SoLID Heavy Gas Cherenkov Update

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For HGC group

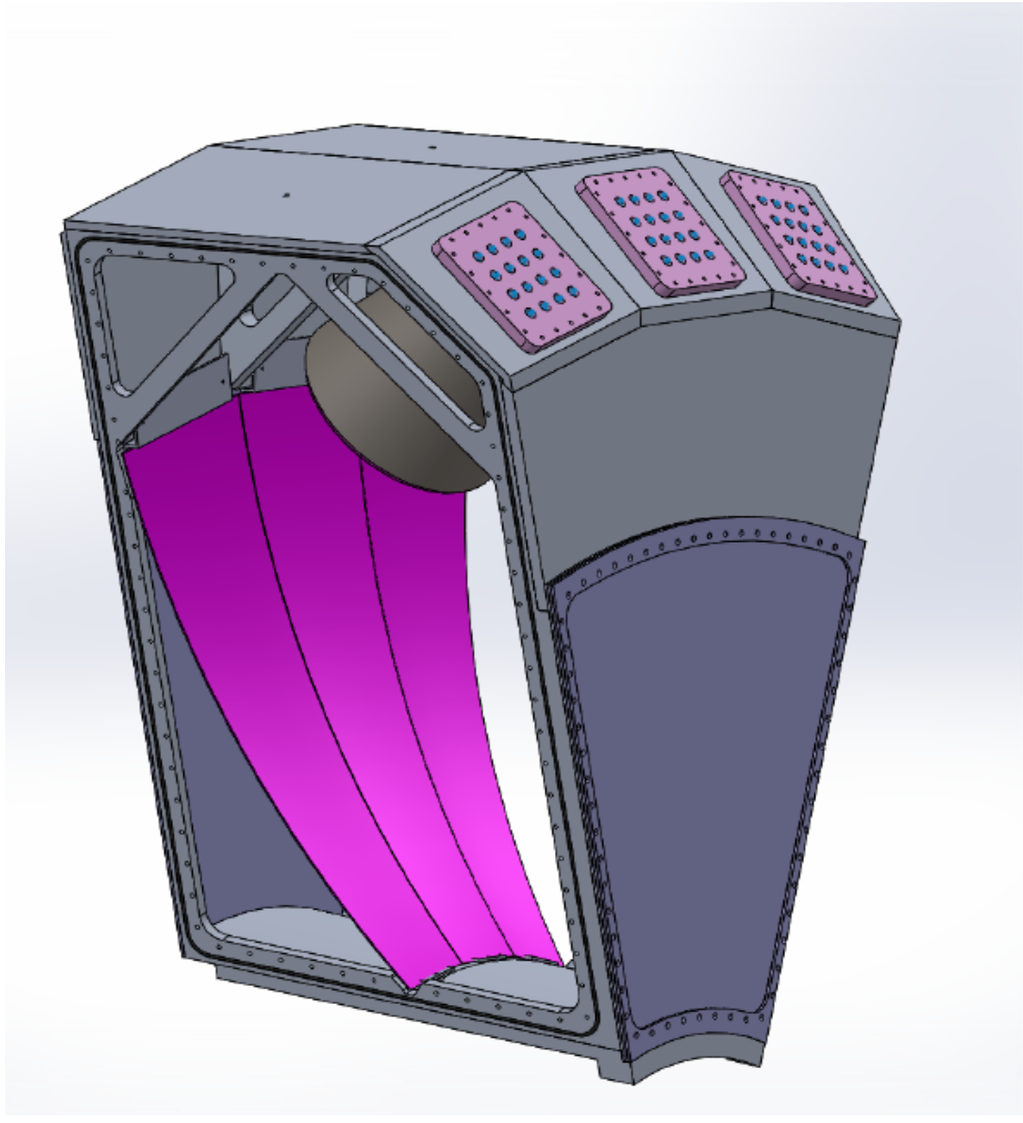
SoLID Collaboration Meeting, October 14, 2017

HGC Prototyping Update

C$100k grants allow the U.Regina group to construct one SoLID HGC module for testing.

Questions to be addressed:

- Enclosure deformation at 1.5 atm operating pressure (investigate design and metal alloy options).
- Performance of the O-ring seals against adjacent units.
- Performance of thin entrance window in terms of light and gas tightness (test several options).



Conceptual design by Gary Swift, Duke U.

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Progress since June 2017 meeting

