

SOLID heavy gas Cherenkov detector prototype

Stephen Kay

Department of Physics

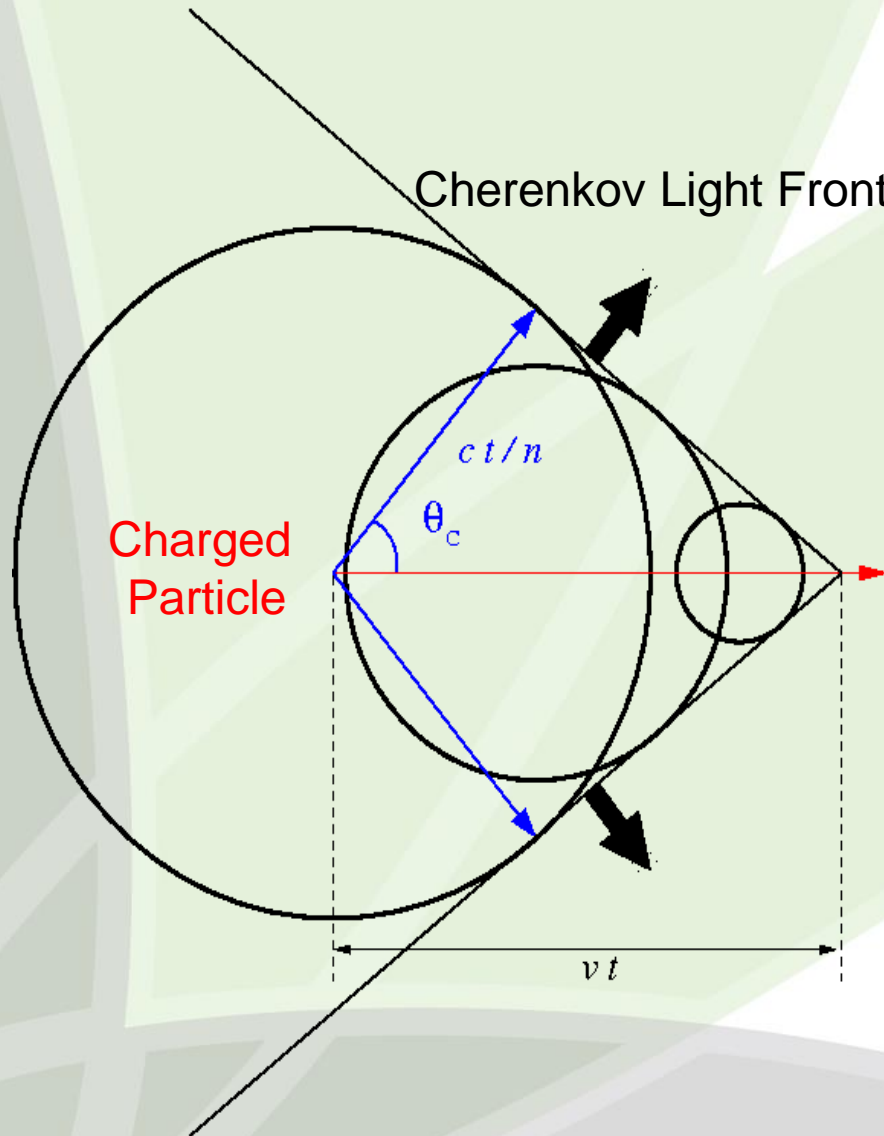
Stephen.Kay@uregina.ca



University
of Regina

Medicine.
Materials.
Energy.
Environment.

