

WP5: HiRadMat@SPS – STATUS REPORT

Outline

- ❑ HiRadMat – overview/reminder
- ❑ Project status
- ❑ Next steps

I. Efthymiopoulos – CERN



The poster for the EuCARD 2010 Annual Meeting features a blue background with a central white oval containing the EuCARD logo. Above the logo is the text 'Technology' and the European Union flag. Below the logo, the text reads 'European Coordination for Accelerator Research & Development' and '1st ANNUAL MEETING 14 - 16 APRIL 2010, STFC/RAL - UK (13 April for WP meetings)'. A welcome message follows, stating: 'Welcome to the first annual meeting of EuCARD. This meeting will combine summaries and highlight talks on the advancement of the work in fields as varied as high field magnets, collimation, linear collider technologies, novel accelerator concepts, networking of the neutrino and accelerator communities and open facilities. One day will be dedicated to other European projects on accelerators, to discussions on the future organization of EU accelerator R&D and to the RAL facilities. The meeting is open to EuCARD and ESGARD members. Other interested participants are welcome to attend, within the limits of the meeting capacity.' Below this, two committees are listed: the Steering Committee and the Organising Committee. The Steering Committee members include Jean-Pierre Estebois (Project Coordinator, CERN), Ralph Assmann (CERN), Herman McCubbin (STFC), Martin Ringold (DFV), Oliver Wigley (CERN), Vincenzo Pallavicini (DFV), Olivier Brunser (CERN), Silvia Passal, Darkan Uzun, Cécile De Righi (CERN), Ryszard Roszko, WUT, Rob Stammers (STFC), Jens Steinmann (CERN), Hans Hübner, CERN, Frédéric Barrot, CERN, Erik Jensen, CERN, Alessandro Vercelli, CERN, Kato Kaku, CERN, and Frank Hasslermann, CERN. The Organising Committee members include Tony Wells (CERN), Chris STFC, RAL, Rob Edwards (STFC, RAL), David Board (STFC, RAL), and Michele Ciadon, CERN. A central image shows a circular particle accelerator structure. At the bottom, there is a registration box with the website 'www.cern.ch/EuCARD2010' and contact information 'Contact: EuCARD-2010@cern.ch'. Logos for 'Sponsored by' Science & Technology Facilities Council and CERN are also present.

Technology

EuCARD

European Coordination
for Accelerator Research & Development

1st ANNUAL MEETING
14 - 16 APRIL 2010, STFC/RAL - UK
(13 April for WP meetings)

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STEERING COMMITTEE

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Frank Hasslermann, CERN

ORGANISING COMMITTEE

Tony Wells, CERN, STFC, RAL
Rob Edwards, STFC, RAL
David Board, STFC, RAL
Michele Ciadon, CERN

REGISTRATION
www.cern.ch/EuCARD2010
Contact: EuCARD-2010@cern.ch

Sponsored by
Science & Technology
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EUCARD Annual Meeting
RAL-UK, April 14, 2010

The HiRadMat Facility



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Goals

- Facility to study the impact of intense pulsed beams on materials
 - ▣ Thermal management (heating)
 - material damage even below melting point
 - material vaporization (extreme conditions), cavitation
 - ▣ Radiation damage to materials – change of properties
 - ▣ Thermal shock - beam induced pressure waves

- Important test bed for the design validation of LHC near-beam components before installation in the machine

- Uses an **LHC-type beam @450 GeV from 1-288 bunches, $1.1-1.7 \times 10^{11}$ ppb**

- **Foreseen clients** : LHC collimators, protection devices, machine components, material studies (bulk, superconductors), high-power targetry, irradiation tests of electronics

- **Transnational Open Access within EUCARD to other teams**

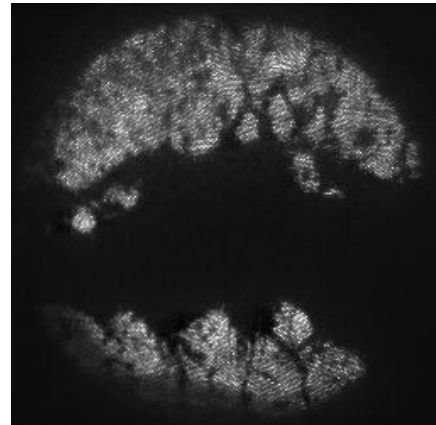
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3 Examples – beam impact on materials

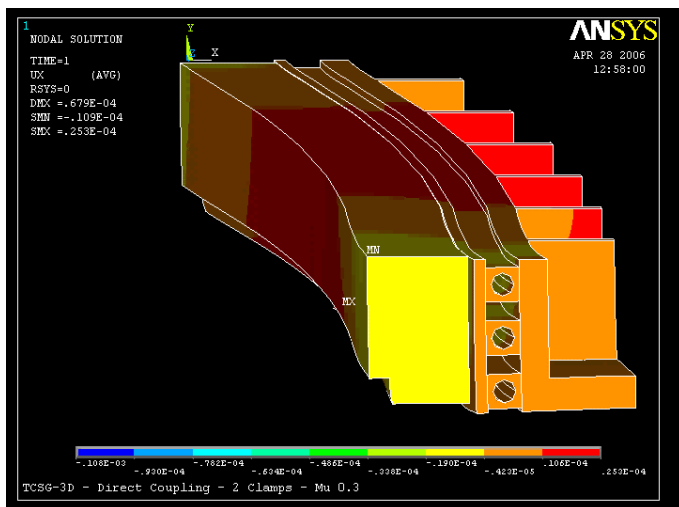


High-intensity beam on a solid target (Tu)

Courtesy: J. Lettry, CERN

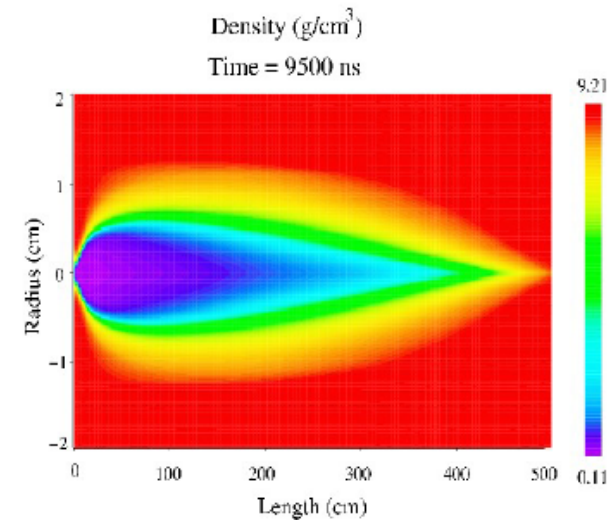


MERIT experiment: High-intensity beam on a liquid Hg-target



LHC collimator:
Displacement analysis
– 500kW load case for 10s
Loss rate 4×10^{11} p/s
(Beam Lifetime 12min)

Courtesy: R.Assmann, CERN



High Energy Density Plasma formation, proton “Tunneling Effect”

Courtesy: N.Tahir, GSI

Making the HiRadMat Facility



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The challenges!

- Construct a high-intensity facility designed to test materials at their damage limits

....without destroying the facility itself !!



- Build ~300m of beam line and a HI irradiation facility without access to the areas!!

