# Using DM-Ice17 as an assistance tool within the IceCube Neutrino Observatory

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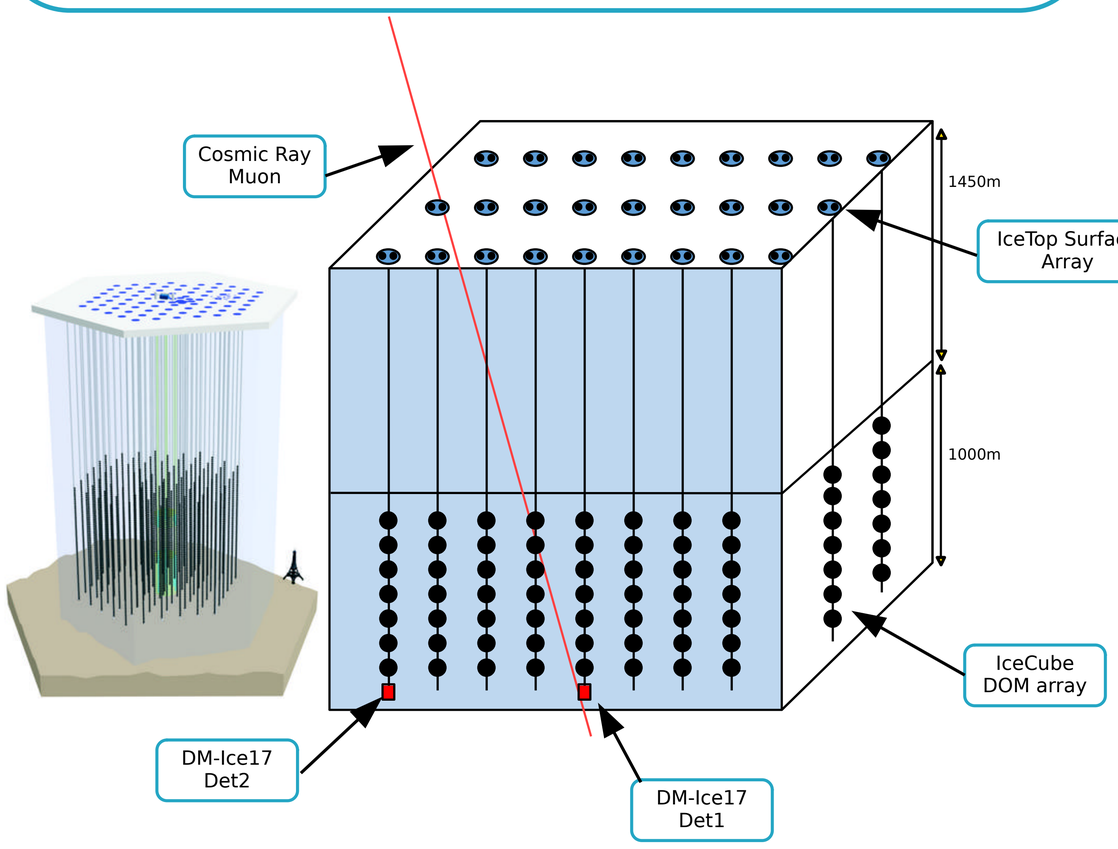
## Introduction

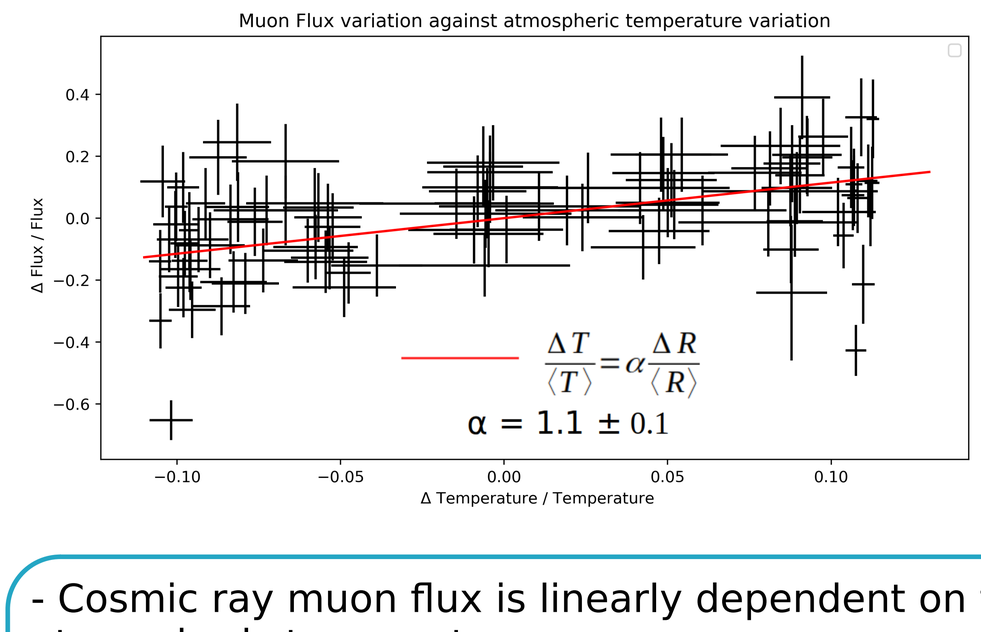
The IceCube Neutrino Observatory is a cubic kilometre neutrino detector, consisting of approx 5000 Digital Optical Modules (DOMs) suspended in the south polar ice cap, as well as the IceTop surface array made up of 86 ice tanks. DM-Ice17 is a pair of NaI(Tl) scintillator crystals at the bottom of IceCube, which can assist as a cross-check for local DOM rates and help reconstruct muon tracks.

