SoLID HGC Update

Zhiwen Zhao for HGC group

2020/06/08

Outline

- 2019 Director Review comments
- Prototype at Regina
- Magnet shielding
- Mirror coating at SBU

2019 Sep Director Review comments

1. "Regarding the sharing of the Hall B gas handling system for recycling/polishing the C4F8 in the Hall A HGC: There remains the potential issue of liquification at expansion points in the return lines to the Hall B system (C4F8 liquification temperatures are about 10C at the HGC operating pressure 1.7atm and -6C at 1atm). This is not a show-stopper nor a cost-driver for SOLID, but is an example of a sub-subsystem that needs more study before it can be costed."

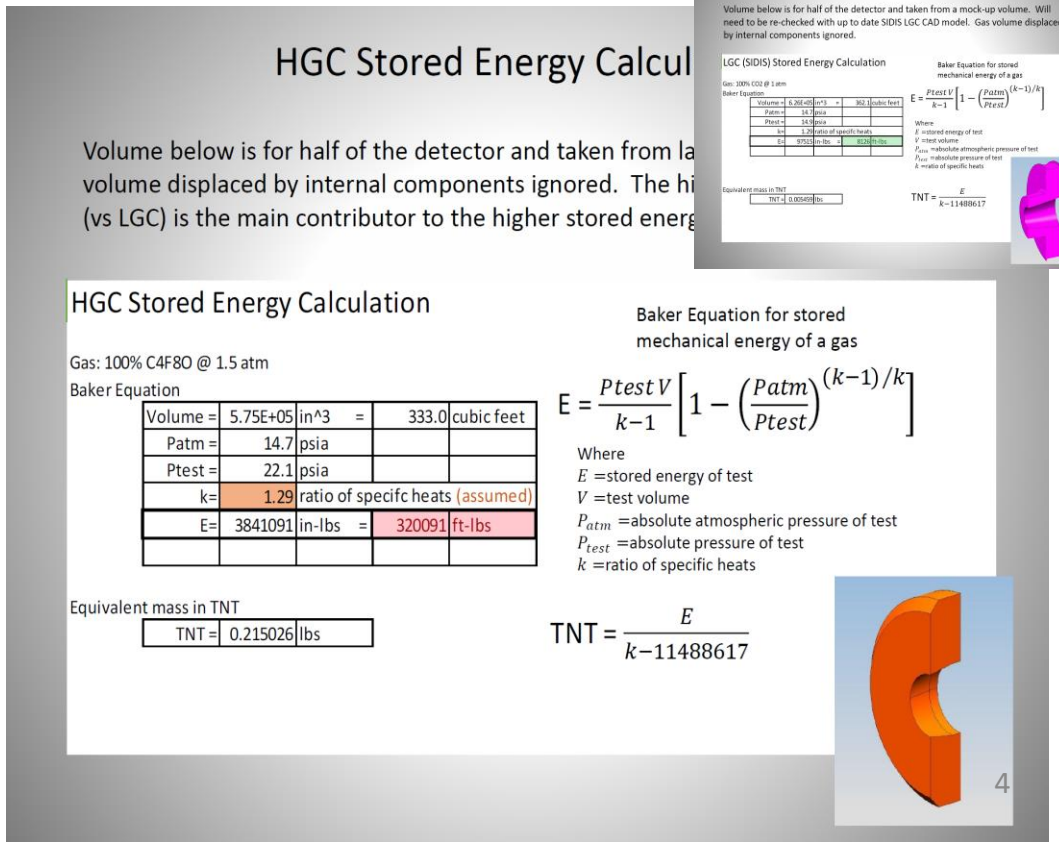
- Duke engineer Gary Swift is working on a preliminary gas system design to have those considerations and provide a more solid base for cost. The initial idea was confirmed with both Bob Miller from HallB and Robin Wine from HallA. The work of defining procedure and flesh out the design is ongoing.
- Comments from Whit Seay and Ed Folts: the temperature never got close to 10C. It's not impossible but highly unlikely. Magnet endcap is a rather closed environment with heat sources like electronics. a procedure could be written to address the situation in case it ever arises.

