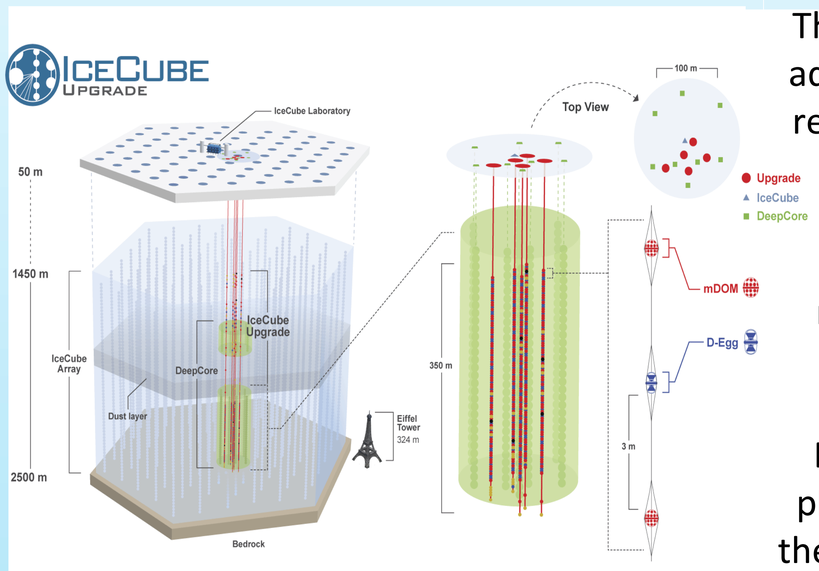
#60

Characterizing IceCube Upgrade Optical Module Efficiency Using GEANT4-Based Photon Transport Simulation

Justin Mitchell[1] for the Southern University Group — Ali R. Fazely[1], Sean Roubion[1]

[1]Southern University and A&M College | IceCube Collaboration

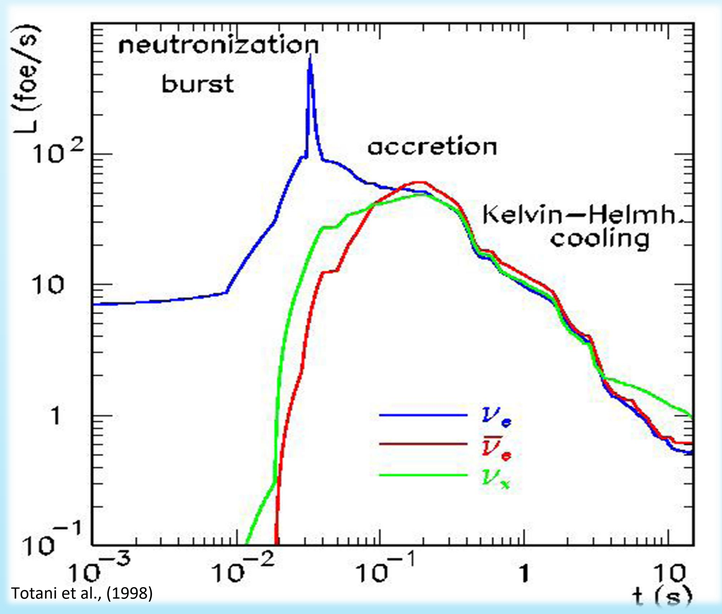
1 Background



The **IceCube Upgrade** has recently deployed 5 additional, denser strings across the DeepCore region. Each decorated with **~700 new DOMs**, the **D-Egg** and **mDOM.**

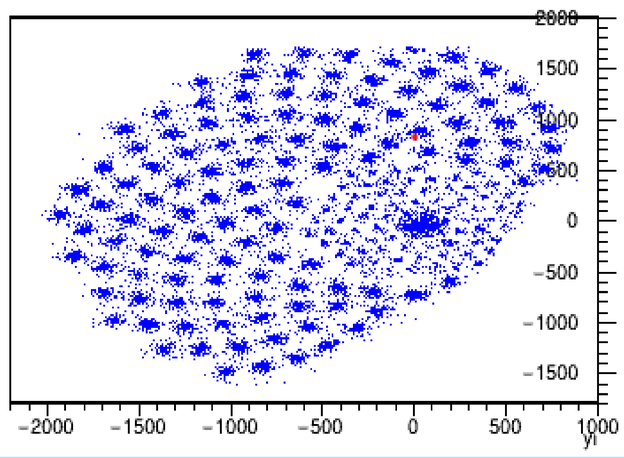
D-Egg: 2 vertical opposing PMTs (8 in.)
mDOM: 24 PMTs in nearly uniform angular coverage (3 in.)

