Cryostat Window Design Comparison

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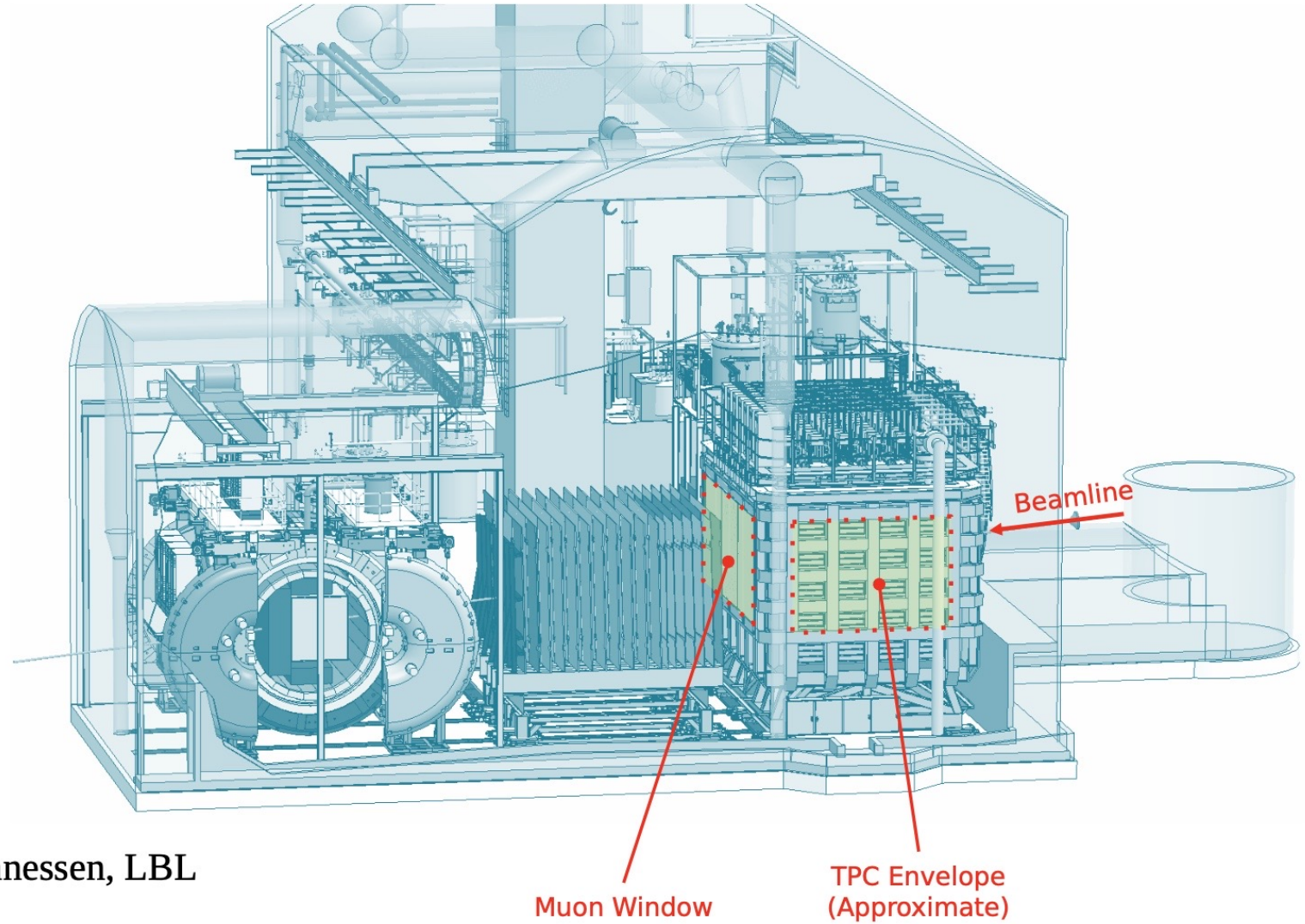
The Cryostat window



