Targetry Program in the US

NUFACT’03

Columbia University

June 7, 2003
Interest in High-power Proton Drivers

High average power—SNS
- Thermal management
- Radiation damage

High peak power—NLC, Superbeams, NUFACT
- Thermal management
- Radiation damage
- Thermal shock
Superbeams

Carbon is a good target candidate

- Higher momentum pions
- Stationary target up to 1.5 MW
- Good thermal properties
- Low energy deposition densities

Two Interaction Length Targets

- Carbon
- Copper
- Mercury

Energy deposition, J/g

28 GeV Proton Beam
Carbon Studies

E951 Results:
Carbon-Carbon strains significantly less than for ATJ Carbon

ORNL Studies—J. Haines, et al.
Carbon sublimation tests at 2000° C

Harold G. Kirk
Neutrino Factory

Maximize Pion/Muon Production

- Soft Pion Production
  - Higher Z material
    - High energy deposition
    - Prone to target dissipation
  - High Magnetic Field

Meson Production - 16 GeV $p + W$

**π⁻**  
**π⁺**

Harold G. Kirk
Mid-Z Iron Based Alloys

Iron alloys are interesting based on either their high yield strengths or their low Coefficient of Thermal Expansion (CTE) properties.

- **Iron**
  - Yield strength—170 Mpa
  - CTE—$12.5 \times 10^{-6} / ^\circ K$

- **Inconnel**
  - Yield strength—1034 Mpa

- ** Vascomax**
  - Yield strength—2242 Mpa

- **Super-invar**
  - CTE—$0.5 \times 10^{-6} / ^\circ K$

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P. Thieberger

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Harold G. Kirk
BLIP Irradiation Tests

- 1 ½ weeks running
- 200 MeV protons
- 5 x 10^{20} protons on target

Target Holder After Irradiation
24 Rads at 2m

Harold G. Kirk
We find that the Coefficient of Thermal Expansion (CTE) of super-invar is sensitive to the level of irradiation exposure.
We placed a Tinus-Olsen Tensile Tester inside the hot cell in order to measure the mechanical tensile properties of the irradiated super-invar samples.
Yield Strength Measurements

Load-Extension Data for Invar Irradiated Samples at various dpa levels

- Invar-22
- Invar-23
- Invar-24
- Invar-25
- non-irrad (#1)

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High-Z Materials

Key Properties
- Maximal soft-pion production
- High pion absorption
- High peak energy deposition
- Potential for extension beyond 4 MW (liquids)

Key Issues
- Jet dynamics in a high-field solenoid
- Target disruption
- Achievement of near-laminar flow for a 20 m/s jet
E951 Hg Jet Tests

- 1cm Diameter Hg Jet
- 16 GeV 4 TP Proton Beam
- No Magnetic Field
CERN/Grenoble Hg Jet Tests

- 4 mm Diameter Hg Jet
- $v = 12$ m/s
- 0, 10, 20T Magnetic Field
- No Proton Beam

A. Fabich, J. Lettry
Nufact’02
High Field Pulsed Solenoid

- 70° K Operation
- 15 T with 4.5 MW Pulsed Power
- 15 cm warm bore
- 1 m long beam pipe
We plan to resume E951 running at the AGS.

But DOE HEP support has been terminated for FY03 and will likely remain so for FY04 and FY05.

We need to explore alternatives.
## Alternative Running

Alternatives for targetry running:

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<th>Parameter</th>
<th>BNL AGS</th>
<th>CERN PS</th>
<th>JPARC RCS</th>
<th>JPARC MR</th>
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