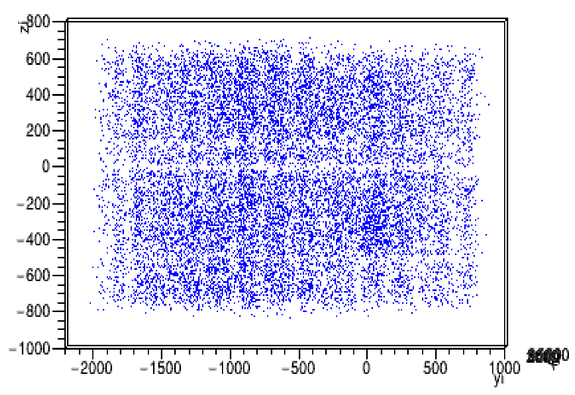
Both anticipated to outperform the original pDOM, we're currently comparing the two by their respective Cherenkov photon yield against expected positron-interaction behavior.

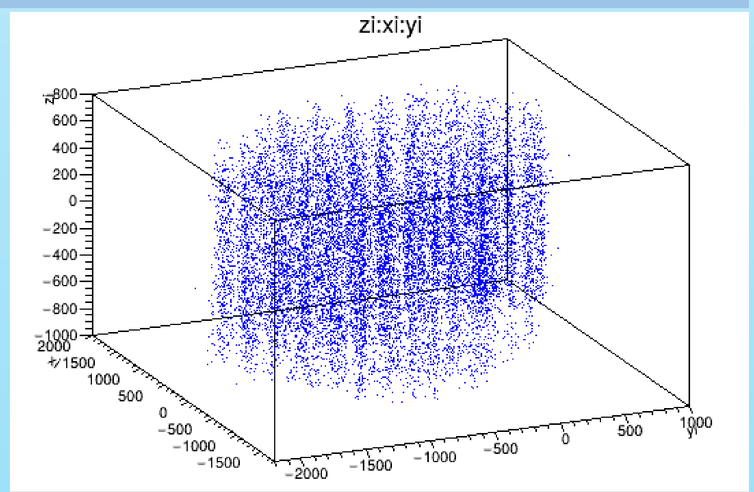


Totani et al., (1998)

2 Simulated Hit Plots



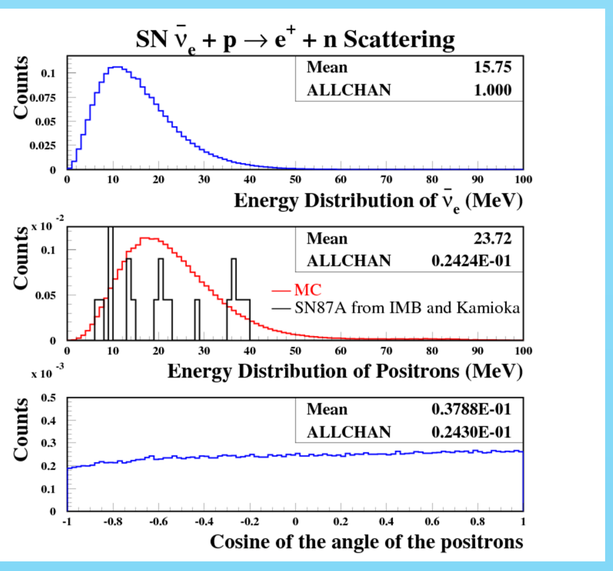




3 Methodology

- $n(E_\nu) = (1/F(\alpha)T^3)(E_\nu^3/\exp(E_\nu/T- \alpha)+ 1)$
  We assume T = 7 MeV and α = 0.
- F(α) normalizes the spectrum to unit flux
- This yields an average neutrino energy of ~24 MeV.
- 99% of the energy produced in Super Nova is carried off by the neutrinos.