- ▣ *Access to underground areas is possible only during the short (movable) stops of LHC and the short 2010/2011 shutdown*

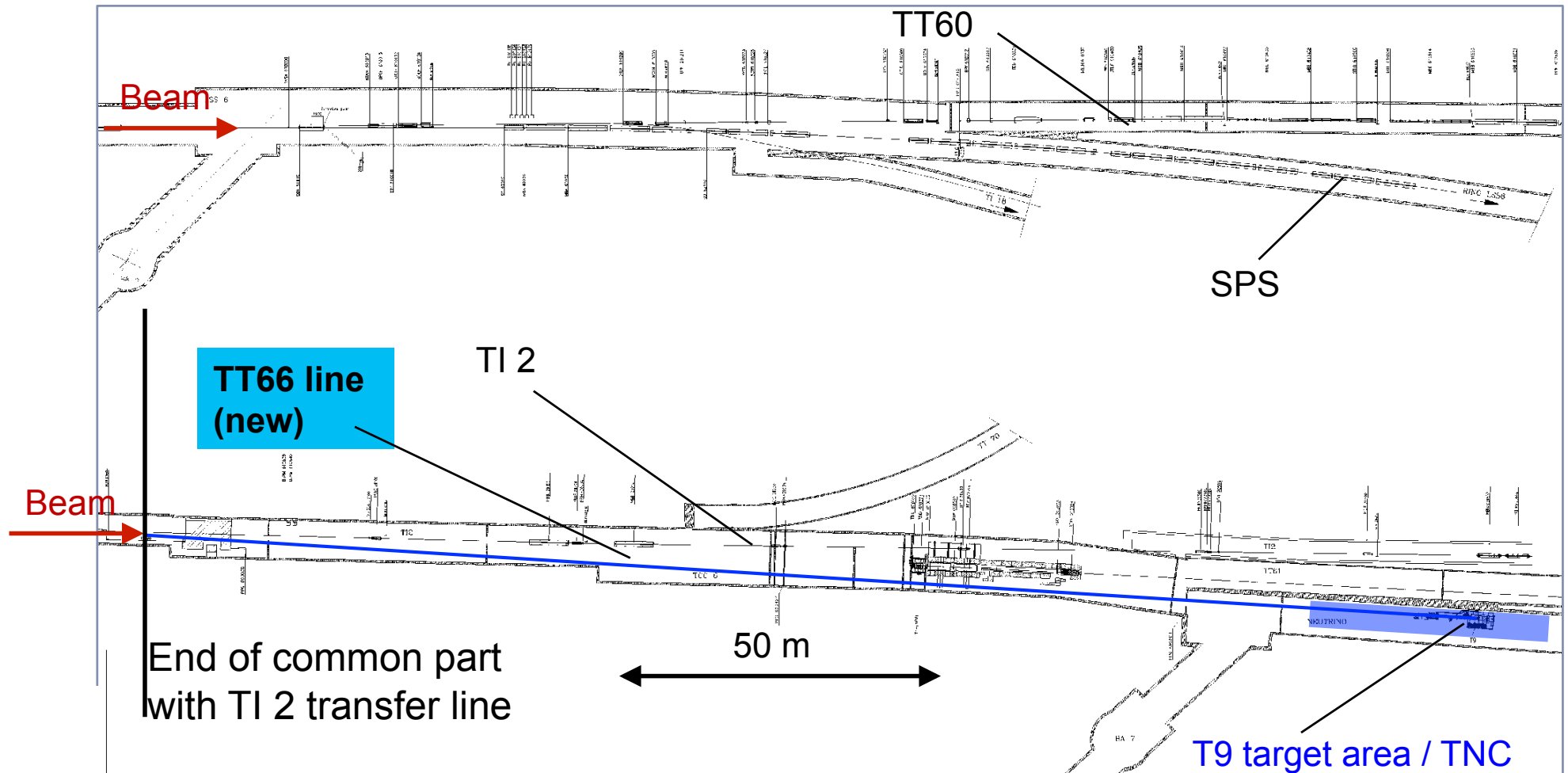


...flexible schedule, able to organize and do work in short notice

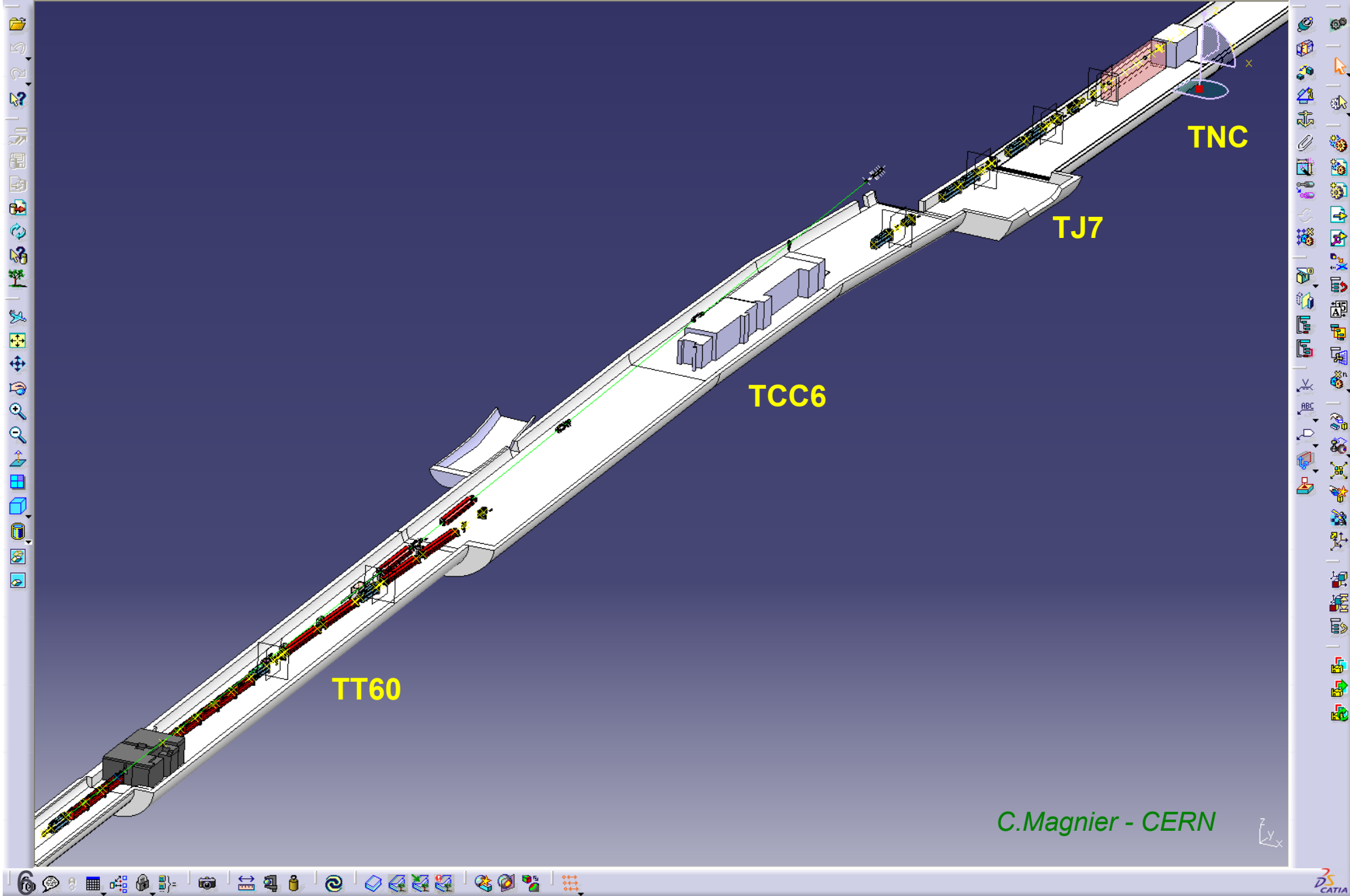
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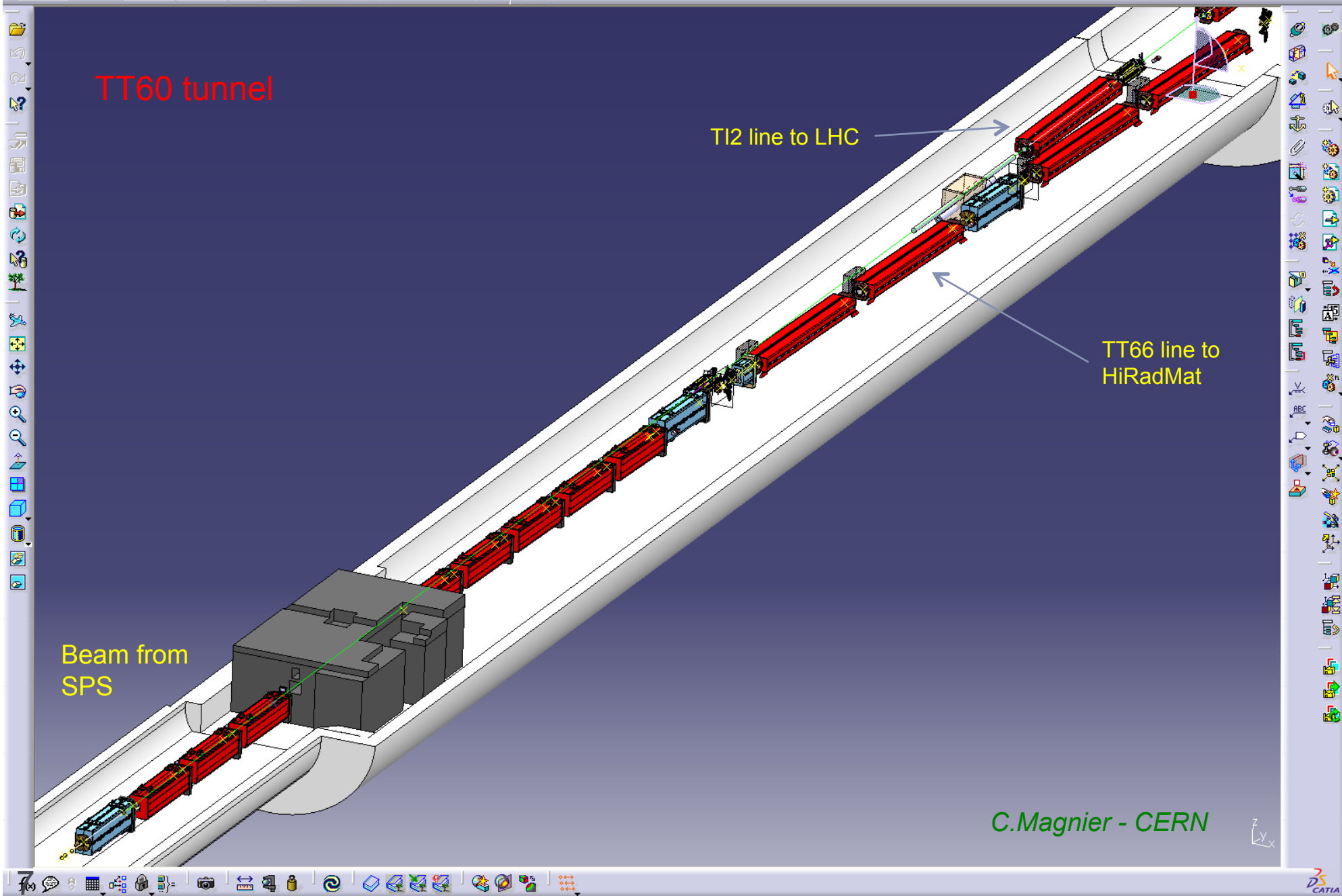
5 Primary beam layout



