



High-Radiation to Materials

HiRadMat facility at the CERN SPS

More information at <http://cern.ch/hiradmat>

Adrian Fabich

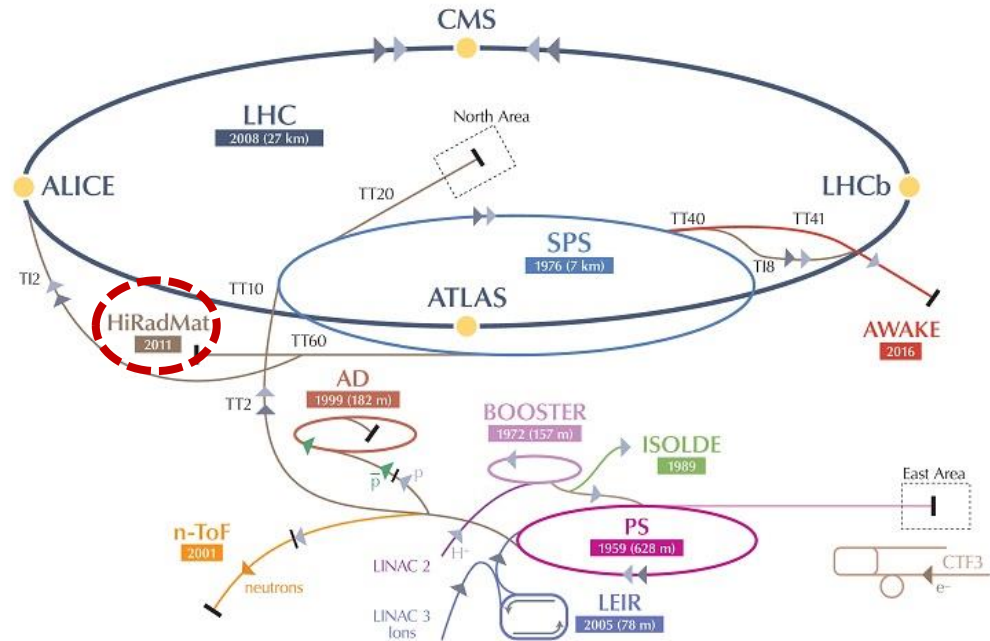
WAMAS at CERN, 19th-20th November 2013

Motivation of HiRadMat

- **Dedicated facility for studying the impact of intense pulsed beams on materials**

Move away from ad-hoc setups for material tests

- material damage
- material vaporization
- Thermal management
- Radiation damage to materials
- Thermal shock - beam induced pressure waves



- **Application areas:**

- materials R&D
- high-power targetry
- benchmark tests
- (survival of) beam line components (windows, coating, vacuum)
- ...