4 Motivations

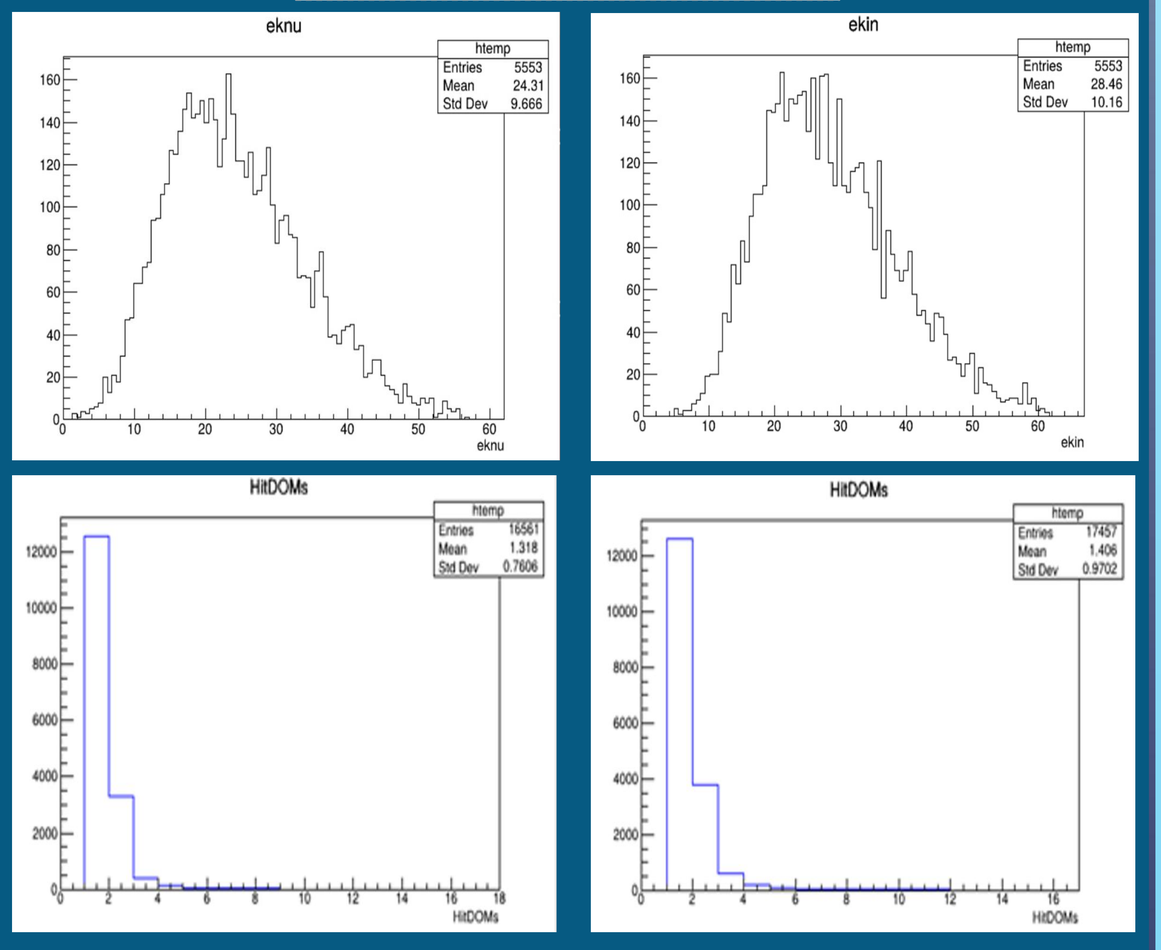


Simulated supernova interaction products ($\bar{\nu}_e$ energy, positron energy, positron angle)

Benchmarked against real SN1987A detections from IMB and Kamiokande

5 Results/ More Plots

SN Electron Antineutrino Spectrum (MeV)



2DOMs/1DOM = 24% , mDOM

2DOMs/1DOM = 28% , DEgg

6 Summary/ Next Steps

- Detector geometry initializes correctly across the IceCube+DC, Upgrade, and Gen2 configurations.
- Simulated hit distributions to reproduce the expected detector profile, and the D-Egg configuration shows a higher two-module coincidence rate than mDOM **(28% vs. 24%)**
- ***Complete QE benchmarking against Collaboration and extend the comparison to angular acceptance and timing response in future*.**

Acknowledgments

This work was supported by the National Science Foundation through the EPSCoR program, under a subcontract from the South Dakota School of Mines and Technology (NSF award numbers 2019597 and 2140571)