Cherenkov Radiation

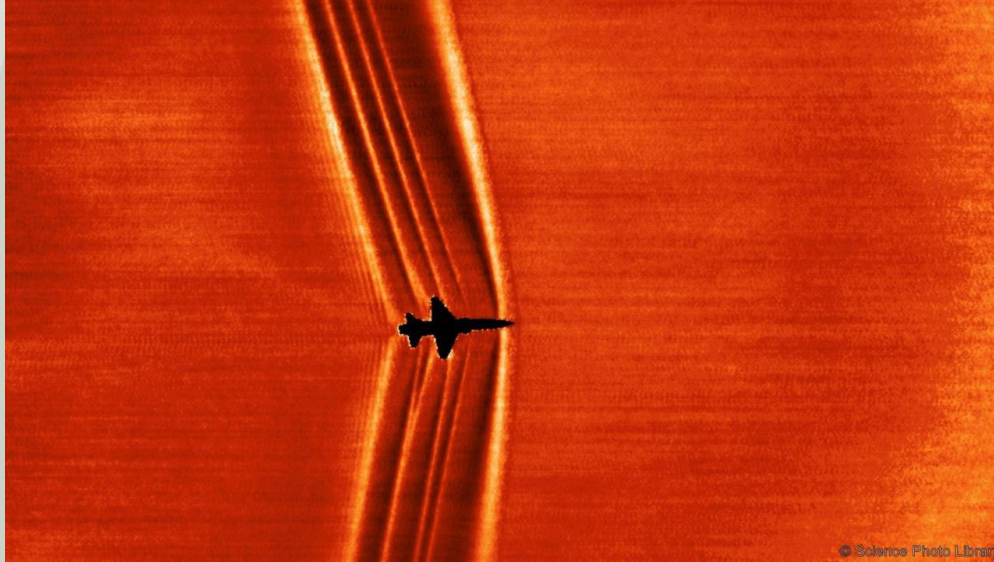


Cherenkov Radiation

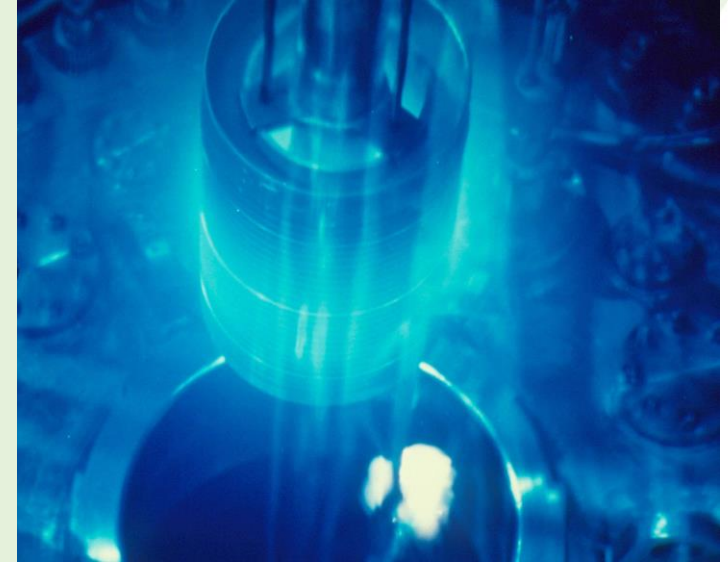
- Light emitted when a fast moving charged particle traverses a medium
- Threshold condition – Particle must be travelling faster than light in the medium, i.e.

$$v > \frac{c}{n}$$

Cherenkov Radiation



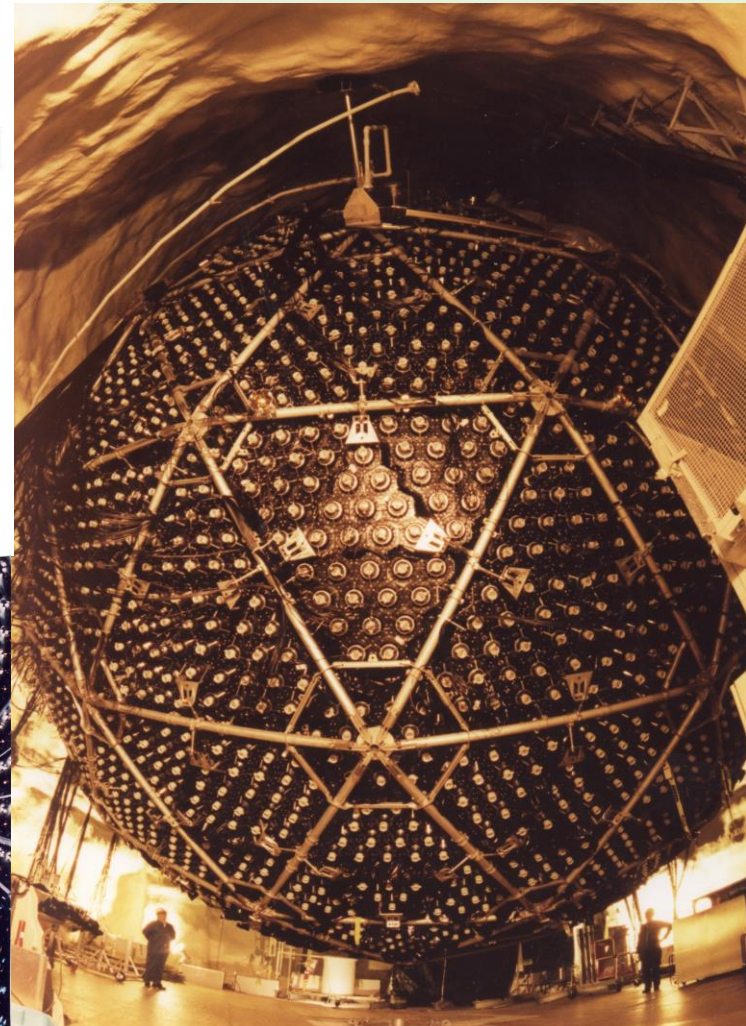
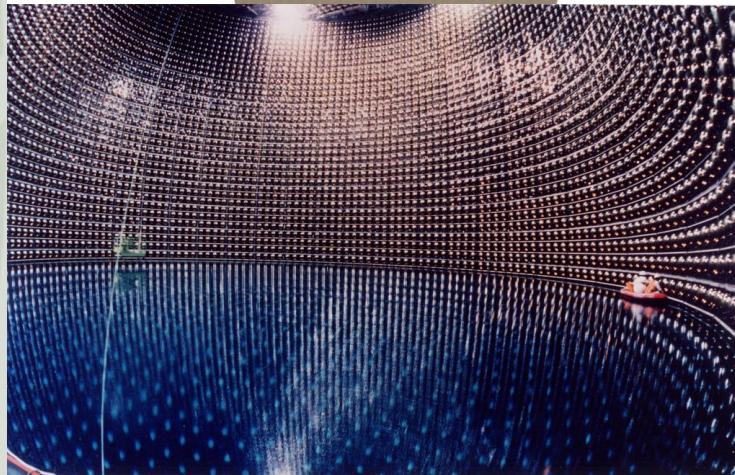
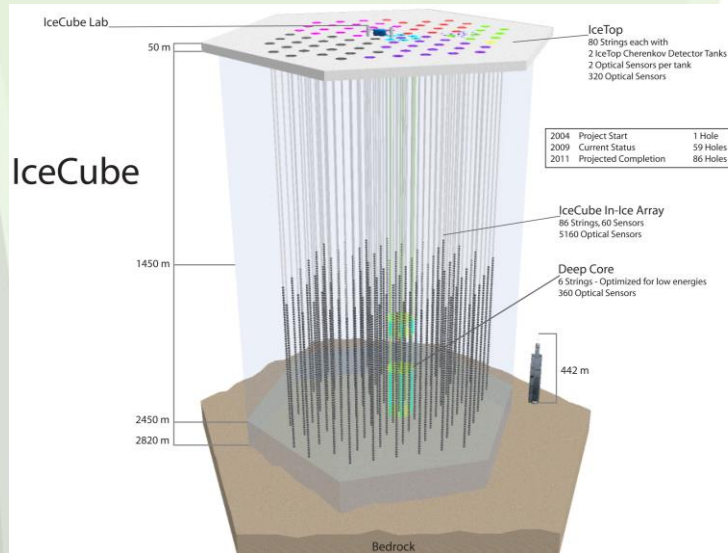
Electromagnetic analog to a
sonic boom



