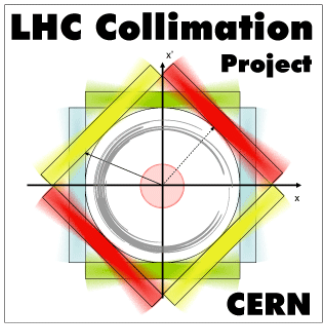
EuCARD² ColMat-HDED kick-off meeting

Adriana Rossi



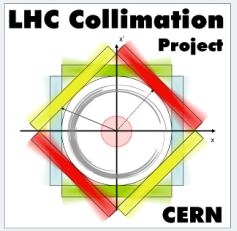
ColMat-HDED

EuCARD-2 is co-funded by the partners and the European Commission under Capacities 7th Framework Programme, Grant Agreement 312453

ColMat-HDED

(Collimator Materials for fast High Density Energy Deposition)

- The collimators determine the **LHC impedance**
  - *Tight collimator settings (2012-13) necessary to improve cleaning performance limited beam lifetime.*
- The β^* **reach** is determined by collimation constraints
  - *Retraction between beam dump and horizontal TCTs (BPM collimators) and TCT robustness.*
- LHC challenges: 360MJ design 500MJ HiLumi and 1E16 p/y doses in IR7 (betatron cleaning)



➲ Improve **impedance** and **robustness**

- *State-of-the-art material and new design for secondary collimator jaws*
- *Improved robustness at critical locations (like tertiary collimators - close to experimental IRs)*

ColMat-HDED

(Collimator Materials for fast High Density Energy Deposition)

- Building upon the results of EuCARD and pushing them into a new and even more innovative regime, the collimation WP in EuCARD² will support **progress with material developments for collimators and targets**.
- Note complementarity with irradiation tests at BLN, different energies and additional materials tested (see A.Bertarelli presentation) within the USLARP program

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- These studied have also **a wide range of possible applications** starting from **thermal management for electronics**, to **nuclear industry**, **fusion research**, and **high temperature space applications**.

ColMat-HDED collaboration

(Collimator Materials for fast High Density Energy Deposition)

Main founding to Kurchatov lab.
From CERN Collimation Project

WP11 Objectives

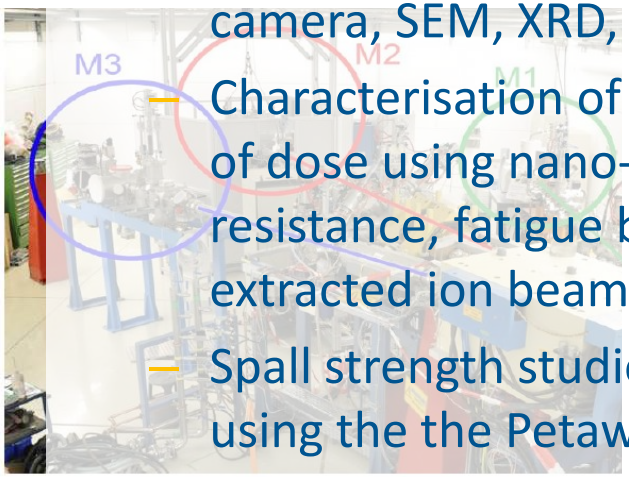
- **Task 11.1. Coordination and Communication** (A. Rossi and J. Stadlmann)

