

Searching for Neutrinos with RNO-G

4th Meeting Astroparticle Physics Committee

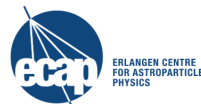
Zack Meyers, 11-10-2020



**HELMHOLTZ WEIZMANN
RESEARCH SCHOOL**
MULTIMESSENGER ASTRONOMY

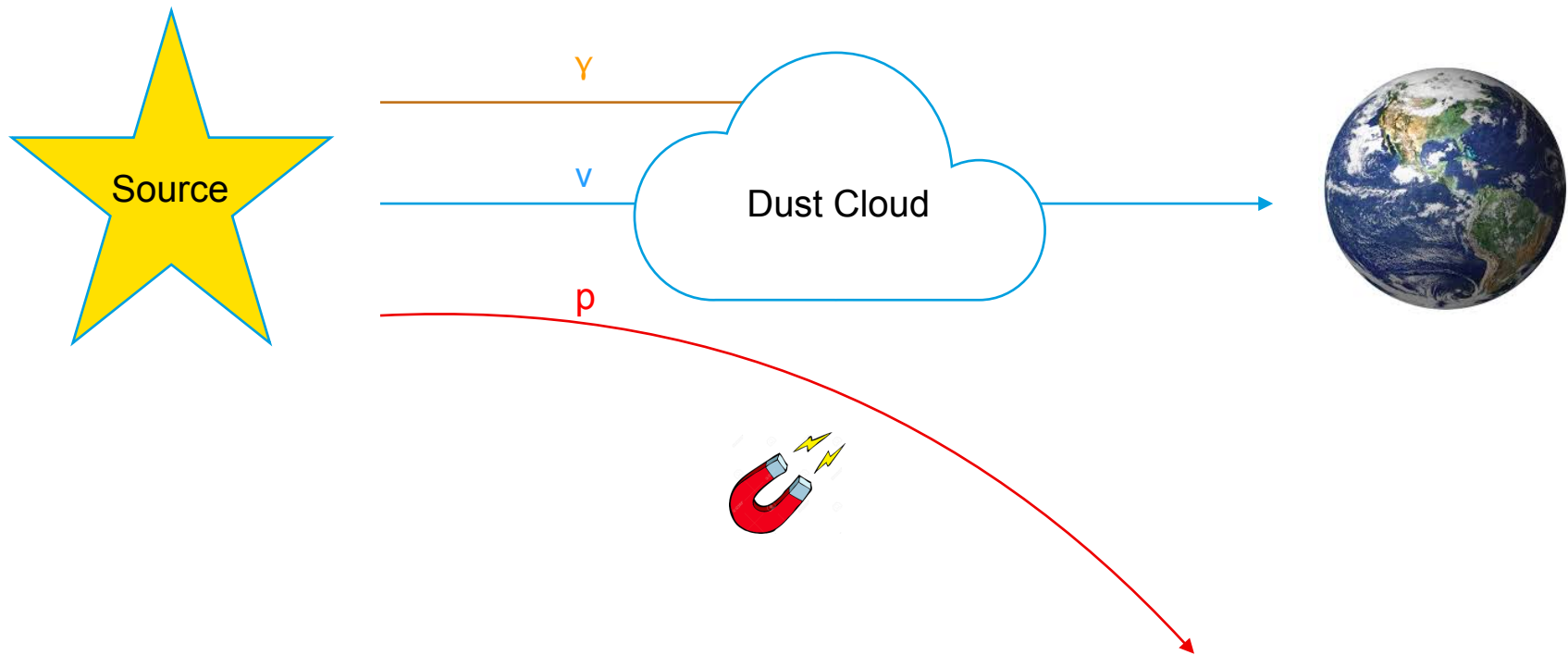
HELMHOLTZ RESEARCH FOR