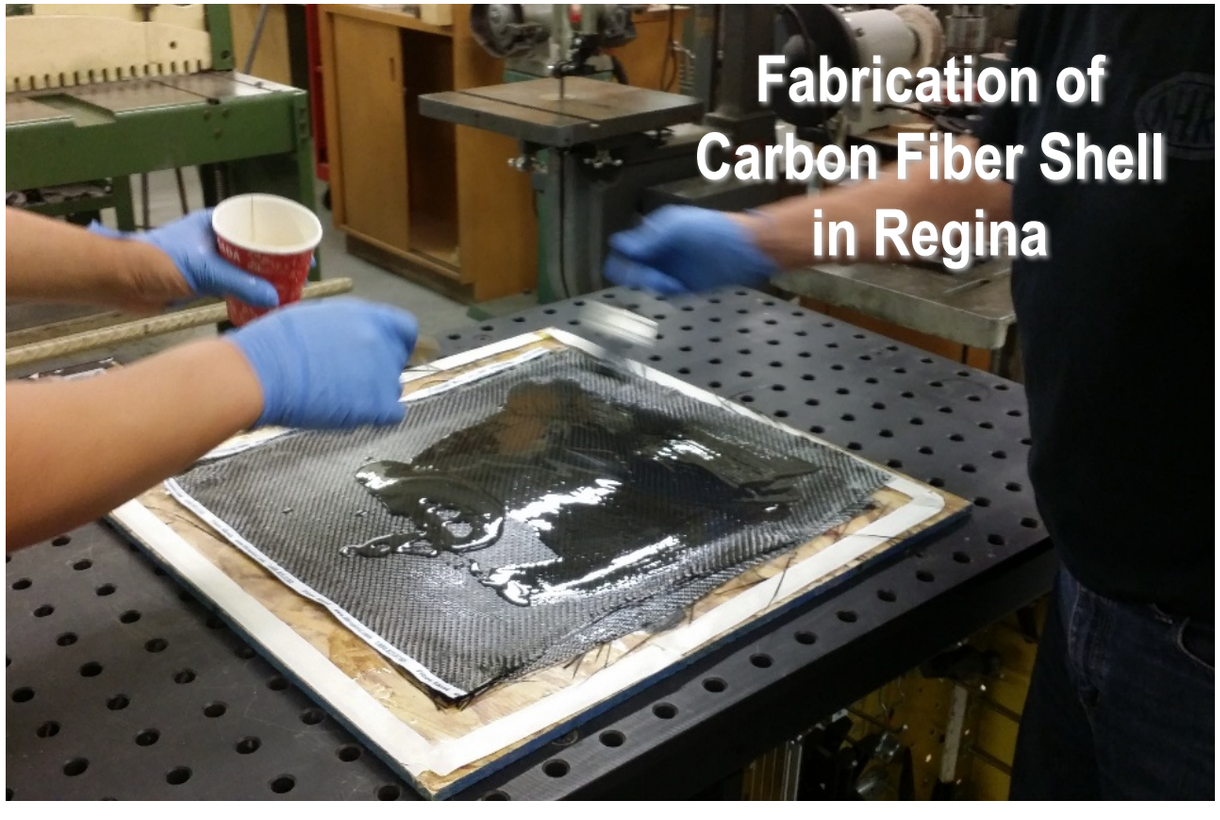
HGC Entrance Window Pressure Tests

- Continuing tests of small scale window.
  - For same window tension as full size window, the maximum pressure needs to be increased 4x.
  - i.e. Small window @ 60 psi roughly equivalent to full size window @ 15 psi.
- Repeated mechanical failures of Kevlar window near maximum pressure, even after epoxy strengthening, have lead us to explore alternatives.

