Agenda

• Recap of last update
  – Concept
  – History

• Progress made since
  – Absorber Components
  – Vacuum Box
  – Additional testing of existing prototype

• Next steps
MEBT Absorber- Concept to Finalized Design

- Previous Update from June: PIP-II-doc-593
- 650mm maximum length
- 0.029 rad grazing angle
- ~17 W/mm² maximum absorbed power density of the face of the absorber
Design History

- Design has been evolving for the past several years
  - Initial concept for Cu absorber (Hassan/Lebedev)
  - All-Mo-TZM absorber to resist blistering
  - TZM/Al thermal contact design

- Prototypes were built and tested in an electron test beam
  - Walton “Pre-Prototype” – better than expected thermal contact
  - “Prototype 1” – met PIP2IT requirements, tricky fabrication
  - “Prototype 2” – met PIP2IT requirements, more manufacturable
Secondary Absorber without sawtooth design

From previous work by Y. Eidelman, it is estimated that ~25% of incoming energy is reflected from the absorber surface.

- >800 Watts Escape
- The potential of reflected particles to pass through the downstream aperture and escape the absorber box was only recently understood. This drives the need for a more complicated (textured) absorber surface.
Energy Reflection – Sawtooth surface

• Saw tooth surface creates a shadow region which prevents reflected beam from traveling into.
• The closer downstream teeth have smaller shadow regions than the teeth upstream.
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Absorber Components - Sawtooth Surface design

- Used to redirect secondary particles
- Method of fabrication: Surface gridding
- Design is complete. Drawings being finalized
Secondary Absorber with sawtooth design

- Sawtooth design with “New” teeth
- <10 Watts Escape

Particle incidence on downstream wall of absorber box
Comparing the Two

Without

With

Absorber

Absorber
Absorber Components - Strong Back Design

- Used to clamp the TZM pieces together
- Able to hold a large clamping load
- Easily installable
- Design is complete. Drawings being finalized

- Strongback supports the assembly of the TZM pieces which consists of the sawteeth piece and the two side fins
- Ensure plenty of compression to maximize conduction
Combing the saw-teeth with the side fins

- Strongback
- Waterback
- Sawteeth Piece
- Set Pin
- Side Fin
- Belleville washers
Absorber Components – Surface Imaging

• Simple flat fold mirror protects viewport from direct irradiation

- Glass first-surface mirror, <1λ, protected Al coating
- Camera location
- Standard fused-silica viewport
- Thermal-conductive path to air
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Vacuum Box

- Design is complete
- The downstream wall (shown in green) was made with a grid pattern to localize thermal stresses
- Currently out for fabrication
Vacuum Box - Secondary Absorber

- Secondary Absorber includes multiple layers
- Heat management involves conduction and convection
Vacuum Box- Top Lid

- Design is still on going
- Not as long of a lead time
- Place holder lid for testing and pumping down is currently out for fabrication with the vacuum Box
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Prototype 2

- 6 PXIE-like TZM fins
  - Graphite thermal contact
  - Individually preloaded

- Aluminum cooling strongback
  - Transverse cooling channels

- Aluminum plumbing to air
  - No in-vacuum material transitions
Additional testing of existing prototype in PIP2IT

• Beam was run to existing prototype during the recent long run
  – 10mA, 1.75ms pulse, 20Hz, ~700 W incident power
  – See e-log entry 119747

• Absorber specific goals for the long run
  – Look for (unexpected) signs of surface damage
  – Attempt to quantify reflection with calorimetry of return water

• Results
  – No surface damage observed (good)
  – Absorber becoming generally dirtier over time (not good)
  – Unexpected, faint OTR visible on camera (helpful)
  – Not enough power for convincing calorimetry, but no wild inconsistencies
Absorber Surface Before and After

Before

After

Contamination

Piece removed
Calorimetry Attempt

- Trip: current drops to 0
- Water return temperature: noisy, dT of 0.2°C visible with heavy averaging
Calorimetry Attempt

- Averaged a quiet 4h of “on” data and 12h of “off” data
  - dT of water with beam on is only ~0.2° C
  - Energy reflection looks like 17% (but with large error bars)
    - Expectation from Y. Eidelman analysis was 25% reflected
    - Lower reflection is favorable to the design
  - Data are poor and must be taken skeptically, but we’re in the ballpark
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Next Steps

• Opportunities for further testing at PIP2IT
  – Existing prototype still installed in MEBT 3.1 configuration
    • Moved to vertical orientation for integrated kicker system testing
  – If and when higher power can be sustained, should exercise the
    prototype further
  – May be able to refine reflection measurement by reducing water
    flow

• Absorber Fabrication
  – Finalize drawings of absorber to create bidding packages
  – Send out bidding packages for fabrication quotes
  – Get funding approval for fabrication
  – Fabricate
Schedule

• Technical
  - Focusing efforts on arriving at viable solution for energy deposition on secondary absorber
  - Then enclosure design can be finalized (allowing for earlier installation of empty enclosure)
  - Then absorber itself will be finalized

• Schedule
  - Fabrication in FY18
    - Procurements Begin in Q1 FY18
    - Assembly Begins in Q2 FY18
    - Ready for installation in Q3 FY18
      - Shooting to be ready before CDS shutdown