GRAND CHALLENGES

FAU
FRIEDRICH-ALEXANDER
UNIVERSITÄT
ERLANGEN-NÜRNBERG
NATURWISSENSCHAFTLICHE
FAKULTÄT



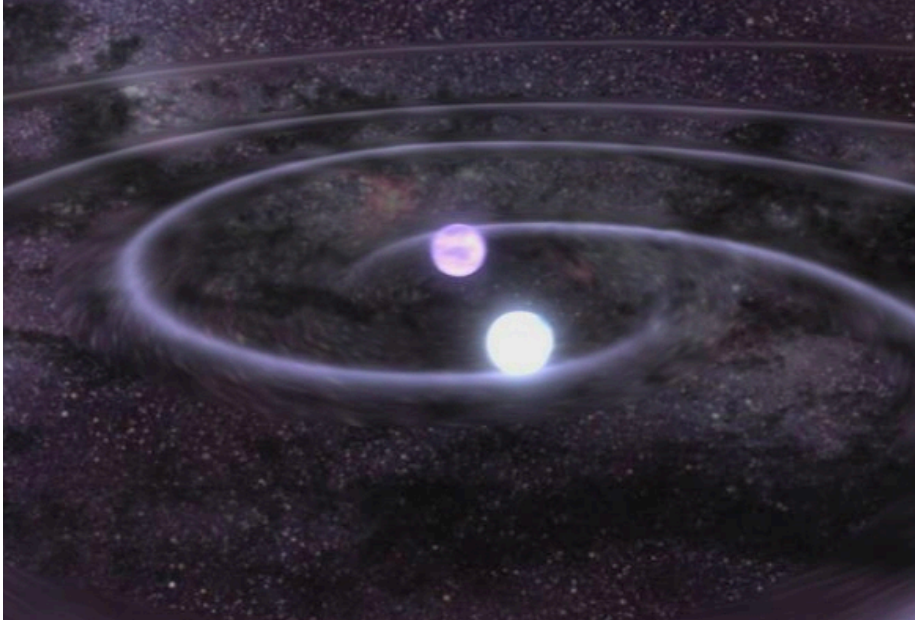
Neutrinos

A cosmogenic and astrophysical messenger



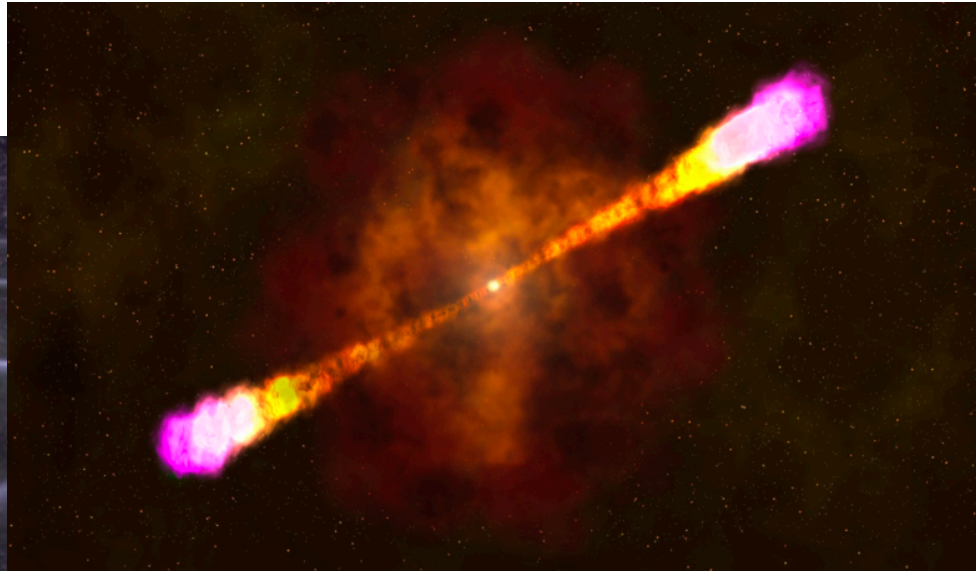
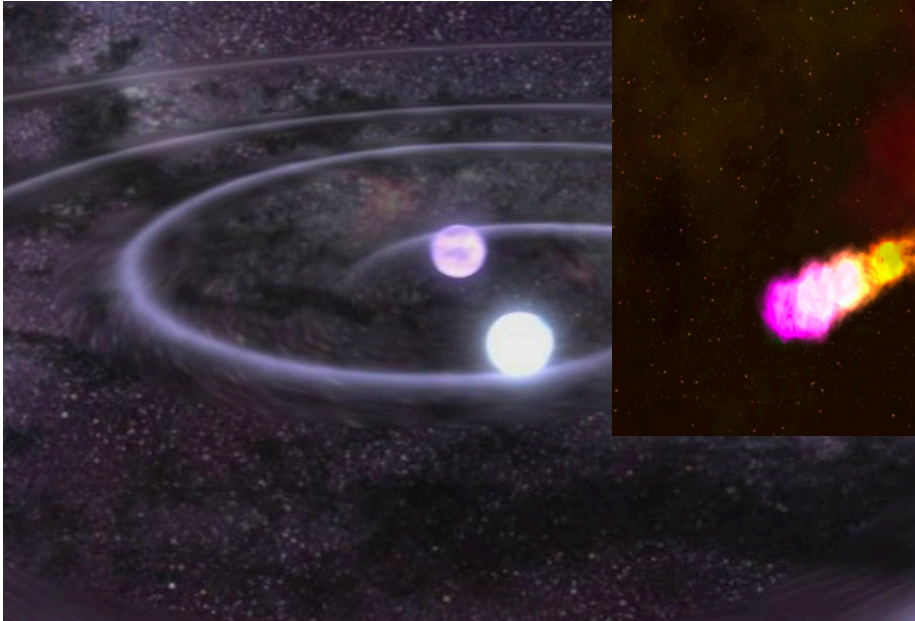
Neutrinos