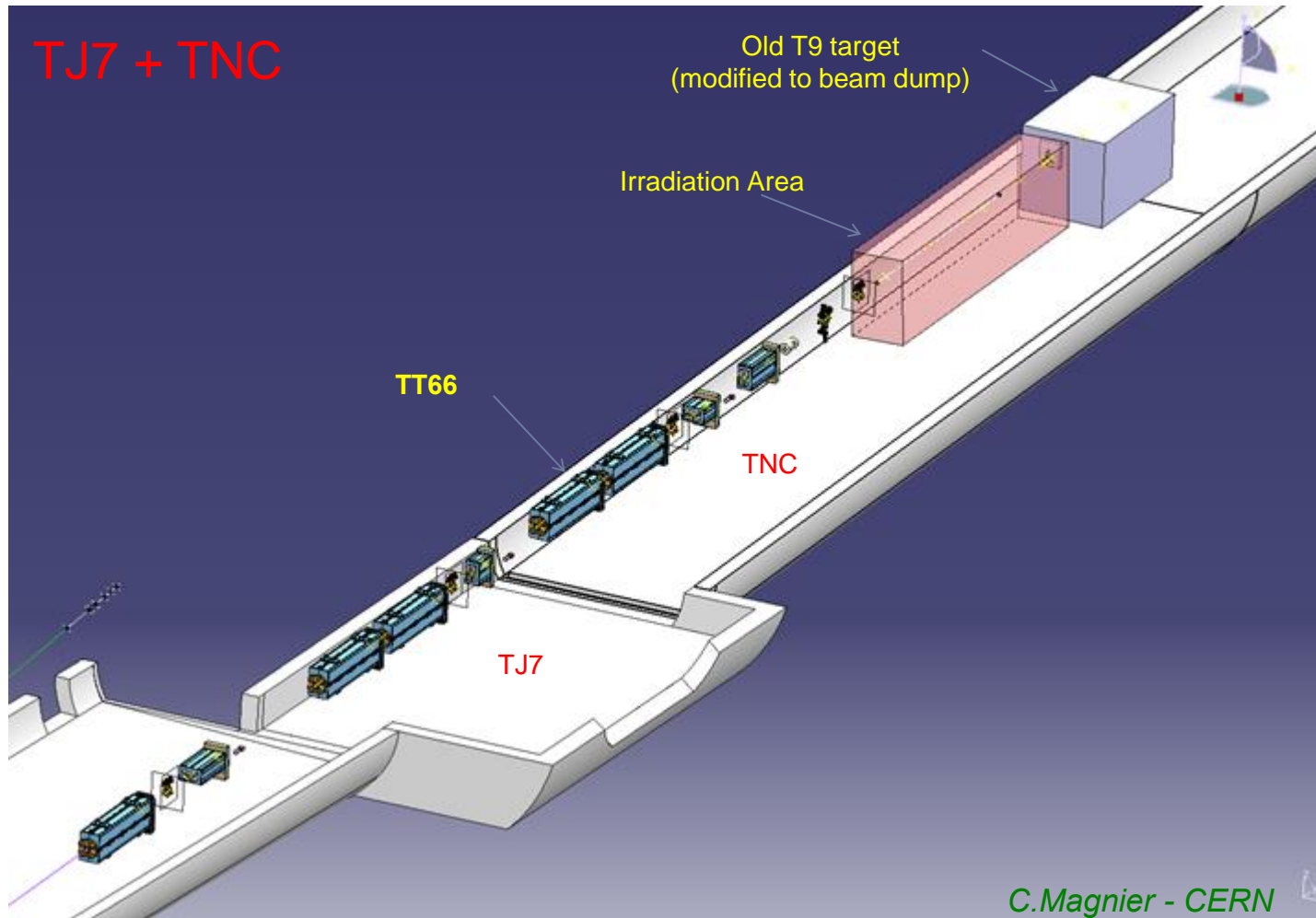
SPS beam parameters

- LHC injection like beam

	Protons	Heavy ions (Pb ⁸²⁺)
Beam energy	440 GeV	173 GeV/u
Bunch intensity	$3 \cdot 10^9$ to $1.7 \cdot 10^{11}$	3 to $7 \cdot 10^7$ ions
Bunch length	11.24 cm	
Bunches/pulse (max)	288	52
Pulse intensity (max)	$5 \cdot 10^{13}$	$4 \cdot 10^9$
Bunch spacing	25, 50, 75 or 150 ns	100 ns
Pulse length (max)	7.2 μ s	5.2 μ s
Cycle length	18 s	13.2 s
Beam spot	variable around 1 mm ²	
Pulse energy (max)	3.4 MJ	21 kJ