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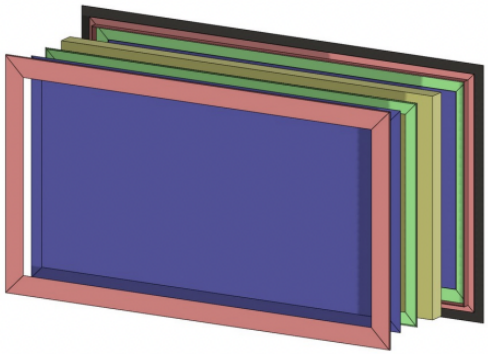
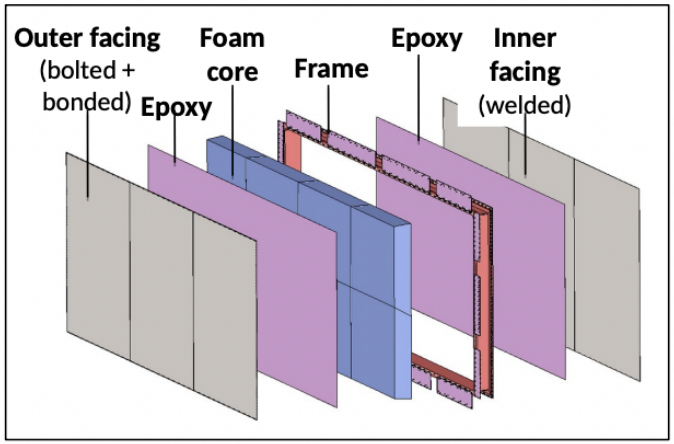
- Important to understand effect on muon reconstruction
- Aim to minimise muons stopping and impact of energy loss corrections

Different versions of the window

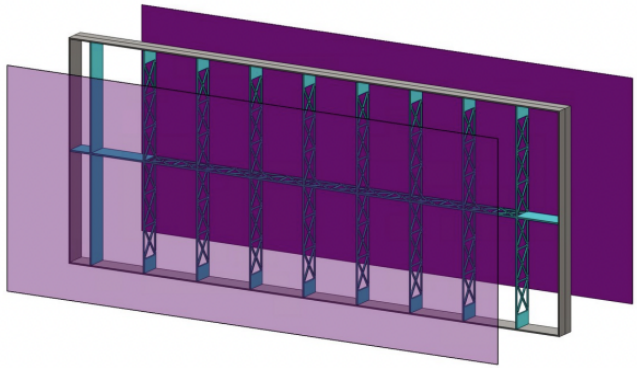
FIBERGLASS / FOAM (2020)



STEEL / FOAM (2021)



ALL-STEEL (2022)



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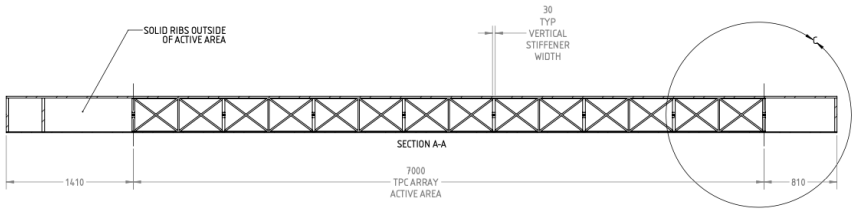
LESS DENSITY VARIATION