Can observe Cherenkov
radiation quite dramatically in
Nuclear reactors

Cherenkov Detectors In Use

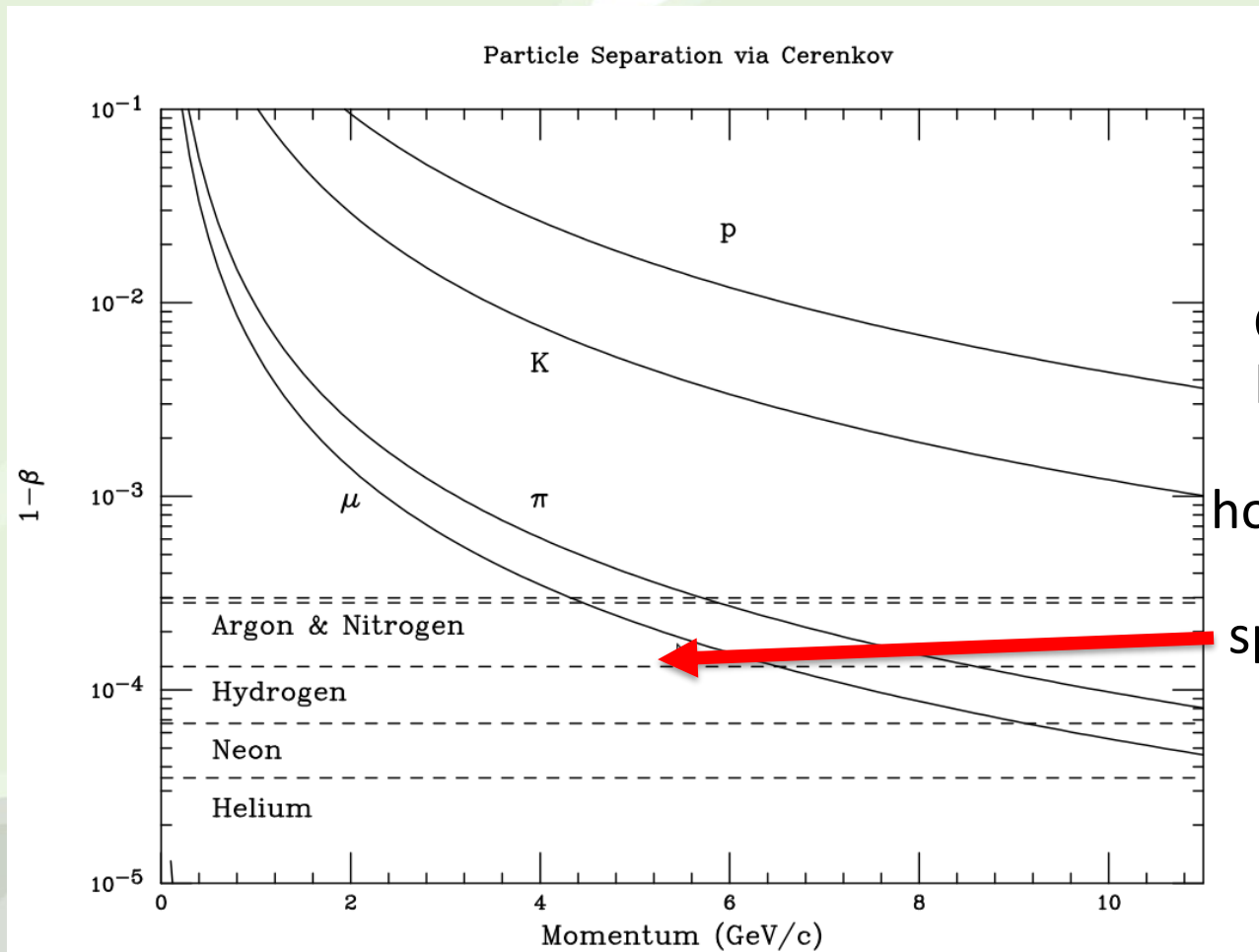
- Cherenkov detectors are widely used in High Energy Physics