Carbon-Fiber Shell + Tedlar/Mylar Inner Window

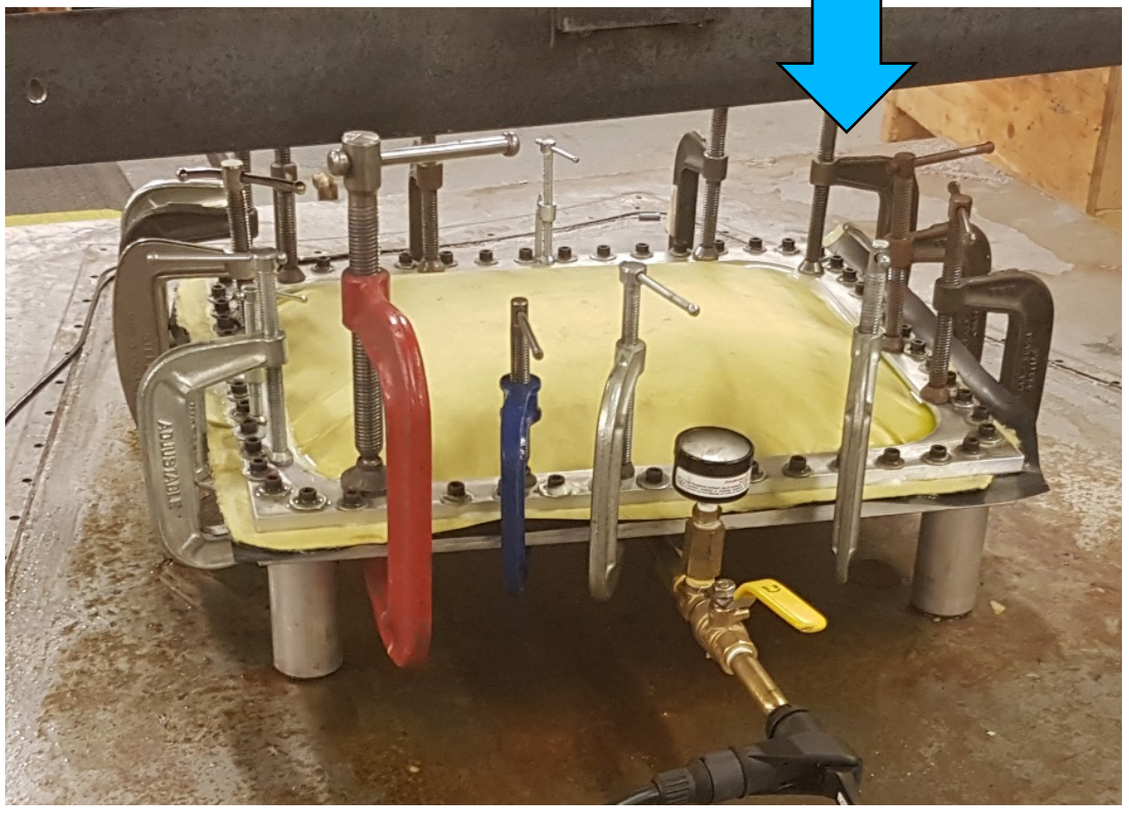
HGC Entrance Window Pressure Tests

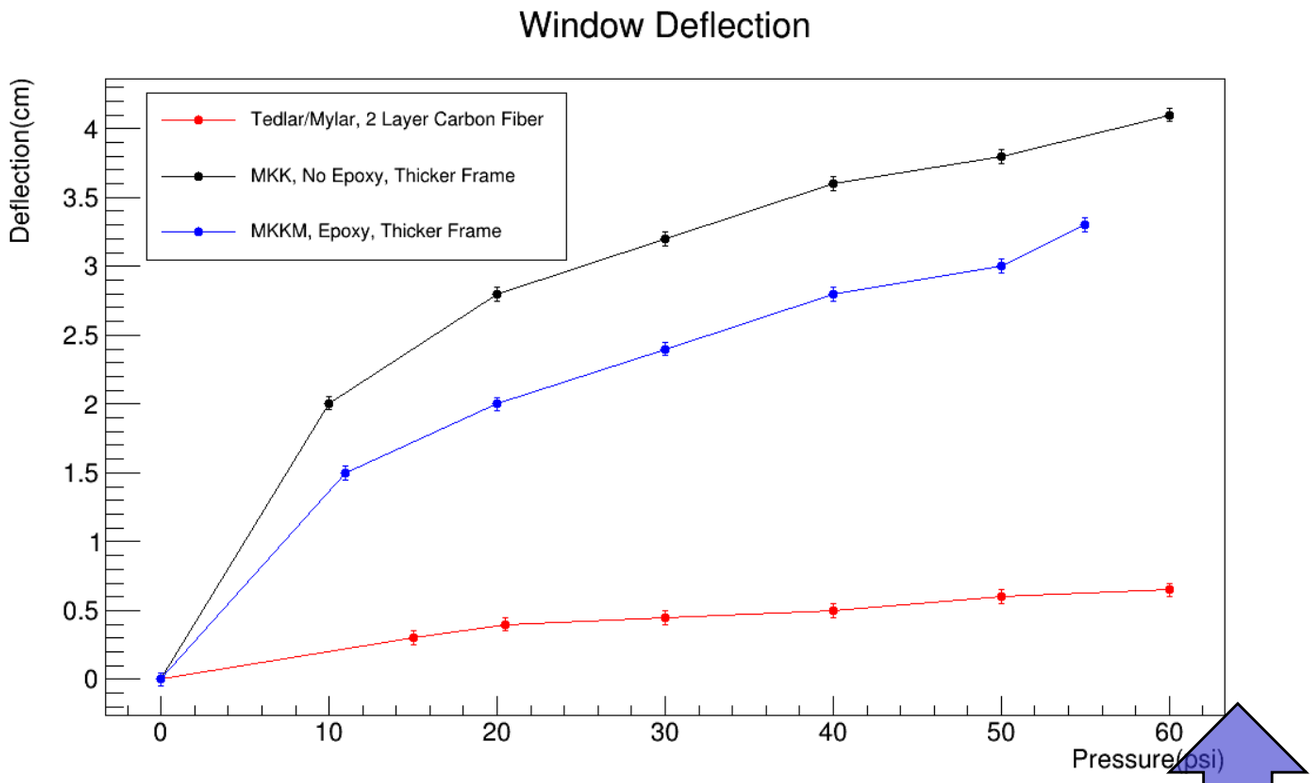
- Hard shell constructed with Fiber-Glast carbon-fiber and epoxy.
  - Shell is molded with a 5cm bulge depth, approximately circular profile.
- Tedlar/Mylar inner window beneath shell is used to seal against O-ring.
- Kevlar from previous test placed on top as a safety measure, as protection against a catastrophic shell failure.



Carbon-Fiber Shell Test Results

- Substantially less deflection above initial height than reinforced Kevlar window.
- Carbon-Fiber Shell is mechanically stable at 60 psi.
- Discover that window frame is too weak, leaking around bolts.
- Temporarily reduce leak using C-clamps around frame.





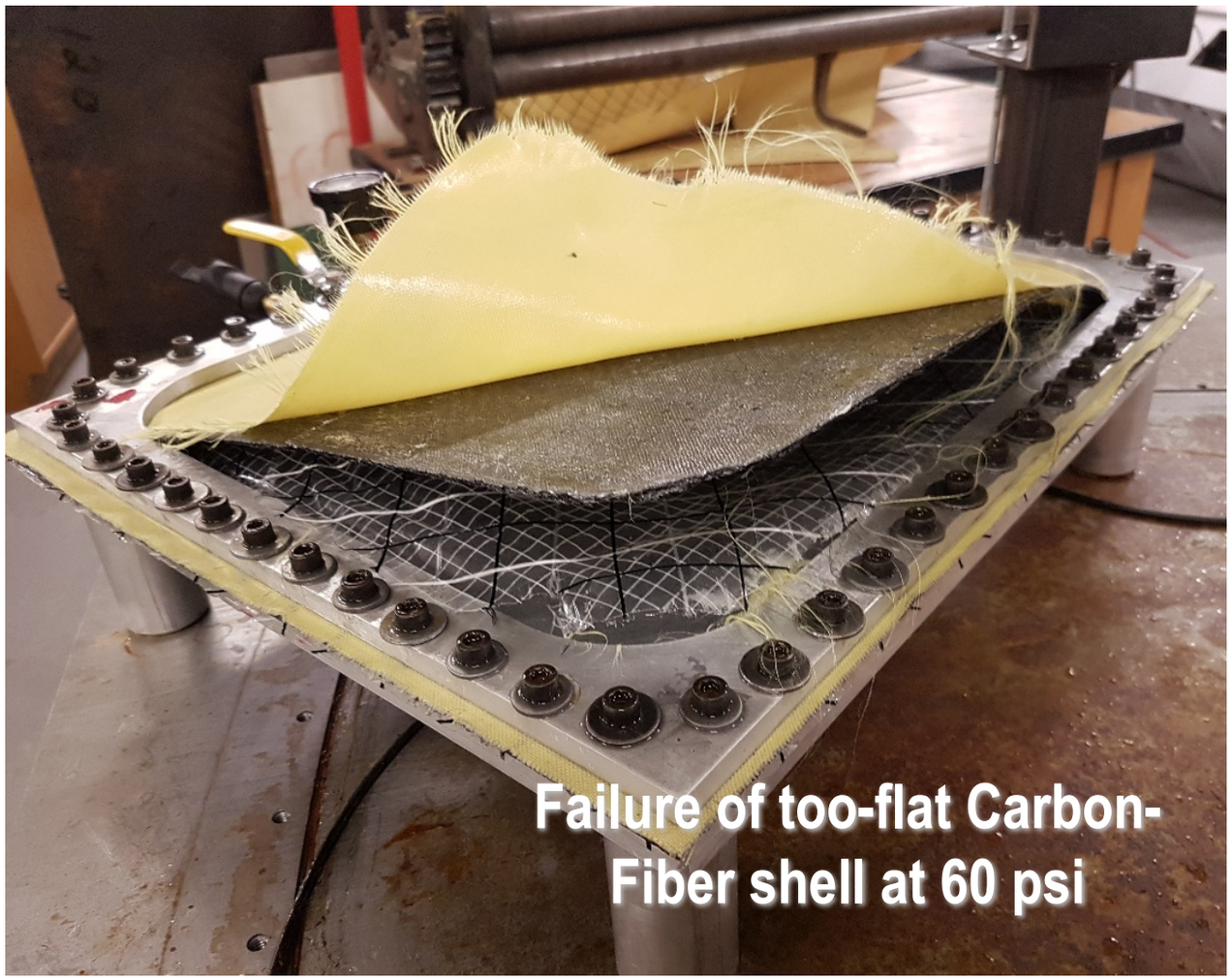
Deflection vs Pressure. The Carbon-Fiber shell had an initial bulge height of 5cm.

