IceCube MASTERCLASS

WORKSHOP ACTIVITY #1:
LEARNING TO RECOGNIZE A NEUTRINO

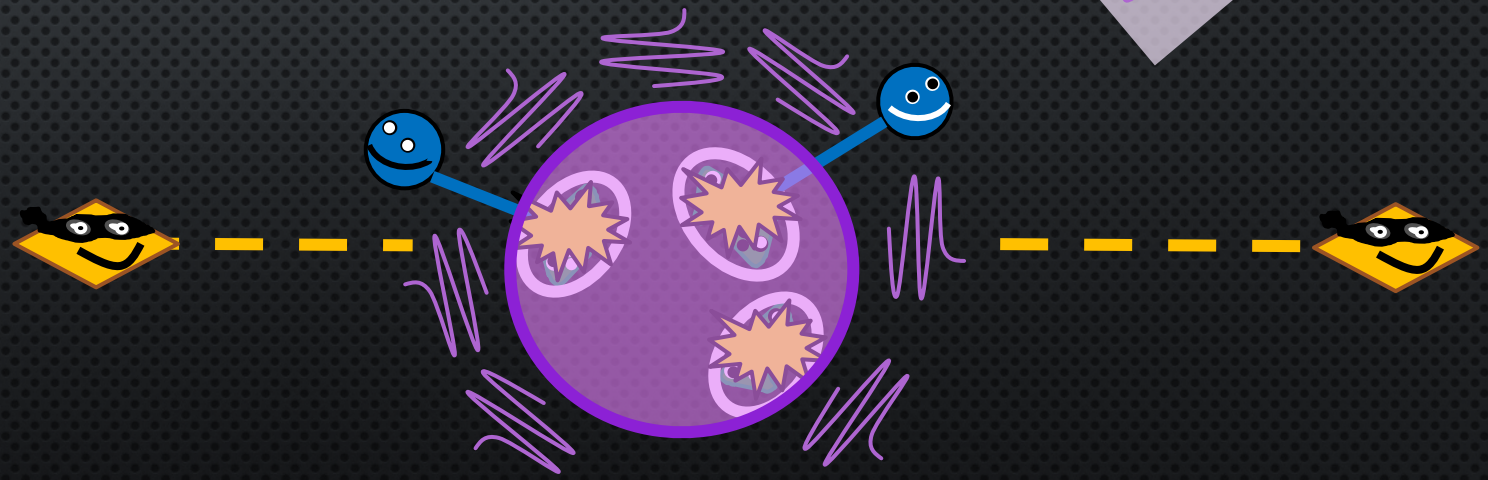
Image credit: Martin Wolf / NSF

REMINDER FROM THE PREVIOUS TALK

There are two types of interactions with IceCube neutrinos:

1. “Track” interactions

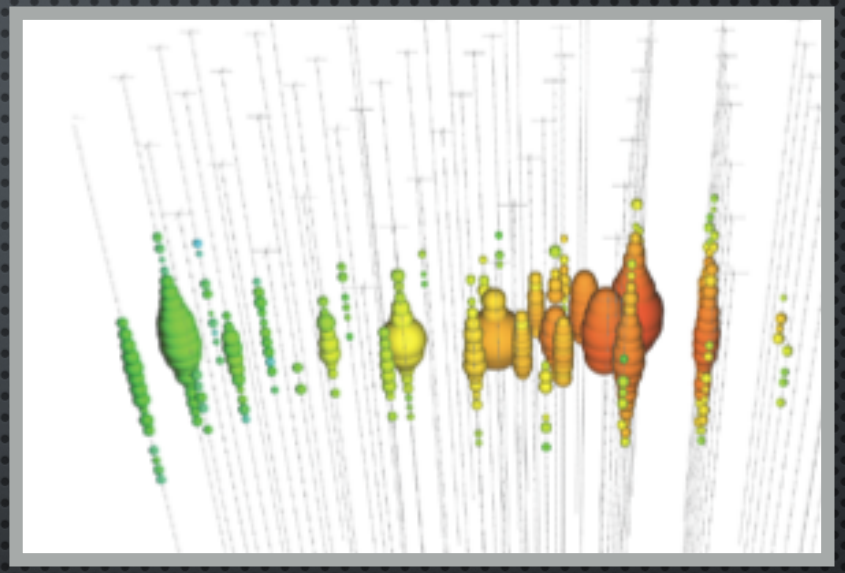
2. “Cascade” interactions



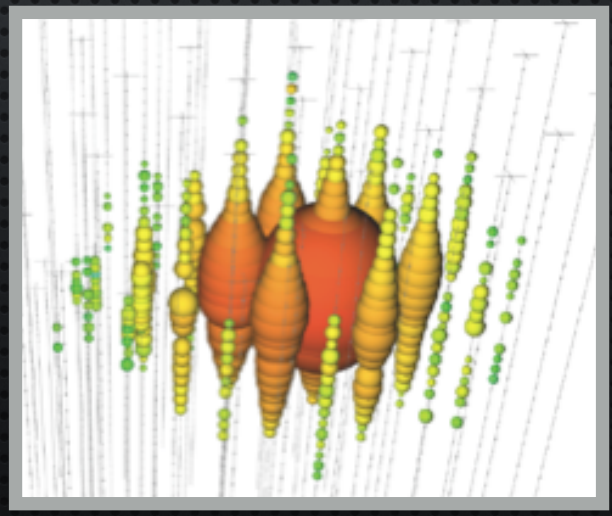
IN REAL DATA…

These neutrinos interactions look like this:

1. “Track” interactions



2. “Cascade” interactions



ACTIVITY!

Look at real events from IceCube here:

icecube.wisc.edu/viewer/quiz

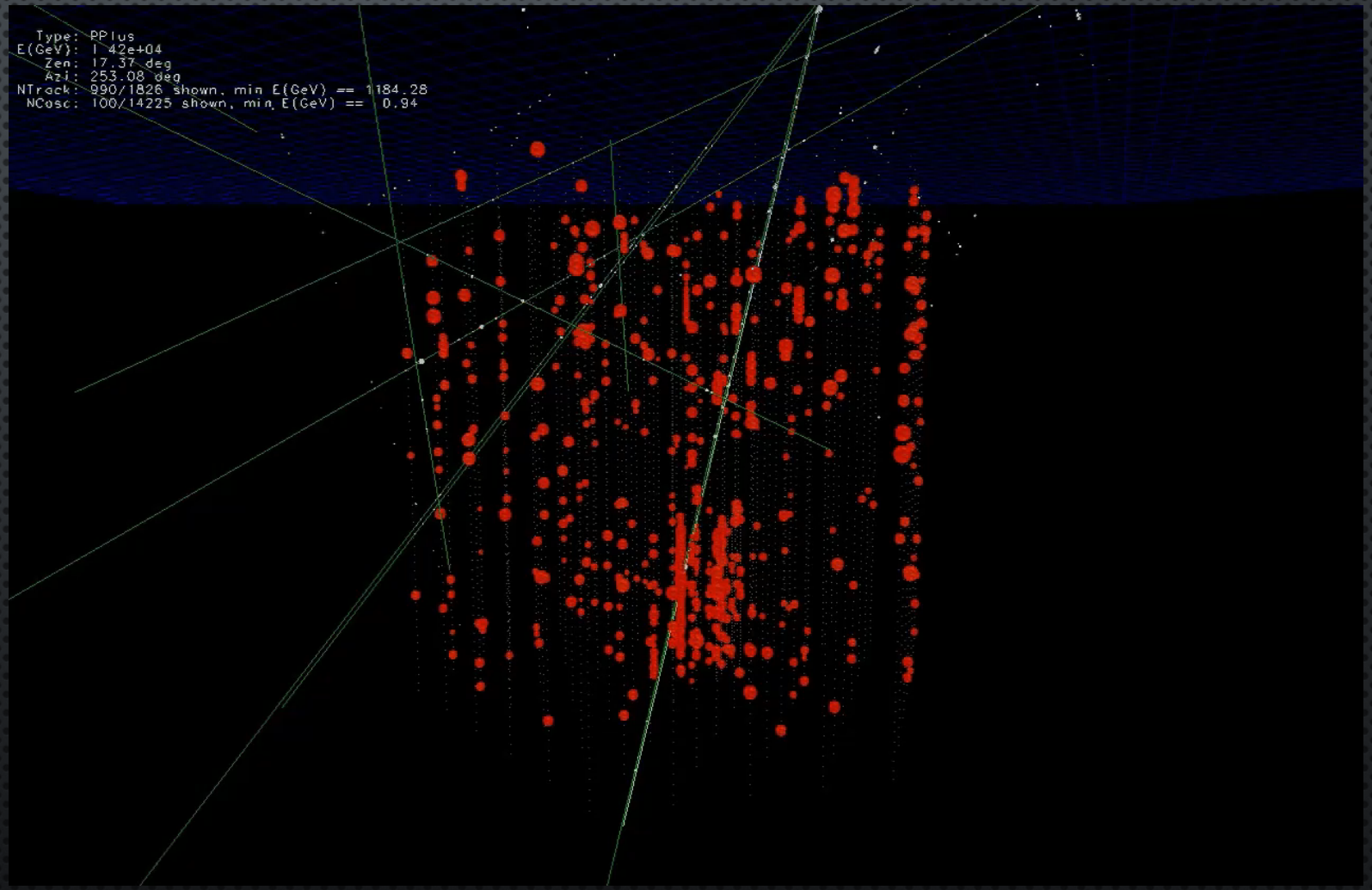
Try to identify the following events:

- Up-going tracks
- Down-going tracks
- Cascades
- Coincident events

SIGNAL VS. BACKGROUND

10 milliseconds of raw IceCube data:

http://icecube.wisc.edu/viewer/background_signal



ACTIVITY!

To find astrophysical neutrinos, you need to distinguish them from background events.

In your groups try to answer the following questions:

- What are the properties of an event?
- What are the background events we want to remove
- Think of a procedure one could use to select signals while removing background from your data

RESOURCES

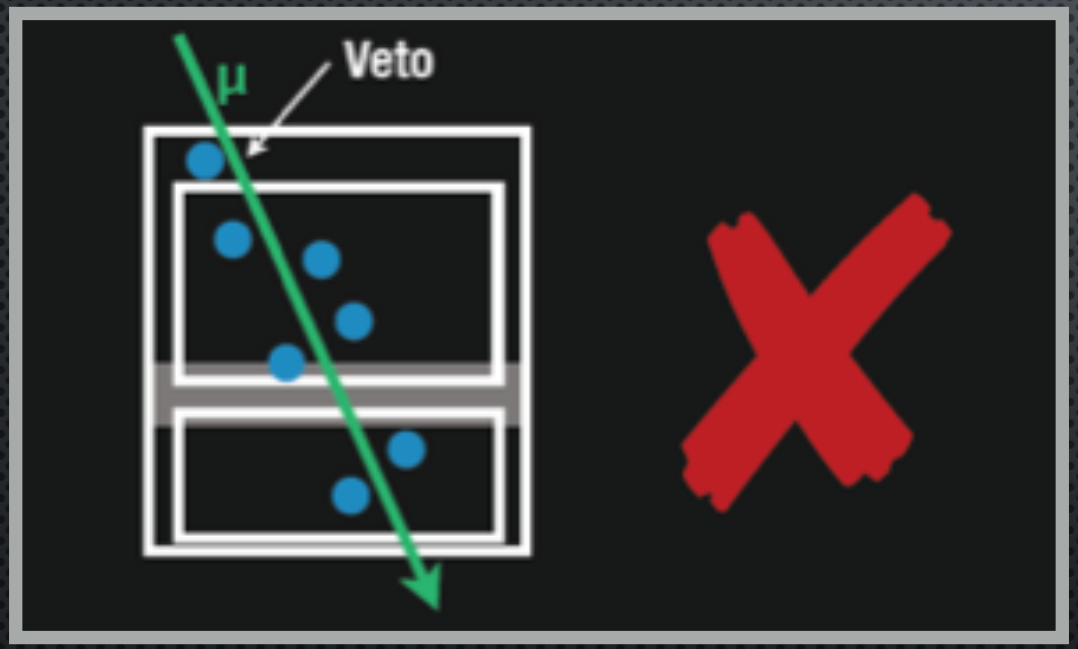
You can compare simulated background event with signal events here:

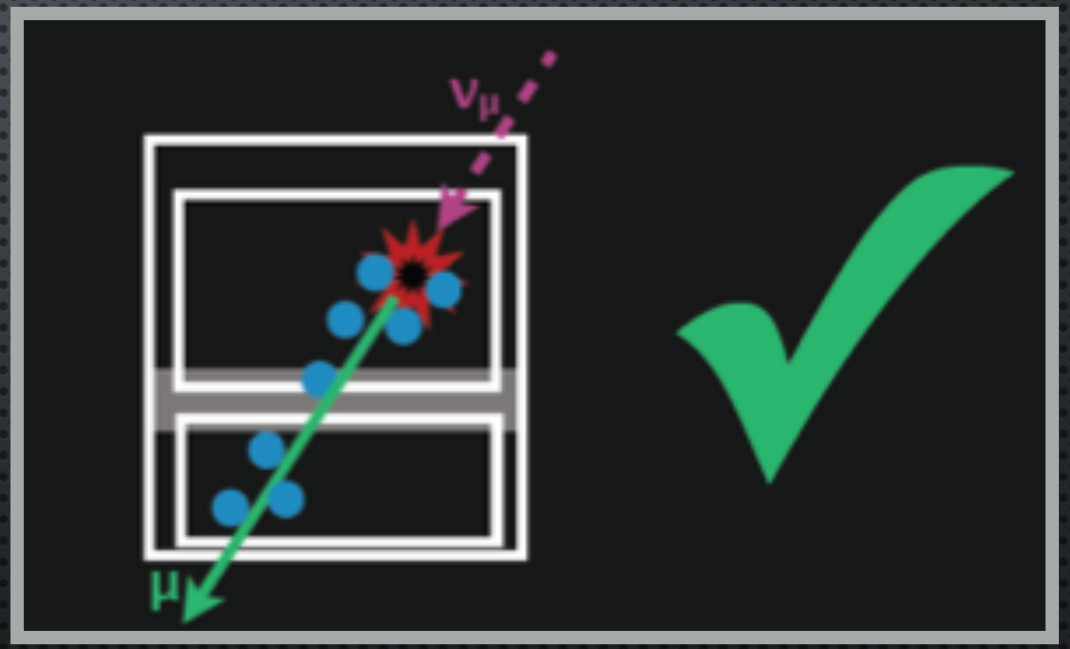
http://icecube.wisc.edu/viewer/background_signal

You can also read more about IceCube's event selection here:

https://masterclass.icecube.wisc.edu/en/analyses/cosmic-neutrinos

THE VETO TECHNIQUE





THE VETO TECHNIQUE

To select neutrinos of astrophysical origin, IceCube has implemented the High-Energy Starting Event (HESE) selection

The criteria for an event to be considered are:

- **Start point:** time when 250 photoelectrons (pe) are detected
- **Veto:** the DOMs in the veto regions must have less than 3 pe
- **Energy:** the event must reach a brightness of more than 6000 pe

You can check ou the selection method here:

http://icecube.wisc.edu/viewer/training

ACTIVITY!

Look at the True HESE event selection:

http://icecube.wisc.edu/viewer/hese_all#

- Can you find the 5 most energetic events in the selection?

Browse through the Event details here:

http://icecube.wisc.edu/viewer/hese

- What properties are interesting for an astronomer?
- What's special about some of the events?

QUESTION FOR YOU:

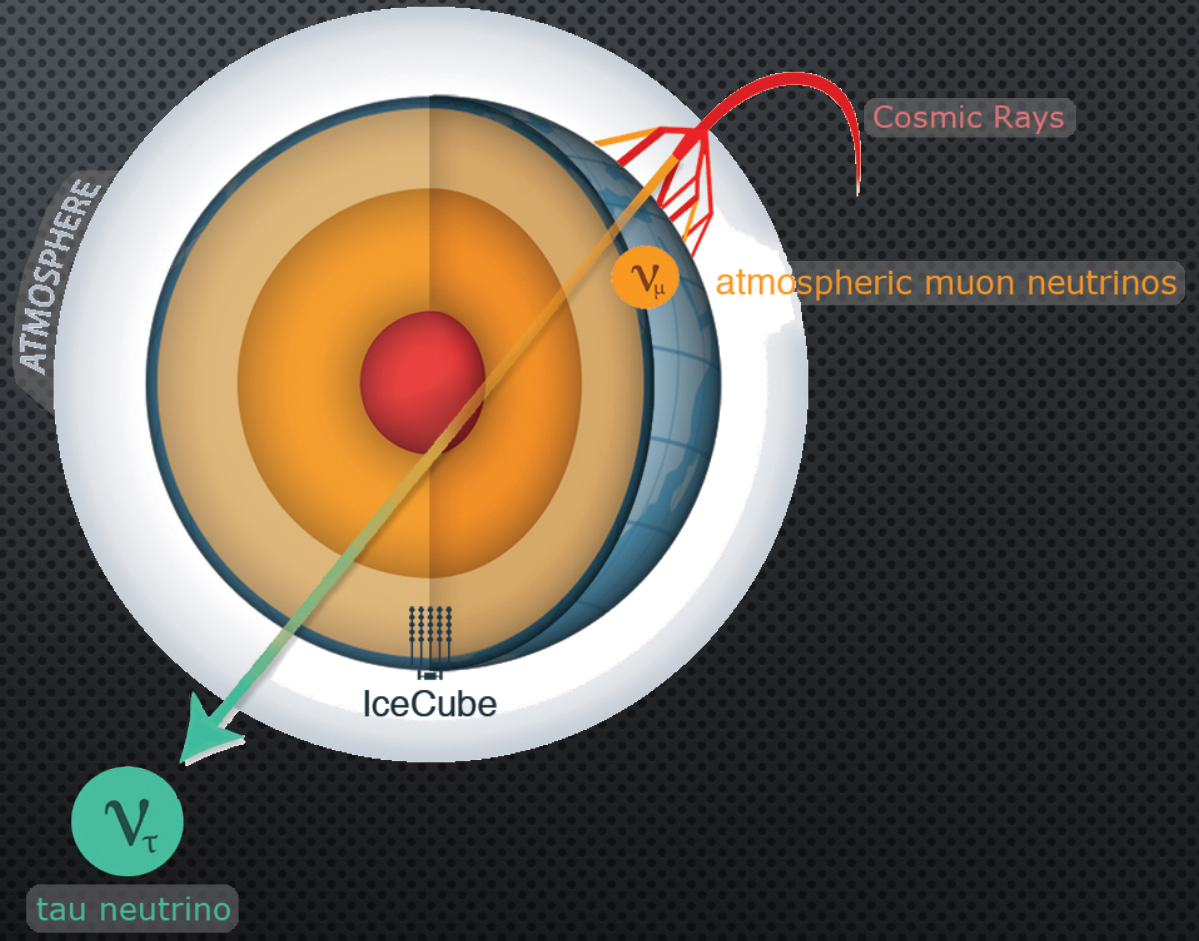
How sure are we that the sample we collected comes from space?