- Annual ion budget limited to $\sim 10^{16}$ proton on target

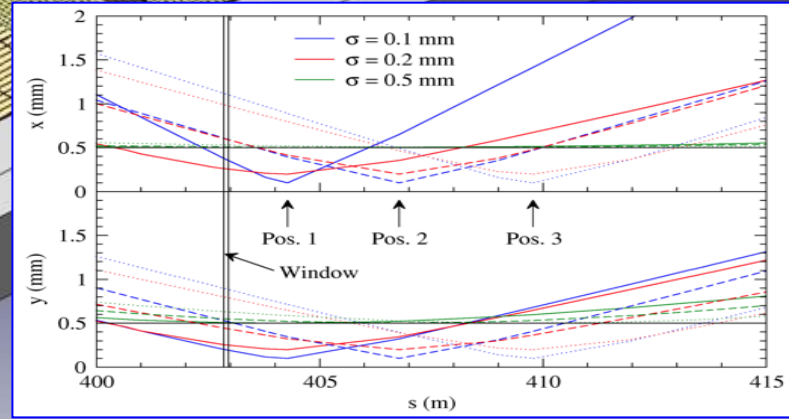
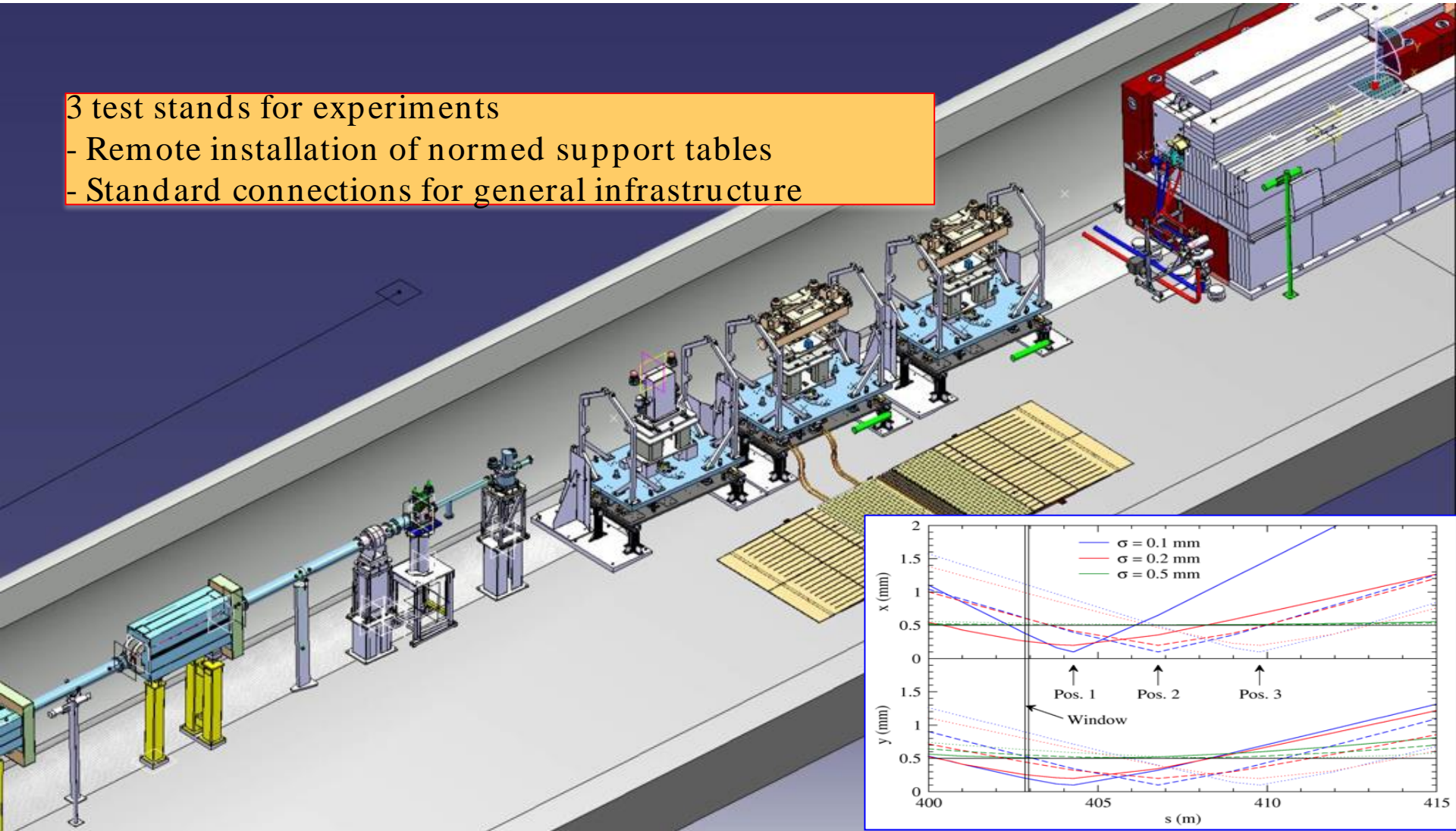
Layout Experimental Area



