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Engineering Department

Introduction to EuCARD2 WP 11: Collimator Materials for fast High Density Energy Density Deposition (ColMat-HDED)

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on behalf of Adriana Rossi (CERN) and Jens Stadlmann (GSI)

**EuCARD2 – WP11 Kick-off Meeting
CERN, Geneva – 9-10 December, 2013**



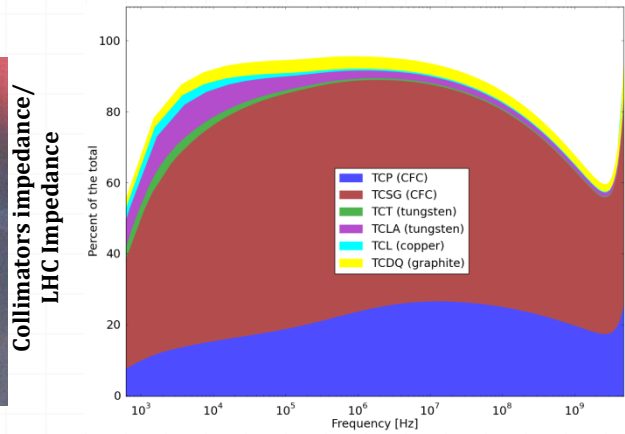
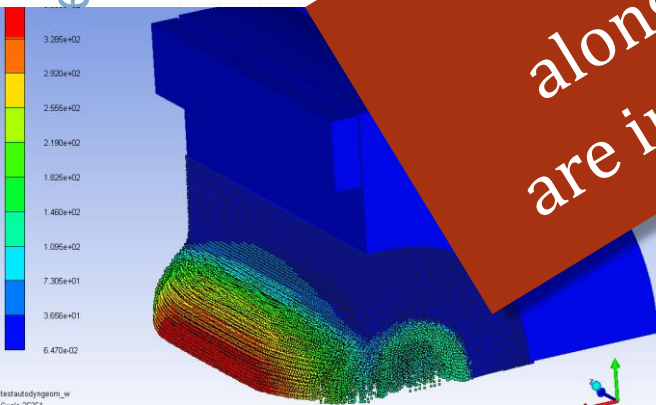
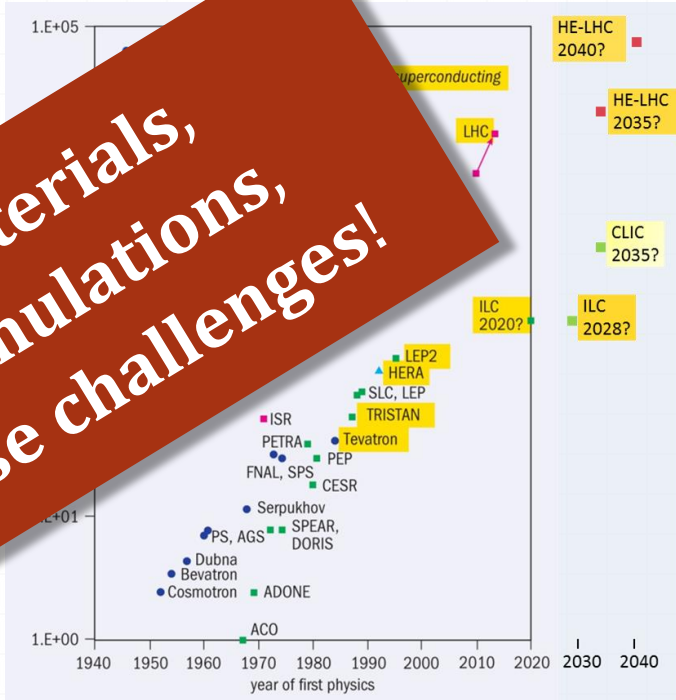
- **Context**
- Partners (WP11 and beyond)
- EuCARD WP8 Main Achievements: Highlights
- WP11 Tasks and Deliverables
- WP11 Objectives
- WP11 Status and Next Events