THE SIGNIFICANCE OF A RESULT

1. Understand the physics of your background
2. Understand the response of your detector
3. Collect enough statistics

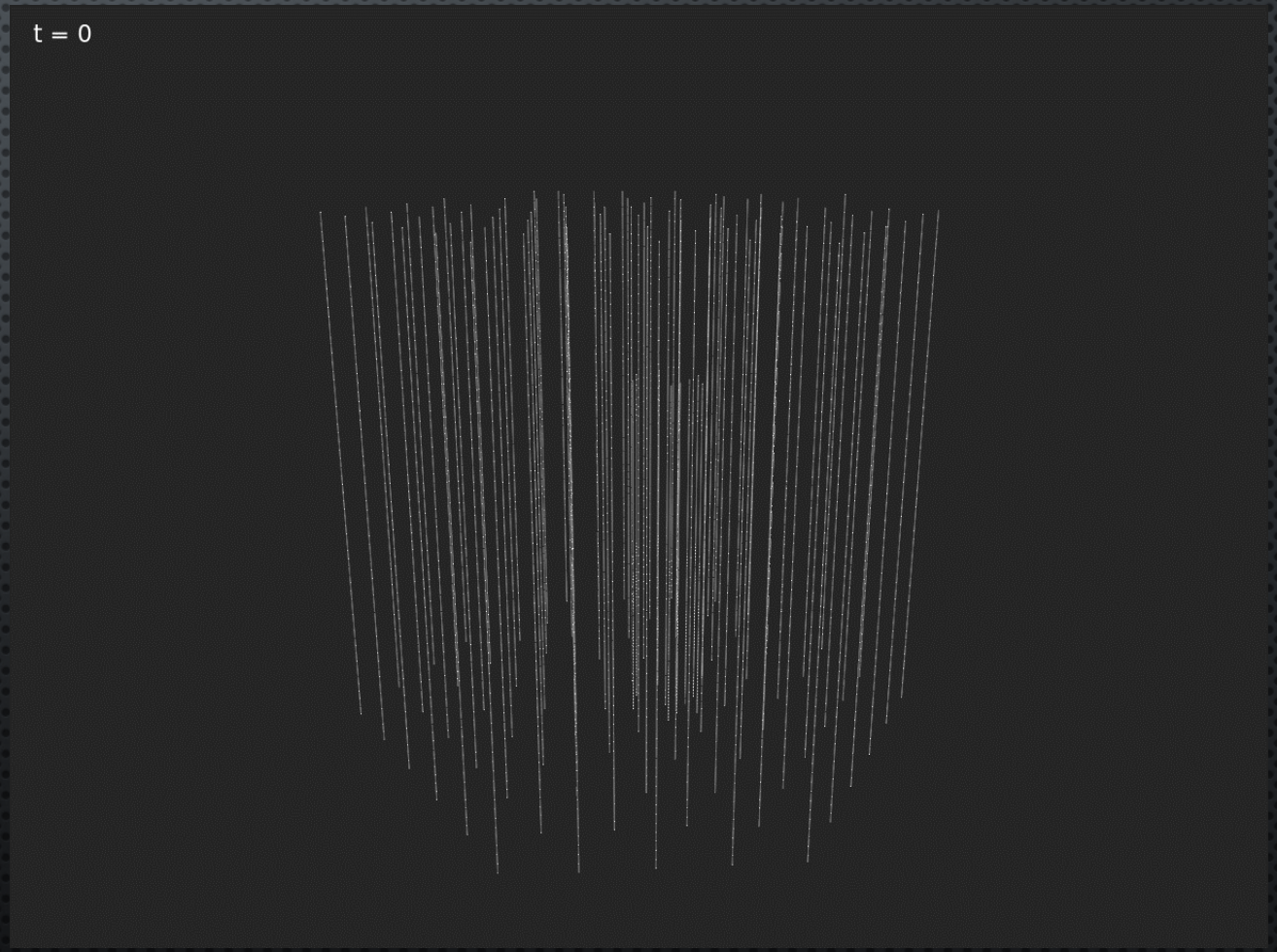
THE SIGNIFICANCE OF A RESULT

1. Understand the physics of your background