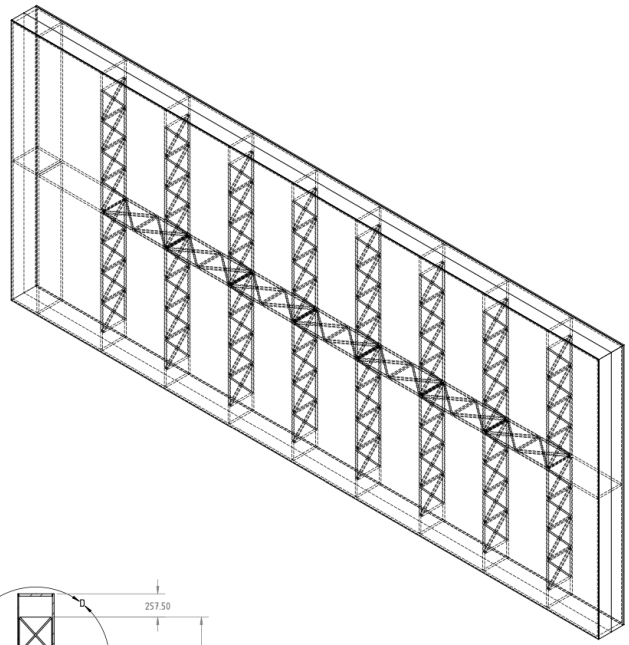
LESS COST AND RISK

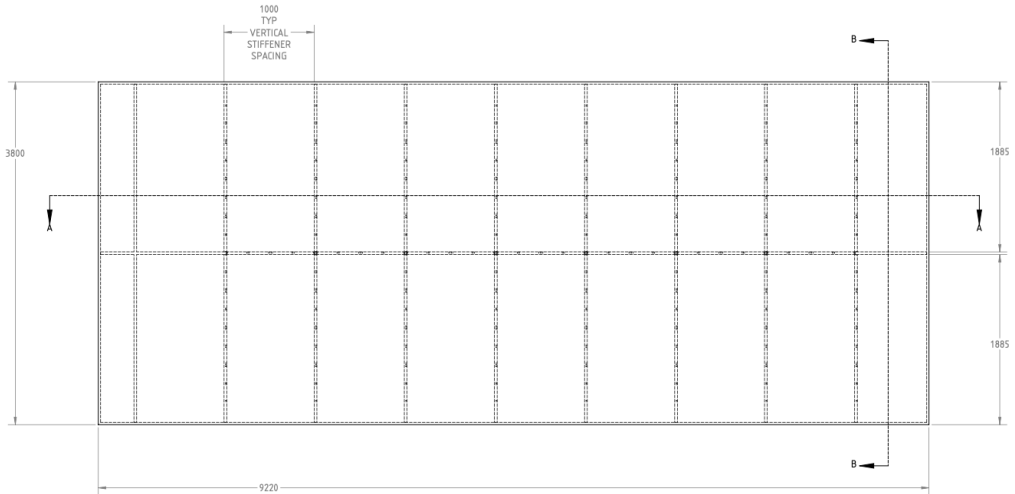
- Thin windows reduce number of muons stopping in window
- Uniform windows reduce impact of muon energy loss corrections
- Target is to not dominate the muon energy resolution of 5%, so the target is 3% impact at 600 MeV muon energy. (From this talk from Chris Marshall
- The all-steel design is less technically risky and less expensive