2019 Sep Director Review comments

2. "The project should continue to work in collaboration with engineering and EH&S staff to evaluate potential risks for the entrance windows for the HGC, including stored energy and personnel and equipment safety in the event of a failure, both during test/assembly and operations."

3. "The main concerns about the Heavy Gas Cerenkov were focused on the large gas windows. It is clear that more testing/studies are needed to be sure they know what will happen if there is a widow failure."

- Whit's calculation in 2017 has "100 gTNT=4.2e5 J=120 Wh" for HGC
- A procedure can be developed to minimize risk
- Full size cabon fiber window bench test has no rupture. Will test more on prototype tank and an Aluminum window



2019 Sep Director Review comments

4. “The project team should put a modest additional effort into re-evaluating alternative approaches. These could include trade-offs such as 1) … use of MCPPMTs on the LGC and HGC, ….. 7) additional robustness (and physics?) using multi-anode readout of the MAPMTs on the Cherenkov detectors versus summed readout”

- Try signal/background separation with pixel, quad,sum by machine learning
- Combine simulation and preRD beamtest

5. “The LGC team should consider laminating both sides of carbon fiber with Lexan to make a symmetric structure to avoid warping from differential coefficient of moisture (and thermal) expansion. Materials will have significant water content at assembly (likely 30%) and will dry over time in inert gas atmosphere.”

- Together with LGC

6. “Combined between the LGC and HGC, 700 PMT’s are needed. The team should check production time required at HPK and plan accordingly.”

- Together with LGC

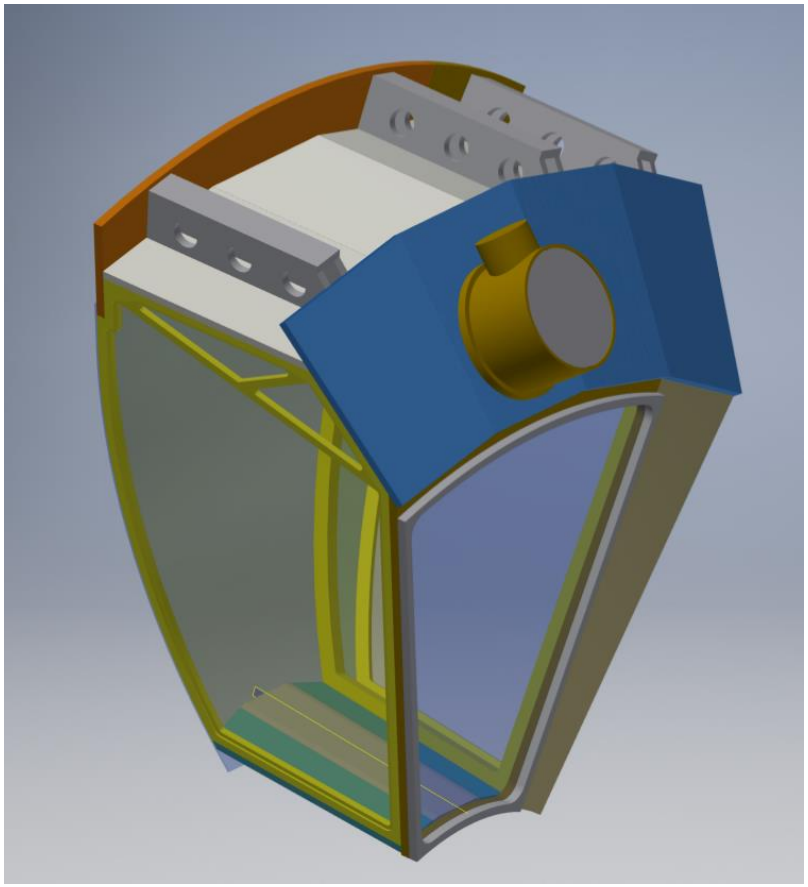
7. “The project team is encouraged to develop a prioritized list of contingency scope with associated cost reductions and science impacts. Items to consider could include 1) dropping the outmost ring of ECL modules, dropping the HGC detector, dropping the 6th tracking plane”

SoLID HGC Prototype

C$125k grants allow the U.Regina group to construct 1⅓ SoLID HGC modules for testing.