From Transients



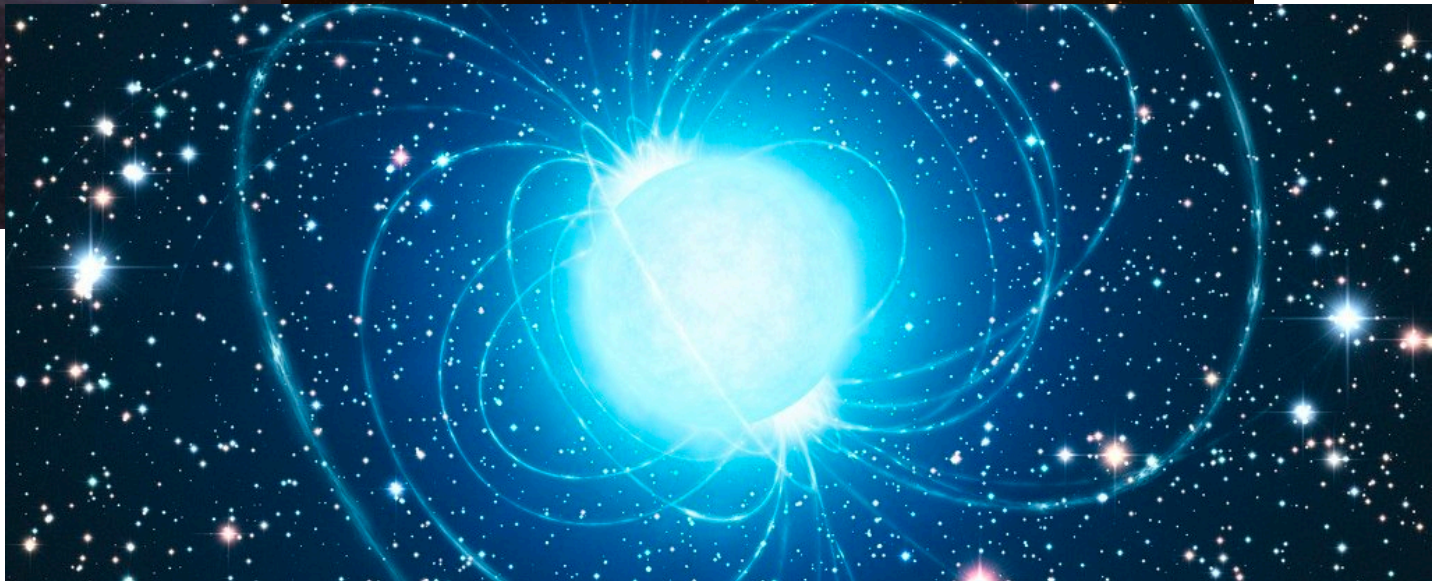
Neutrinos

From Transients



Neutrinos

From Transients



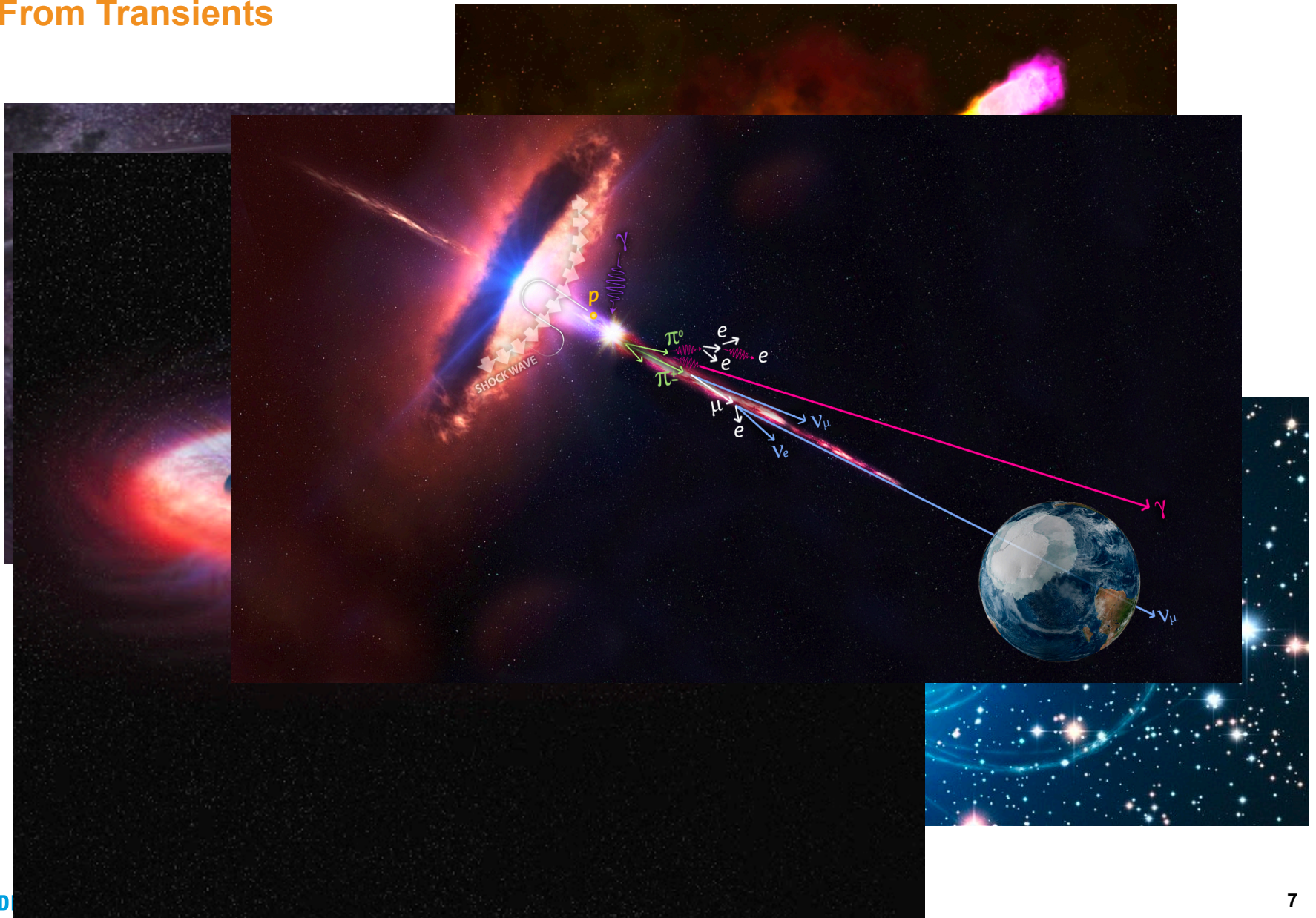
Neutrinos

From Transients



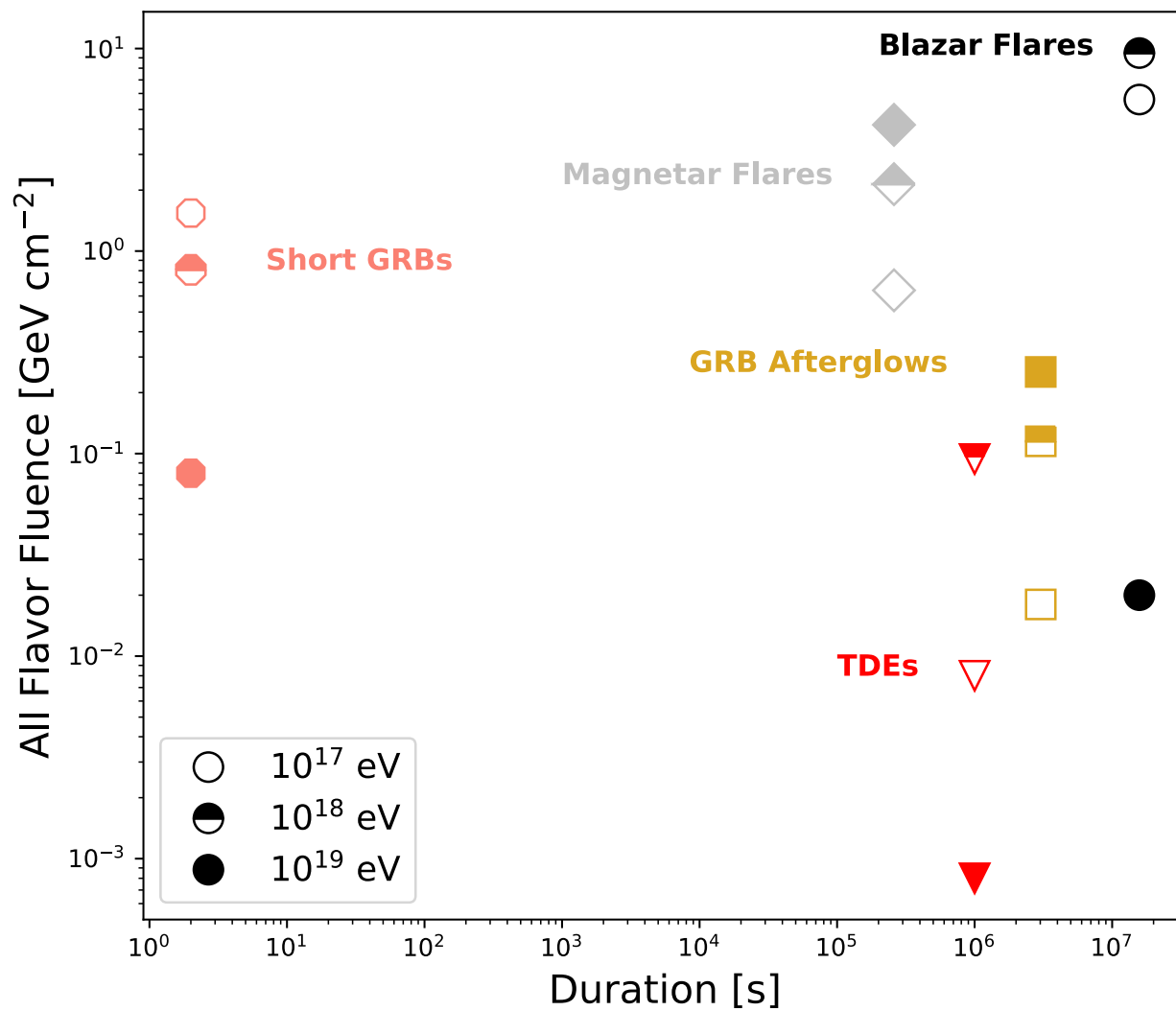
Neutrinos

From Transients



Neutrinos

From Transients