- Carbon-Fiber Shell certainly has the required strength, looks very promising.
  - Shell survived to be used in subsequent tests before failing.
- Results suggest clamping wire is interfering with the O-ring, and/or other sealing problems.

Ongoing Carbon-Fiber Shell Testing

With promising results for 5cm bulge Carbon-Fiber Shell, further modifications were made:

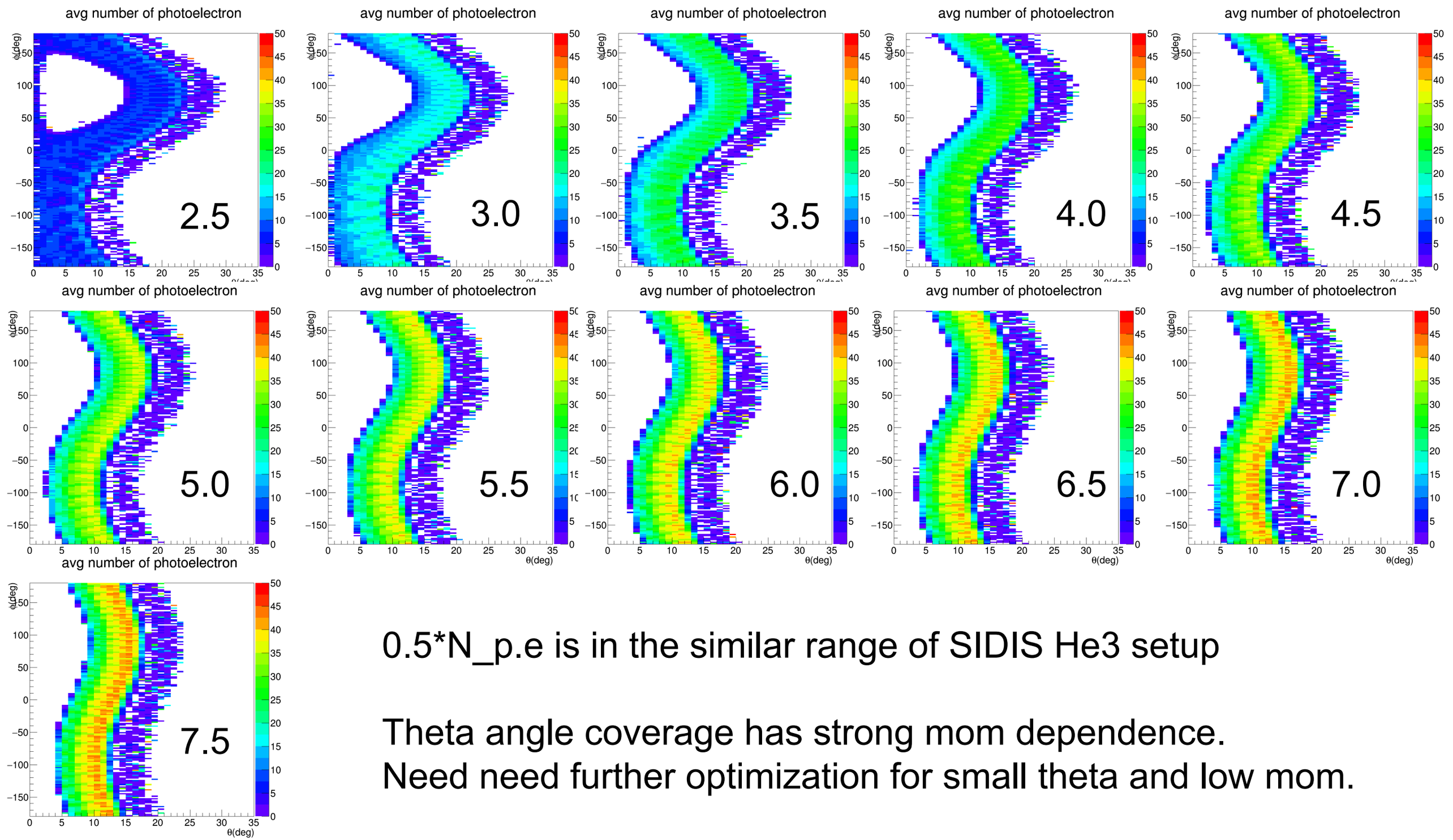
- Decreasing the depth of the shell resulted in catastrophic failure!
- Still experiencing issues with leaking, but likely ready to move on to full-size window tests.
- **Several questions to still be addressed:**
  - What is the optimal bolt/wire/ O-ring arrangement on frame?
  - How thick does the frame need to be to ensure adequate clamping?
  - How many layers of carbon-fiber are needed?
  - Can fractures in the shell be repaired and operate normally?



Failure of too-flat Carbon-Fiber shell at 60 psi

SIDIS NH3 setup
with the new location (20cm downstream) and old SoLID field

- Both target field and SoLID field are on
- Showing 0.5*N_p.e. in vertex Theta and Phi at different Mom for pi-