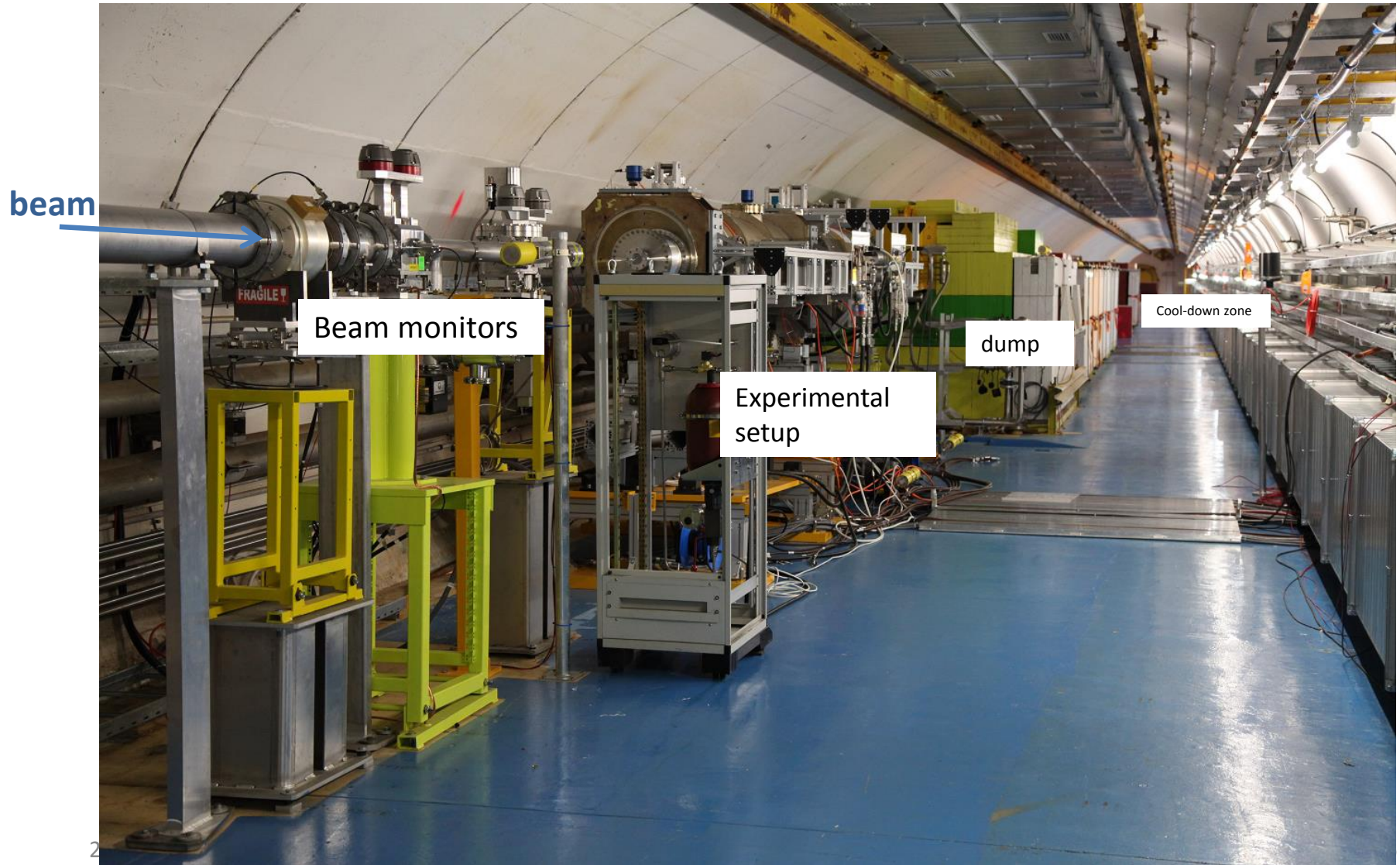
C. Magnier - CERN

Layout Experimental Area

- 3 test stands for experiments
- Remote installation of normed support tables