Questions to be addressed:

- Enclosure deformation at 1.7 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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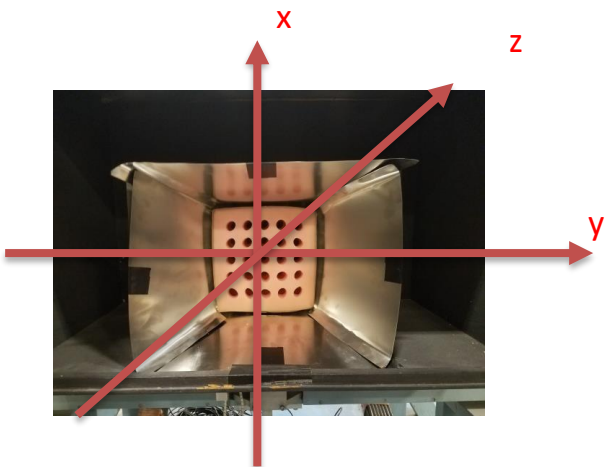
- **It's delivered to Regina safe and sound on 3/31**
- **Wait for testing when allowed back to work**

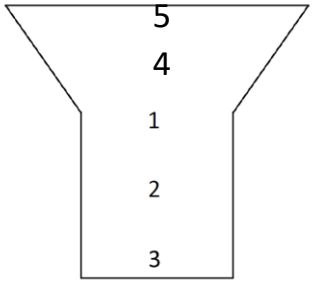
- **Seal all enclosure joints**
  - Will try RTV, need to devise testing methods
  - Due to high cost of C_4F_8 (or other gas used), achieving a low leak rate is critical!
  - Document all methods for future
- **Fabricate and install back window**
  - Will try Gary's ad–hoc method, hopefully it works!
- **Fabricate and test two new front windows**
  - Carbon fiber window with the new size
  - AL-2024-T4 window