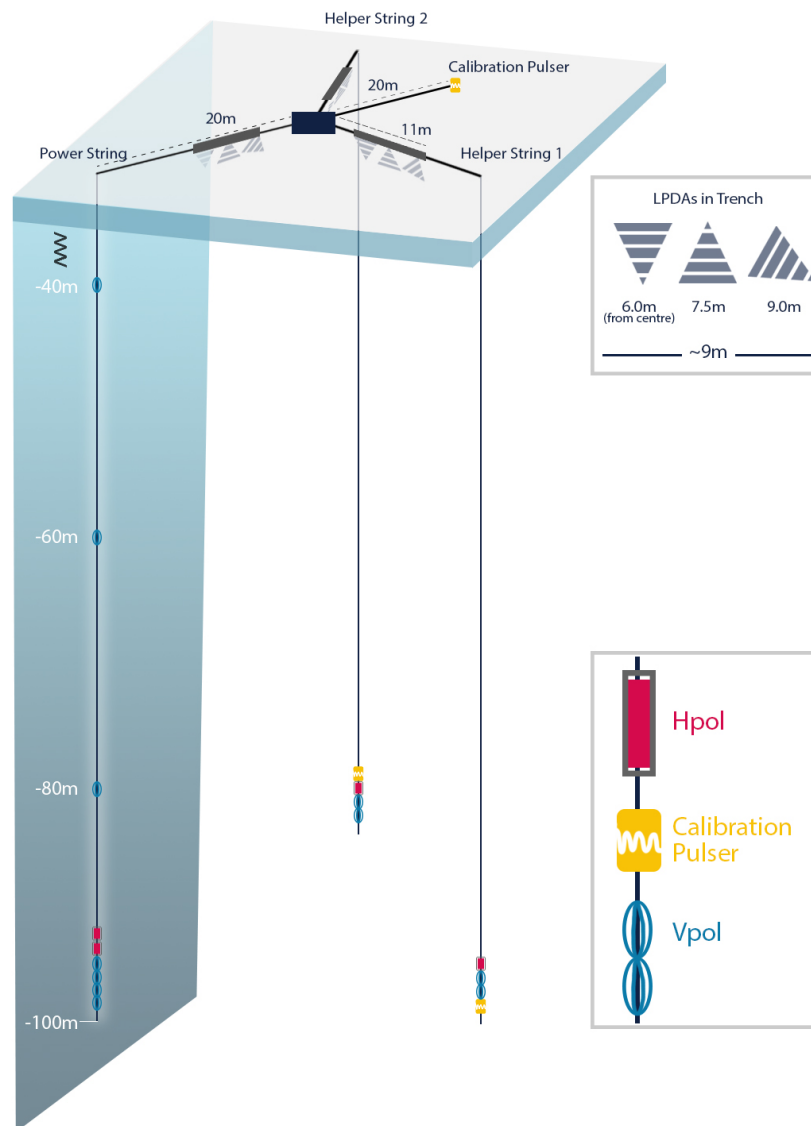
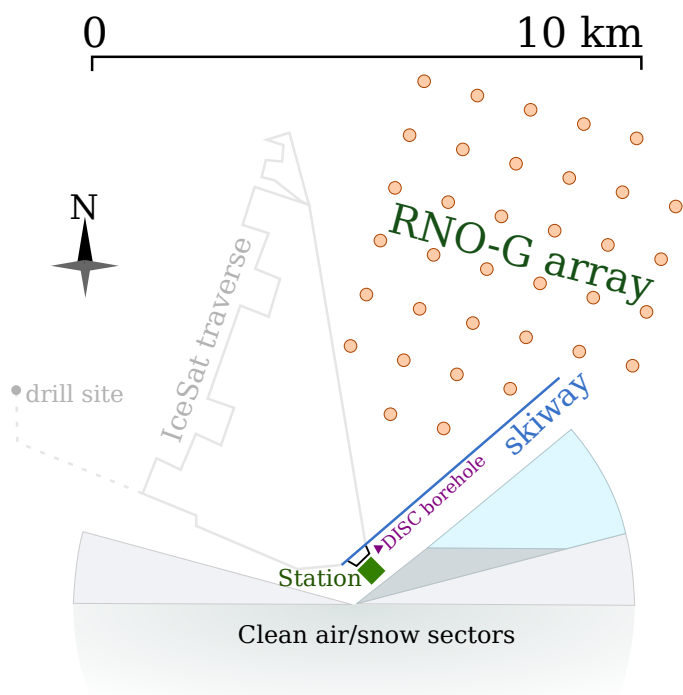


The Radio Neutrino Observatory in Greenland



RNO-G

Array and Station Design



RNO-G

Deployment

- 2020 deployment **cancelled**
- 10 stations for 2021
- New Drill, bigger holes, more design iterations