- Standard connections for general infrastructure



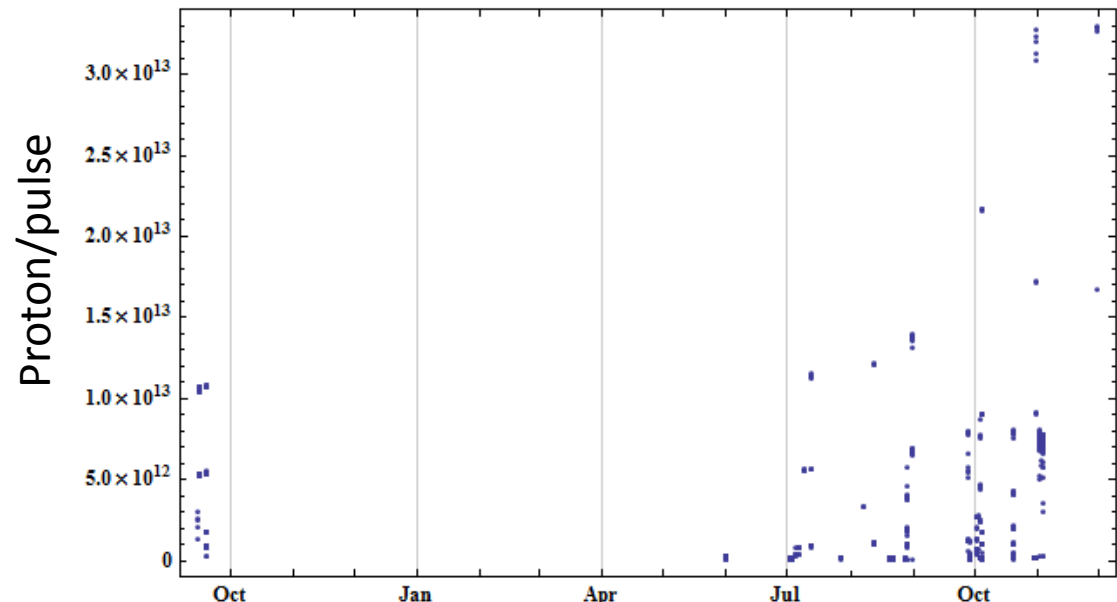
Target area



History

- Commissioned in 2011
- Operational since May 2012
 - 9 experiments/tests completed in 2012

