Lessons learnt at

5th High-Power Targetry Workshop

Fermilab, 20-23 May 2015

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ColUSM 6.6.2014

Outline

- Workshop structure and objectives
- Topics of interest for collimators:
  - Materials radiation resistance: RaDIATE
  - Numerical simulations
  - Remote handling
- Conclusions

Workshop Structure

5th High Power Targetry Workshop

Fermilab, Batavia, Illinois - USA, May 20th – 23rd, 2014

indico.fnal.gov/event/HPT14

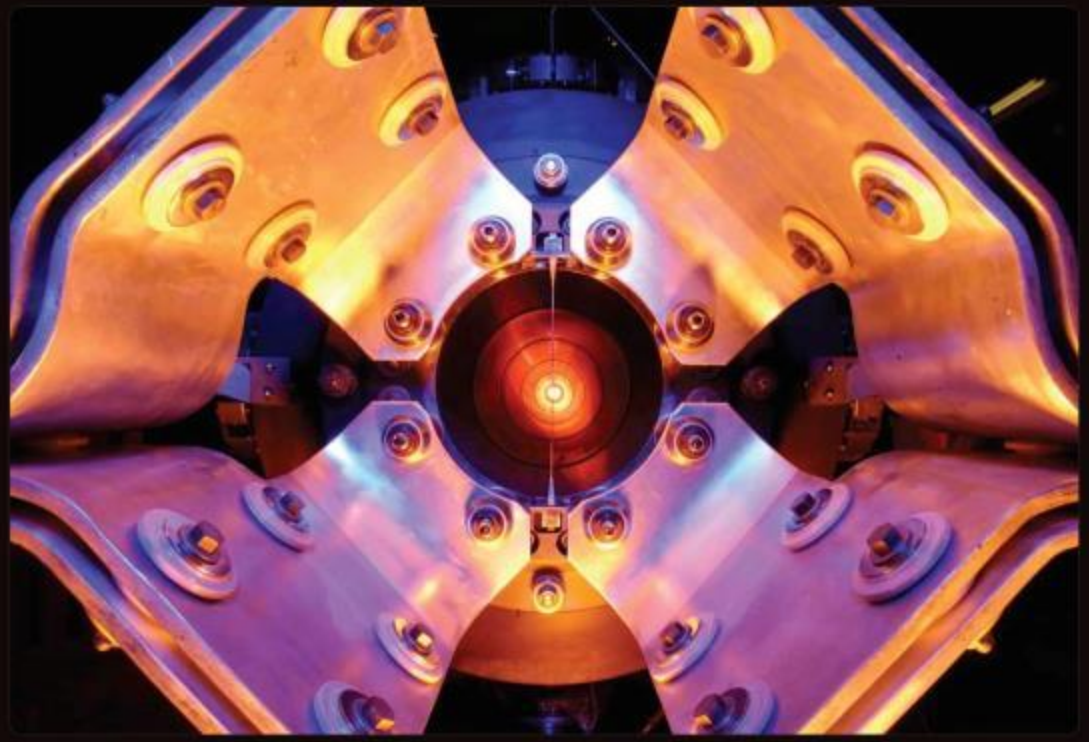
The High Power Targetry (HPT) Workshop series brings together interested scientists and engineers from the international community, in particular those operating or designing high power targets.

TOPICS
Target Design Challenges
Radiation Damage and Material Limits
Target Facility Simulation Challenges
Target/Beam Monitoring & Instrumentation
Target Facility Challenges

Program Committee
Chair: Harold Kirk (BNL)
Chris Densham (RAL)
Katsuhiro Haga (J-PARC)
Patrick Hurh (FNAL)
Jerry Nolen (ANL)
Kirk McDonald (Princeton)
Nikolai Mokhov (FNAL)
Francois Plewinski (ESS)
Bernie Riemer (ORNL)
Thierry Stora (CERN)
Helmut Weick (GSI)
Michael Wohlmuther (PSI)

Local Organizing Committee
Chair: Patrick Hurh
Kavin Ammigan
Brian Hartsell
Cynthia Sazama
Suzanne Weber
Robert Zwaska

Fermilab ENERGY Office of Science RaDIATE



Workshop Structure

RaDIATE Collaboration

- **Objective**:
  - Form an inter-disciplinary team between STFC, Fermilab and allied institutions to foster long term expertise in understanding the response of materials to radiation damage in the high energy proton regime
- **Website**: http://www-radiate.fnal.gov/index.html
- **Materials studied**:
  - **Graphite** and **Carbon-Carbon Composites**
  - **Beryllium**
  - **Tungsten** (with or without tantalum cladding)
  - **Titanium alloys**
  - **Other**

