# Science Results from the DM-Ice17 Dark Matter Experiment



Analysis of 4 Years of Data of the DM-Ice17 Dark Matter Experiment Antonia Hubbard (Yale University) for the DM-Ice collaboration

# Only operating direct detection experiment in the Southern Hemisphere

DM-Ice17 has a unique ability to identify a dark matter modulation and examine the nature of the DAMA modulation. It is the first of three generations of NaI(TI) detectors that will run across both hemispheres to separate a dark matter modulation (same phase across hemispheres) from seasonal variations (opposite phase) like the muon flux (right).



DM-lce17 was designed to determine the feasibility of a South Pole Nal(TI) experiment. Its mass and contamination levels preclude a stringent exclusion limit. The full-scale, 250 kg, DM-lce250 detector will confirm or exclude a DAMA-sized modulation to 5 $\sigma$  in 2 years with a 2 dru (2x DAMA-level) background rate in the region of interest.



#### Muon modulation and phosphorescence

Muon events are identified by their pulse height and shape. The observed muon rate of 2.93±0.04 muons/crystal/day with a 12.3±1.7% modulation is consistent with atmospheric temperature expectation and lceCube observation.

Muon-induced phosphorescence is observed, inducing up to tens of millions of photons directly following the muon interaction. These photons arrive as single photoelectrons in the low energy region but are rejected by noise cuts in data processing. They exhibit a decay time of  $5.5\pm0.5s$ . *Preprint in preparation* 

Amundsen-Scott South Pole Station









## **Background characterization**

We have determined the background contamination by measuring components before deployment and comparing internal contamination lines to GEANT4 simulation. Detector response exhibits competitive resolution and light yield stability to within 2%. Changes in light yield are characterized and accounted for in analysis.





#### **Cosmogenic activation**

Isotopes are activated during shipment, deployment, and pre-deployment testing. The sources of cosmogenic activation and minimization considerations for the fullscale detector have been studied. Short-lived isotopes offer a unique calibration tool for the in-ice DM-Ice17 detector. W. C. Pettus thesis

Before



### IceCube muon coincidence



Muons in DM-lce17 are correlated with lceCube muons by their event time. 93% of Det-1 muons are coincident. Knowing the direct path of the muon through the DM-lce17 volume provides a new lceCube reconstruction metric and improves misreconstruction rates by a factor of two. *A. J. F. Hubbard thesis* 

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