



Accelerator Science – Targets et al.

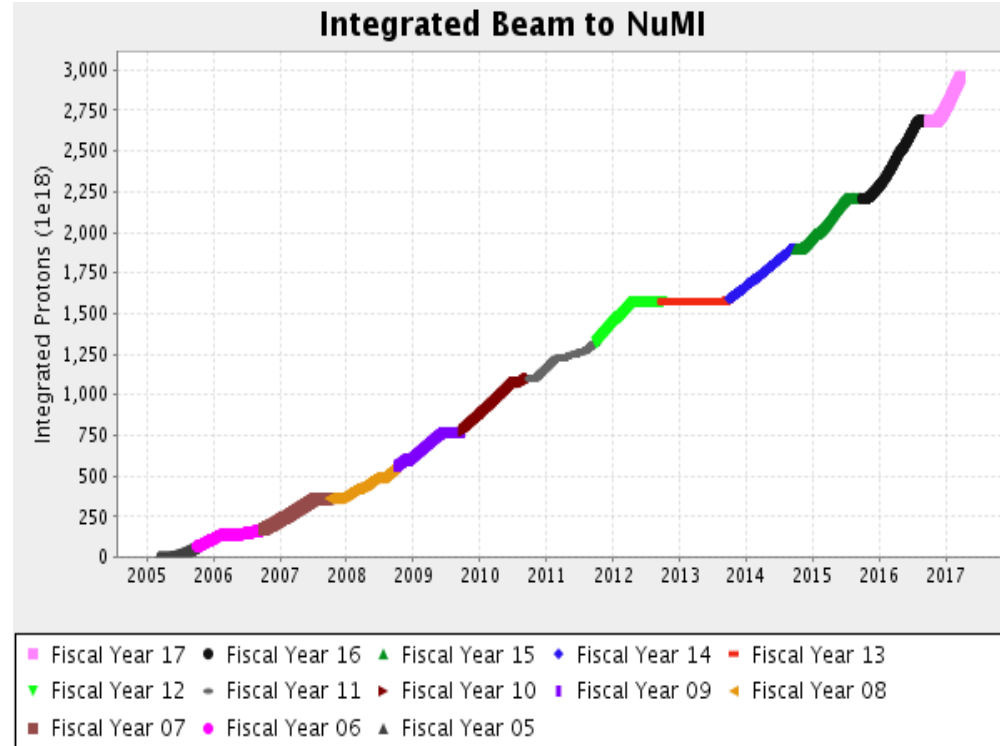
All-Scientist Pre-Retreat

April 5, 2017

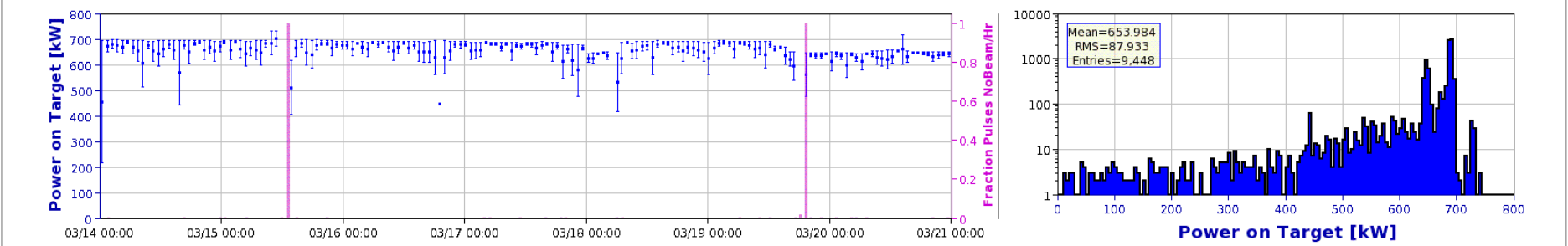
Bob Zwaska

700 kW – a reality

- Have achieved extended running above 700 kW
 - Up to 750 kW for short periods (7% above design)
 - Up to 53.9e12 protons (10% above design)
- Typical running is 650-700 kW (10% reduction for timeline sharing)
- BNB operating near its limits
- Muon g-2 starting (today?)