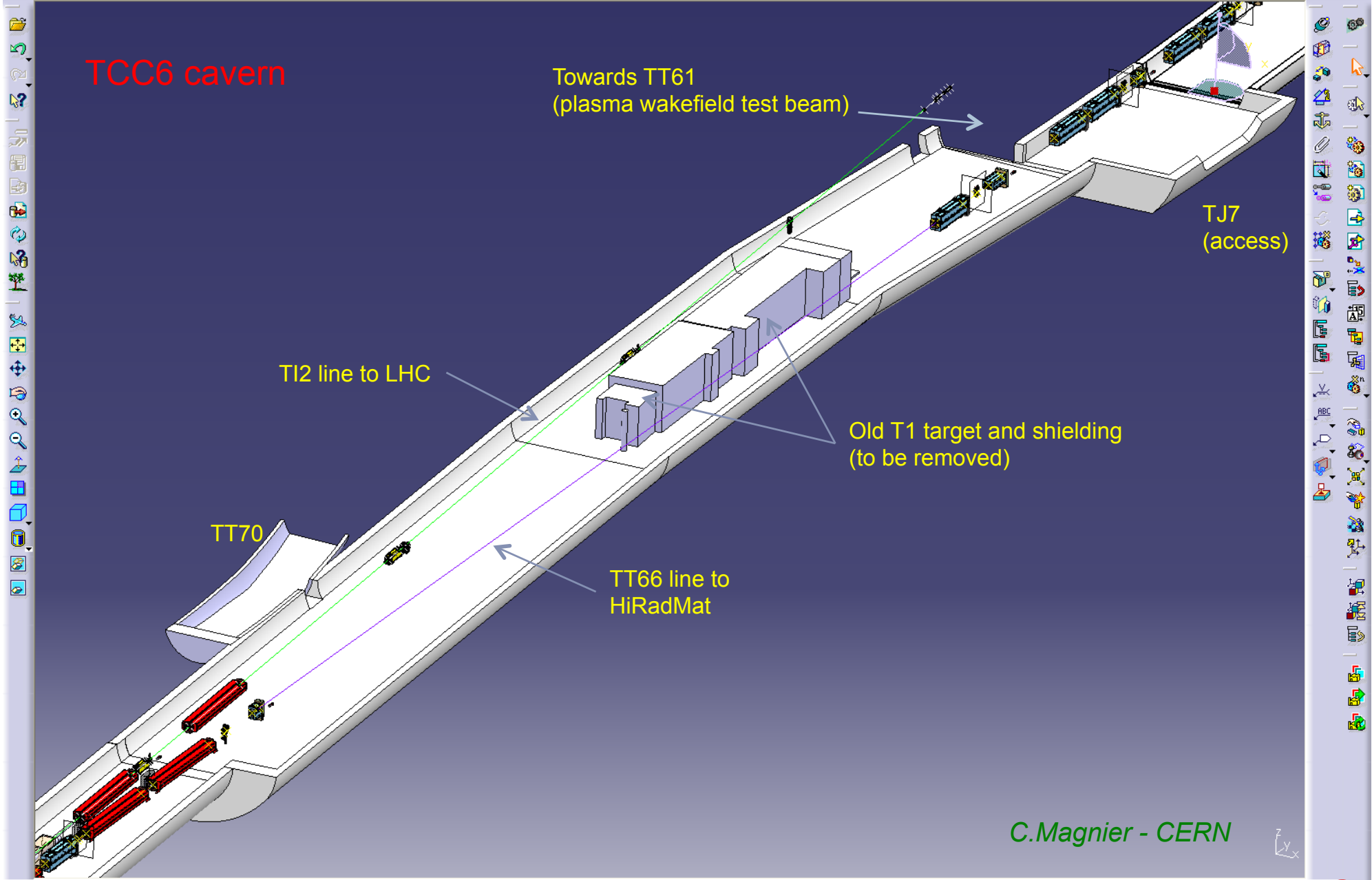
C. Hessler, 26/01/09

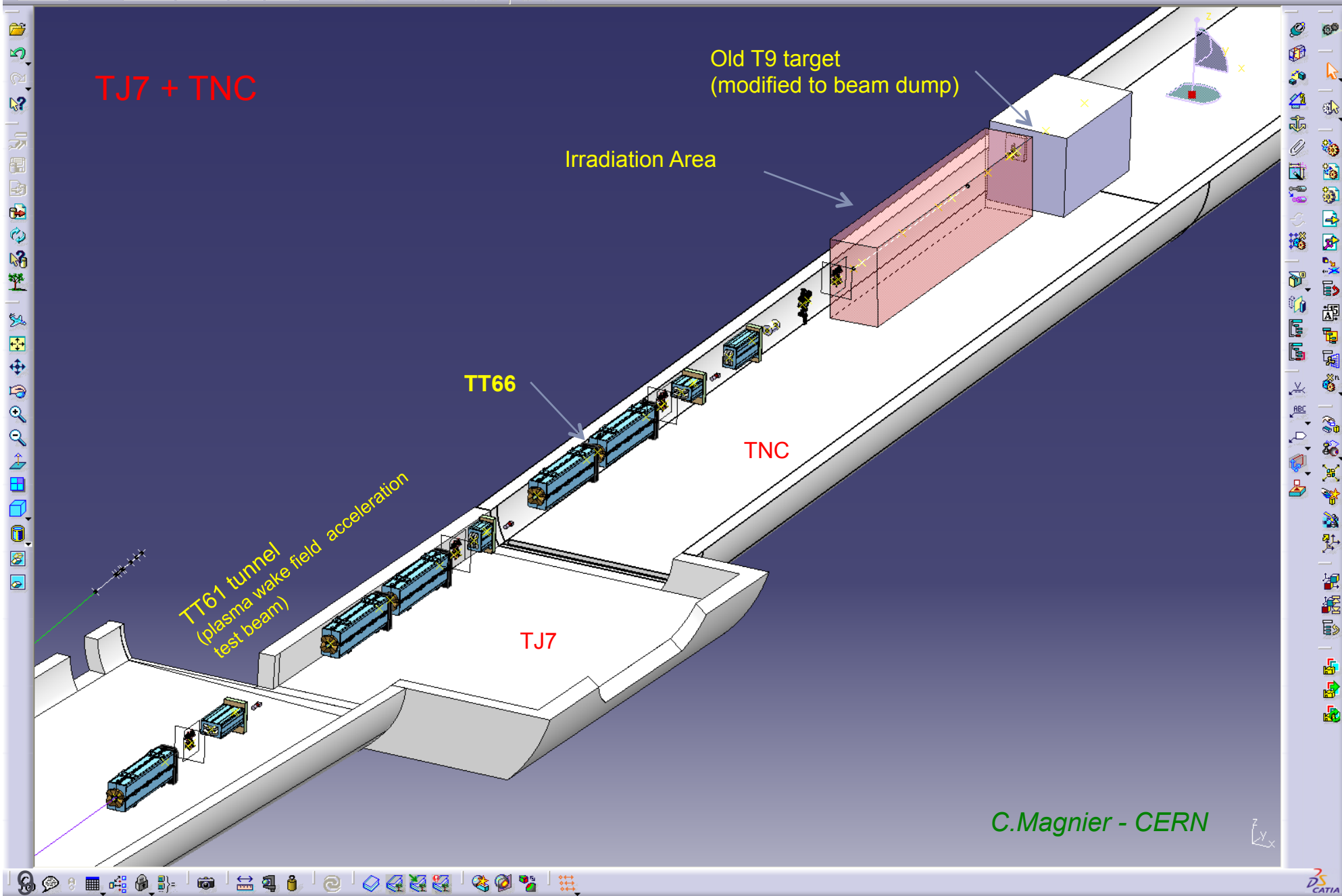


C.Magnier - CERN



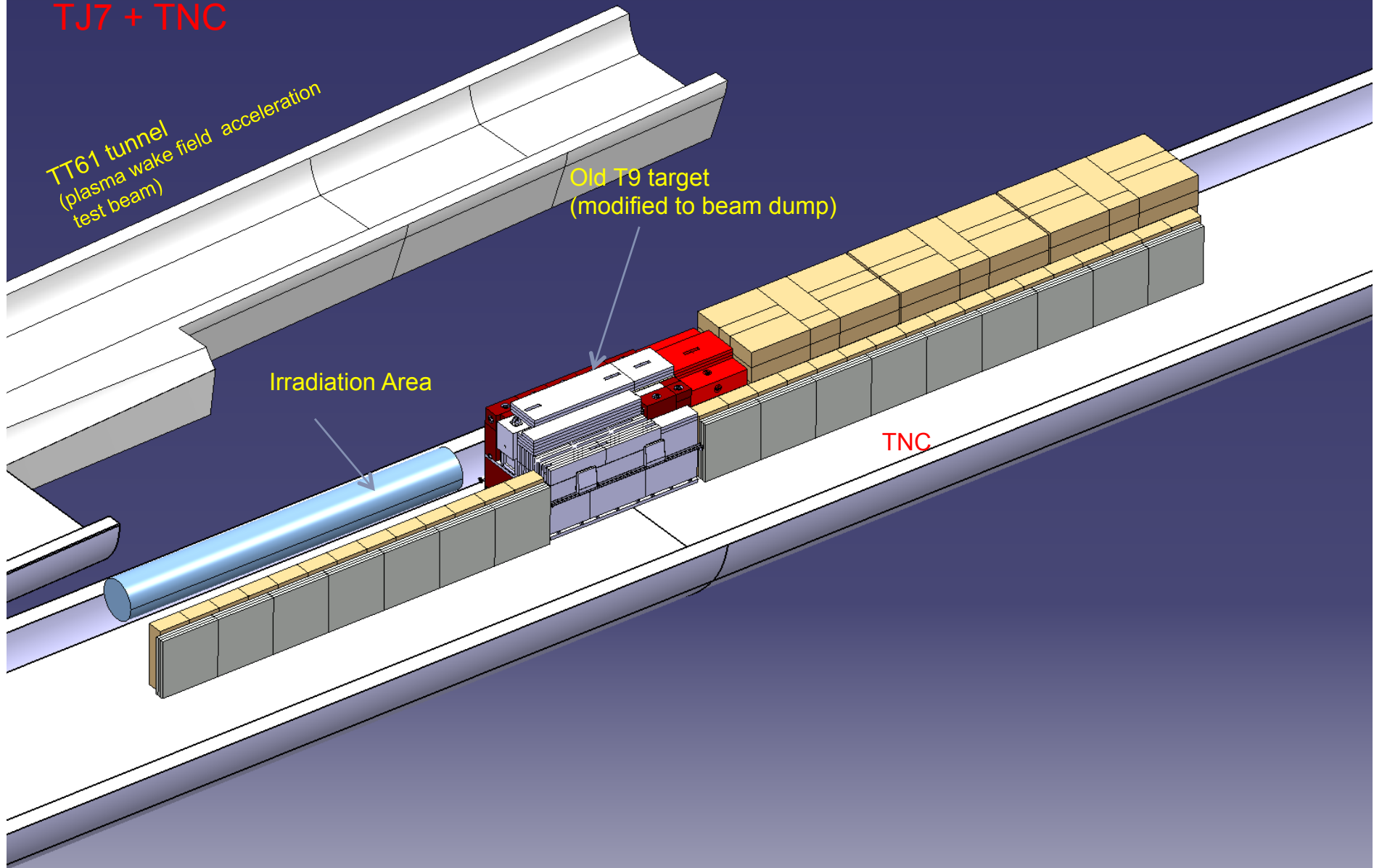
Select an object or a command





C.Magnier - CERN

TJ7 + TNC



M.Lazzaroni - CERN

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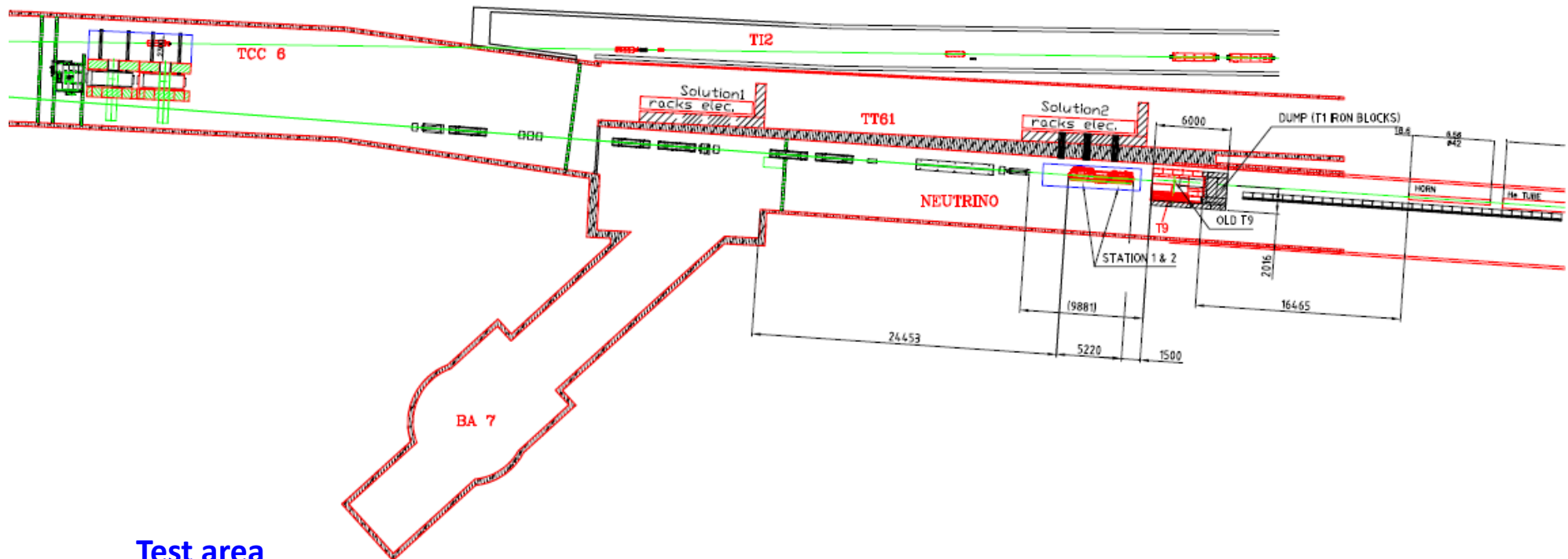
11 Primary proton/ion beam parameters