Total
 2×10^{16} pot



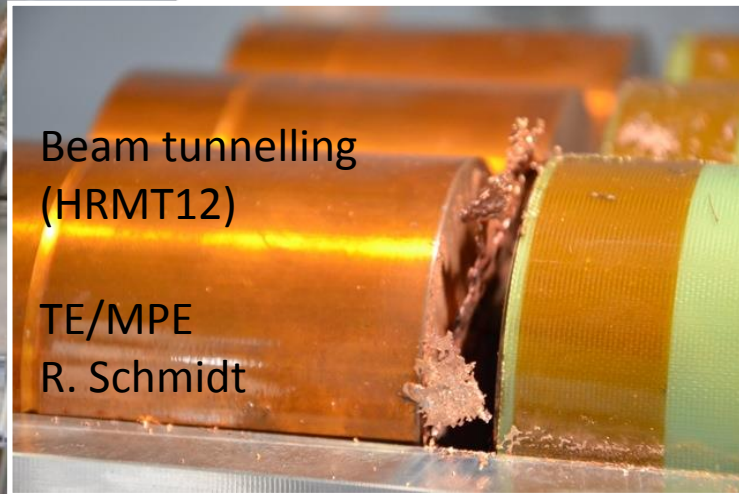
- Restart operation in Autumn 2014

Completed experiments in 2012

9 experiments in total

- Material studies
 - Benchmarking
- Testing of accelerator components
 - Collimators, vacuum windows, targets
- Performance of detector technologies

Material/collimator tests

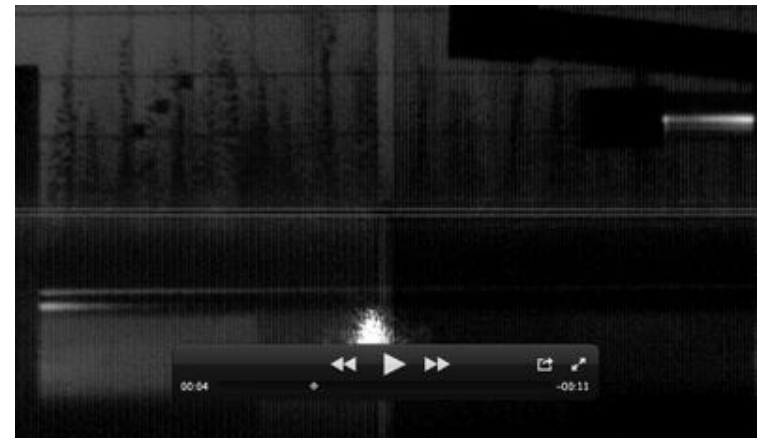
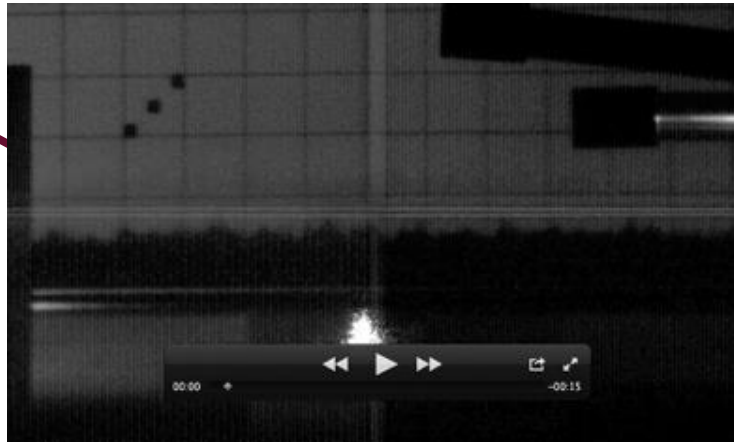
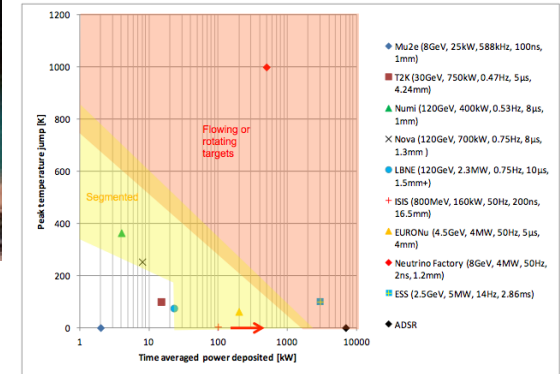
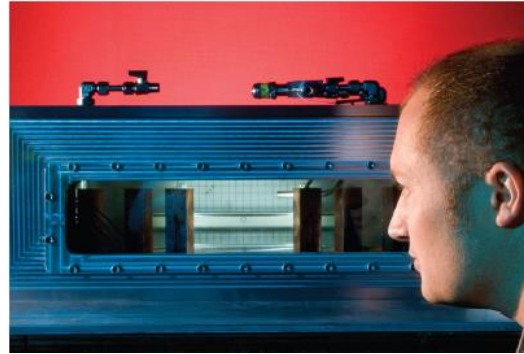
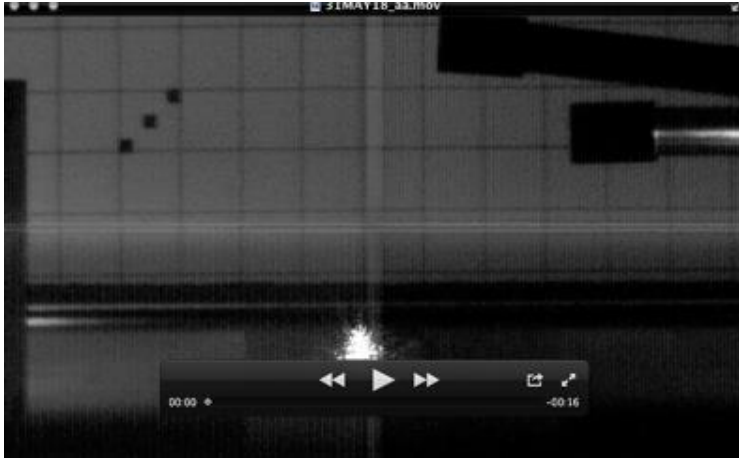