Context

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- LHC is reaching unprecedented **beam brightness** and **energy** leading to extreme **energy density (15 GJ/mm²)**
- At such energy densities **Beam-induced accidents** among the most dangerous events for particle accelerators.
- **Collimators** are inherently exposed to such events (**β^* reach** is determining factor)
- Collimators are, by far, the most vulnerable machine **impedance** sources and **instabilities** are a major concern

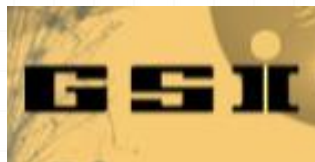
Development of advanced materials, along with state-of-the-art simulations, are instrumental in facing these challenges!



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- **WP 11 Partners (ColMat-HDED)**

ColMat-HDED



- **Partnership agreement with CERN (KN2045)**

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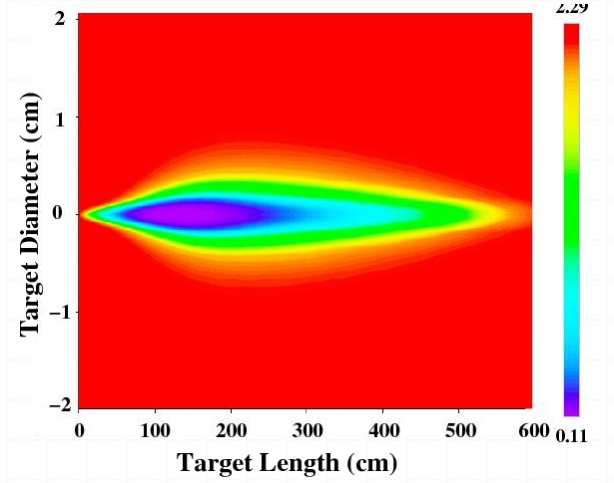
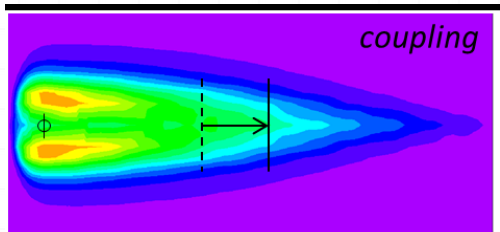
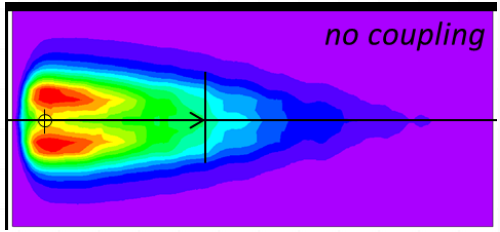
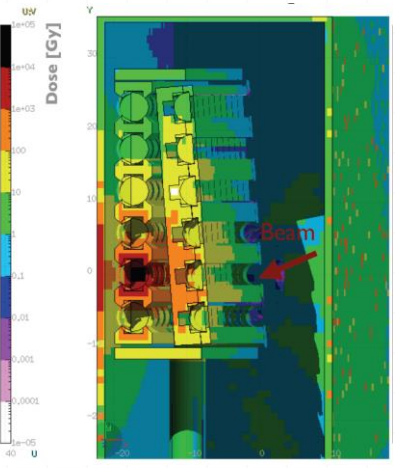
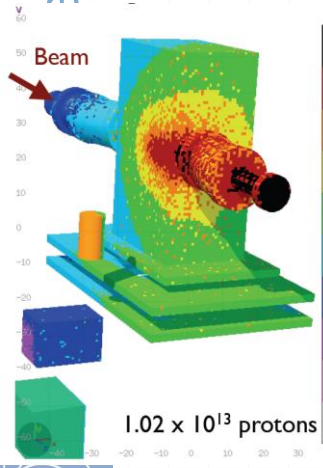
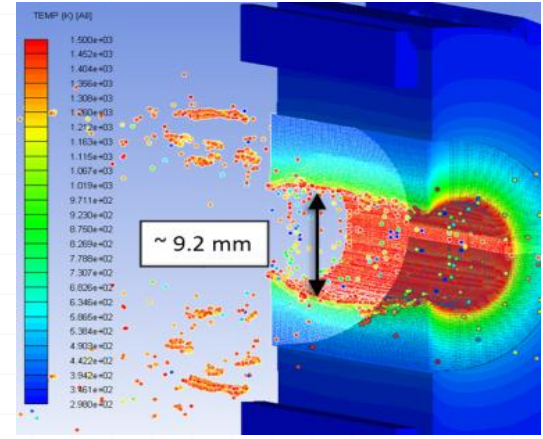
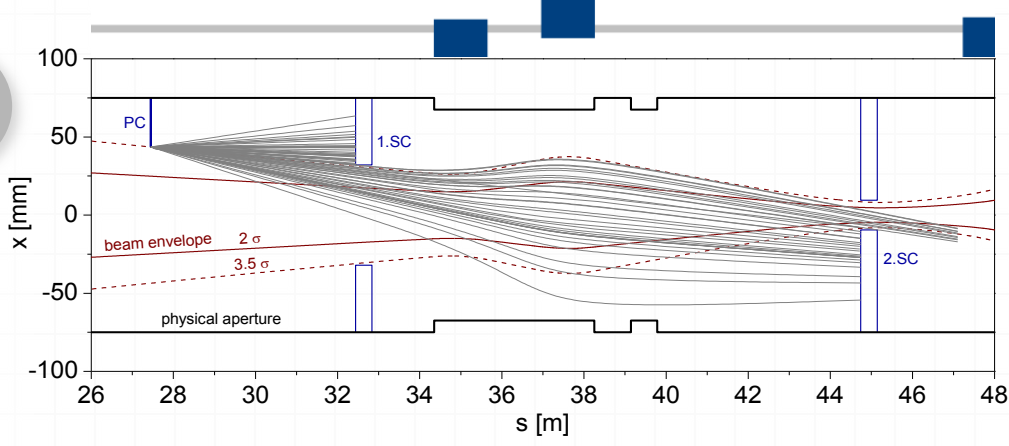
- **Collaboration with US-LARP**