Parameter	Unit	Value (proton beam)	Value (lead ion beam)
Beam energy	GeV	450	36.9×10^3 (177.4 GeV/n)
Bunch intensity	particles	5×10^9 to $1.15(1.75) \times 10^{11}$	7×10^7 to 3.64×10^9
Bunch length	cm	11.2	11.2
Number of bunches	-	1 – 288	1 – 52
Bunch spacing	ns	25	≥ 100
Pulse energy	MJ	2.4	21.5×10^{-3}
Pulse length	μs	7.2	5.2
Peak power	GW	340	2.3×10^{-3}
Normalized emittance (1σ)	μm	3.5	1.4
$\sigma_x \times \sigma_y$ at exp. (baseline)	mm^2	1.0	1.0
$\sigma_x \times \sigma_y$ at exp. (request)	mm^2	0.25 – 4.0	0.25 – 4.0
Integrated beam intensity (protons)		10^{16} protons/year 10 experiments $\times 10^{15}$ protons(max)/exp $\sim 30 \div 100$ extractions/exp	

Beam design: C.Hessler, M.Meddahi

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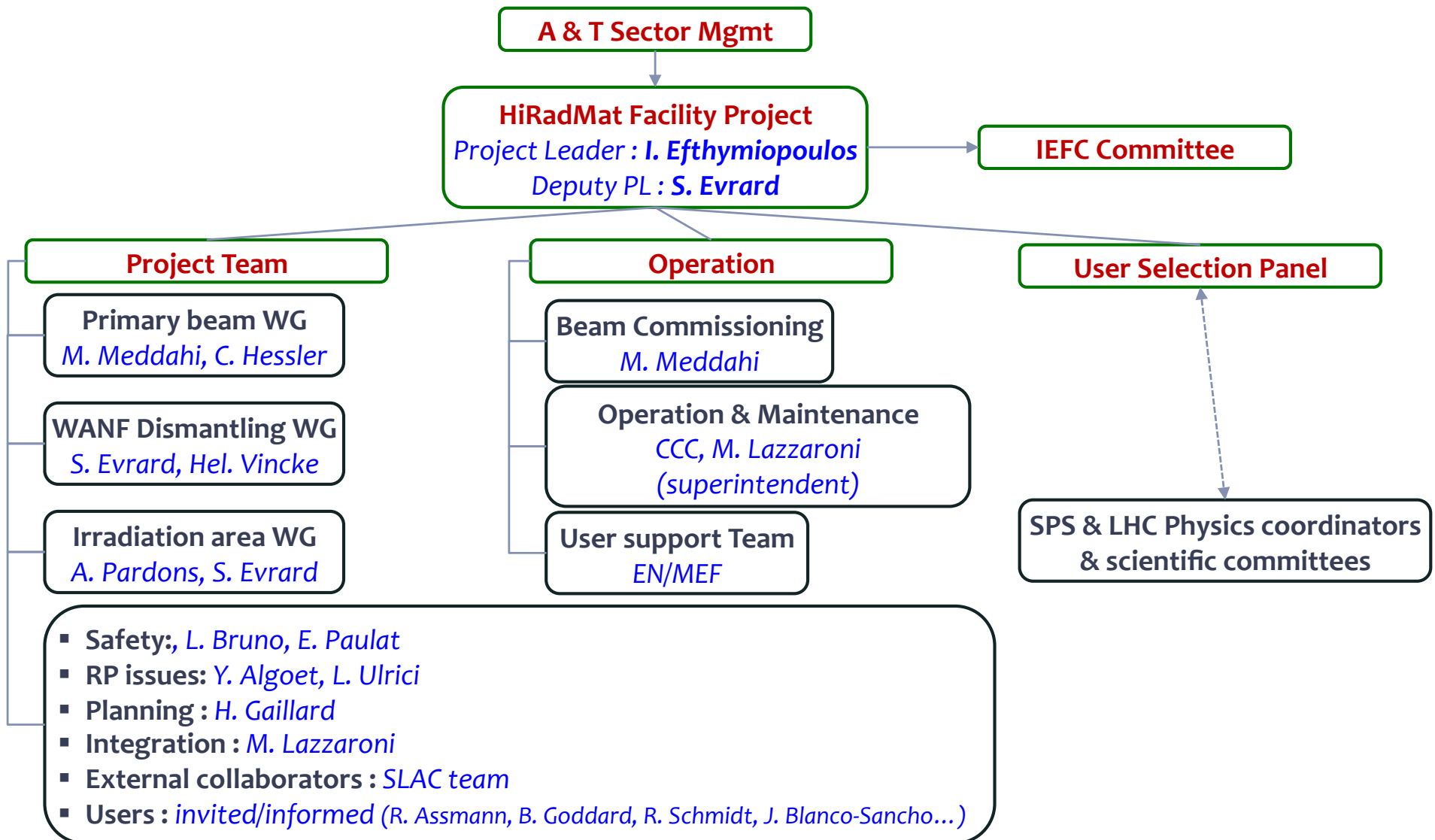
12 Irradiation area layout: TT66 line & TNC tunnel