Cherenkov Detectors In Use

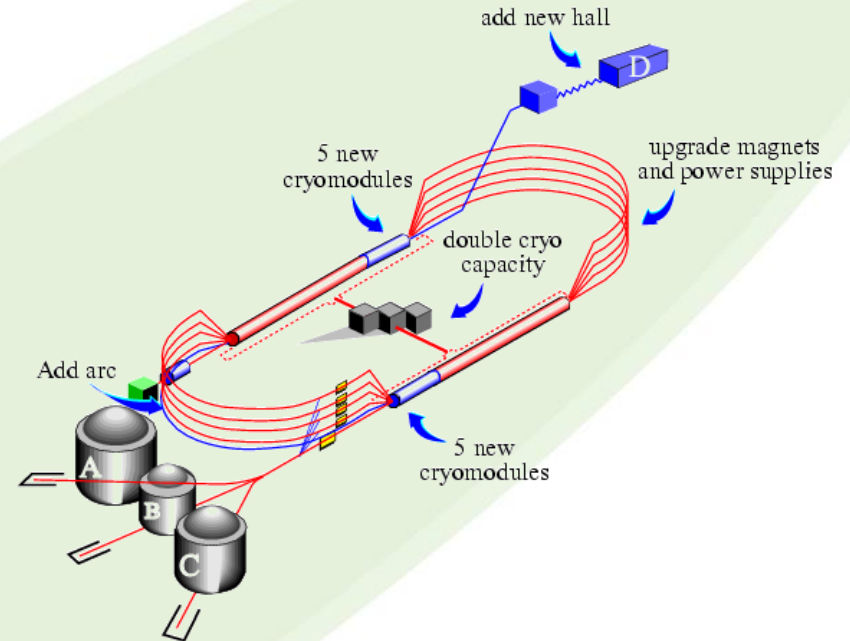
- Cherenkov detectors can be used to distinguish different charged particles

Velocity (as $1 - \beta$)



Only get Cherenkov light when below the horizontal line for the specified gas

Jefferson Lab



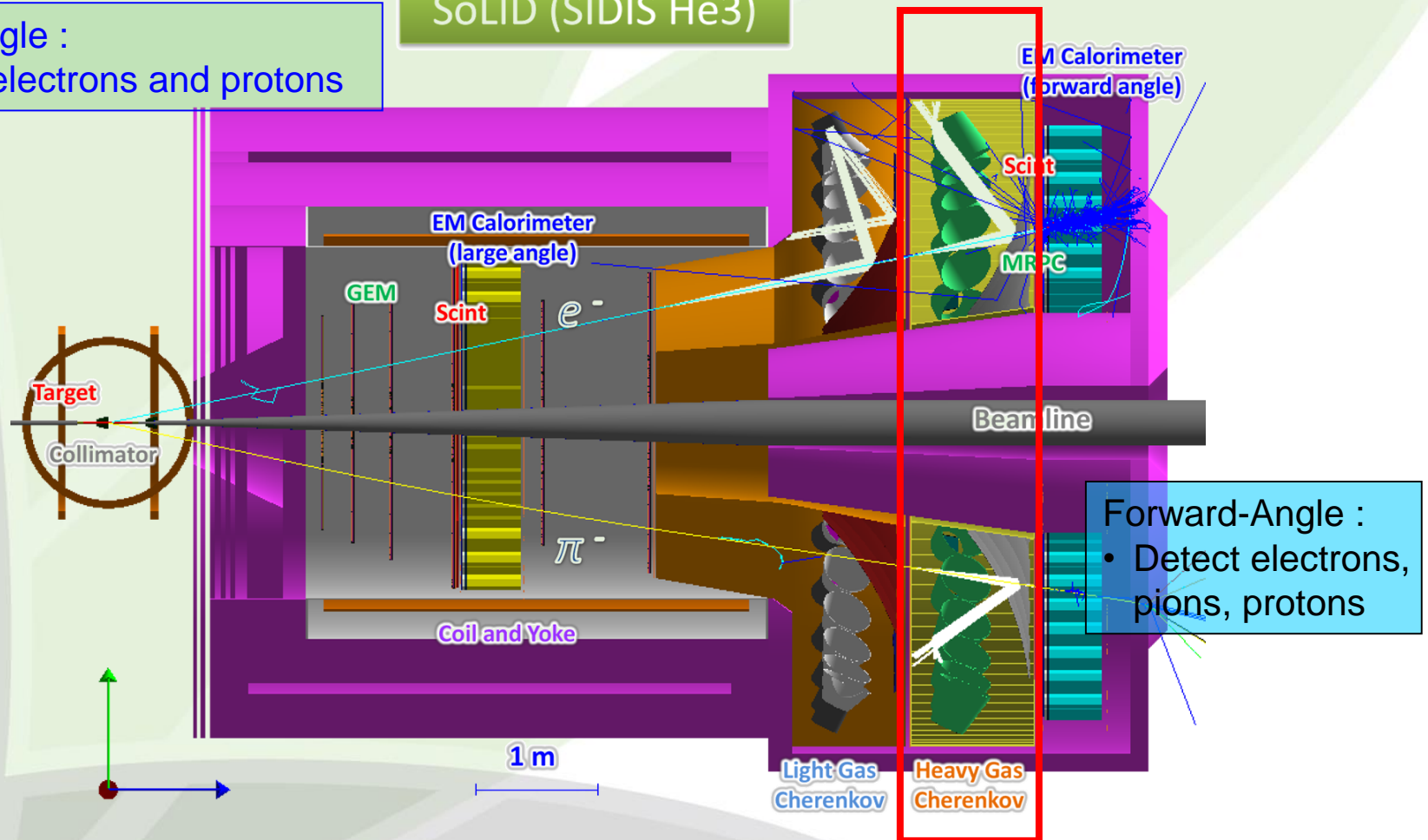
- Recently undergone a large upgrade
- High energy, high current electron beam facility

SoLID = Solenoidal Large Intensity Device

Large-Angle :