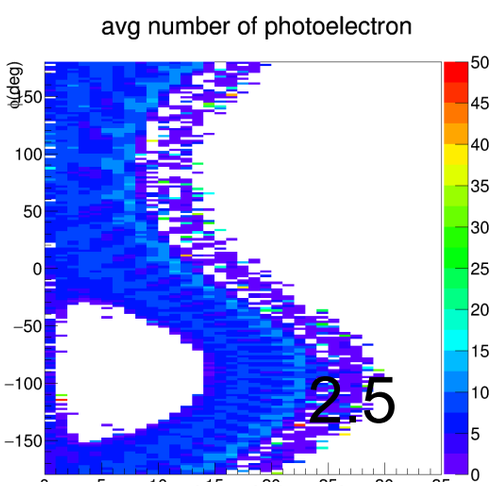


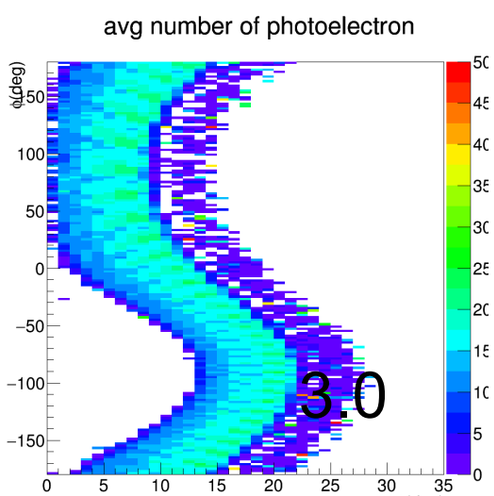
0.5*N_p.e is in the similar range of SIDIS He3 setup

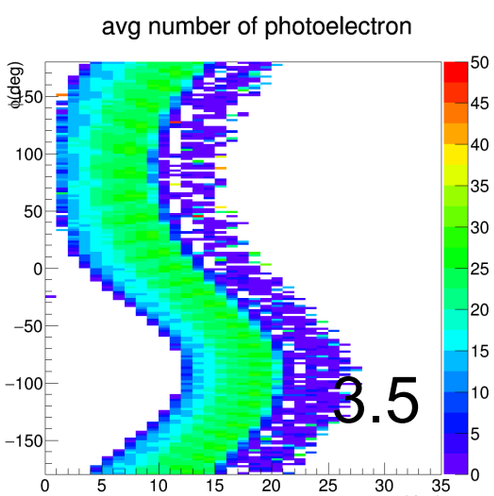
Theta angle coverage has strong mom dependence.
Need need further optimization for small theta and low mom.

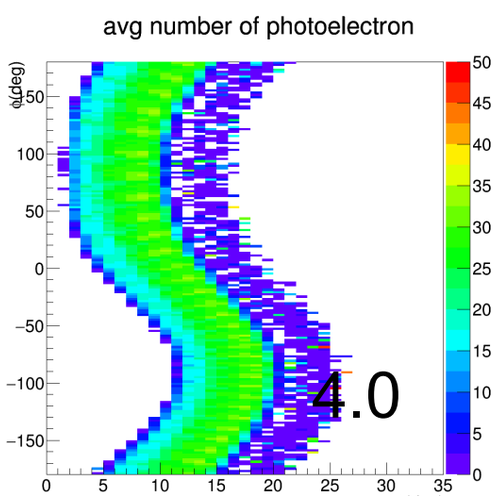
SIDIS NH3 setup
with the new location (20cm downstream) and old SoLID field

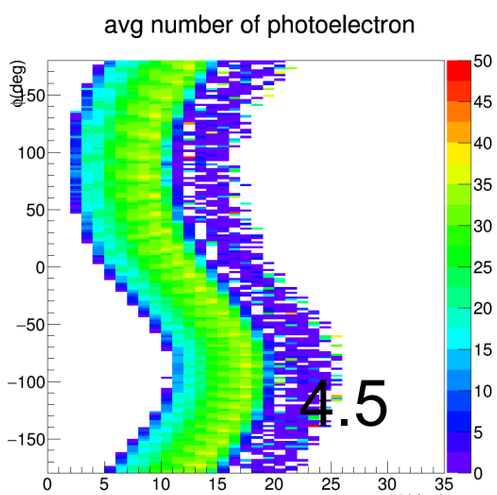
- Both target field and SoLID field are on
- Showing 0.5*N_p.e. in vertex Theta and Phi at different Mom for pi+