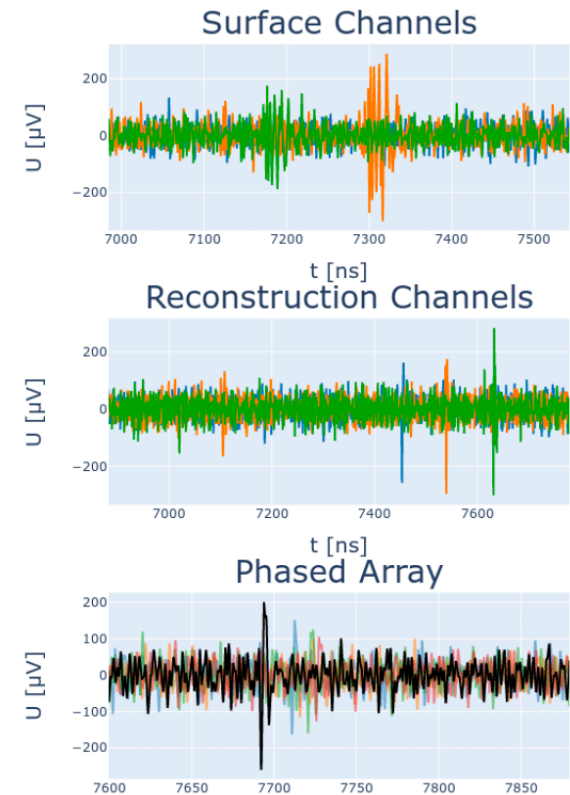
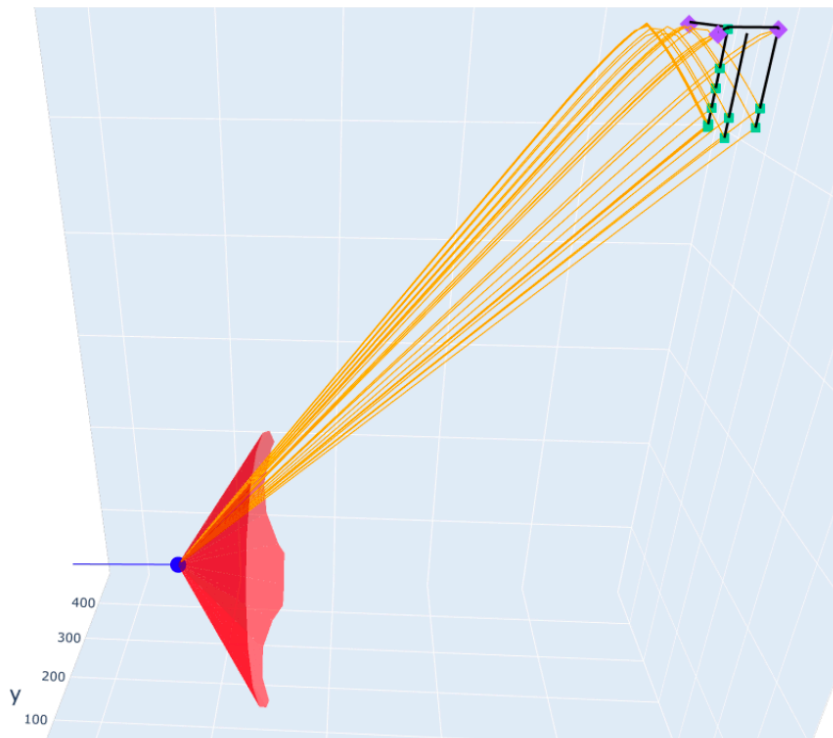


RNO-G

Events

- vertex
- ray path
- dipoles
- LPDAs

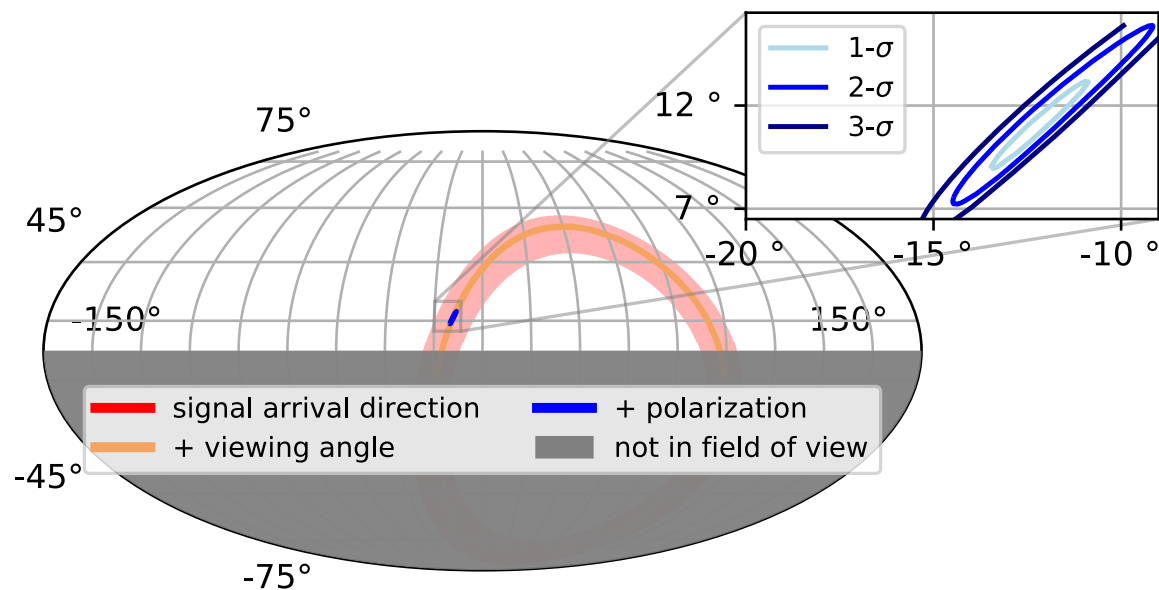
$E=2e+18\text{eV}$
 $\theta=93.3^\circ$
 $\varphi=178.8^\circ$