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Numerical Simuations: Beam tracking, Fluka, Themo-mechanical, Hydrocodes ...

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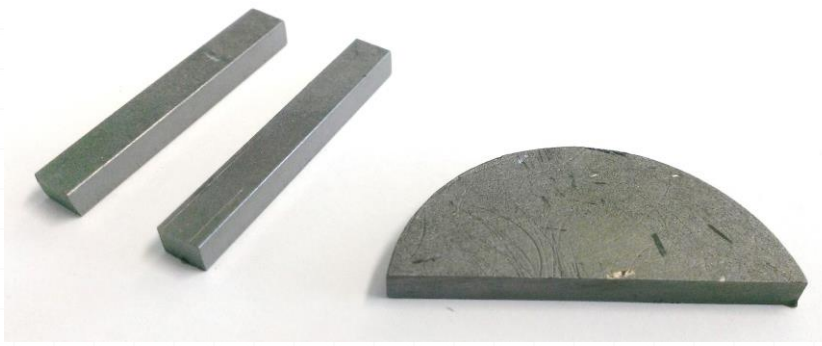


EuCARD WP8 Highlights

Materials: Cu-CD, Ag-CD, MoCuCD, Mo-Gr, Mo-coated Mo-Gr

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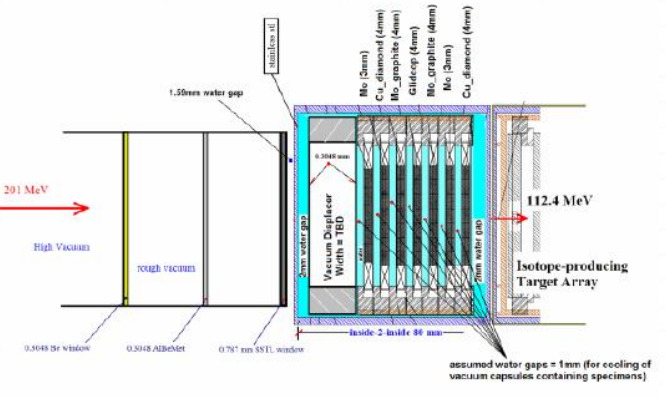
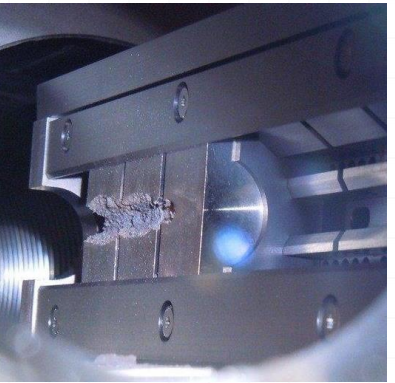
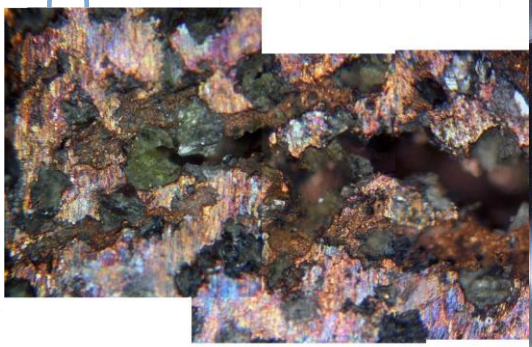
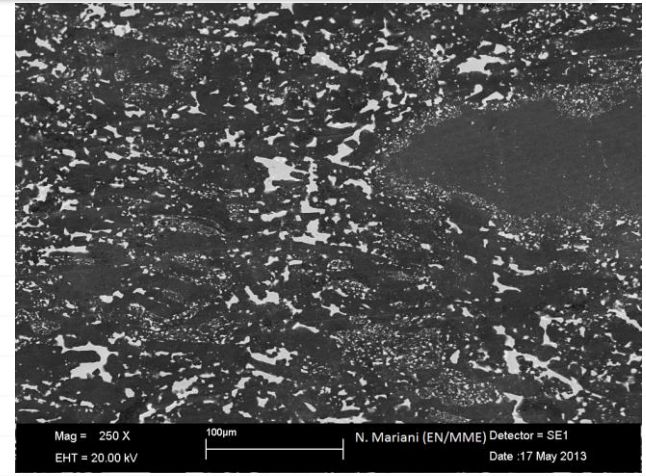
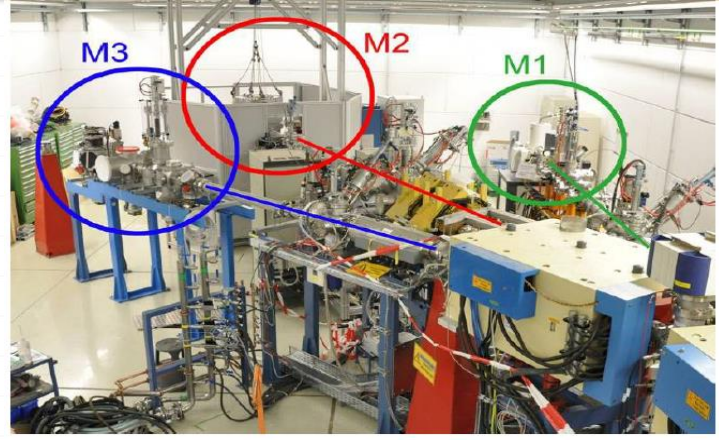
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Experiments and characterization