Power on target & Fraction of pulses without beam per hour vs. time



Total protons on target: 1.947E19/164.1 hours, 1.186E17 pph

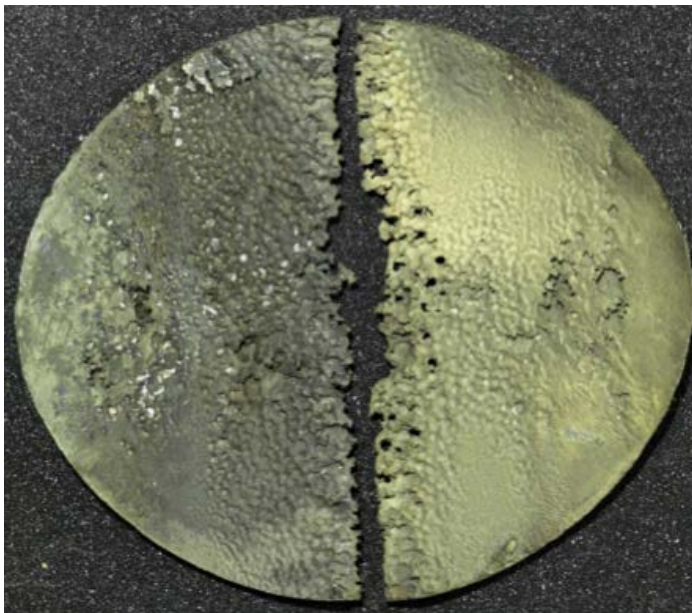
This image can be found as http://mccorv.fnal.gov/performance/2017/RRLosses-Week/RRLossesSummary_2017-03-21_00:00.png

PIP-I+

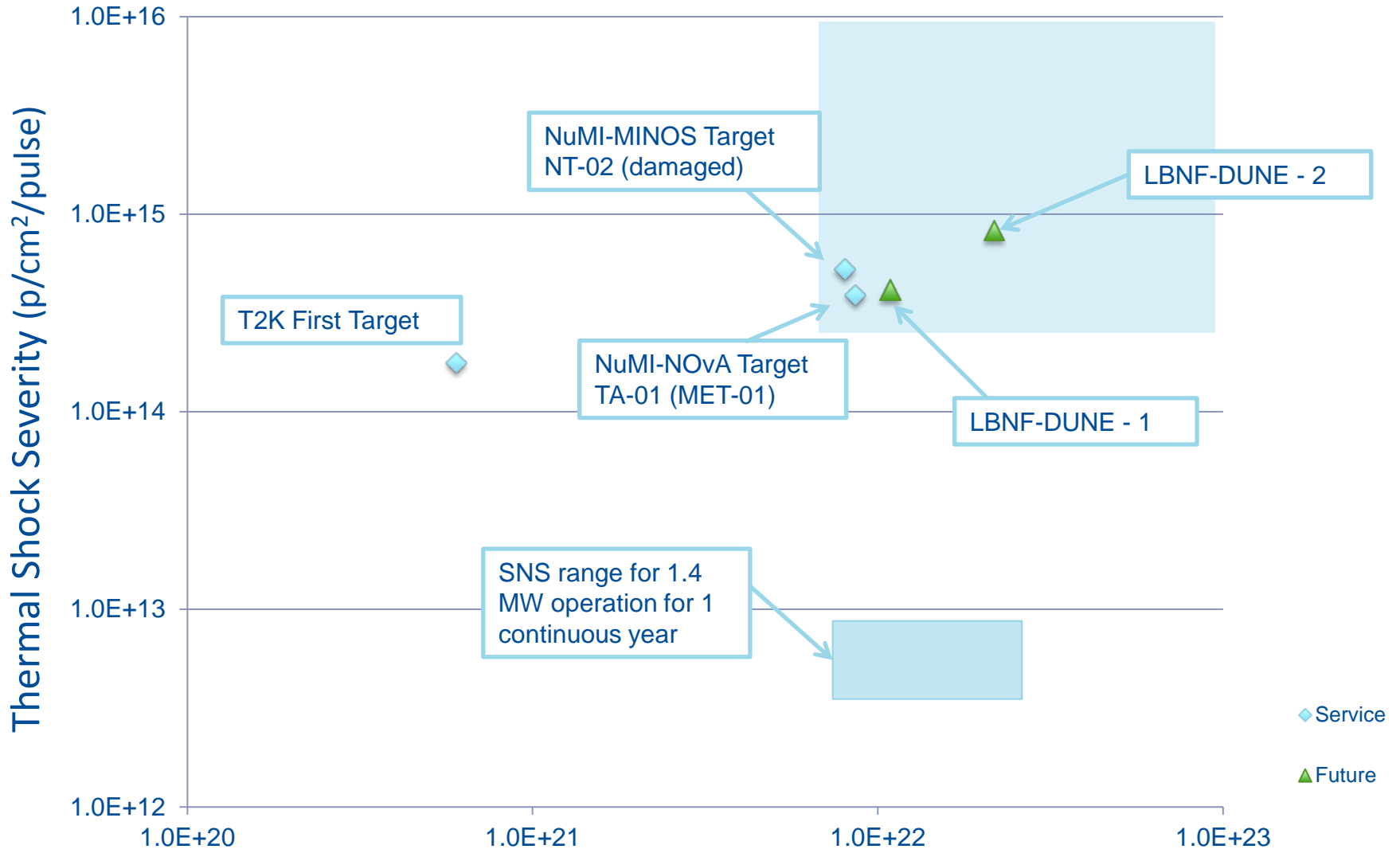
- Possible plan to upgrade Fermilab accelerator complex performance before PIP-II:
 - Booster PPP $4.3e12 \rightarrow 5.5e12$ 28%
 - MI cycle $1.33 \text{ s} \rightarrow 1.2 \text{ s}$ 11%
 - 20 Hz PS/RR/MI $15 \text{ Hz} \rightarrow 20 \text{ Hz}$
- Performance improvements:
 - Beam to NoVA $700 \text{ kW} \times (1.28 \times 1.11) = 992 \text{ kW}$
 - Beam elsewhere
 - BNB $4\text{-}5 \text{ Hz avg} \rightarrow 7\text{-}8 \text{ Hz avg}$
 - Muon Campus $55\% \text{ of plan} \rightarrow 110\% \text{ of plan}$
- We have been encouraged to continue and have started planning.