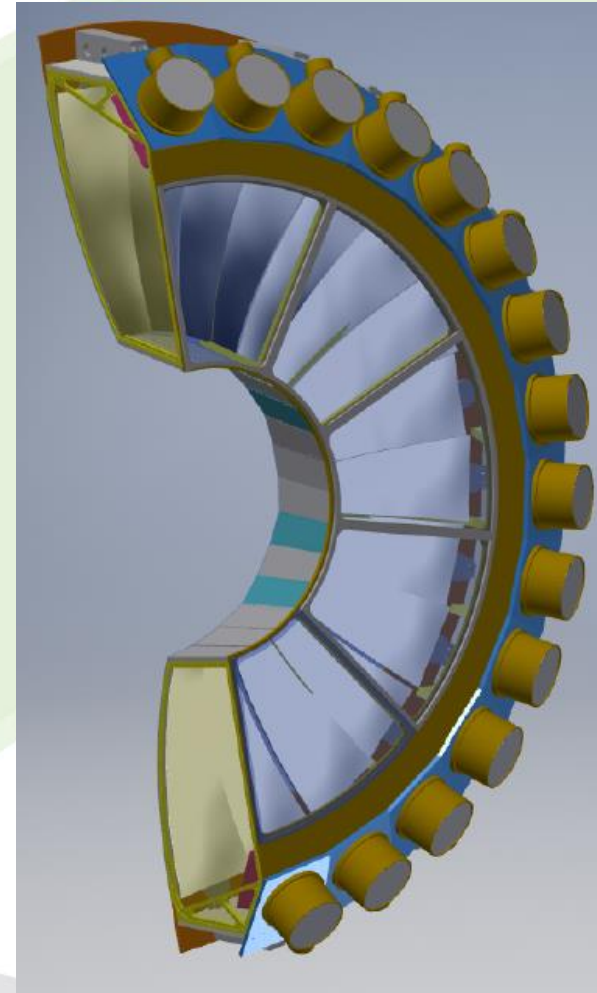
- Detect electrons and protons

SoLID (SIDIS He3)



SoLID Heavy Gas Cherenkov - SoLID HGC

Radiator Gas	C_4F_{10}
Gas Pressure	1.5 atm
Tank Diameter	5.4 m
Tank Thickness	1.0 m
Active Area	8.5 m ²
Number of Spherical Mirrors	30
Number of PMTs	480
Projected Cost	US\$3.9 million



HGC Project Partners



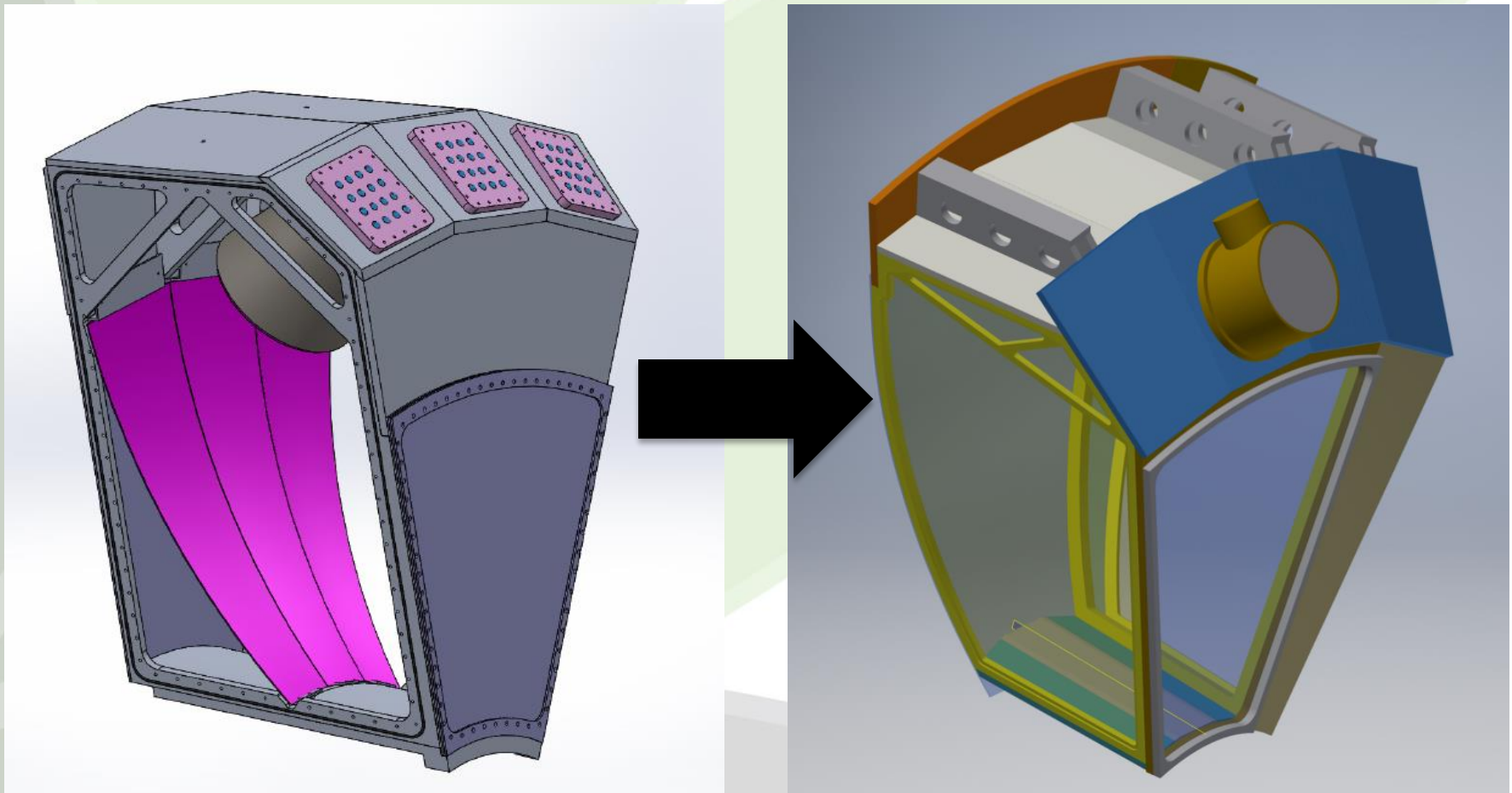
Canadian Project Funding Provided by:



FRN: SAPIN-2016-00031

SoLID HGC Prototype

Prototype design has evolved over the past year



SoLID HGC Prototype

Main Changes

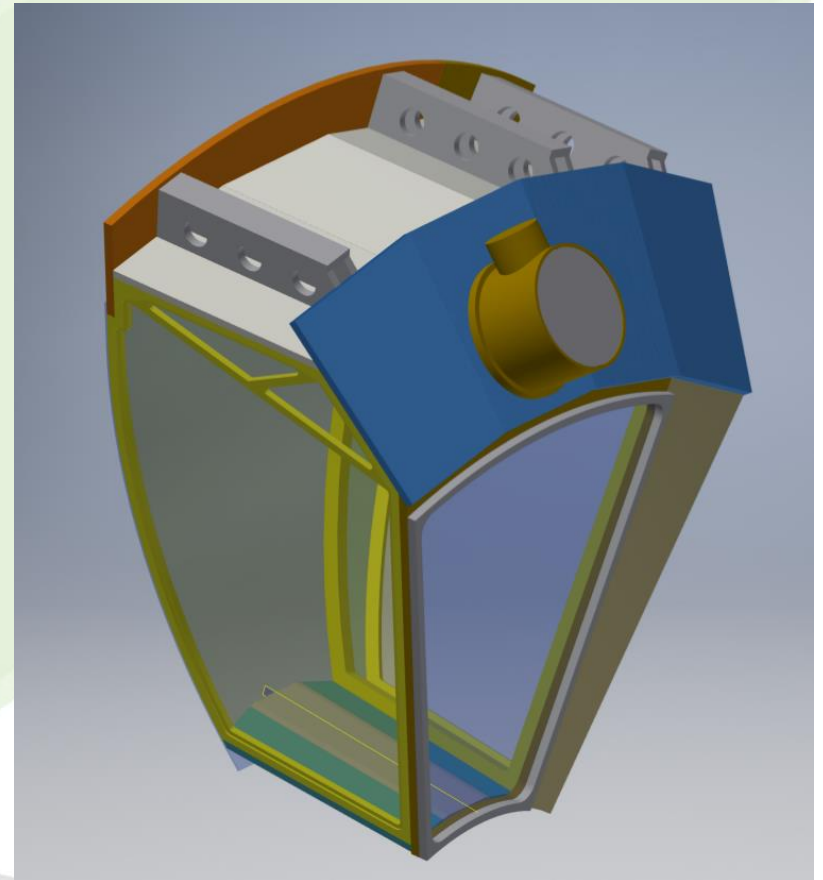
- 1 + 1/3 module to test interface between sections
- Due to stored energy device must be considered as a pressure vessel
- Informal review last Monday (8/10/18) with JLab collaborators
- Positioning with respect to other detectors considered
- Slight redesign of window size and position due to this

SoLID HGC Prototype

C\$100k grant to construct one module of the HGC for testing

Questions to address:

- Deformation at 1.5 atm operating pressure
- Performance of seals against adjacent units
- Performance of the thin front entrance window

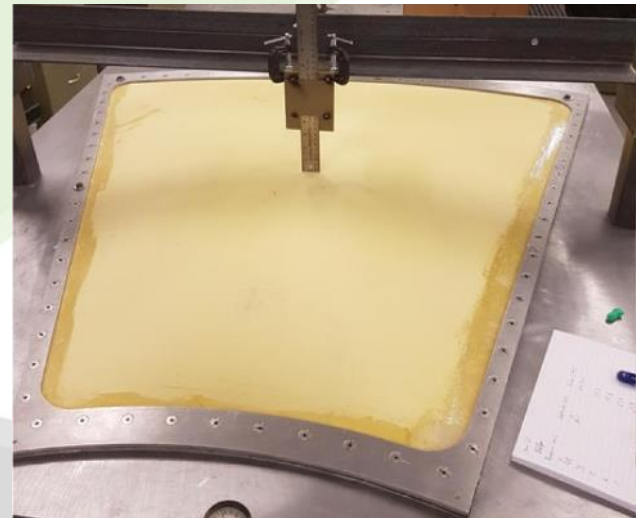


SoLID HGC Prototype - Testing

Testing has currently focused on the front window design

Testing Requirements:

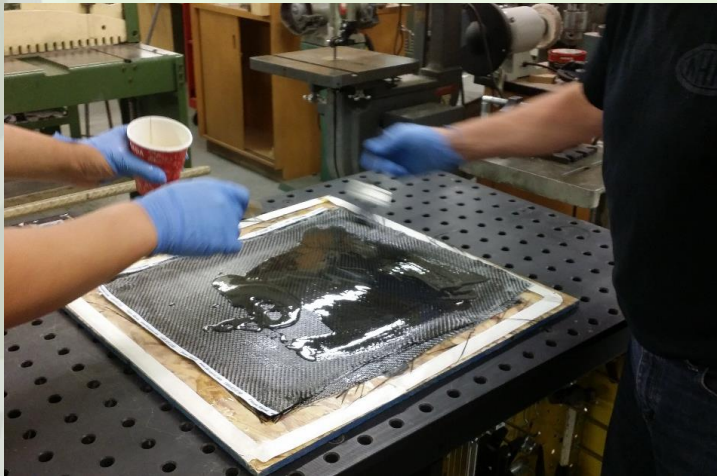
1. Hold 2x operating pressure for long periods
2. Minimal bulging of window
3. Accurately reproducible fabrication
4. Two tests frames, $\frac{1}{4}$ size at +4 atm (L) and full size at +1 atm (R)