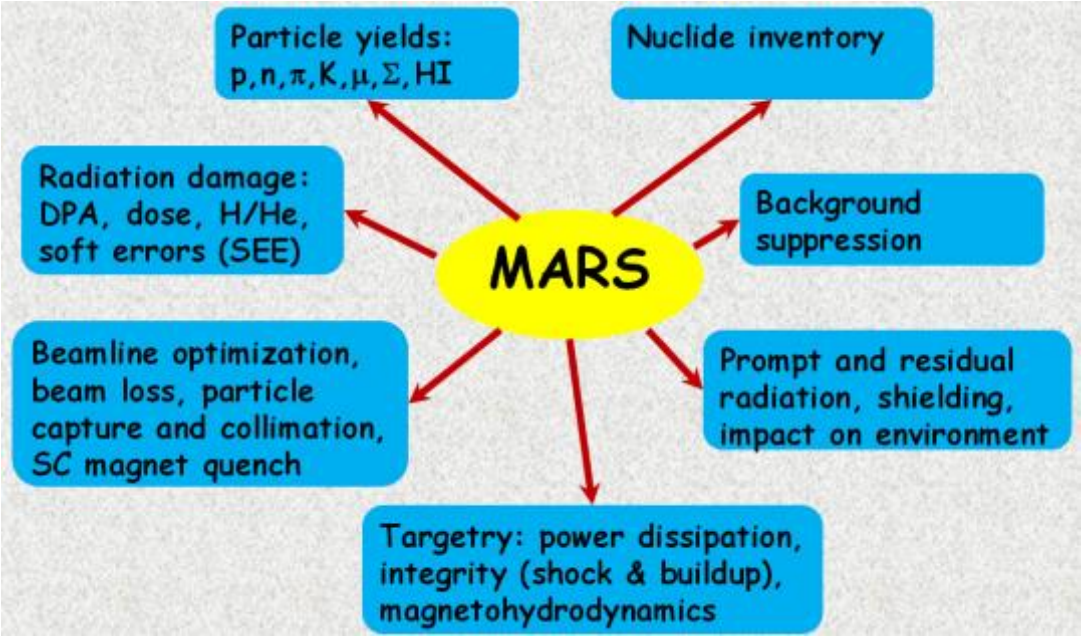
RaDIATE Collaboration

- The ultimate ambition is to be able to **predict operating lifetimes** for as many of the aforementioned materials as possible in terms of integrated proton fluence for the high energy proton accelerator parameter space
- **Open to collaborations**
- Even without a formal collaboration, people interested can be added to the **mailing list** (contact Patrick Hurh or Chris Densham)

- **Proposal**: one (or more) persons from the collimation project to be added to the mailing list, to follow-up advancements, future meetings, etc.

Numerical simulations

- Focus Session: Target Facility Simulation Challenges (chairman: N. Mokhov)
- **Particle physics simulations: MARS**
- In majority of real-life complex applications, FLUKA and MARS15 energy deposition results **coincide within 10% and agree with data**



Numerical simulations

- **Thermo-mechanical simulations**
  - Several software and methods are used to predicted the thermo-mechanical response of targets impacted by high-energy particle beams:
    - Implicit codes (e.g. ANSYS)
    - Explicit codes (e.g. Autodyn, BIG2, LS-Dyna)
    - Fluid dynamics and acoustic codes (e.g. OpenFOAM)
- My personal outcome: **CERN is at the state of the art in simulating all the complex phenomena involved during a particle beam impact on solids or fluid targets** (explosion, spallation, phase changes, etc.), predicting the survival or failure of the component.