Test area

- ~10 m long. space upstream the T9 target
- [1.5,3.0] m lateral space
- Possibility for fast installation of experiments
- Cool-down space downstream the TNC tunnel
- If requested, areas for test of electronics or component irradiation can be prepared

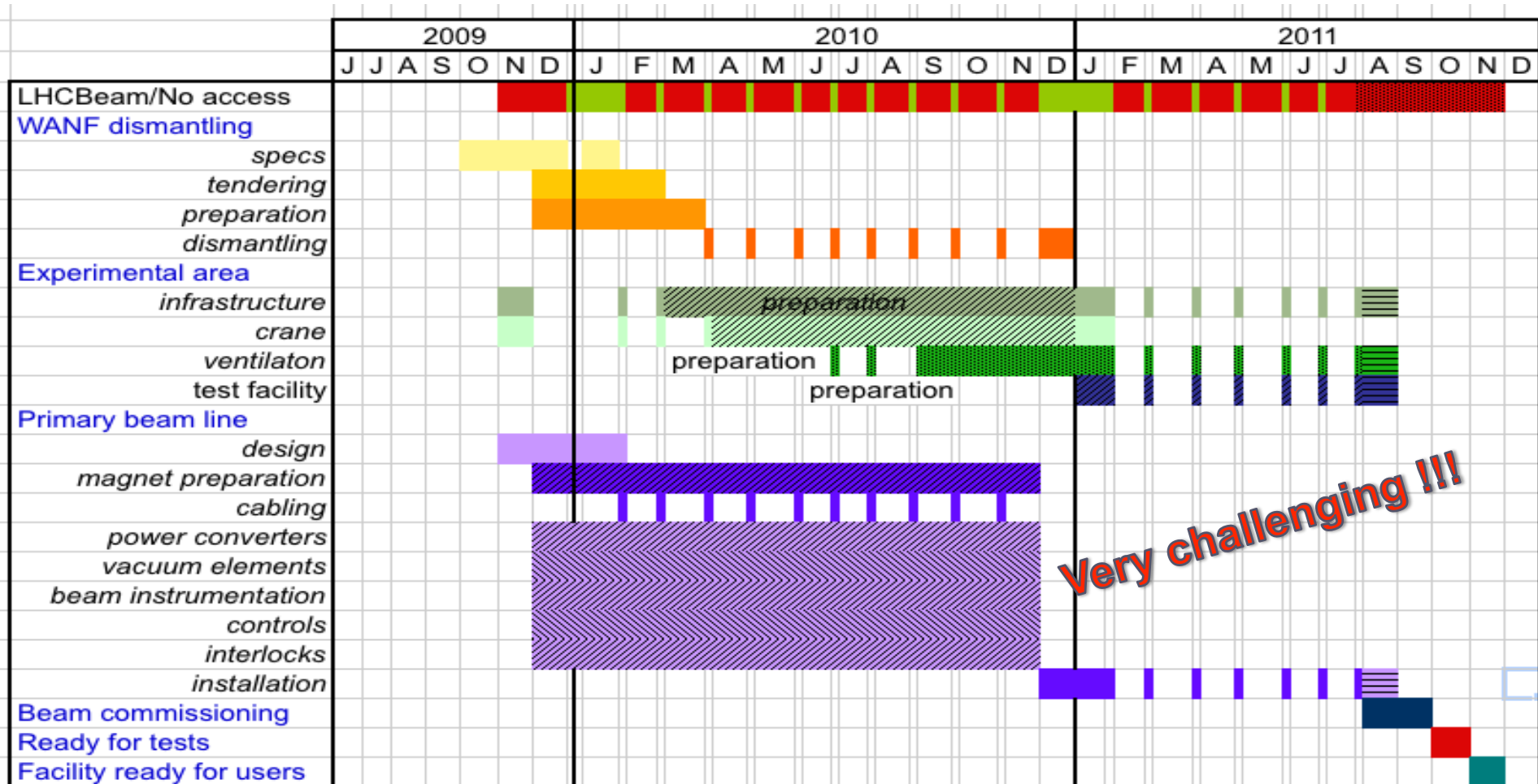
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Post-Chamonix 2010 schedule



14 Master schedule



Ilias Efthymiopoulos EN-MEF, Feb 2010

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Project status

- **Primary beam**
 - ▣ Design completed
 - ▣ Weekly meetings with equipment groups to monitor projects
 - ▣ Integration ongoing; installation schedule available

- **WANF dismantling**
 - ▣ Good progress → (photos)

- **Irradiation area**
 - ▣ Design ongoing : beam dump, test setup
 - ▣ Focus on services & infrastructure needed for the tests
 - ▣ **Safety issues**