High-Power Targets

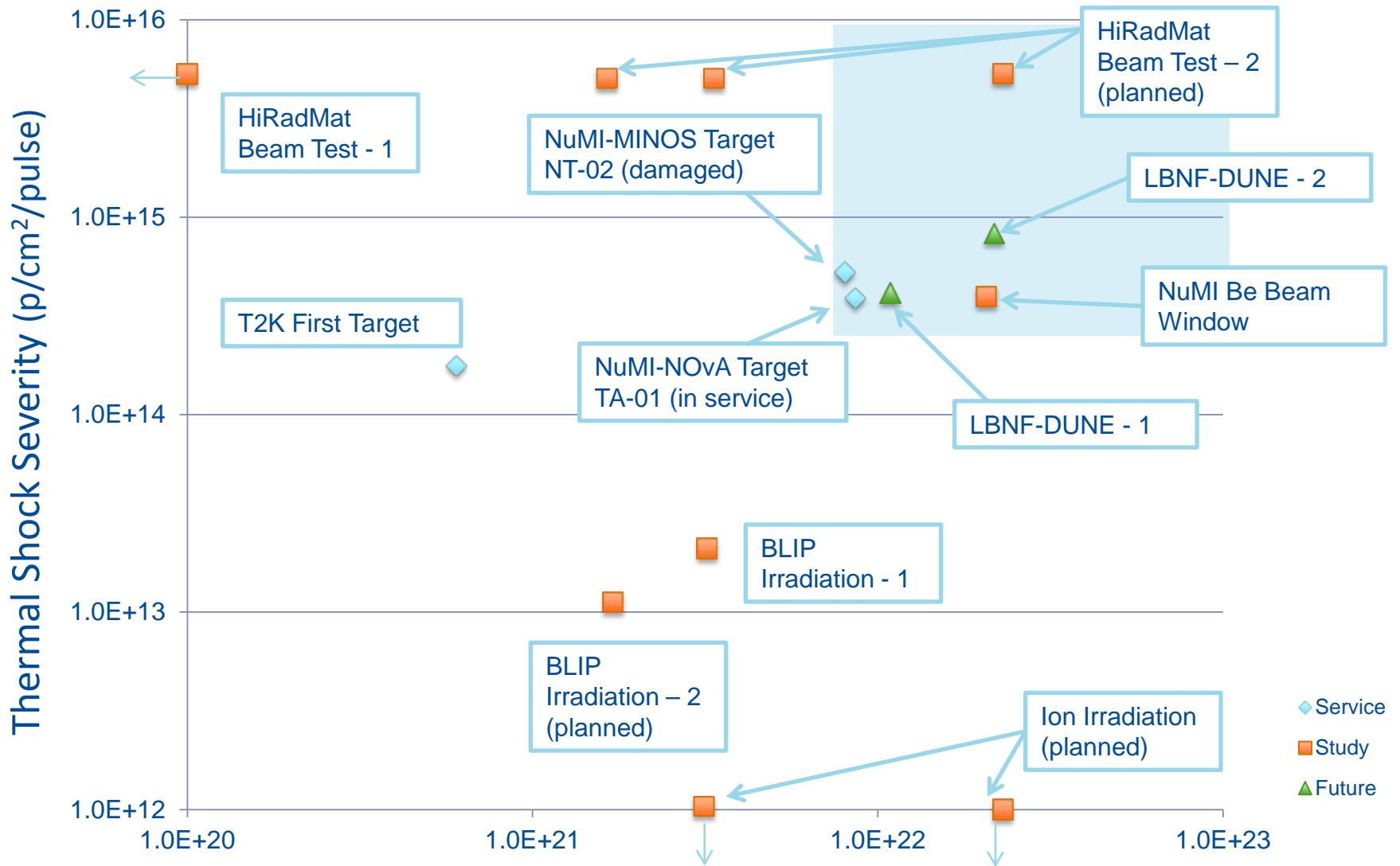
- Many accelerator facilities world-wide are limited by the capabilities of their targets
 - Compromised in physics performance are sometimes made
 - Future facilities will use higher powers and have higher demands for performance
- Fermilab build & operates target facilities
 - Focused research supported by projects
 - Fledgling research supported by GARD