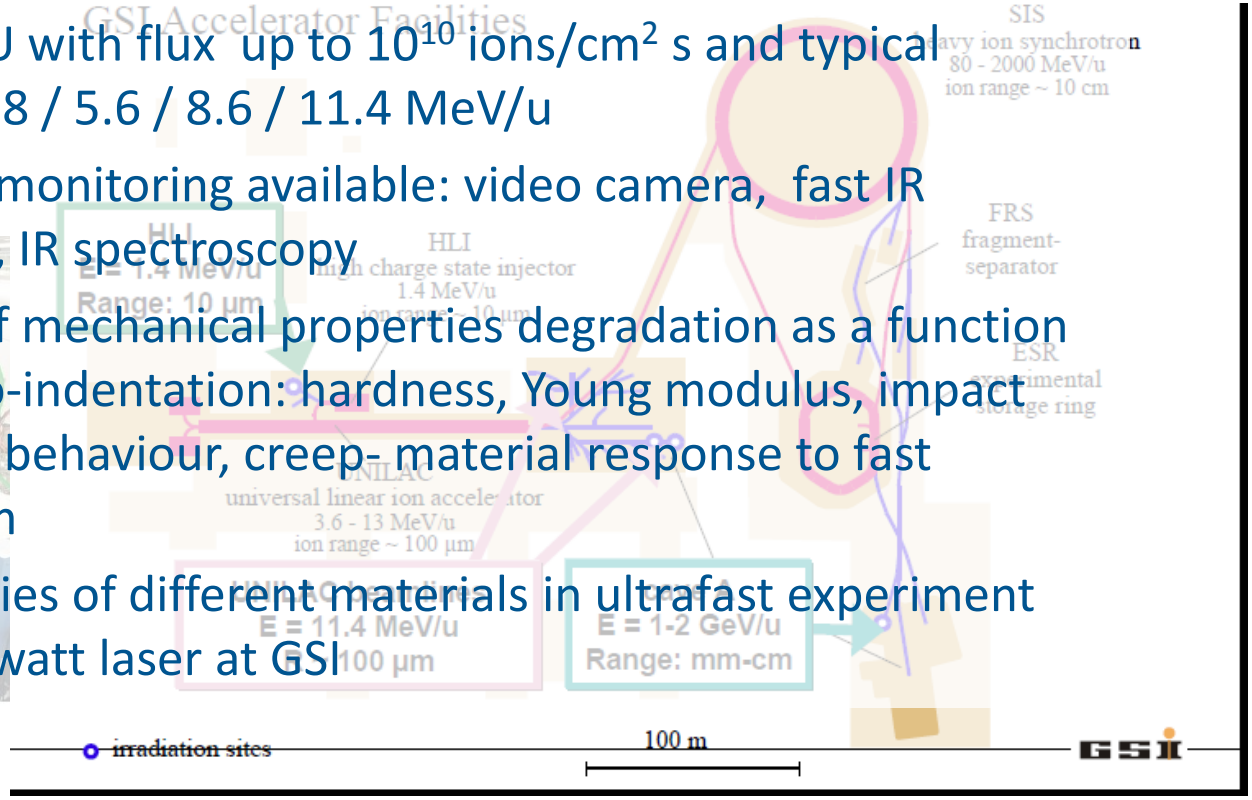
- **Task 11.2. Material testing for fast energy density deposition and high irradiation doses** (A. Bertarelli)
  - Aim of this task is to revi
    experimental tests on ma
    high energetic beam imp

- **Task 11.3. Material mechanical modelling** (A. Bertarelli)
  - Theoretical modelling of
    energy deposition follow
    radiation damage.

Material testing, some examples

- Material irradiation at M-branch – UNILAC GSI
  - Energies close to Bragg peak to maximize energy deposition and damage and to avoid activation
  - Ion species C, Xe, U with flux up to 10^{10} ions/cm^2 s and typical energies of 3.6 / 4.8 / 5.6 / 8.6 / 11.4 MeV/u
  - Online and in-situ monitoring available: video camera, fast IR camera, SEM, XRD, IR spectroscopy
  - Characterisation of mechanical properties degradation as a function of dose using nano-indentation: hardness, Young modulus, impact resistance, fatigue behaviour, creep- material response to fast extracted ion beam
  - Spall strength studies of different materials in ultrafast experiment using the the Petawatt laser at GSI





Courtesy of M. Tomut

WP11 Objectives

- **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 and iterate on material specifications to address the needs of future accelerator developments.

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  - New request from Collimation Project Leader: are the irradiation tests at high intensity and low energies relevant to LHC like beams? -> Simulations on DPA and re-crystallisation.

WP11 Objectives

Citing from http://en.wikipedia.org/wiki/Radiation_material_science

Main aim of radiation material science

Some of the most profound effects of irradiation on materials … (is that) atoms comprising the structural components are displaced numerous times over the course of their engineering lifetimes (DPA). The consequences of radiation to core components includes changes in shape and volume by tens of percent, increases in hardness by factors of five or more, severe reduction in ductility and increased embrittlement, and susceptibility to environmentally induced cracking, change in conductivity. For these structures to fulfill their purpose, a firm understanding of the effect of radiation on materials is required in order to account for irradiation effects in design, …, or to serve as a guide for creating new, more radiation-tolerant materials that can better serve their purpose.

For composite materials re-crystallisation may enhance these effects.

Kick-off meeting

- “Restart the engine” by meeting together
- Push for GSI measurements which represent the added value of EuCARD²
- Mainly focussed on the Material tests and modelling
- Daresbury meeting on beam computations