IceCube Flasher Data Reconstruction

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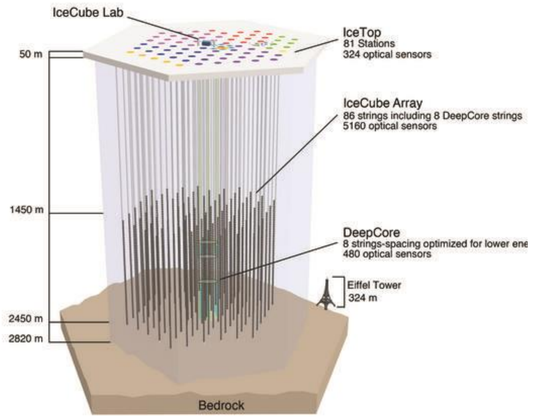
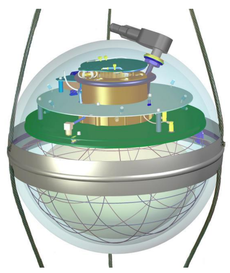
Introduction

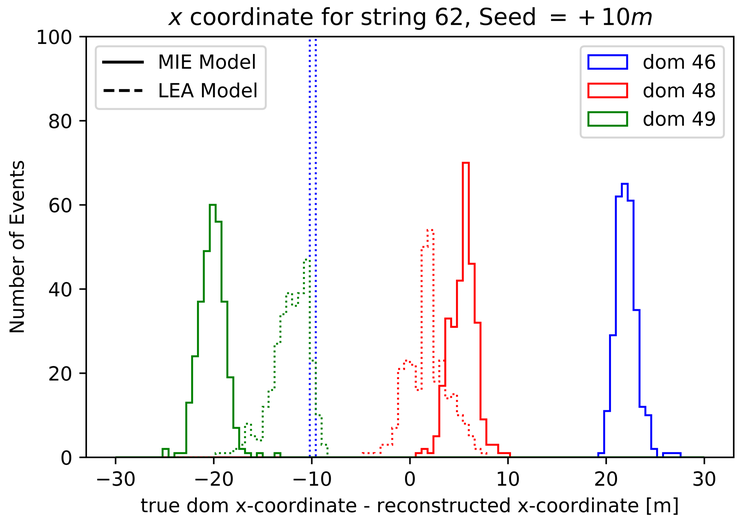
- IceCube is a neutrino observatory (pictured below, left) located in the geographic south pole. It encompasses about a square kilometer of ice.
- Neutrinos are light particles that travel close to the speed of light
- They are detected via Cherenkov Radiation which is produced when a particle travels faster than the speed of light in a medium.





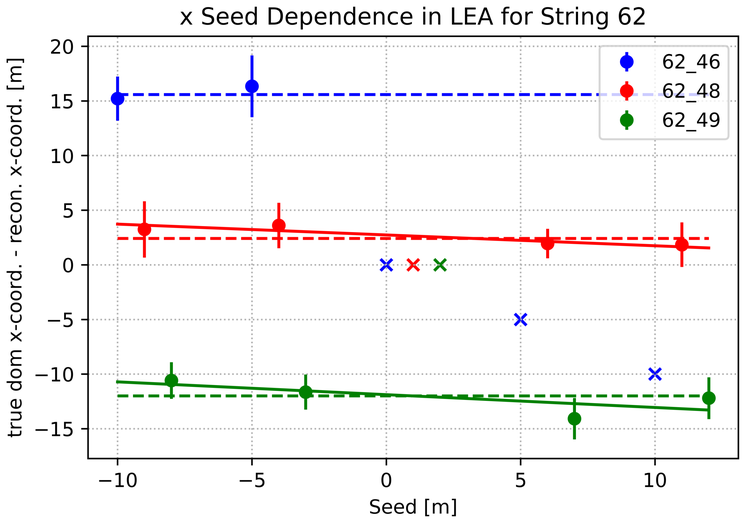
Methods

- IceCube consists of 86 “strings” each with 60 “digital optical modules”, or “DOMS” (pictured above, right) that detect the Cherenkov light.
- Each DOM is outfitted with “flashers”, LEDS that produces light pulses to mimic energy from an event.
- Flashers mimic ν_e event topology. The reconstruction algorithm used in these events, known as ‘monopod’ is applied to flasher events. Monopod uses charge and time information to give a maximum likelihood value for the vertex and energy from flasher and neutrino events.
- Flashers are used for geometry and energy calibration and to learn about the optical properties of the ice, the largest uncertainty in neutrino analysis.



(above) This plot compares the accuracy of two different ice models. The sharp peak indicated a problem with the reconstruction algorithm.

(below) Monopod uses an initial “guess” called a “seed” for the reconstruction value. This plot summarizes average reconstructed values as a function of seed.



$dom48_{lin} = 27(10)x10^{-1} + 0.10(14) * seed$
$dom49_{lin} = -11.89(88) - 0.12(11) * seed$

$dom46_{const} = 156(16)x10^{-1}$
$dom48_{const} = 2.42(92)$
$dom49_{const} = -12.00(88)$

Conclusions

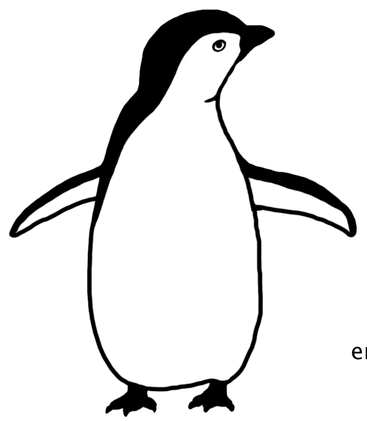
- The monopod reconstruction using the LEA ice model for three DOMS on the same string is not dependent on the seed value.
- A possible solution for dom 46 convergence is increasing the number of iterations monopod goes through to find the reconstructed value.
- In the future I will study the effects of iteration number, flasher brightness, and ice model on seed dependence.

Acknowledgement

- My work is a continuation of former Stony Brook student, Lorena Mezzini. Special thanks to her, my mentor, and everyone in the Stony Brook IceCube Group for their insight, guidance and support.

References

1. IceCube, www.icecube.wisc.edu.



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