Nu HPT R&D Materials Exploratory Map

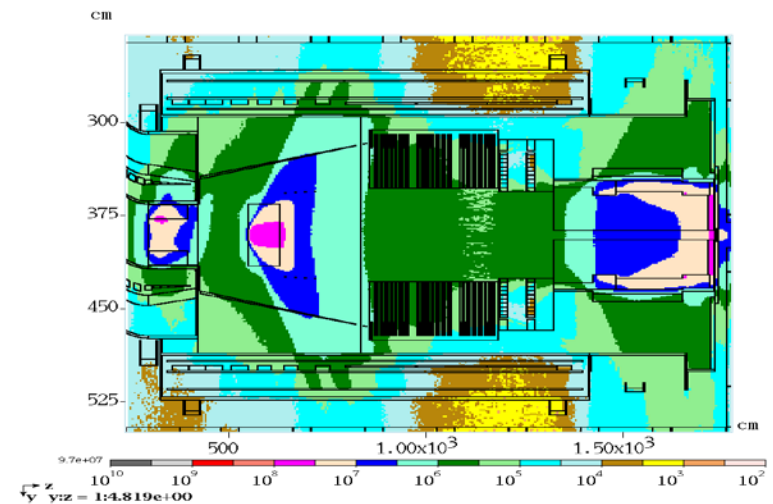
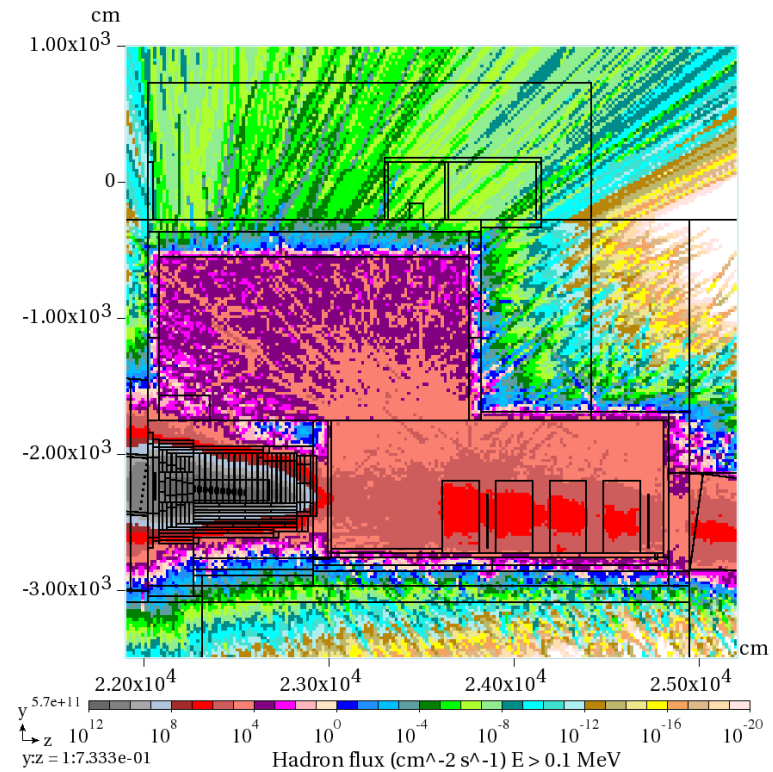


Nu HPT R&D Materials Exploratory Map



Energy Deposition Simulations (MARS)

- Developed and supported over ~3 decades
- MARS is the backbone of all targetry, beam loss, collimation, background and radiological developments at Fermilab since early 80's
 - <https://mars.fnal.gov/>
- Multi-turn tracking in accelerator lattice, with entire 3D component geometry, materials, magnetic fields with accurate shower modeling
- All physics processes for all particles and nuclei in the energy range spanning 16 decades (0.001 eV to ~ 10 TeV) and the probability for a “signal” ranging over 20 decades
- Multiple variations of component and setup configurations, beam parameters and new ideas to maximize performance
- Used world-wide at various facilities
- A strategic tool for Fermilab



Education

- USPAS
 - Very successful university-style school
 - Reviewed extremely well with HEPAP
 - Under threat from bureaucratic stove-piping
 - Looking for a new director
- Accelerator PhD program
 - Support 4-6 students at a time

Even More Topics

- Beam Instrumentation
- Beam Manipulation
- LLRF / Fast Electronics
- Advanced Accelerator Concepts
 - Plasma / laser / dielectric / etc.