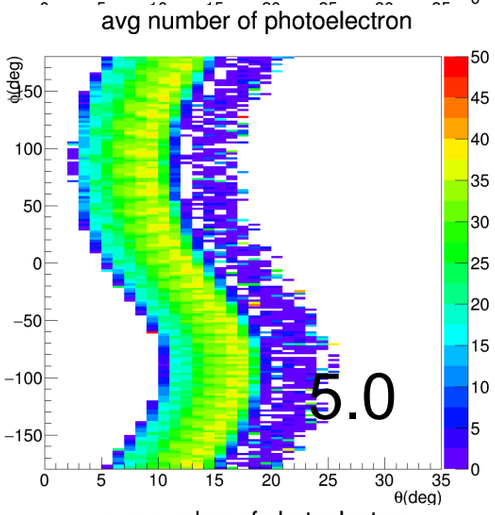


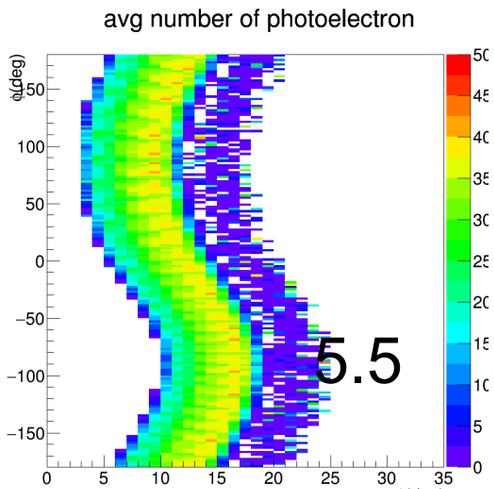


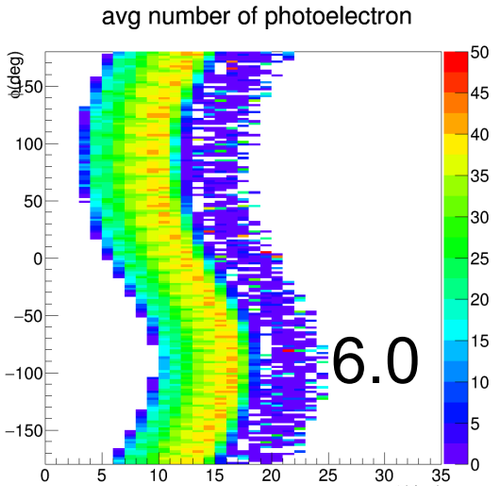


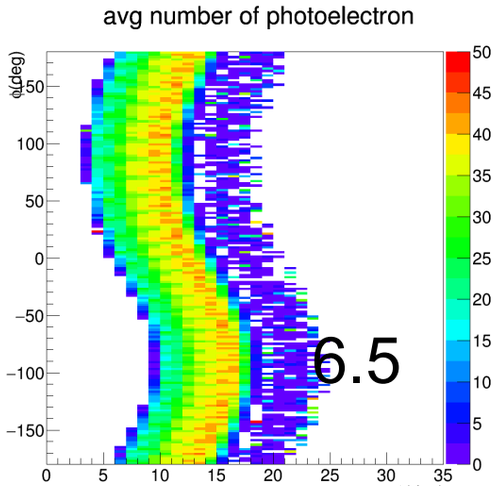


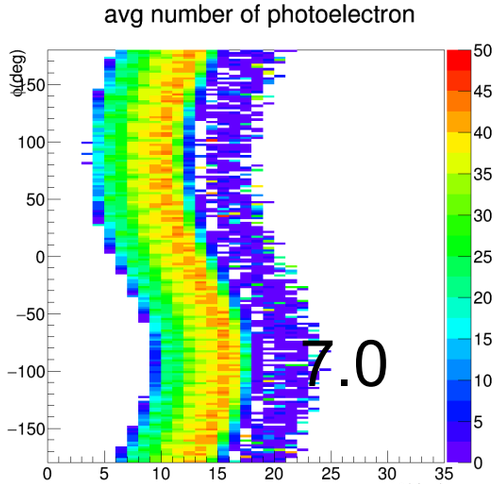


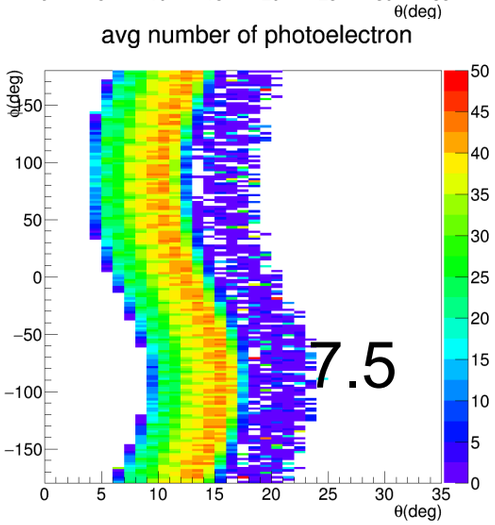








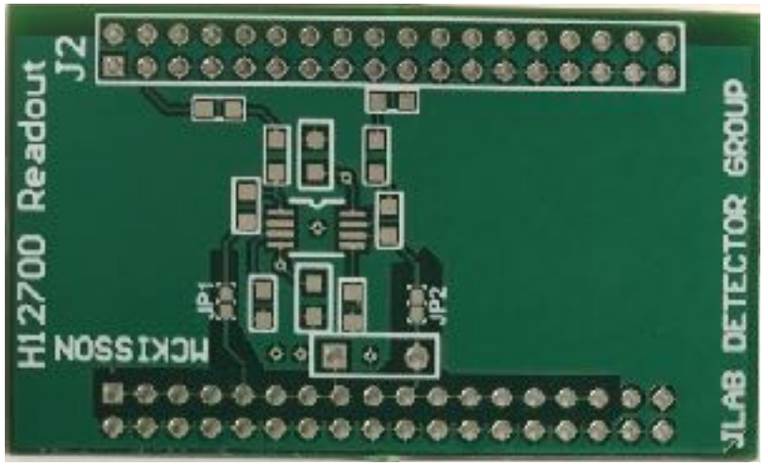




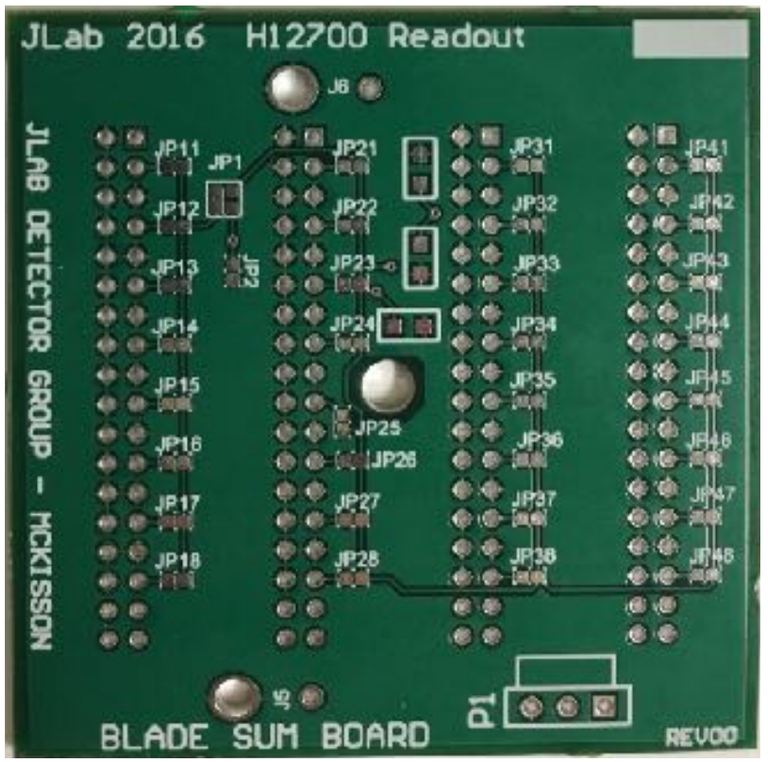
Similar to pi- result except flipping over phi

Readout System

- Blade sum board designed by Jack McKisson
  - The soldering work for the blade sum board has been finished by McKisson
  - Rebuilding the DAQ system to test these blade sum boards, will start soon
- MAROC readout system
  - Test of MAPMT with MAROC readout system for Hall B CLAS12 RICH, some information might be useful for us
  - Test with their test platform