## Background

- DM-Ice17 originally installed to look for signal due to dark matter modulation
- Repurpose to search for cosmic ray induced muons in the separate IceCube dataset
- Use this to quantify cosmic ray muon rate at the bottom of IceCube
- Potential to improve low energy IceCube muon track reco for nearby events




## Seasonal Muon Modulation



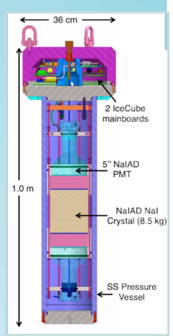

- Cosmic ray muon flux is linearly dependent on the atmospheric temperature
- Parametrise this by measuring the modulation in temperature and DM-Ice measured flux over a year
- Observe the slope parameter α consistent with other detectors at similar overhead

## Find coincident events

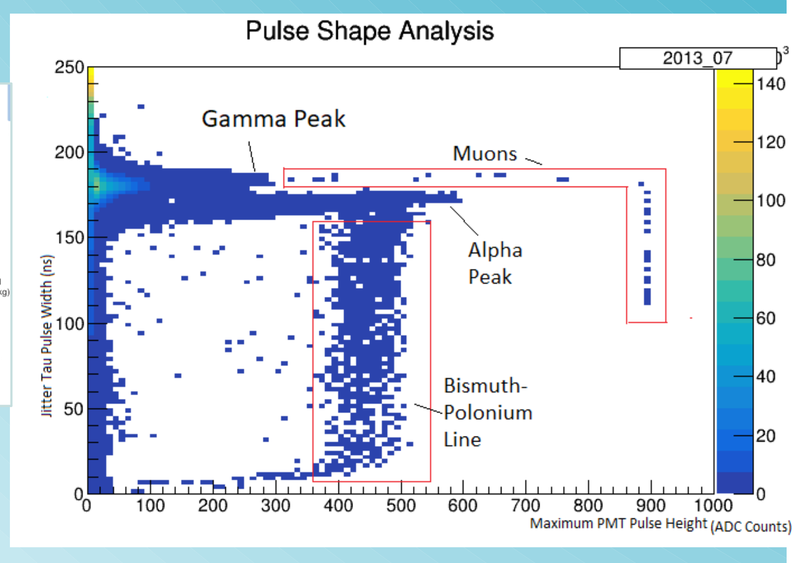
Identify DM-Ice17 muons based on pulse shape and height

Match to IceCube events using time coincidence

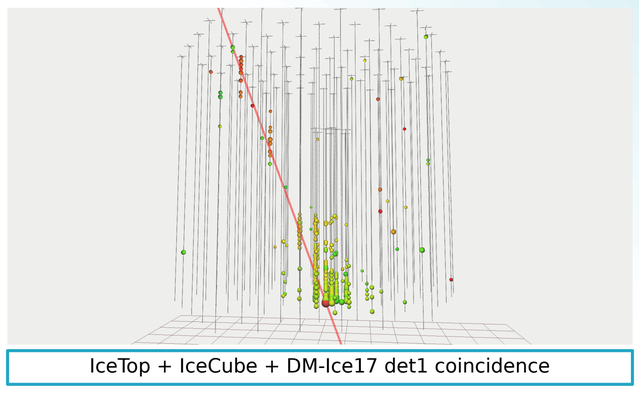
Apply IceCube filters to look for subset (ie High Enery, IceTop)