Magnetic Shielding test

for 2 of 0.095" NETIC (iron) layers in an external field 90G

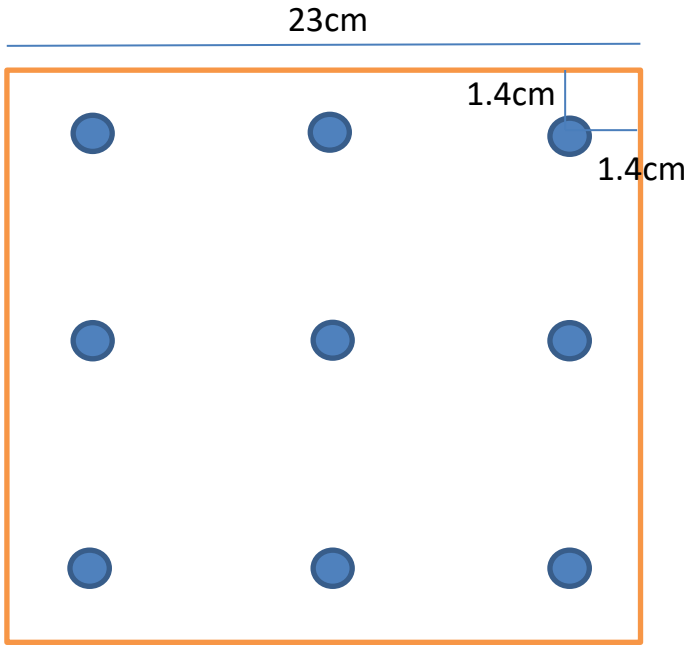
Defining axis and coordinate





Measurement at the central point at plane 1 - 5

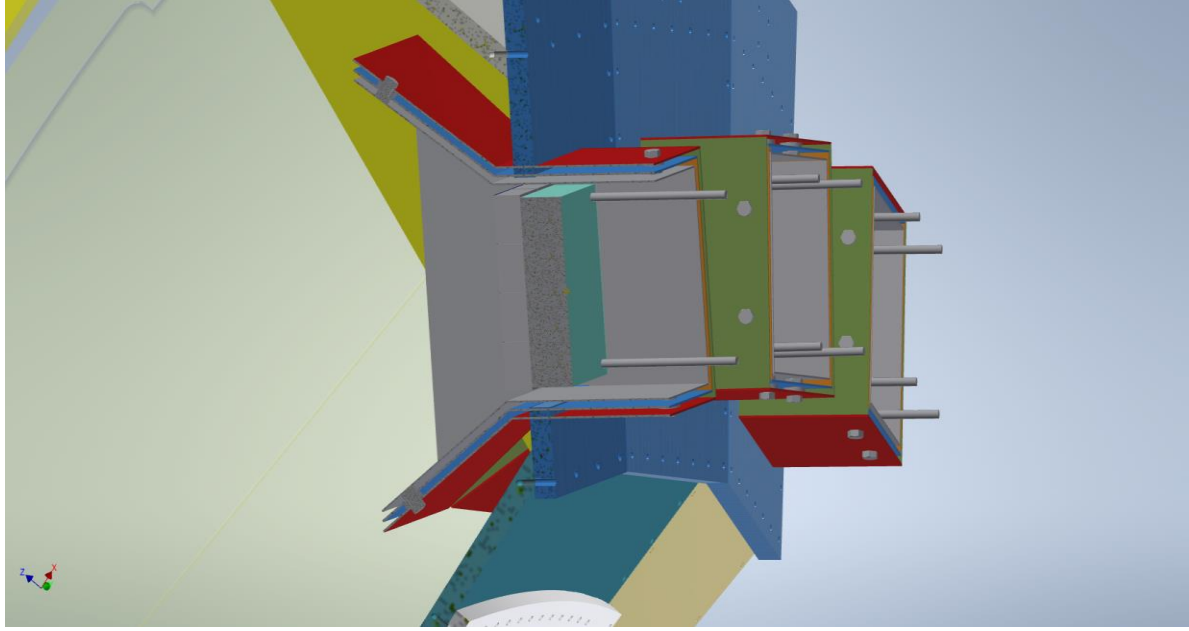
Measurement done with or without of 1 layer of endcap
Measurement done with Transverse Gauss probe and Longitudinal probe

