the West Area Neutrino Facility - WANF.
HiRadMat - Layout Exp. Area & TNC

3 test stands for experiments
WANF and T1(west area) target

- Re-use of existing tunnels for the new facility
  - The WANF beam was stopped in 1998
  - The T1 target was stopped in 2004
- 95t of waste, 323 m³
- 800t of blocks moved around
- Optimized procedures and tooling
HiRadMat Beam Parameters

- LHC type beam extracted from SPS, protons or ions

<table>
<thead>
<tr>
<th></th>
<th>Protons</th>
<th>Heavy ions (Pb82⁺)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulse energy</td>
<td>up to 3.4 [MJ]</td>
<td>up to 21 [kJ]</td>
</tr>
<tr>
<td>Bunch intensity</td>
<td>3 × 10⁹ to 1.7 × 10¹ⁱ [protons]</td>
<td>3 × 10⁷ to 7 × 10⁷ [ions]</td>
</tr>
<tr>
<td>Number of bunches</td>
<td>1 to 288</td>
<td>52</td>
</tr>
<tr>
<td>Max intensity</td>
<td>4.9 × 10¹¹ [protons]</td>
<td>3.64 × 10⁹ [protons]</td>
</tr>
<tr>
<td>Bunch length</td>
<td>11.24 [cm]</td>
<td>11.24 [cm]</td>
</tr>
<tr>
<td>Bunch spacing</td>
<td>25, 50, 75 or 150 [ns]</td>
<td>100 [ns]</td>
</tr>
<tr>
<td>Pulse length</td>
<td>7.2 [μs]</td>
<td>5.2 [μs]</td>
</tr>
<tr>
<td>Cycle length</td>
<td>18 [s]</td>
<td>13.2 [s]</td>
</tr>
<tr>
<td>Beam spot at the experiment</td>
<td>variable around 1 [mm²]</td>
<td>variable around 1 [mm²]</td>
</tr>
</tbody>
</table>

- Intensity:

  - **10¹⁵ protons/experiment** (max 100 high-intensity pulses)
  - 10 experiments/year - **10¹⁶ protons in total/year**
HiRadMat Beam Parameters

- Constraint: the beam must be >0.5mm in [x, y] at the last beam window of the line and at the dump

- Larger beam sizes can be achieved, <2mm
Experiments in HiRadMat

- Life cycle of an experiment:
  1. Prepare 1(2) test setups each on is platform in the lab or assembly area
  2. Move them to the irradiation area – do the irradiations; swap between the two remotely (either base platform movement or object)
  3. Move them to the cool-down area
  4. Recuperate them later for post-irradiation inspection/analysis in the lab
HiRadMat – Experimental Area

- Test stands and handling
  - Interface table with remote connections allows easy manipulation remotely with the overhead crane
  - Alignment 0.1mm by mechanics
    - use surface lab with “copy” installation
  - The test equipment will be in vacuum or inert gas depending on the test and safety requirements - windows?
HiRadMat - Experiments

- Interface table allows experiment assembly outside the experimental area
  - Access (time) limitations due to LHC operation
  - Access limitations due to radiation

**Surface lab:**
- Experiment assembly on the interface table
- Alignment using a test stand, “copy” of the installation at the tunnel
- Readout / movement tests

- After the experiment assembly and tests are completed in surface, everything is lowered down to the experimental area for final tests and installation
### HiRadMat Generic Experiment

**Dose rate after 1E16 protons in 200 days + 1 month of cooling**

<table>
<thead>
<tr>
<th>Cooling time</th>
<th>Dose rate between wall and beam line [mSv/h]</th>
<th>Dose rate maximum value [mSv/h]</th>
<th>Dose rate between wall and beam line [µSv/h]</th>
<th>Dose rate maximum value [mSv/h]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 hour</td>
<td>26</td>
<td>1300 Sv/h</td>
<td>800</td>
<td>32</td>
</tr>
<tr>
<td>12 hours</td>
<td>2</td>
<td>66 mSv/h</td>
<td>600</td>
<td>24</td>
</tr>
<tr>
<td>1 day</td>
<td>0.660</td>
<td>15 mSv/h</td>
<td>480</td>
<td>20</td>
</tr>
<tr>
<td>1 week</td>
<td>0.066</td>
<td>3.3 mSv/h</td>
<td>280</td>
<td>12</td>
</tr>
<tr>
<td>1 month</td>
<td>0.026</td>
<td>0.7 mSv/h</td>
<td>200</td>
<td>6</td>
</tr>
</tbody>
</table>

- The dose rate level in the tunnel after one year of operation is higher than the dose rate in the empty WANF tunnel today.

- The dose rates would depend on the material used.

- RP analysis and study for each experiment should be done.
HiRadMat will be a **single pulse** facility

- Beam on request by pressing a button in the CCC - **manual operation !!!**

HiRadMat will use the beam from SPS in a time-sharing mode with the other users

- Medium/Low (<72 bunches) can be executed parasitically to FT and CNGS beams
- Low/High (>72 bunches) run in competition to FT or CNS programs
New Primary Beam line (TT66) to HiRadMat

- Branching off the existing TI2 line to LHC
  - 25 magnets, 13 power converters
  - 17 beam instrumentation elements
  - 200m of new vacuum, + TI2 vacuum adaptation
  - 460 new cables, 4 km, 300 old cables removed

- **Phase-I commissioning:**
  - Low intensity beam commissioning in June 22-28, 2011

- **Phase-II commissioning:**
  - Low/High intensity beams as of week-33
HiRadMat – Status

- Installation:
  - Primary beam (TT66) completed
  - The Exp.Area ~80% completed
    - remaining works: ventilation system,
    - cables for experiments

- Project Review and Report on “triptite” (French & Swiss authorities) meeting - OK

- Presently working on Project and Safety Documentation
  - Must be completed to get the beam permit for Phase-II commissioning in August
  - Hearing Session on July 28(27)

- We are now focusing on the experimental area and discussions with the first users
  - Ready for scheduled users from week 26 onwards
  - Possible windows for installation on w31, w38, with beam in w32-36, w38-44
HiRadMat is also included in EUCARD/FP7 project as Transnational Access

- http://eucard.web.cern.ch/EuCARD/activities/access/

- Funds available to support EU users for the exploitation of the facility

  - The budget from FP7 would be used to support collaborators for travel expenses, for expenses related to the stay at CERN, and for transport of material related to experiments at the facility.

  - Access unit: 2h of beam within a stay of 5 days
  - Total accesses: **40**, until March 31, 2013 (end of EUCARD)
  - Estimated number of users: **20**
  - Estimated number of days spend at the infrastructure: **200**
  - Estimated number of projects: **4**
HiRadMat Project Structure

A & T Sector Mgmt

HiRadMat Facility Project
Project Leader: I. Efthymiopoulos
Deputy PL: S. Evrard

Project Phase
Proton beam WG
M. Meddahi, C. Hessler

WANF Dismantling WG
S. Evrard, Hel. Vincze, C. Theis

Irradiation area WG
A. Pardons, S. Evrard

Operation
Commissioning Coordination
M. Meddahi

User Selection Panel

IEFC Committee

- Physicist in charge: I. Efthymiopoulos
- Engineer in charge: S. Evrard
- Beam Operation & Monitoring: CCC
- Area Manager: D. DePaoli
- User support team:
  - engineering: A. Pardons
  - tech. support: M. Lazzaroni, MEF

- Project Planning: H. Gaillard
- Layout & Integration: P. Trihle, C. Magnier
- Waste Management: Y. Algoet, L. Ulrici