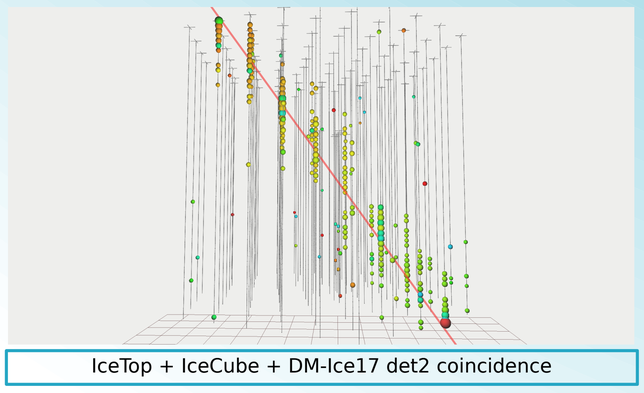

DM-Ice17 Module




From 05/2012 to 05/2021 we see
- 9975 muons in DM-Ice17 detector 1
- 1190 coincident between DM-Ice17 detector 1 and IceCube event filters

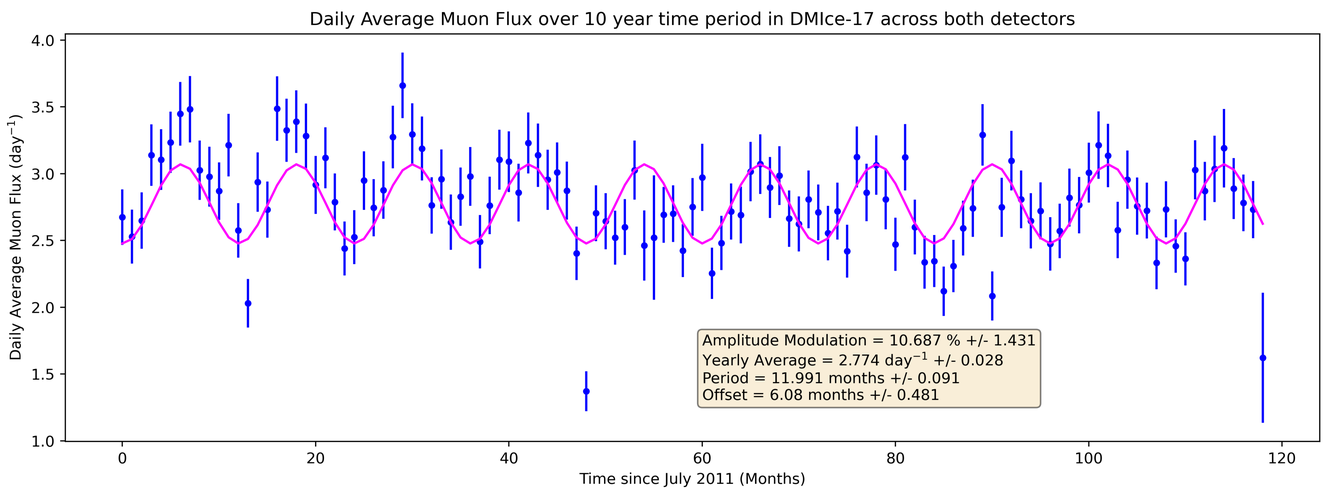


IceTop + IceCube + DM-Ice17 det1 coincidence

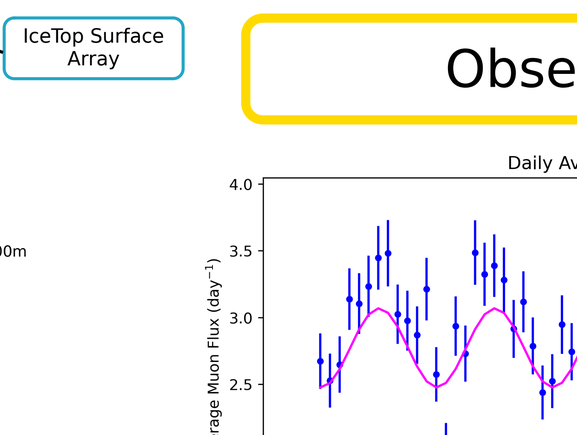


IceTop + IceCube + DM-Ice17 det2 coincidence

## Observed muon rates in DM-Ice17




## Using DM-Ice17 to seed reconstructions



Well reconstructed (94.4%)

Standard MPEFit

Mis-reconstructed (5.6%)

DM-Ice seeded fit




- Using DM-Ice17 as the initial seed for reconstruction results in higher fail rate than using the standard MPEFit
- Work with including DM-Ice17 in a better way is ongoing.

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