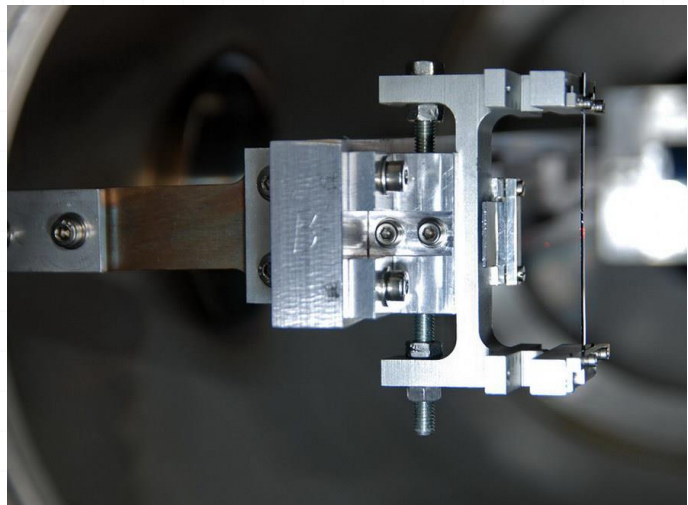
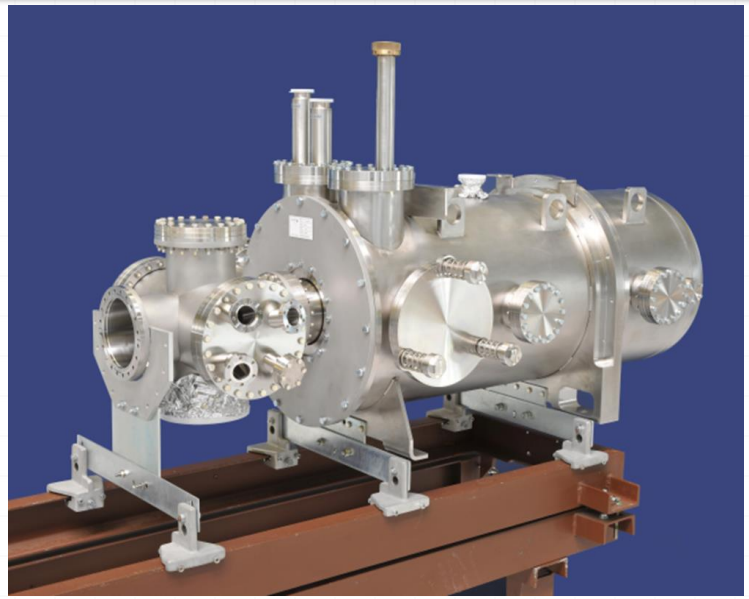
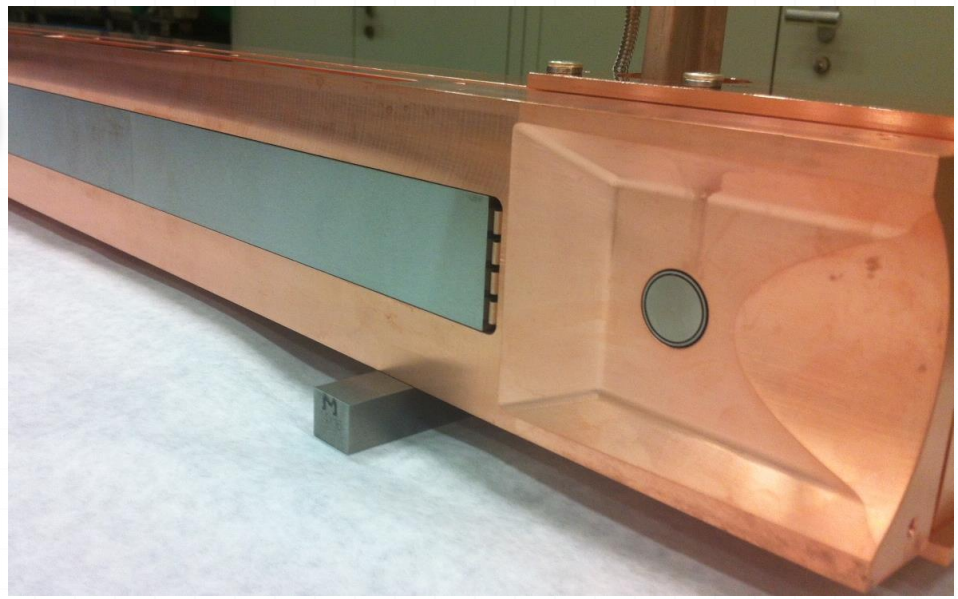


