1st Princeton/Oxford High-Power Targets Workshop

Oxford

May 1-2, 2008

Harold G. Kirk
Brookhaven National Laboratory
Workshop Purpose

Post-MERIT discussions of the next steps in high power target design

- Review current knowledge
- Define what we do not know
- Engineering challenges
- Define R&D requirements

http://www.physics.ox.ac.uk/users/peachk/HPT/Talks.htm
# Workshop Speakers

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<td>Harold Kirk</td>
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<td>Stephen Brooks</td>
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<td>Chris Densham</td>
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<td>Bob Palmer</td>
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<td>Van Graves</td>
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<td>Goran Skoro</td>
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<td>Nick Simos</td>
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<td>Roman Samulyak</td>
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<td>John Back</td>
<td>Warwick</td>
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<td>Tristan Devenne</td>
<td>RAL</td>
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Post-cooling $30\pi$ Acceptance

![Graph showing proton kinetic energy vs. pion-muons/protons*GeV for Positives and Negatives.]
The Study2 Target System

Count all the pions and muons that cross the transverse plane at $z=50m$.

For this analysis we select all pions and muons with $KE < 0.35$ GeV.
Mesons 100 < KE < 800 MeV at 50m

MARS14

Mesons/Proton

Mesons/Proton normalized to beam power

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The Target Interaction Length

Hg/Beam angle = 33 mrad
⇒ 30.3 cm Hg/Beam overlap

Hg/Beam angle = 60 mrad
⇒ 16.6 cm Hg/Beam overlap
Meson Production Efficiency

10GeV Proton Beam

0.1GeV < KE < 0.8GeV at 50m

Positives
Negatives

Peak at 25cm (40mrad)

50GeV Proton Beam

0.1GeV < KE < 0.8GeV at 50m

Positives
Negatives

Peak at 30cm (33mrad)

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Key Merit Result

24 GeV Proton Beam

Disruption Length, $m$

Disruption Length

17cm
Powder jet targets for Neutrino Facilities

Ottone Caretta, Tristan Davenne, Chris Densham (Rutherford Appleton Laboratory),
Richard Woods (Gericke Ltd),
Tom Davies (Exeter University), Goran Skoro (Sheffield University), John Back (Warwick University)
A flowing powder target for a Superbeam or Neutrino Factory?

Chris Densham--RAL
Feasibility test results:

(Thanks to EPSRC Intrument Loan Pool for use of a high speed video camera)

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Tungsten powder jet – feasibility test results

Initial bulk density
= 8660 kg/m³
= 45 % W (by volume)

Jet bulk density
(approx. results):
Jet velocity = 7–15 m/s
(100 kg in 8 seconds)
~ 5000 kg/m³
~ 28 % W by vol.
(~ 2.5 x graphite density)
MARS calculation of muon and pion yield from
(i) solid W and
(ii) 50% density W

$\pi$ and $\mu$ yield for one 30 cm W rod
($d = 2\text{ cm}$; $r_{\text{beam}} = 1\text{ cm}$)

NB 1: Calculation is for 10 GeV protons
NB 2: Calculation is for total yield from target ie capture losses excluded

$\pi$ and $\mu$ yield for one 60 cm W rod at
50% density ($d = 2\text{ cm}$; $r_{\text{beam}} = 1\text{ cm}$)

MARS simulation by J. Back

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Studies of the solid high-power targets

Goran Skoro
University of Sheffield

HPT Meeting
May 01 – 02, 2008
Oxford, UK
Comparison with existing experimental results

Tests at the ISOLDE
Tantalum Cylinder, 1x10 cm

(d) First 20 μs.
(c) First 100 μs.
(b) First 1 ms.

LS-DYNA simulations

Violin modes (target bending,...)
Mercury Jet Studies

Tristan Davenne
Rutherford Appleton Laboratory
Numerical simulation of Sievers & Pugnat Result

Click on image above to watch video of 2cm mercury target responding to concentric parabolic energy deposition

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Targetry Action Items

(To be presented at the October Princeton Workshop)

1. Complete MERIT analysis
2. Extend MERIT-related MHD simulations
4. Simulations of splash of Hg in collection pool (B = 0).
5. Pion acceptance cuts refined, pi production plots updated.
6. VISAR data of pulsed wires
7. Mechanical analysis of Helmholtz coil configuration for wheel target.
8. W bar in ISIS beam.
9. Update of Study 2 target concept
10. W wheel design
11. Hg erosion
12. Hg nozzle: engineering design, prototype R&D