Collimator
Materials
(HRMT14)

EN/MME
A. Bertarelli

See <http://cern.ch/hiradmat> for links

W-Powder Target for high power proton beams

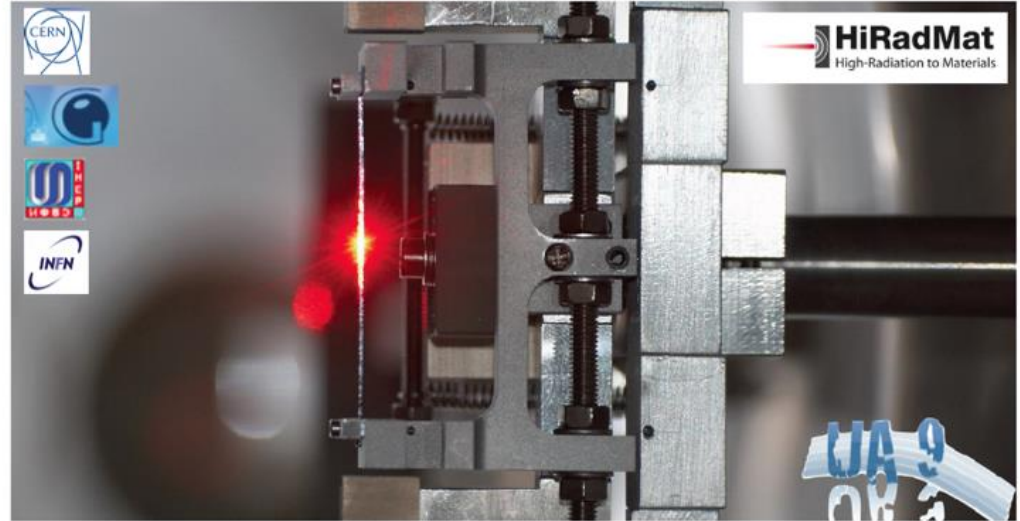


Courtesy HRMT10, N. Charitonidis, C. Densham

time



Crystal collimators



HiRadMat Scientific and Technical board - 18 October 2012

Proposal of the HRMT16- UA9CRY experiment

Simone Montesano (CERN – EN/STI)

Reporting on the work by many people including:
A. Lechner, M. Di Castro, C. Maglioni, A. Perillo
Marcone, J. Lendaro, F. Loprete, M. Calviani, G.
Smirnov, R. Losito and W. Scandale



Robustness test of a beam septum protection
collimator; 9 m long experimental installation

J. Borburgh, CERN TE

Detector testing

Radiation-protection detectors in neutron and mixed radiation field



Transnational Access

- HiRadMat is member of FP7/EuCARD².