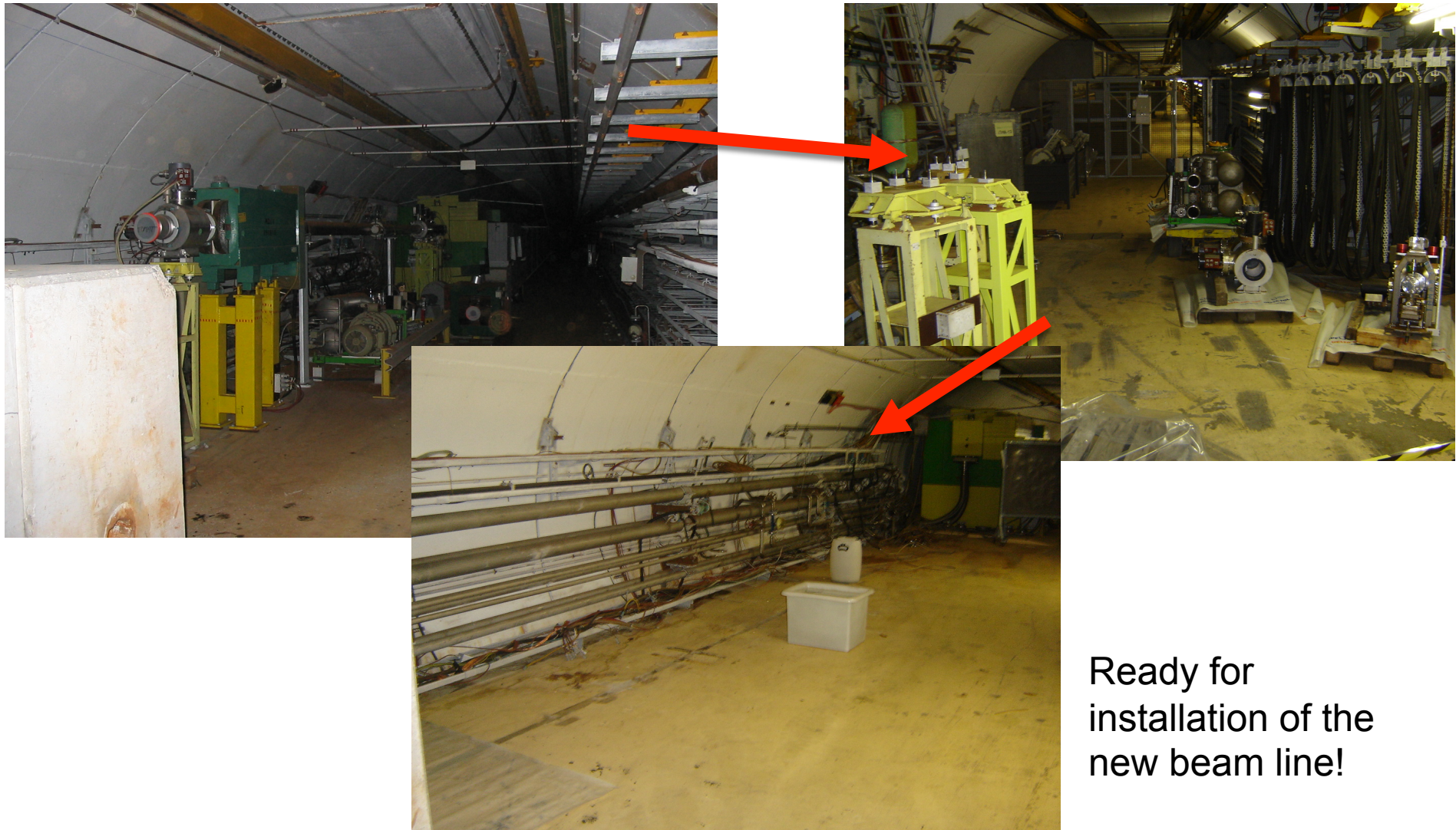
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16 Highlights – Dismantling old WANF beam line



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17 Highlights – Dismantling old TT66 beam line



Ready for
installation of the
new beam line!

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18 Highlights – Dismantling old T1 target

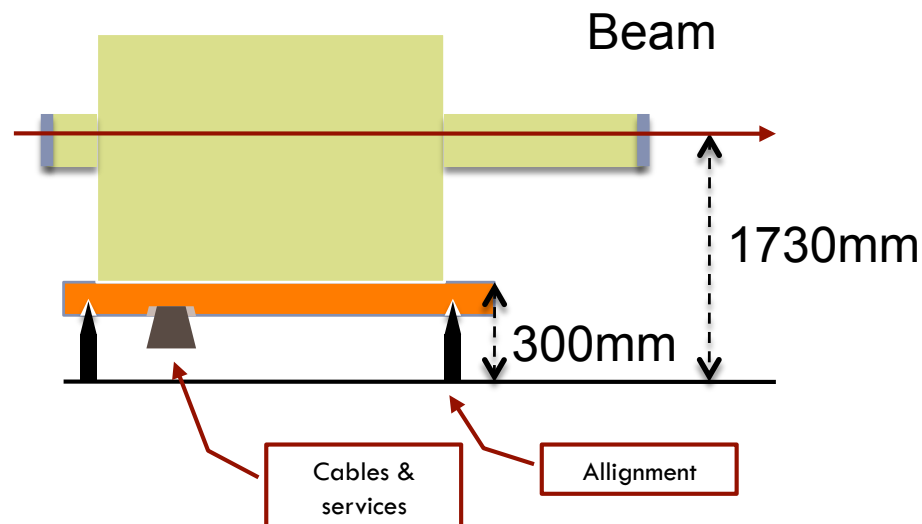
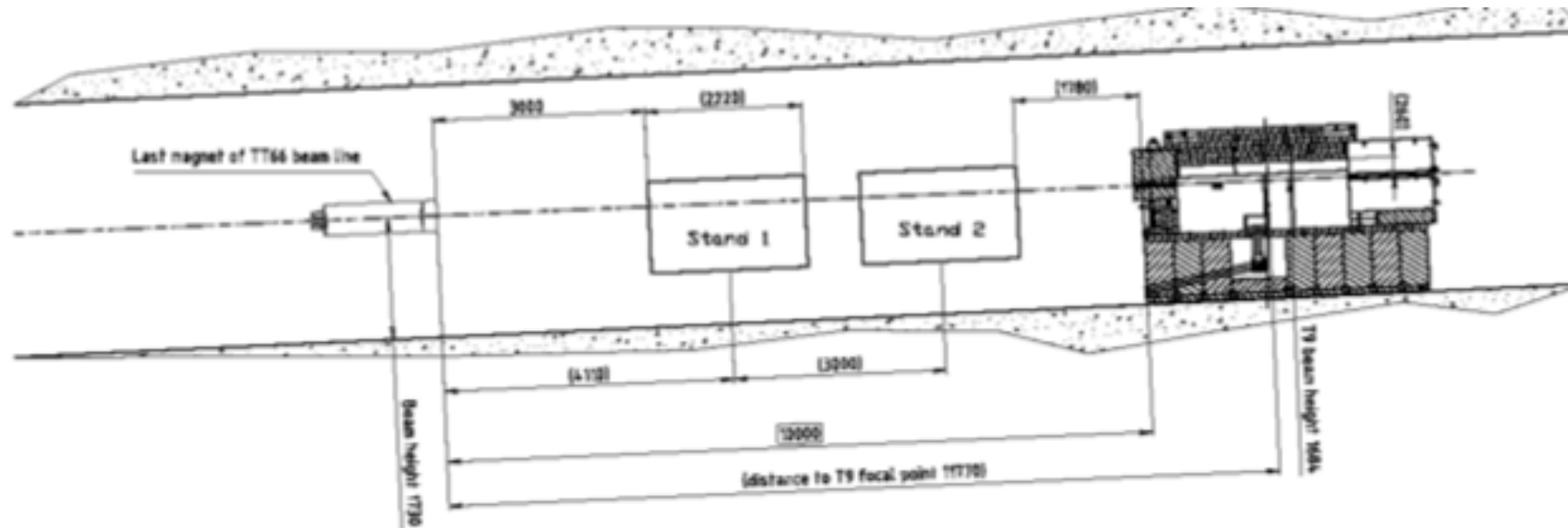