1. Station Trigger - Mostly garbage

2. Event selection

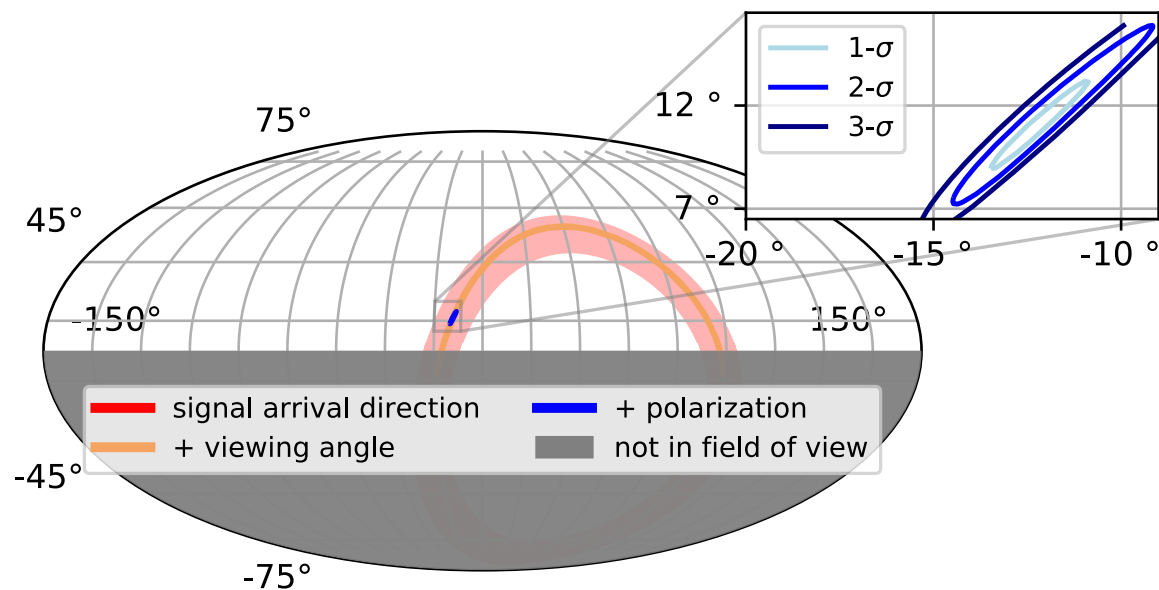
3. Reconstruction



1. Station Trigger - Mostly garbage

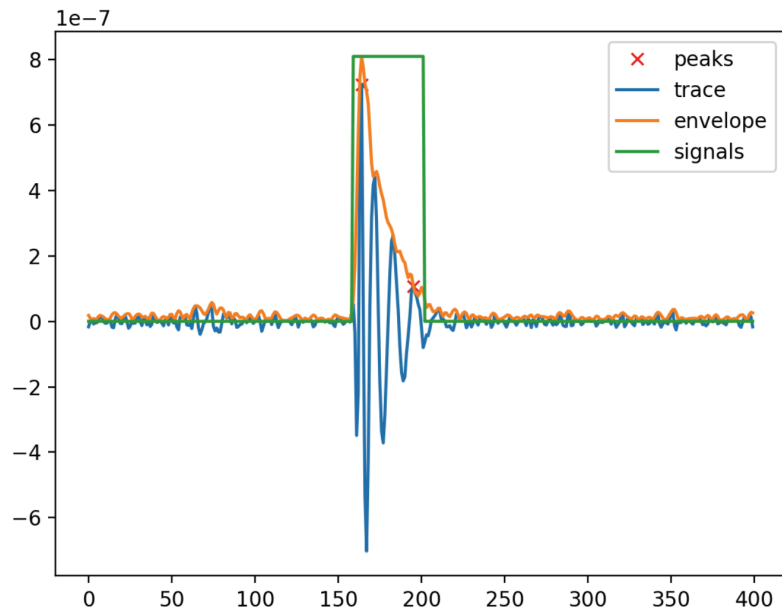
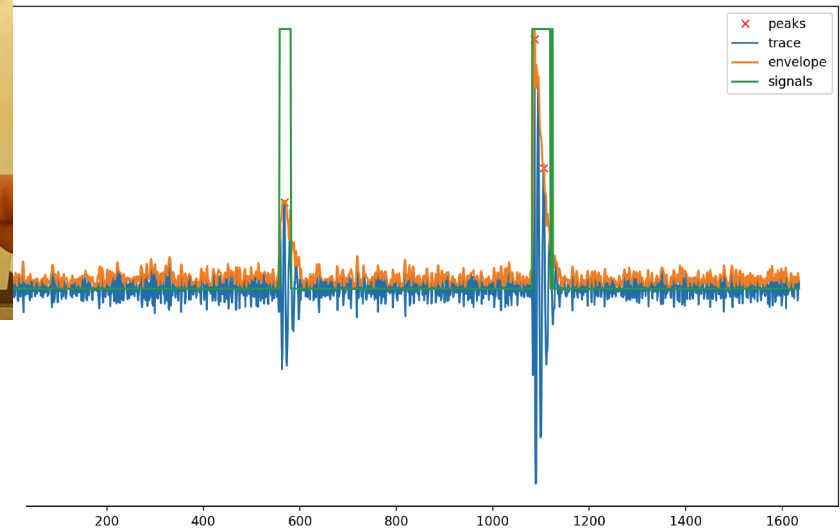
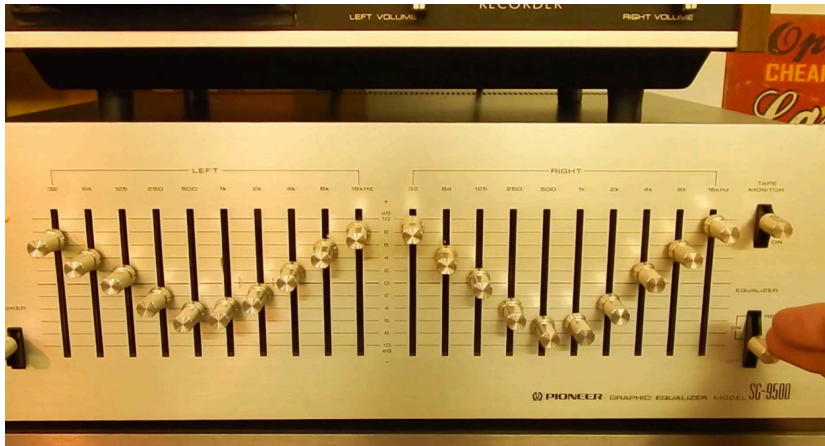
2. Event selection