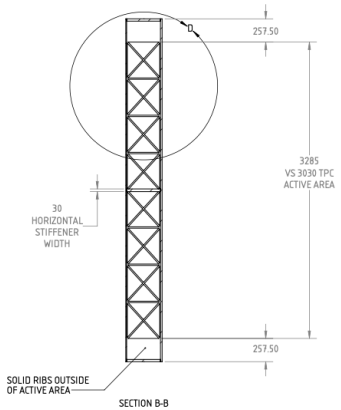
Engineer Window design

DRAFT FOR DISCUSSION ONLY
2023-07-14



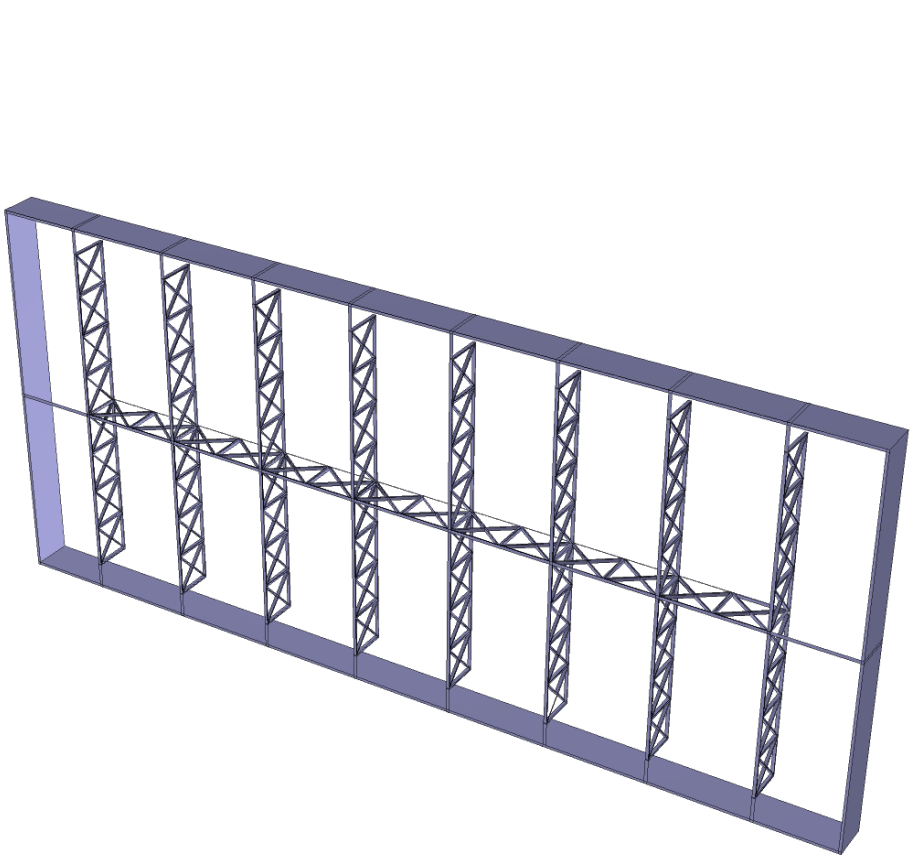


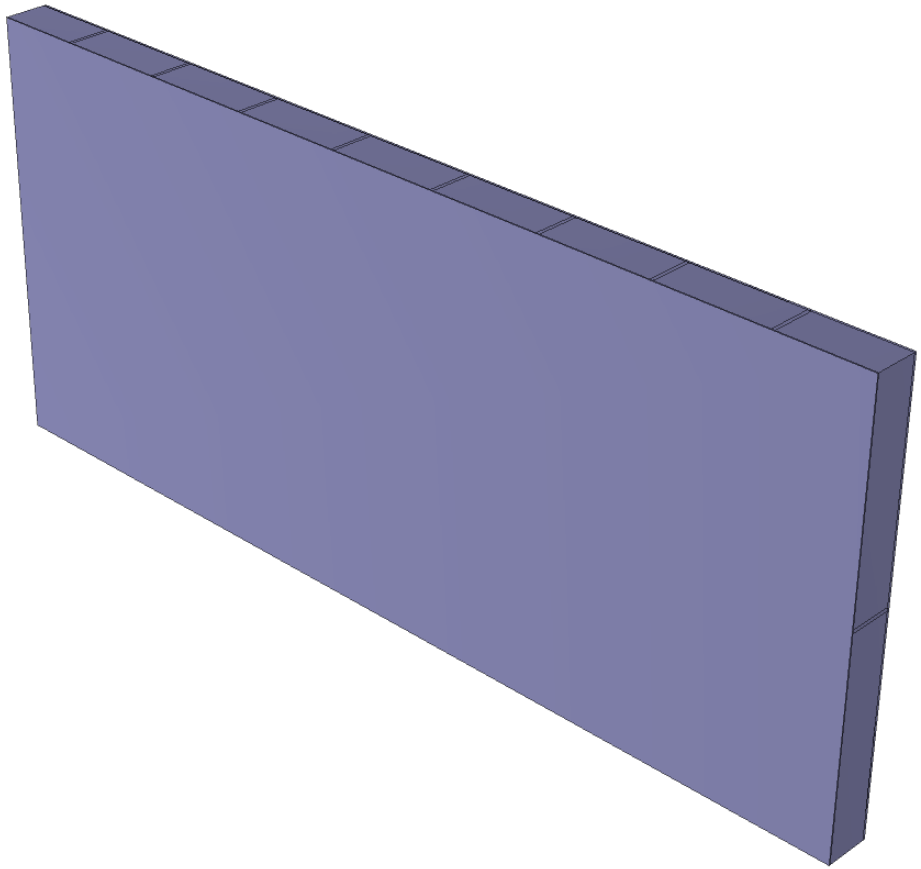




- Uses steel support "x" struts
- Has a lot of empty space to reduce energy deposited