EuCARD WP8 Highlights

Hardware: LHC BPM collimators, Cryo-catcher, Crystal Collimators

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- **Work Package subdivided in 4 Tasks**

1. **Coordination and Communication** (A. Rossi and J. Stadlmann)
2. **Material testing for fast energy density deposition and high irradiation doses** (A. Bertarelli)
3. **Material mechanical modelling** (A. Bertarelli)
4. **Material Specification** (A. Rossi)

- **4 Main Deliverables**

Deliverable Number ⁶¹	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature ⁶²	Dissemination level ⁶³	Delivery date ⁶⁴
D11.1	Results on simulations of new materials and composites	12	30.00	R	PU	36
D11.2	Report on comparative assessment of beam simulation codes	1	20.00	R	PU	40
D11.3	Irradiation test results	20	23.00	R	PU	46
D11.4	Results on characterisation of new materials and composites	26	30.00	R	PU	46
			Total	103.00		

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■ Task 11.1

Coordination and Communication

(A. Rossi, CERN and J. Stadlmann, GSI)

- Define the global system taking inputs from different work-package (WP) tasks
- Coordinate and schedule WP tasks, to monitor work progress and inform the project management and WP participants
- Follow up the WP budget and use of resources
- Prepare internal and deliverable reports

■ Task 11.2

Material testing for fast energy density deposition and high irradiation doses (A. Bertarelli, CERN)

- Research and Development of Novel Materials with:
 - High robustness against high intensity impacts (both low-Z, such as Me-Gr and high-Z materials such Mo, Carbides etc.)
 - Low RF impedance
 - Good radiation resistance
- Characterization and mechanical testing of these materials (low and high strain rates; RT and T-dependent)
- Experimental tests on material specimens and full assemblies under highly energetic beam impacts (HiRadMat)
- Long term irradiation tests and assessment of material property changes (Kurchatov and BNL).



■ Task 11.3

Material mechanical modelling (A. Bertarelli)

- Theoretical modelling of materials and novel composites (Equations of State, Strength models, Failure models).
- Energy deposition calculations and coupling with hydrocodes.
- Modelling of dynamic phenomena (stress and shock waves, spall, melting, fragmentation, tunnelling ...) induced by fast abnormal beam loss events.
- Modelling of long-term radiation damage. Equivalence between high fluence, low energy and lower fluence, high energy irradiation with various species.
- Benchmark numerical results with experimental data.



■ Task 11.4

Material specification (A. Rossi)

- The increasing beam intensity in accelerators requires ever better cleaning efficiency, and lower collimator impedance. Aim of this task is to evaluate the potential, advantages and disadvantages of materials and report on comparative assessment of beam simulation codes
- Simulate the potential of new collimator materials like metal-graphite, metal-diamond composites or carbide-based composites for collimation of hadron beams and iterate on material specifications to address the needs of future accelerator developments.
- Comparison between SixTrack, Merlin and FLUKA.
- Implement cross-sections for novel materials and composites.



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■ Task 11.1

- Website shortly online
- Next WP meeting to be decided after EuCARD2 Steering Committee (12-14 December 2013)
- Proposals for place and date are welcome ...

■ Tasks 11.2 and 11.3

- Material R&D well on its way
- Well received participation at WAMAS (Workshop on Advanced Materials and Surfaces) at CERN on 19-20 November
- Report from KI-RRC on Cu-CD being received ...
- Tasks meeting on 10 December '13
- BNL results (Mo, Glidcop, Cu-CD, Mo-Gr) expected by early 2014.

■ Task 11.4

- Ad-hoc meeting in Daresbury on 15 November after HiLumi 3rd meeting



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Thank you for your
attention!