Results of DM-Ice17 and Prospects of the DM-Ice Experiment

Vale

Motivation

- Dark matter signal modulates due to Earth's motion in galactic rest frame, with period of one year
- DAMA collaboration observes annual modulation accurate to 9.3σ , in conflict with other experiments
- DM-Ice aims to operate an experiment of same target material (NaI(Tl)), similar mass and background rate to provide definitive test of DAMA's annual modulation claim



FIG 1: DAMA's result is in conflict with other experiments. Recent results from LUX and PandaX further exclude DAMA result.

DM-lce17

- Aim: Demonstrate feasibility of performing lowbackground measurements in Antarctic ice
- Operating in Southern Hemisphere places seasonally modulating environmental backgrounds 180° out of phase with Northern Hemisphere experiments
- Two prototype detectors currently deployed 2450 m deep in Antarctic ice
- Physics run: June 2011 to January 2015



FIG 2: Schematic of the detector and placement within IceCube.

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FIG 3: DM-Ice17 Det-1 background data at low (left plot) and high (right plot) energies. Detector components with main contaminants simulated. Background peaks are used for energy calibrations.

Background Modeling

- Calibrated with intrinsic and cosmogenic backgrounds • Dominant sources of contamination are from ⁴⁰K, ²³⁸U and ²³²Th chains in the crystals, PMTs and
- pressure vessels, as confirmed by simulations
- ¹²⁵I peak, used in calibration, confirmed by matching the decay time with the expected half-life of 59.4 days



FIG 4: Det-1 (red) and Det-2 (green) modulation amplitudes of each energy bin compared to the values from DAMA/LIBRA.

Modulation Analysis

- Low energy analysis threshold of 4 keV (6 keV) for Det-1 (Det-2) due to the low signal acceptance below these energies
- Maximum likelihood fits of the background subtracted event rates for each energy bin; period and phase fixed to 1 year and June 2, respectively
- Results are consistent with both the null hypothesis and DAMA's claim

FIG 5: Best fit with confidence levels (red). Result consistent with DAMA's result and null hypothesis.



FIG 6: Schematic of the COSINE-100 detector.

- background
- to the crystals



- Results are consistent with both the null hypothesis and DAMA's results
- Results give the strongest exclusion limit in the Southern Hemisphere
- DAMA's results

COSINE-100

• 40 cm active liquid scintillator veto to tag • 8 crystals adding to a total of 106 kg of NaI(Tl) • Low background and high QE 3-inch PMTs attached

- Collaboration between DM-Ice and KIMS
 - 37 panels of 3 cm thick plastic scintillator to tag muons
 - 20 cm thick Pb shielding and 3 cm thick Cu box



FIG 7: Crystals inside Cu box with PMTs connected.

FIG 8: Projected sensitivity for COSINE-100 with 1 keV(2)*keV) threshold in* black (red) with 2 years of data.

Conclusion & Prospects

• <u>**DM-Ice17**</u>, the only dark matter detector in the Southern Hemisphere, is operating successfully under Antarctic ice • Detectors characterized and operated remotely

• **<u>COSINE</u>**: more massive + lower backgrounds + LS veto • 2 years of data with 1 keV threshold to be sensitive to