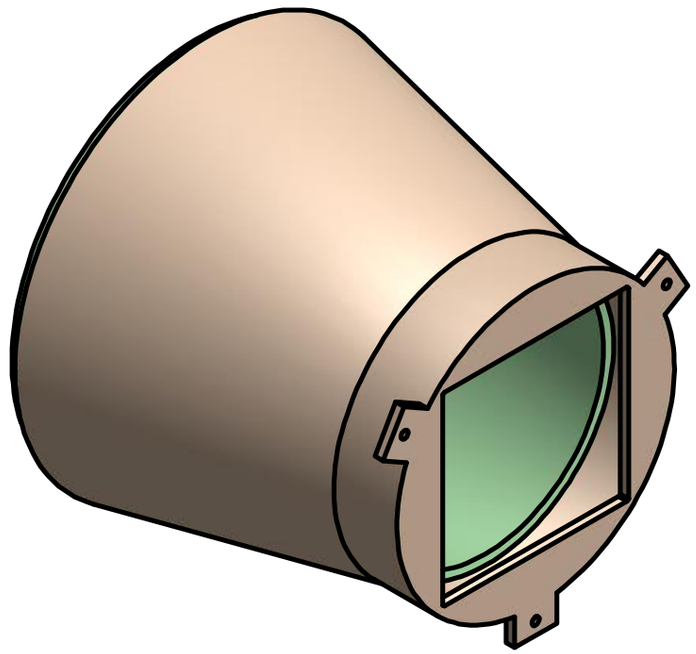
Blade board prototype (with 3 different sum configuration: sum of 2, 4, 8 channels)



Sum board

Shielding

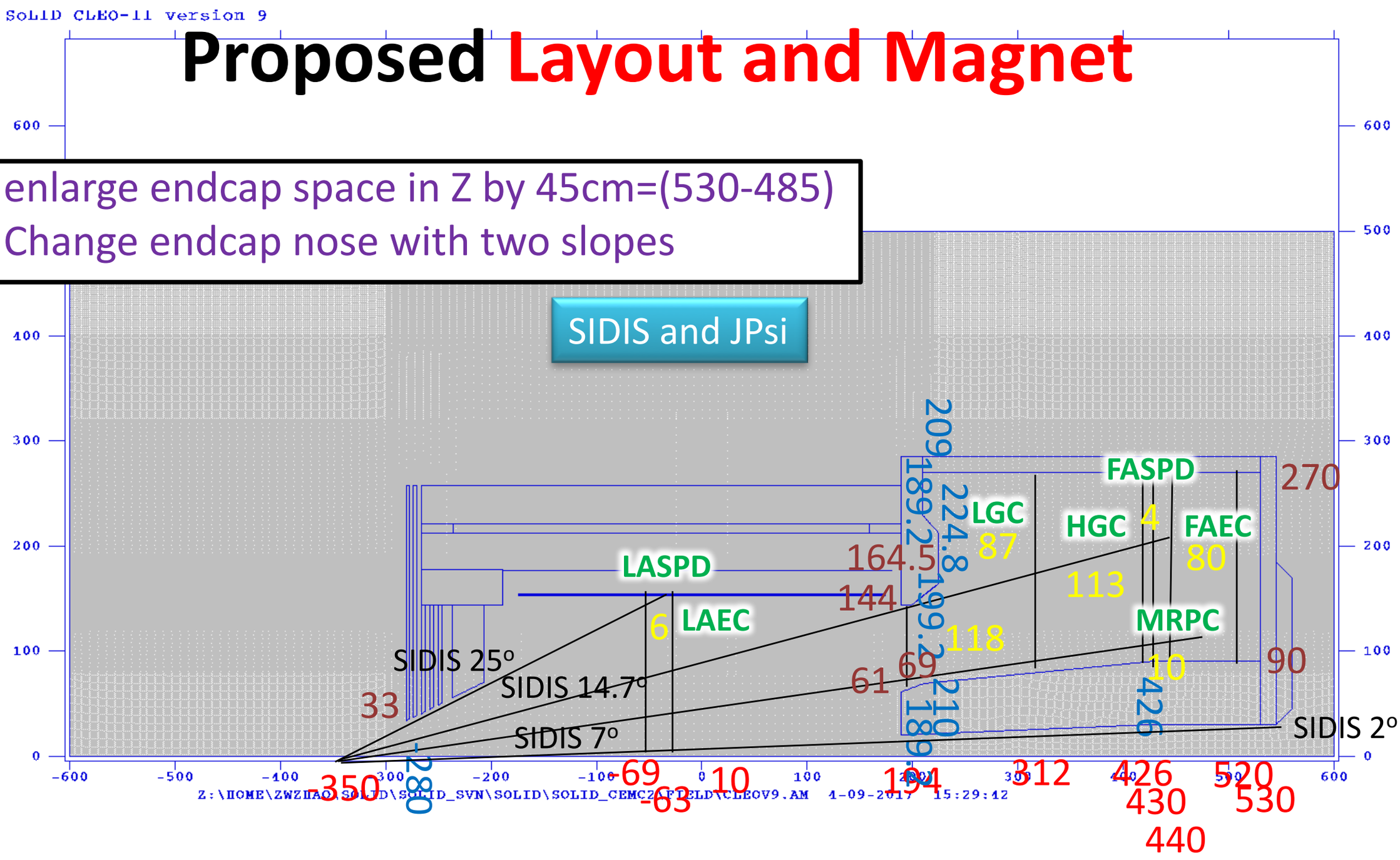
- Cone shielding
  - No good estimation of how much the cone will suppress the field
- Cylinder shielding
  - 18 inch diameter cylinder: one end open and one end closed with cap with 16 1 cm holes on the cap
  - Need a separate reflection cone
  - Attenuation is roughly 25:1 if we consider the open end effect
  - Plan to order one prototype to measure the attenuation