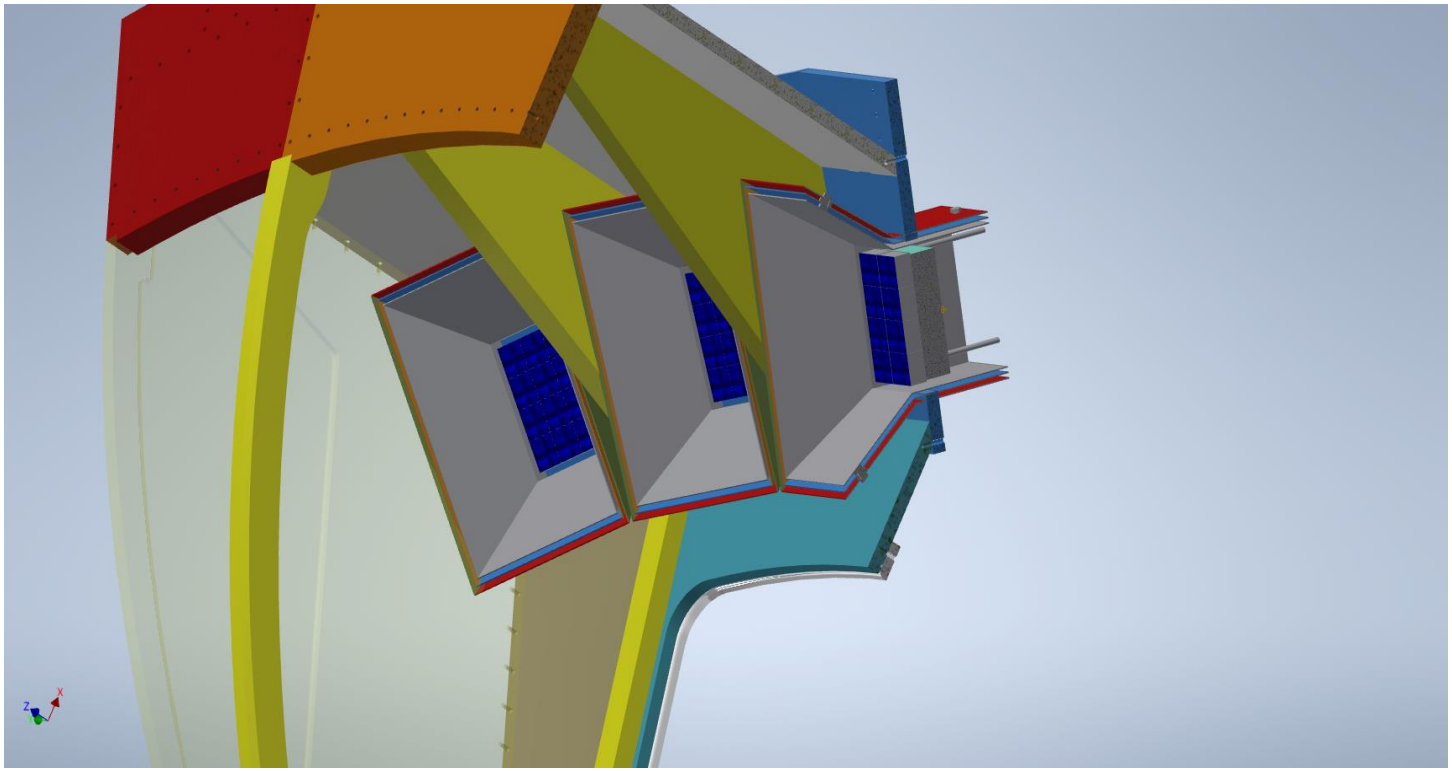


Measurement points at plane 1

at PMT location (plane 1)
For transverse field, we got 9G or shielding factor 10
For longitude field, we got 18G or shielding factor 5
With or without an iron endcap at plane 3 doesn't affect the result

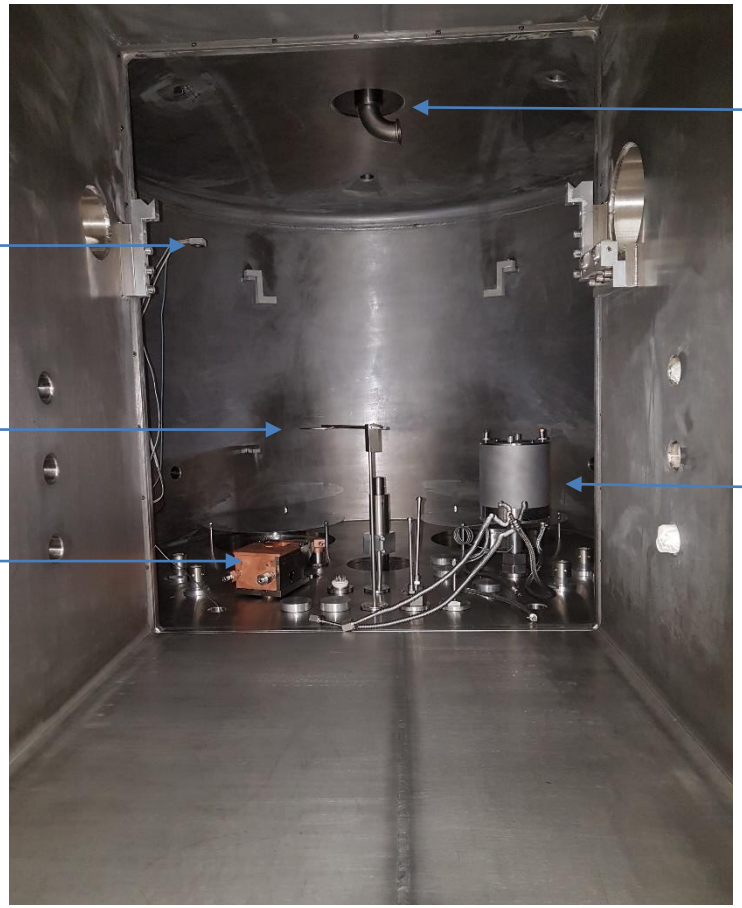
- prototype is designed with 2 of 0.095" NETIC layers and 1 inner mu-metal layer.
- All component removable.
- Delivered at Duke and wait for test





SBU mirror coating setup in 2020/01

CHAMBER INTERIOR



HGC mirror is too big for chamber
Half size can work

The plan is to first
coat small CFRP coupons with
radius of curvature (210cm)