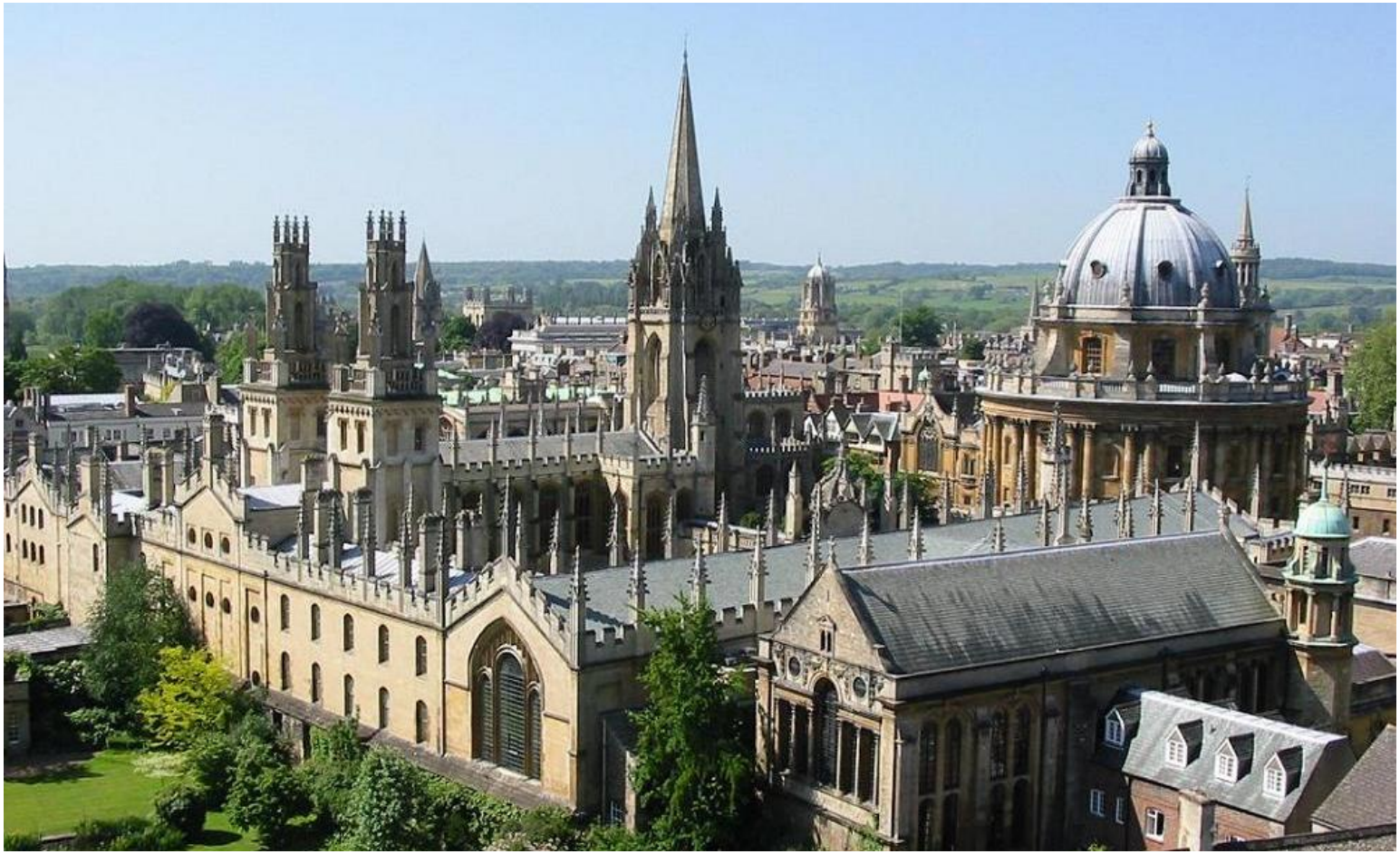
Remote handling

- Focus Session on Remote handling and Target facility challenges (chairman: R. Losito)
- Very interesting presentations; in particular, Dr. A. Rolfe (Oxford Tecnologies Ltd) showed videos of remote handling operations done at CERN
- Lessons learnt: **RH requirements should be taken into account during the design phase**
  - If components are designed for RH, then operations take the **same time or less than with human**
  - If not: **5 to 10 times more**!
- More about remote handling for collimators → R. Losito

Conclusions

- **HPTW 14**: particularly interesting for my personal education (design of targets and target facilities) and for my PhD (simulations, tests, materials, …)
- **Collimation Project**, fields of interest:
  - Materials and study of radiation damage → **RaDIATE collaboration**
  - **Numerical simulations**:
    - Particle physics → **MARS15, FLUKA good benchmarking** (10% difference in the results)
    - Thermo-mechanical simulations → **CERN methods are at the state of the art**
  - **Remote Handling** (even more important now, with access to the collimators becoming more and more difficult due to the high radiation)

Next Stop: Oxford! (HPTW 2016 at RAL)



Thank You For your attention!