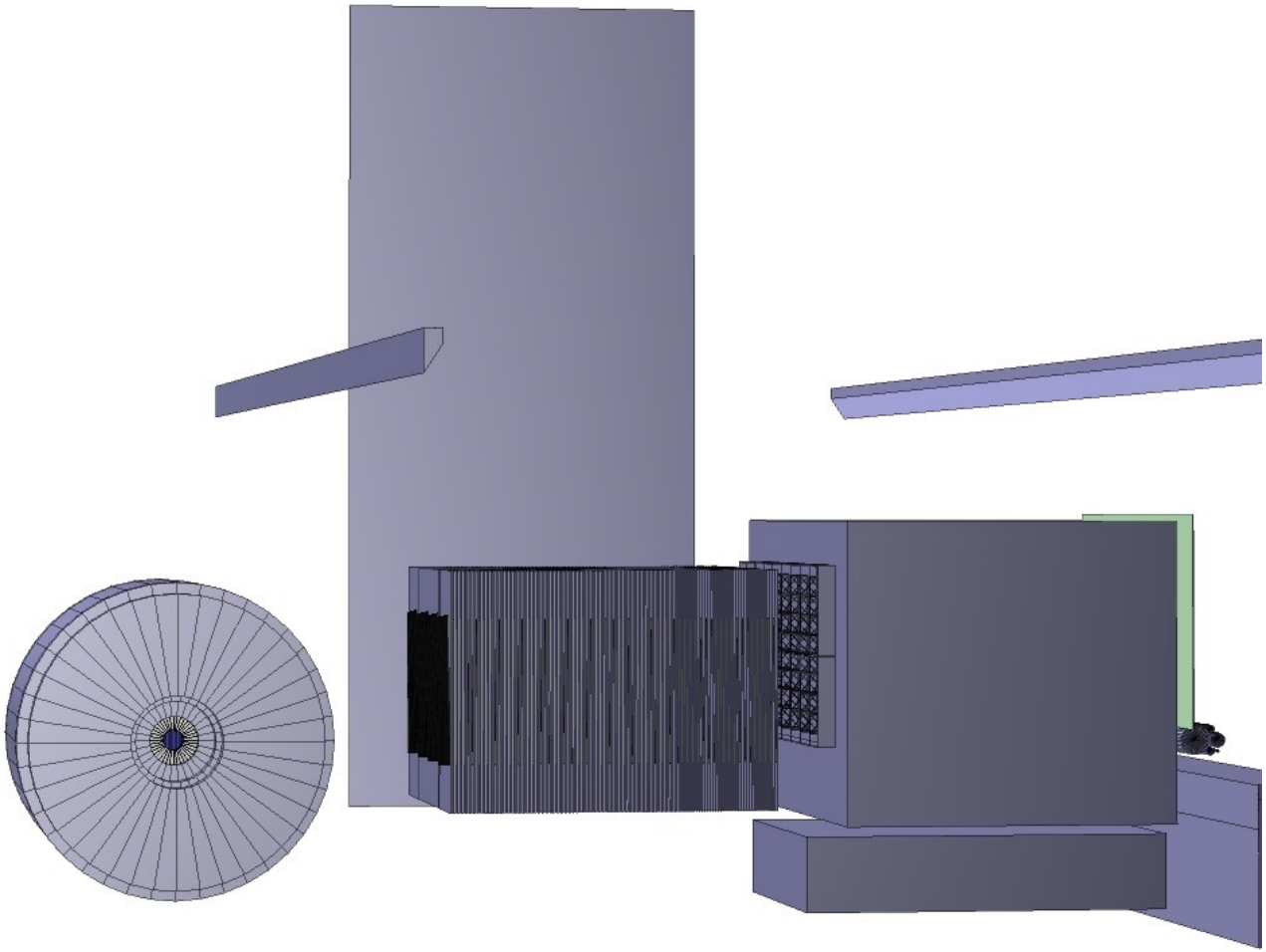
Visualising the geometry





- Left is inside, right is with thin panels either side
- Looks like it may be missing lines due thin lines not being displayed
- Lacks metal ribs

