

Minutes of the 39th Collimation Upgrade Specification Meeting 6th of June 2014

Participants: C. Adorisio (CA), A. Bertarelli (AB), R. Bruce (RB), F. Carra (FC), M. Garlasche (MG), P. Gradassi (PG), A. Lechner (AL), R. Losito (RL), A. Marsili (AM) (scientific secretary), A. Perillo-Marcone (APM), E. Quaranta (EQ), S. Redaelli (SR) (chairman), G. Valentino (GV).

Remote: T. Markiewicz (TM) (SLAC), N. Mokhov (NM), M. Tomut (MT).

Indico event [here](#).

1 Report from meetings: US-LARP, FNAL visit and EuCARD2

Slides are available [here \(pdf\)](#).

1.1 Summary of the presentation

SR explained that the previous month had been very busy in the matter of meetings relevant for collimation, and listed them. The point of this meeting is to report on these meetings and their implications for collimation at CERN: the US-LARP meeting, the visit at FNAL and the EuCARD2 meeting. The US-LARP effort is now shifting from research to development and production, especially of magnets and Crab Cavities. However, several important collimation activities are still ongoing: hollow e-lenses, irradiation tests, and the completion of the SLAC rotating collimator.

The conceptual specifications of the hollow e-lens are now completed. And “S-shape” is now considered for the e-lens by opposition to a “C-shape”, in order to compensate the asymmetries at the injection and extraction of the electron beam. A talk will be given by GS at IPAC’14. E-lenses have been implemented in LifeTrack. The latest developments on the SLAC RC were reported at this meeting by AB.

The irradiation of collimator materials has also seen important progress: the irradiation tests with 200 MeV p are completed by now. At Tandem, N₂-cooled samples were irradiated by 28 MeV protons in a small area with high dose. The diffraction patterns inside the samples (inter-atom) allow to see the swelling at the atomic level.

Then, a very profitable contact was established with FNAL teams, in particular cryogenics, powering system and modulator, and the overall design and test stand. The test stand for e-beams was very impressive, and possibly harder to set up at CERN than initially thought. A student exchange is still considered. SR also met with NM, who will work on radiation studies for the e-lenses as LRBB compensator.

During the EuCARD2 annual meeting, there were two presentations on collimation. SR reported that the collimation Work Package (WP11) reported already important progress, mainly based on measurements of novel material properties and beam irradiation at GSI with ion beams. It is the only WP to have brought industry at the Annual Meeting. Some strong statements were made by J. Stadlmann (who reported on behalf of MT) on material irradiation by ions, which will need a dedicated meeting before drawing conclusions. A good synergy was observed with WP4 and the Manchester team working on material irradiation

(Mark Owen) and will be extended. There was no WP11 session, but this will be remedied before the end of the year. SR added that a description of the detail status of the samples should be added to the ColUSM website [**Action: EQ, AM**].

Finally, the setup of thermal conductivity studies of EuCARD2 WP11 materials (Mo-Gr) was presented in a conference in Hannover. SR presented a very nice picture of AB at this conference.

1.2 Discussion

MT commented on the irradiation of Mo-Gr samples, and the degradation of thermal conductivity which is higher than with Cu-cD. Some cracks in the sample were observed, showing that there are stresses in the sample. AB added that the material were sent directly, without allocating time for thermal annealing. This step could be very important and should not be skipped again. SR specified that the priority is to address concerns before the next ion beam run. He suggested to have a dedicated ColUSM to address beam test plans, at a suitable date after IPAC.

2 Report on RESMM'14 workshop (E. Quaranta)

Slides are available in [pdf](#) and [pptx](#).

2.1 Summary of the presentation

EQ presented a summary of the Radiation Effects in Superconducting Magnets and Materials workshop 2014 (link in presentation). Its goal was to try to predict numerically the response of different materials, and benchmark it with experimental results. EQ gave a presentation on radiation damage studies for the LHC collimator materials, and had a suggestion by B. Skoczen to use “acoustic” devices, meaning here long-distance real time monitoring.

B. Skoczen's work could be useful in collimation, especially the studies of mechanical load and lifetime. He presented an overview of the state-of-the-art in radiation-induced damage in materials exposed to high doses. EQ specified that they don't have an irradiation facility.

Another interesting presentation is in-situ hydrogen-pressure monitors integrating high doses. They are made of a polymer placed in a volume closed by a thin membrane. The polymer deteriorates with irradiation and produces hydrogen and the pressure builds up. The deflection of the membrane gives the pressure, hence the integrated dose. The membrane is designed to beak at a given integrated dose, which depends on the membrane and the volume.

Other ideas for the future include electron irradiation, submitted by A. Ryazanov. This would have the advantage of avoiding radioactive samples after irradiation. In addition, a facility is already available: NCBJ, Poland. However, the correlation between the type and energy of the irradiation particle with the damage in material is not well known yet.

In conclusion, this workshop provided several promising ideas for the future.

2.2 Discussion

The question of relation between the specie and energy used for irradiation and the actual damaged was raised by AB. AL answered tat it is still an open question, and there are differences between given energy deposition, particle fluence and displacement per atom (dpa). dpa is the only measure of irradiation over different materials, and the correspondence in degradation of the material properties is not direct.

3 5th High-Power Targetry Workshop, Fermilab (F. Carra)

Slides are available in [pdf](#) and [pptx](#).

3.1 Summary of the presentation

FC presented the main interests of the workshop: the RaDIATE collaboration on material radiation resistance, numerical simulations, and remote handling of material. MT and her student were present.

The objective of RaDIATE is to form an inter-disciplinary team between STFC, Fermilab and allied institutions to understand the response of materials to radiation damage by high energy protons. FC suggested to follow the activities by registering to the mailing list [**action: EQ**]. SR agreed, added that no close following by a sent representative is needed.

FC presented the numerical simulation tool called MARS for particle-matter interaction, similar to FLUKA, and the tools for predicting the thermo-mechanical response of targets impacted by high-energy particle beams. CERN is then at the state of the art in both cases.

Another useful point is the remote handling of targets and other activated materials, which can greatly decrease the handling time if used and considered from the design phase.

In conclusion, this workshop was seen as very useful; the next one will take place in Oxford in 2016, as also mentioned in EQ's presentation.