Backups

Proposed Layout and Magnet

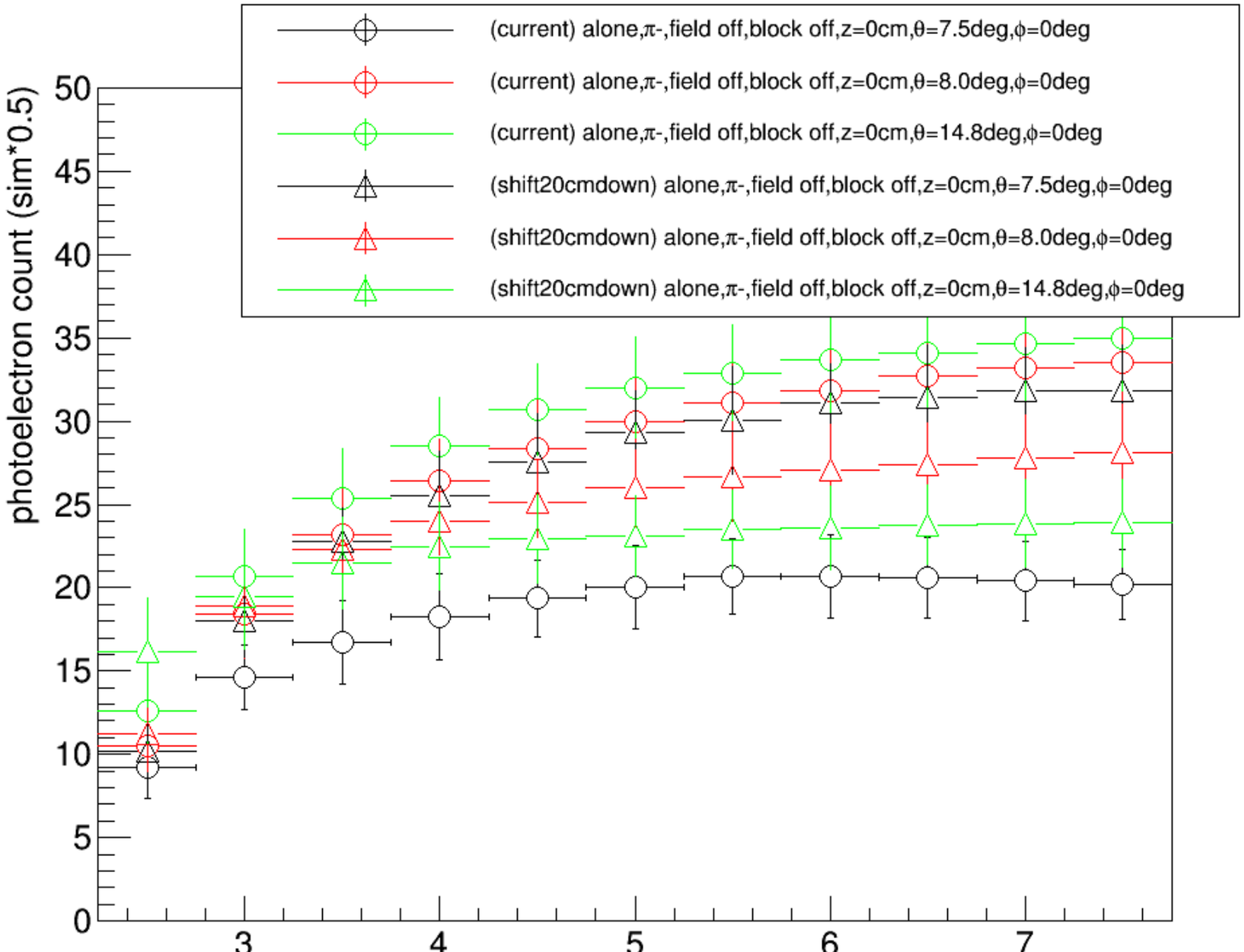
enlarge endcap space in Z by 45cm=(530-485)
Change endcap nose with two slopes



HGC is expected to move 20cm downstream
It's optics needs to be tuned for the new location

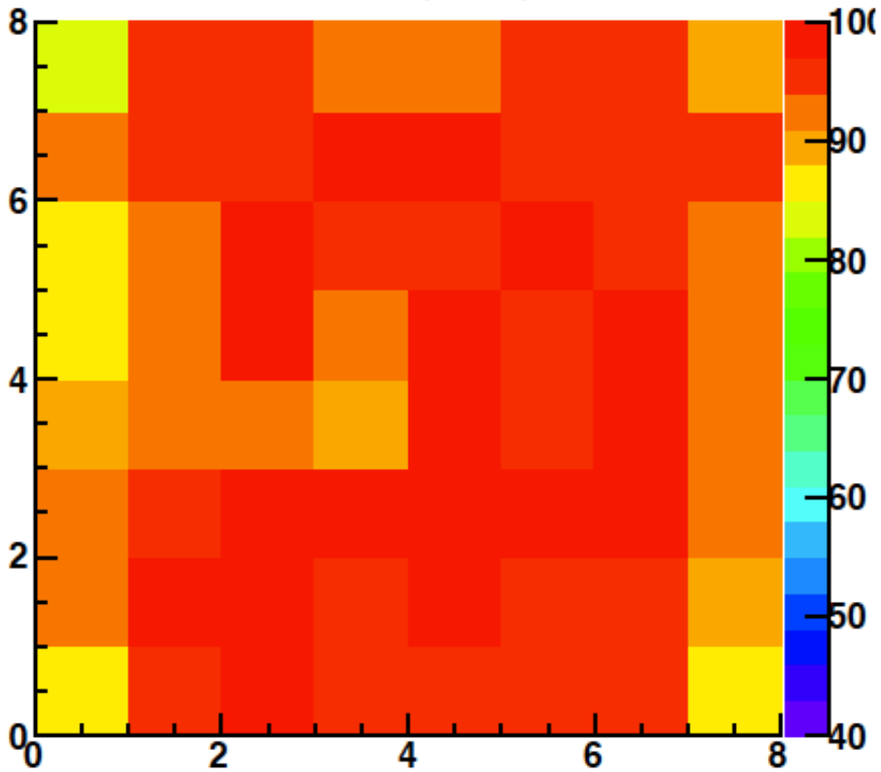
First attempt at 20cm downstream

- No field, pions from at target center
- Optimize for 7.5 degree
- Obtain similar performance, need more tuning
- Only He3 case here, need to check NH3 case



FE Electronics: SPE Discrimination

Relative efficiency map



Relative gain map