Integration into ND GDML

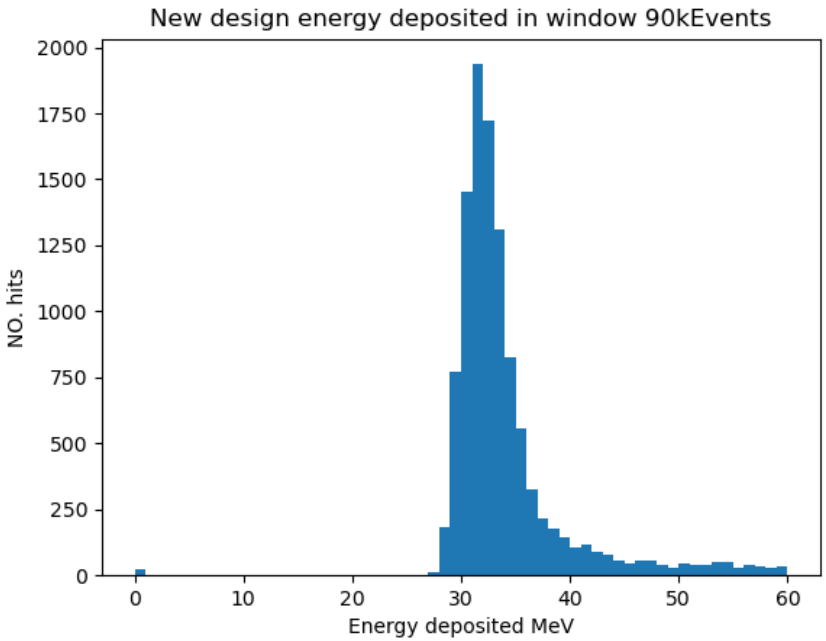


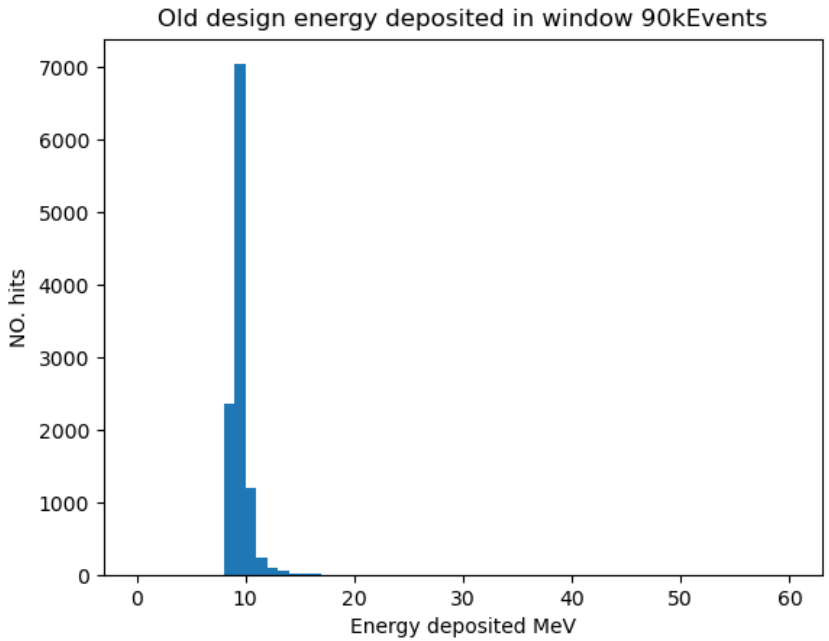
- GDML shows new window is successfully integrated

Method of simulation and analysis

- Simulated events in the ND with **Genie** version **v3_04_00d**, and propagated with **Edep-Sim version v3_2_0**
- For each muon within the fiducial cut, found the total energy that was deposited in the window
- Compare the results for both designs of the window
- Confirm that the energy deposited in the new window does not dominate the muon energy resolution.

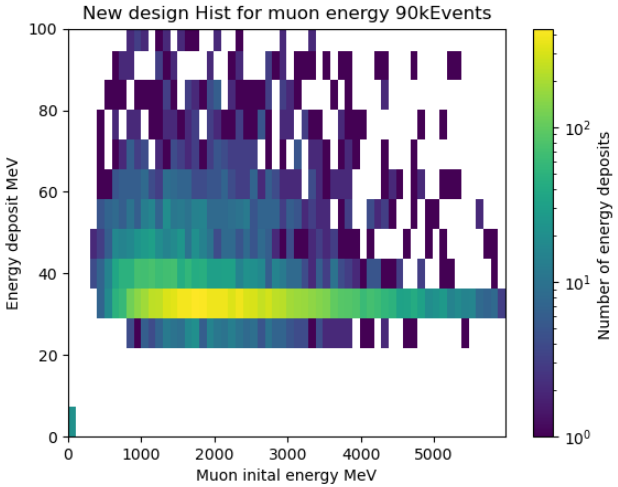
Old vs New design 1d hist energy deposits