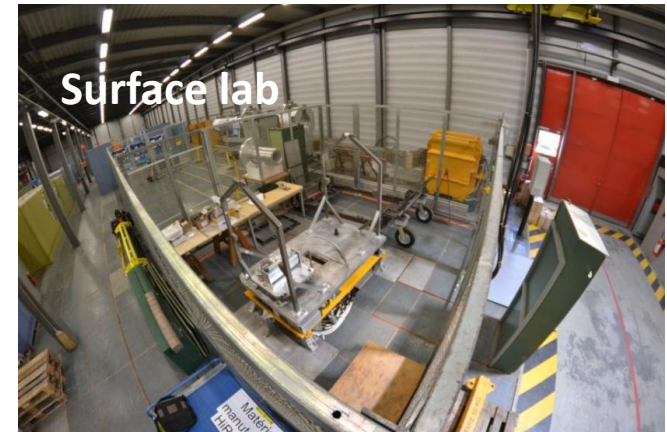


- HiRadMat is available to member countries
 - Financial support granted on participation
 - Travel, accommodation and technical support
- More information at <http://cern.ch/hiradmat>

Facility services

Provision of dedicated irradiation infrastructure

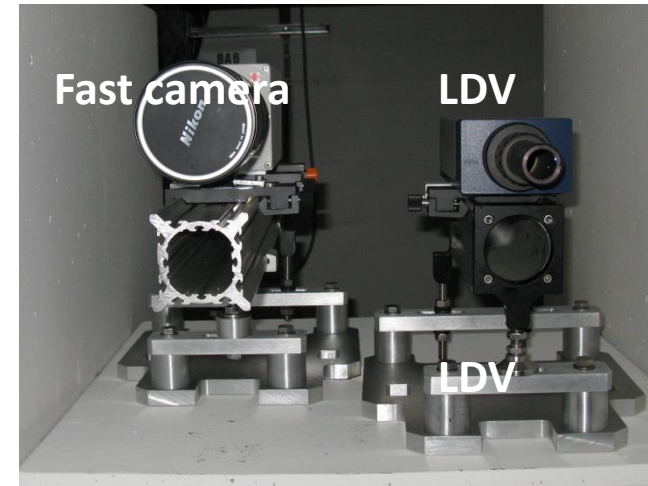
- Preparation lab at surface
 - Same interfaces as in the tunnel
- Control room
- Irradiation position
 - Standardized installation (remote)
 - General supplies (water, electricity, cabling)
 - Beam monitoring
- Observation tools
 - Camera, LDV (EN/STI), BLMs (diamond)
- Application/logistics/installation at CERN



Measurement tools

With the expertise of various groups at CERN

- Laser-Doppler vibrometer
 - Measuring surface velocities of several m/s
 - tens of MHz sampling
- Optical high-speed recording
 - High-speed camera with several kHz frame rate
- Diamond detectors, strain gauges, temperature sensors, microphones ...
- Transverse beam monitoring
 - High precision (< 0.1 mm) alignment to experimental tables
 - Based on pCVD diamond detectors





Outlook

HiRadMat is a unique facility, specially designed to perform experiments with high energy beams impacting on materials.

- Call for new proposals by January 2014
 - Experiments need preparation time
 - For any discussions we are open right away!
- SPS beam will return:
 - Protons in autumn 2014
 - Argon ions early 2015

HiRadMat is participant to the EUCARD/EUCARD2 Transnational Access program - some financial support to HRMT experiments available.

Visit <http://cern.ch/hiradmat> for more information;
Contact hiradmat.sps@cern.ch