SoLID HGC Prototype - Testing

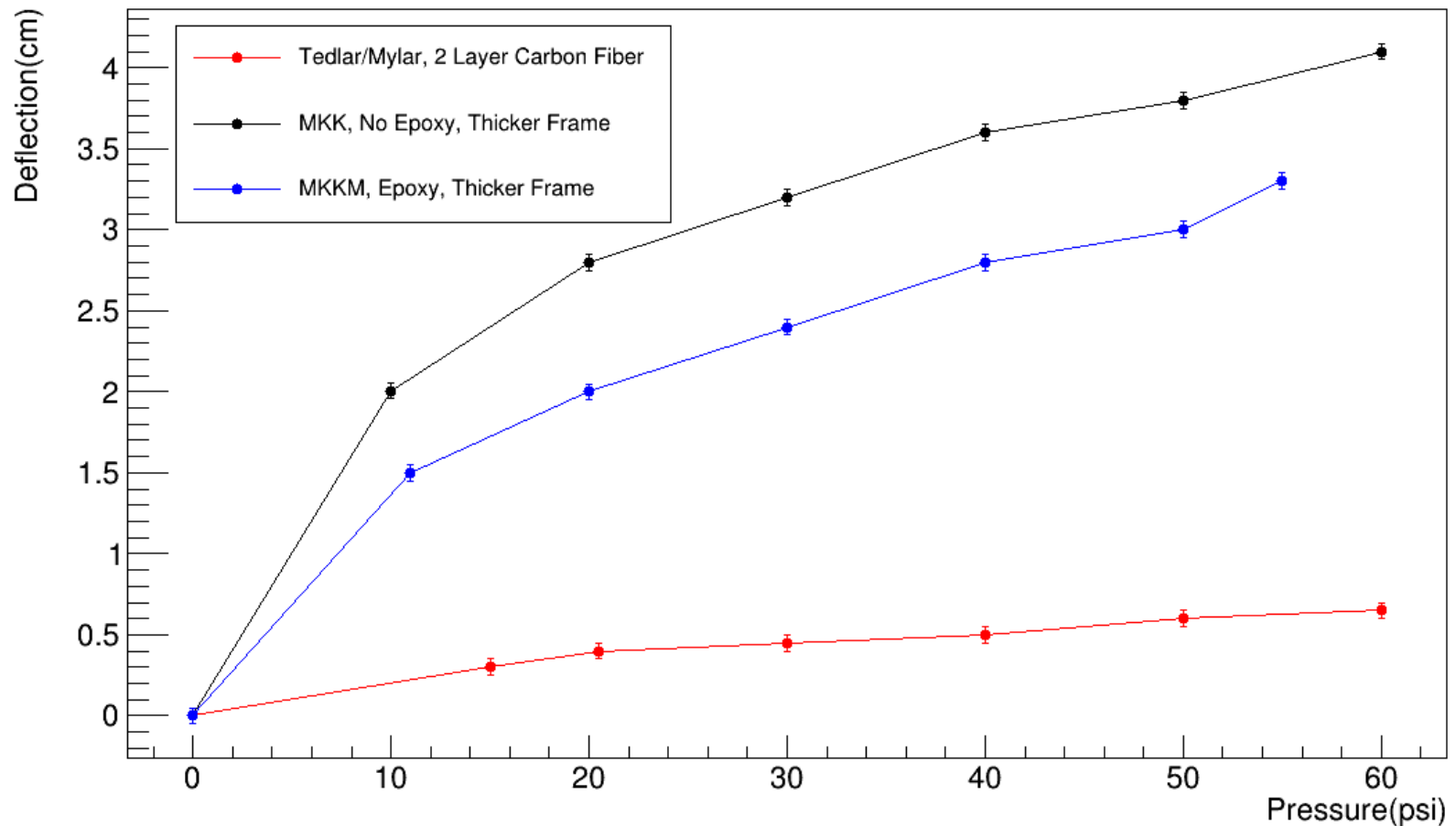
Early tests using Mylar-Kevlar windows were disappointing

- Tests using carbon fibre shell with a Mylar inner window much more promising
- Tests identified a minor issue with the frame which was resolved



