ASPIRE Mathematica Workshop

Part 2: Interferometry, Reconstruction, and Analysis

Brian Clark
August 10-13 2015
ASPIRE Workshop

Supported by NSF CAREER Award 1255557
Reconstruction Locations

Green = Geographic South Pole

Black = human campsites/ bases

Orange = Taylor Dome Ice Core (pulser)

Blue arrow = location of reconstructed neutrino

Red circle = “error” zone on the neutrino location
Publishing your Data

• Part of doing science is convincing other scientists that your conclusions are scientifically plausible

• For professionals, this is usually done via a peer-reviewed journal process
  o We write 8-40+ page papers that detail our methods, data, and conclusions
  o Fellow scientists evaluate our work, looking for good scientific practice:
    ◆ thorough lab notebooks
    ◆ meaningful analysis techniques
    ◆ correctly analyzed errors
    ◆ scientifically plausible and repeatable conclusions
Public Share Out

• Today, let’s just try and convince each-other!
• Go ahead and write on the board if your pair thinks a particular event is a
  o Base
  o Taylor dome pulse
  o Neutrino candidate!

• Now, each pair, explain why you came to your conclusion
Congratulations! You just performed, by hand, what the ANITA experiment does everyday by computer.

For a single flight, we perform this basic analysis algorithm on something like 80,000,000 (eighty million) events!
The ANITA team performed these calculations, with some other more advanced ones, for all of the ANITA-2 data.

We discovered no neutrinos; this data placed the strictest limits yet on the cosmic neutrino flux.

In fact, no neutrinos have ever been seen at the energies where ANITA is looking.
If you were a member of the ANITA team and found neutrino candidates in real data, you and the rest of the ~30 member collaboration could publish the result as the first discovery of ultra-high energy neutrinos.

Even if you didn’t find a neutrino, you could still publish your results as a limit on the cosmic flux of neutrinos.
Well done, fellow scientist!
Any last questions?

Jerrod Roberts, Univ of HI
Back Up
Extra Problem

• Open the “extra” notebook, and perform the analysis on this single event

• Does anything look suspicious about this event’s location?
Extra Problem (cont)

This “extra” event lies very near the location of event 4, which we as a group decided was a neutrino candidate!

Event 4—Neutrino Candidate
-13, 39.9, -86.1, 27, 39285

Extra Event
-13, 41, -85, 28, 38310
Extra Problem Answer

- Recall that the Askaryan interaction is very rare
- So, are we suspicious?

- Absolutely!
- It is extraordinarily unlikely for two events to come from the same place in the ice
  - This casts serious doubt on our decision to call event 4 a neutrino candidate
  - So, in real analysis, we would probably discard the event
A human probably made something that looked like a neutrino, and did it twice.

Nature would very rarely have a neutrino interact in the same place twice.