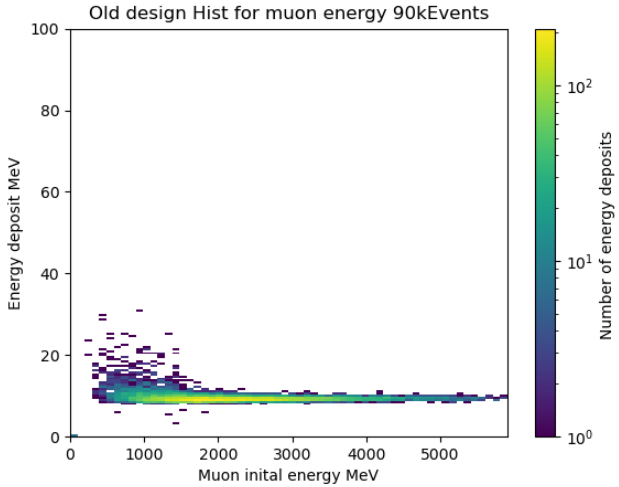


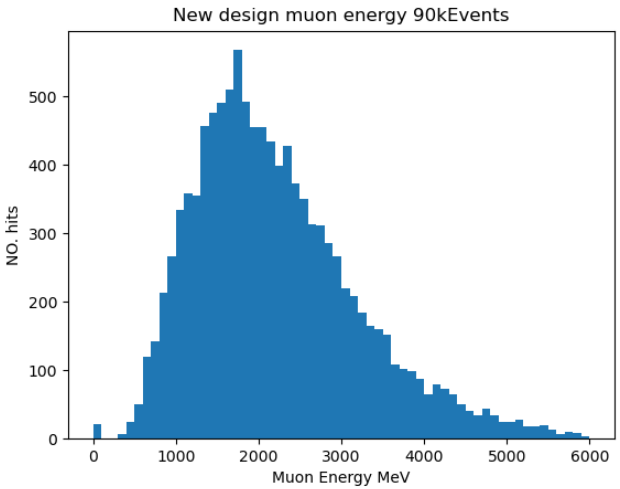


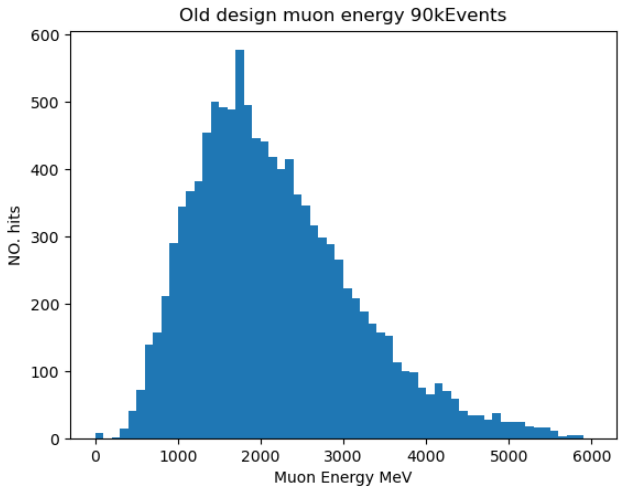
- Both designs have very few muons passing through the window without making a hit
- Old design has less energy deposited in it

Old vs New design 2d hist energy deposits



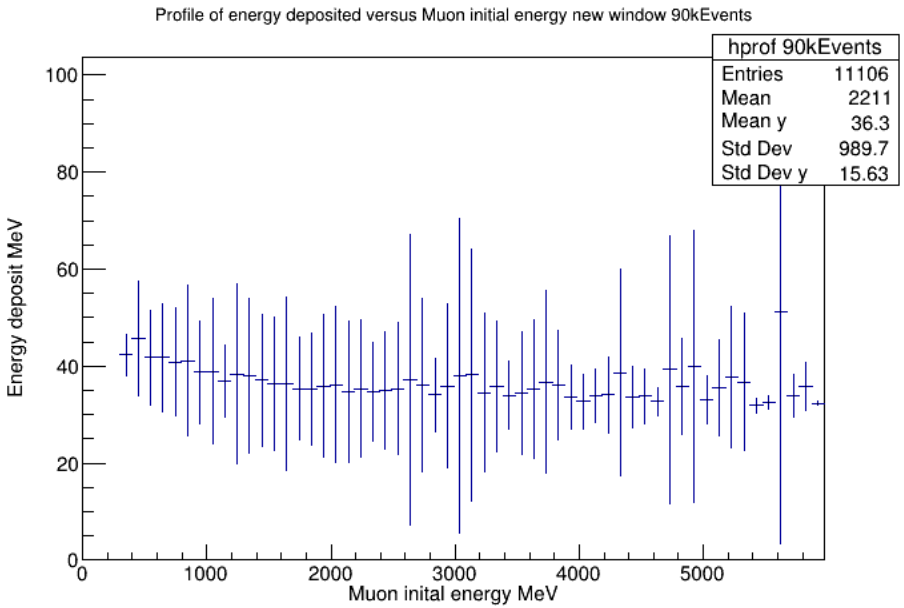


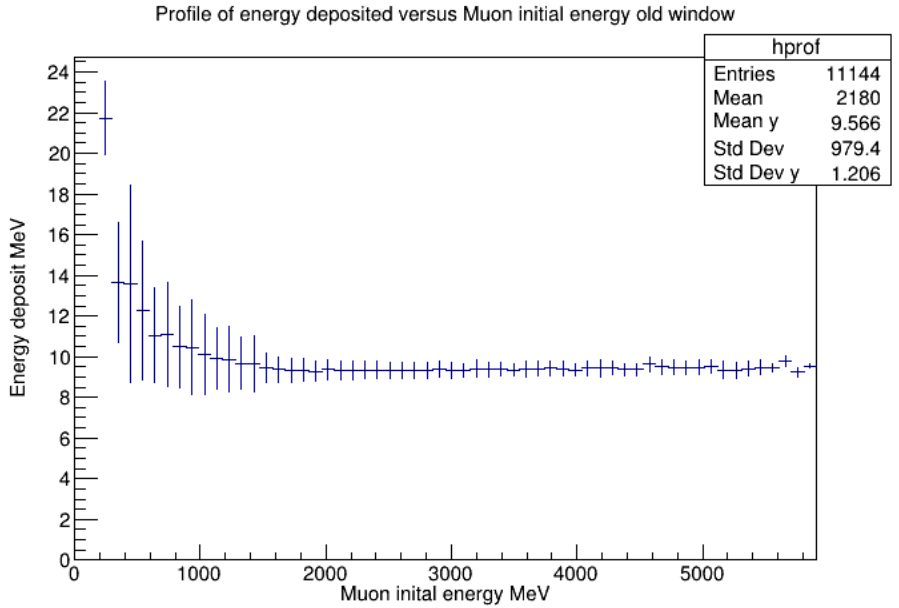




- 2d histogram used for profile plot
- Different distribution of Muon energies for different designs