THE SIGNIFICANCE OF A RESULT

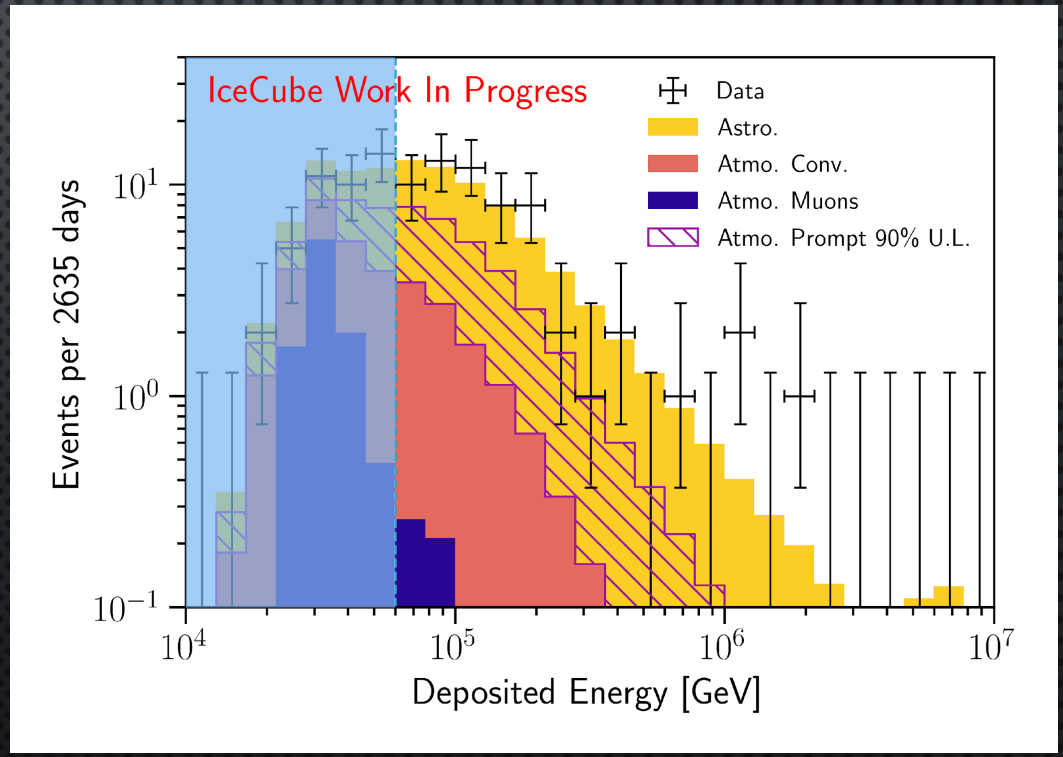
2. Understand the response of your detector



THE SIGNIFICANCE OF A RESULT

3. Collect enough statistics

(wait longer…)



THE SIGNIFICANCE OF A RESULT

3. Collect enough statistics

(or upgrade your experiment!)