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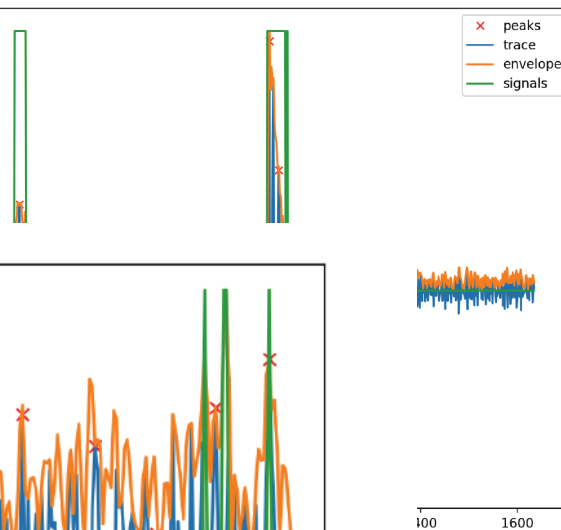
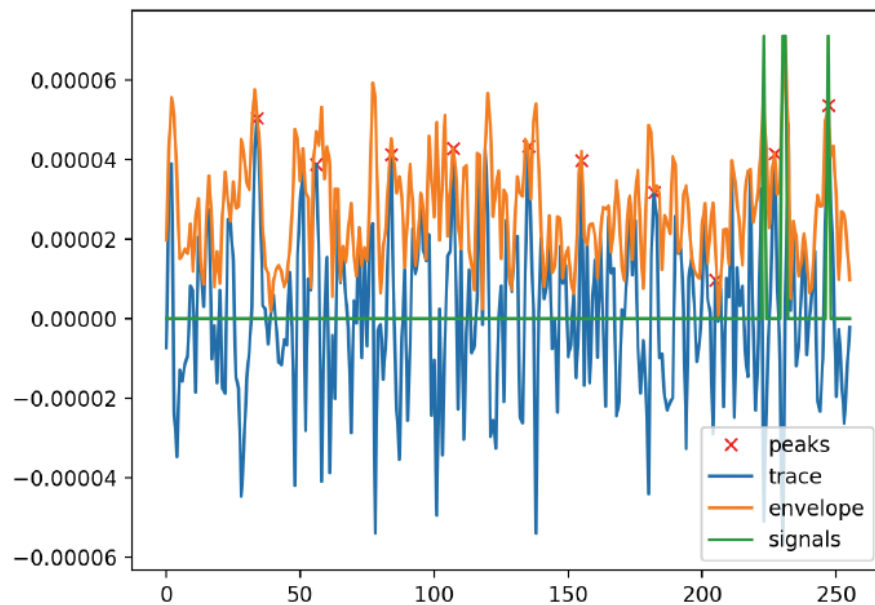
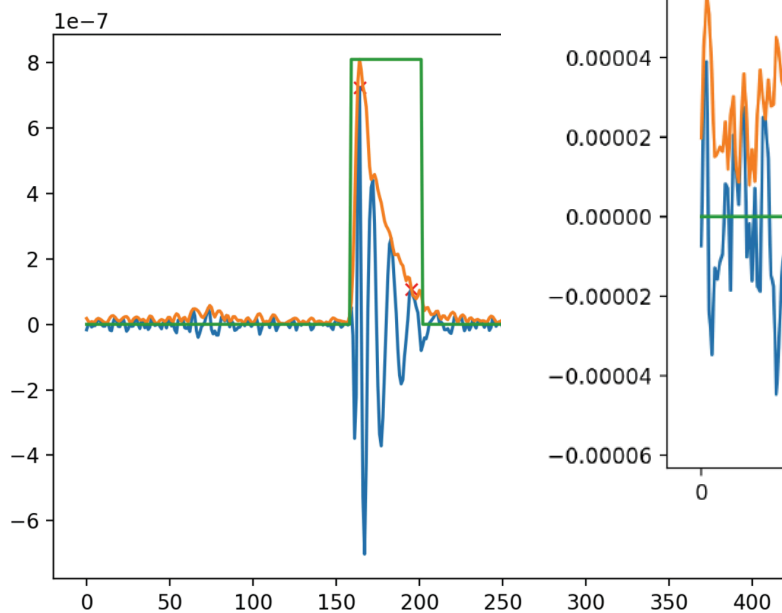
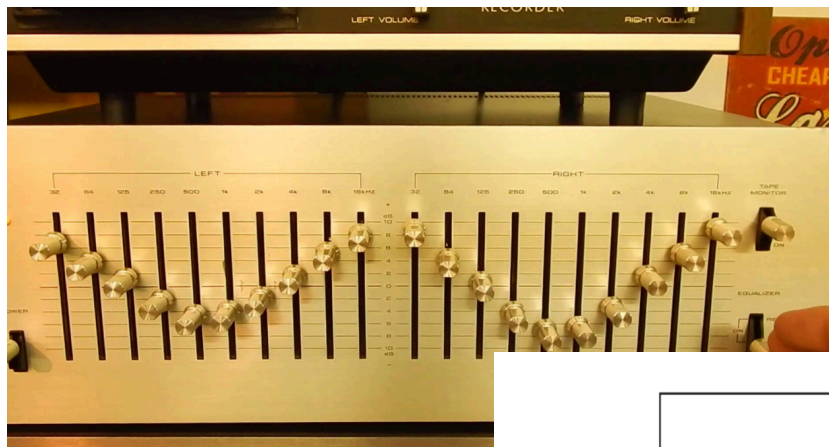
Event Selection

Signal Finder



Event Selection

Machine Learning?