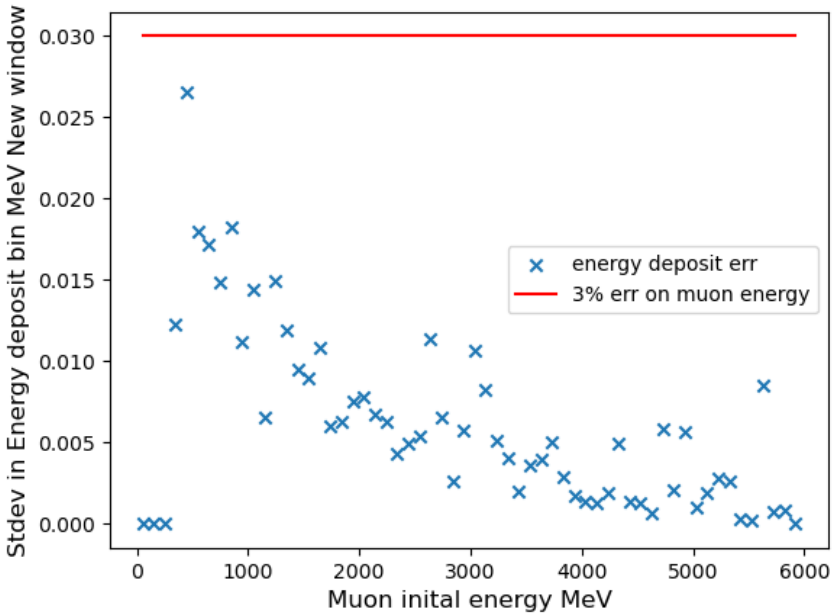
Profile hist comparison

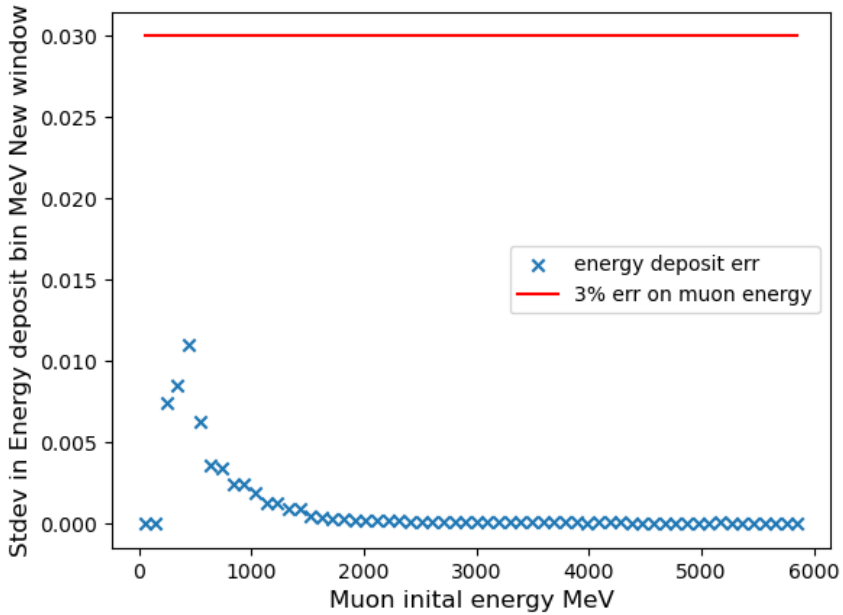




- Profile plot showing the mean energy deposited in the window with standard deviation per bin

Old vs New design 2d hist energy deposits





- Comparing the standard deviation per muon energy with target of 3%
- Has small sample size at low energy, 5th bin has 25 entries for new design

Ongoing investigations and Conclusion

- The new design meets the aim target to not dominate the muon energy resolution at 600MeV, but...
- Should the aim actually be to have 3% impact at 600 MeV muon energy for all the dead material in the cryostat?
- Currently using Steel as the material for the window, should the material be SSteel304, the same material as the VaporBarrier?
- Warmsteel is made from LowDensityCarbonSteel, which has a density of 0.754*g/cc, is this right?
- Has the structure of the cryostat changed with the new design?

Thanks For Listening