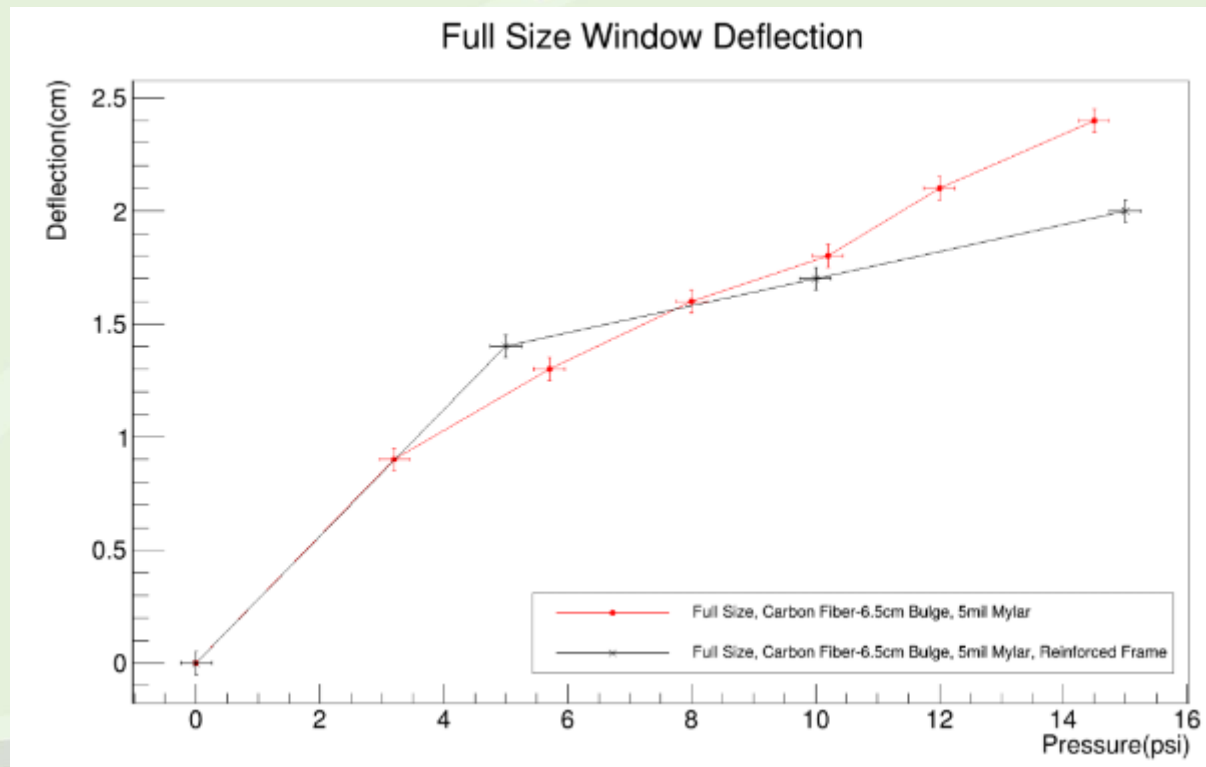
SoLID HGC Prototype - Testing

Window Deflection



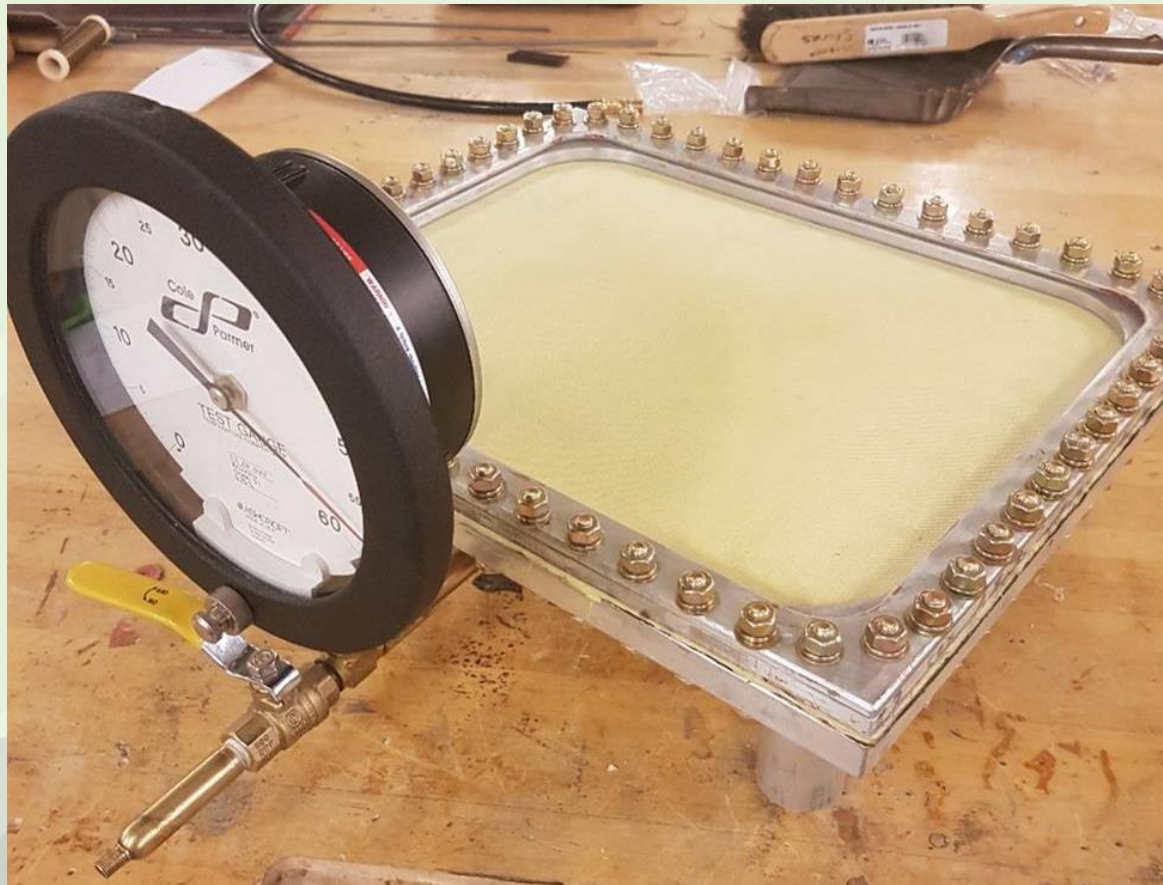
SoLID HGC Prototype - Testing

Full size carbon fibre window results were also very promising



SoLID HGC Prototype - Testing

Testing with a heavier stock carbon fibre with a flat window has proved very promising on the small scale test frame



SoLID HGC – Next Steps

Next step is to test the flat window on a full scale frame

- Expect to complete this test very soon
- If successful this is likely to be the final thin window design
- Expect to finalise the rest of the prototype components very soon and begin procurement process
- Construction of the prototype expected to commence in the Summer of 2019
- Fedoruk funds are invaluable!