Existing passage for magnets!
Almost impossible → **decided to completely remove T1 target**



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19 The Irradiation area



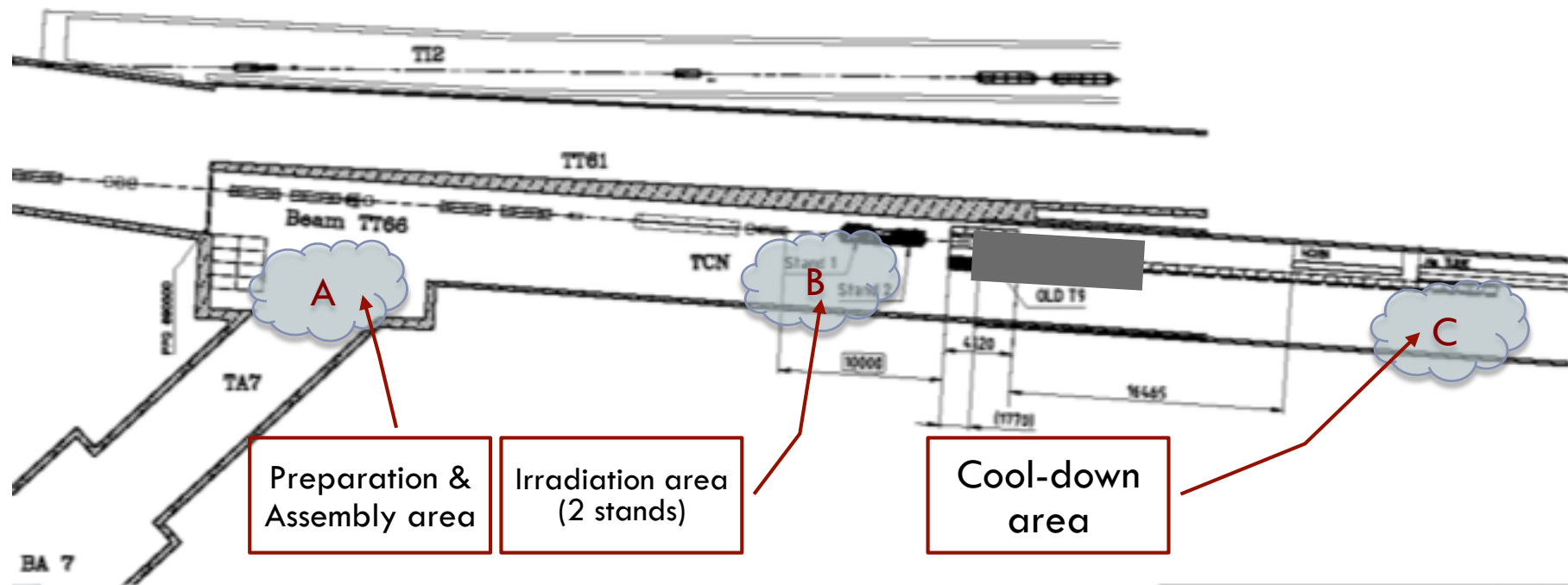
- ▶ Use base plate equipped with plug-in connectors for cables, cooling, etc. as interface
 - ▶ alignment to 0.1mm
 - ▶ remote operation with overhead crane – minimal human intervention for setup
 - ▶ Test equipment in vacuum or air depending on the test
- ▶ Beam windows is a critical issue → use same as CNGS

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The irradiation area

- ▶ Life cycle of a test setup:
 1. Prepare 1(2) test setups each on its 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 ...)
 3. Move them to the cool-down area
 4. Recuperate them later for inspection/analysis in the lab



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Open access

- Web pages for project and open access available

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

The HiRadMat Facility at CERN SPS

Home | HiRadMat&Collimation | WG1: Primary beam | WG2: WANF dismantling | WG3: Irradiation Area

The HiRadMat Facility at CERN SPS > Wiki Pages > Home

Home

Welcome to the High-Radiation to Materials (HiRadMat)

Introduction

The High Radiation to Materials (**HiRadMat**) facility is designed to allow testing of the impact of high-intensity pulsed beams. The facility was originally proposed by conceptual study and proposal was coordinated by R. Assmann and a [specificat](#) was produced. The creation of the facility was also [recommended](#) by the CERN F

Once build the **HiRadMat facility** will be commonly available to the CERN us [Transnational Access](#) and support to EU collaborators. Further information is

The facility is currently under construction, as approved [CERN project](#). The during the [2010-2011 shutdown](#). It will be opened to external access after co

Beam Parameters

Irradiation Area

Operation

The HiRadMat facility is open to all CERN users and external groups as all o

In addition, the facility has been awarded funds within the [EUCARD FP7](#) pro intersted in using the facility for tests of materials for accelerator or detector costs including studies for radiation protection and safety issues, and some the EUCARD [WPs](#) web pages.

Users are requested to submit an [application form](#) which will be considered t established on a yearly basis following the general CERN Accelerator compl is **September 1st** for the run period starting April to November of the followi



European Coordination for Accelerator Research and Development

[Publications] [Related Projects] [Industrial Partners] [Education] [General Public] [Search]

EuCARD >> Activities >> Transnational Access >> HiRadMat >> How to Apply

How to apply for HiRadMat Access

- Submission procedure
- Expenses covered
- Evaluation procedure
- Access Policy for oversubscriptions

Submission Procedure

If you are **eligible** to apply for Transnational Access, you can download and fill in the HiRadMat Transnational Access **application form** (Word file). Completed forms should be submitted to hiradmat-sps-pb@cern.ch

Submission deadlines

Applications for access in 2011 have a deadline of **1 September 2010**.
Applications for access in 2012 have a deadline of **1 September 2011**.

[Find out more about the HiRadMat facility >>](#)

Expenses covered

For applications that are approved, some expenses will be covered, details will follow in due course.

Visitors are strongly encouraged to seek accommodation on site at the CERN hostel, which can be reserved through the **CERN Housing Service**.

Evaluation Procedure

Incoming proposals will be examined by HiRadMat for formal compliance with the EU rules, and then forwarded to the

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Open Access

- **EUCARD/WP5 provides funds to support user teams to exploit the facility**
 - ▣ Application review at the **User Selection Panel**
 - ▣ Deadline : September each year for the next SPS run starting Spring the year after
 - ▣ **Need still to clarify the operation of the facility as it will eventually take beam time from the SPS physics program**

- **So far: 8 beam requests, four more in the pipeline**
 - ▣ **Contractual requirement: 20 users/10 projects**

- **To optimally exploit the facility, would be excellent to couple the existing support with :**
 - ▣ online monitoring, instrumentation (cameras, laser vibrometers, temperature measurements etc.)
 - ▣ beam-material impact simulation (also relevant for safety issues)
 - ▣ post-exposure analysis (lab, metrology, etc.)

...and finally agreement for waste

Possible collaborations or a new EU project with material science colleagues?

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Summary

- The design of the facility is being completed, presently focusing on the irradiation area
- The construction of the facility is advancing as access allow. The excellent collaboration and support from all teams is our way out to the very tight and uncertain schedule
- Our target to have the installation of the facility completed for Summer'11 remains; **and we look forward to welcome the first users later in the year after commissioning is completed**

Thank you!