Collaboration

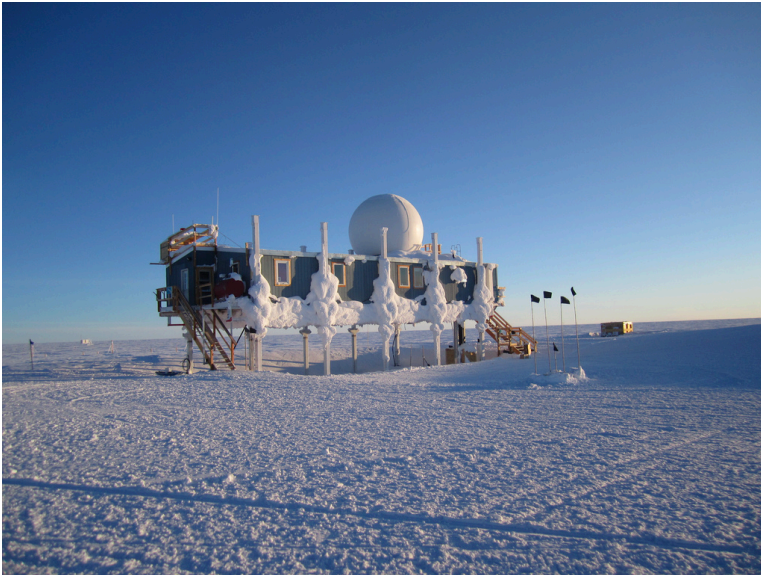
Working in the Multi Messenger School



Next Steps

Next Steps

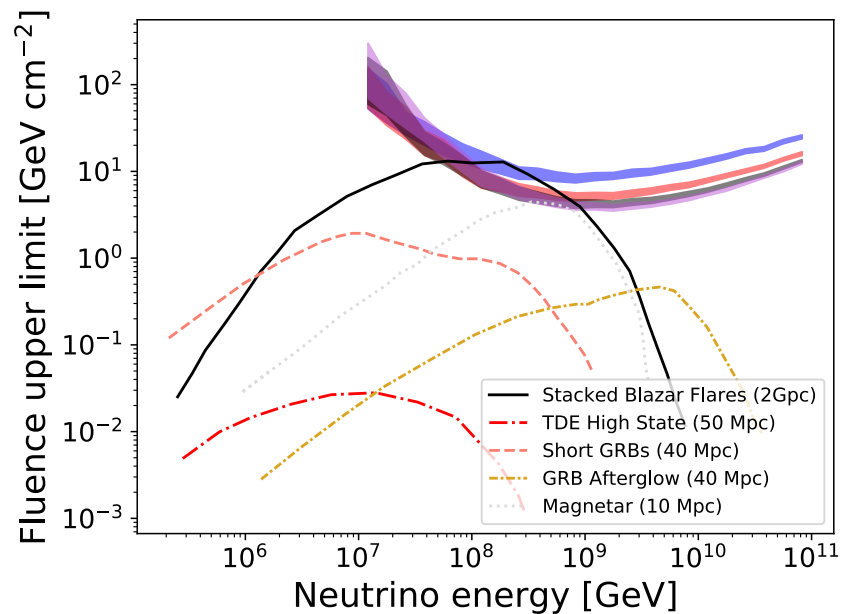
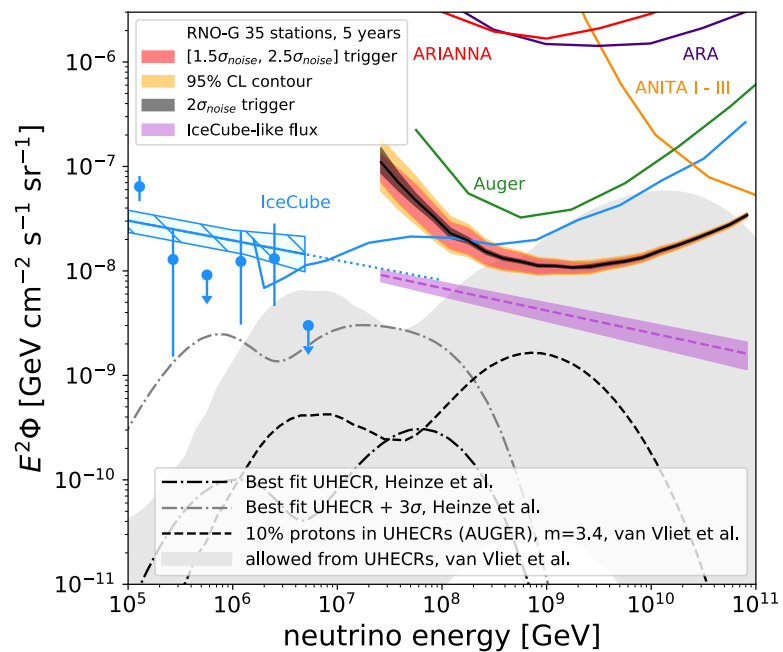
Summary



The future of my project:

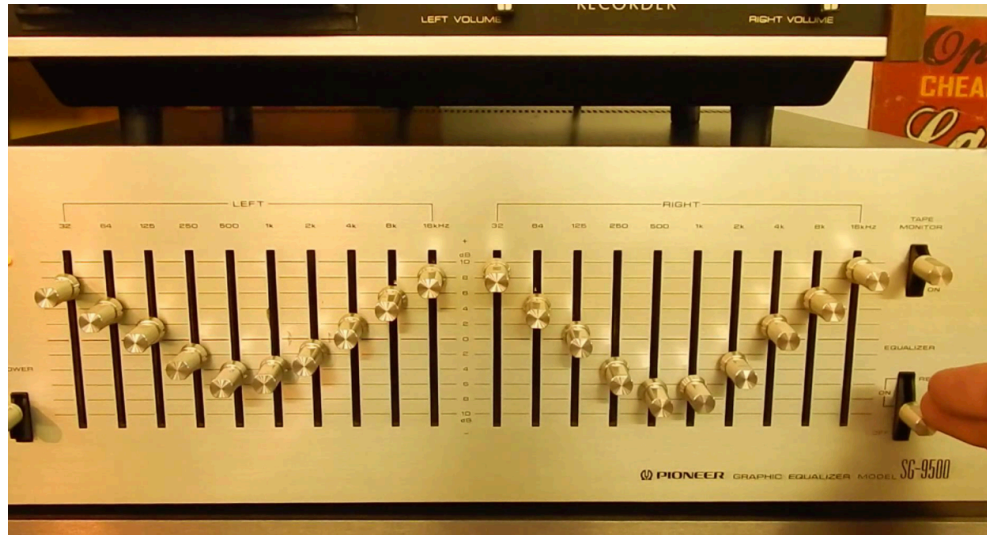
- Deploy! Real data, real noise
- Crucial: DENOISE..... with deep learning? Matched Filtering? Travel to Weizmann.
- Transient Neutrino Astronomy for the future: R&D

Bonus



Matched Filtering

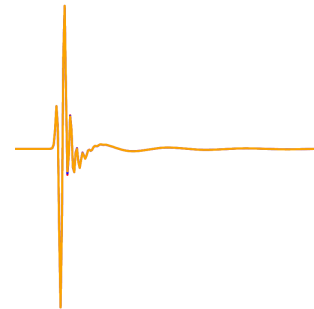
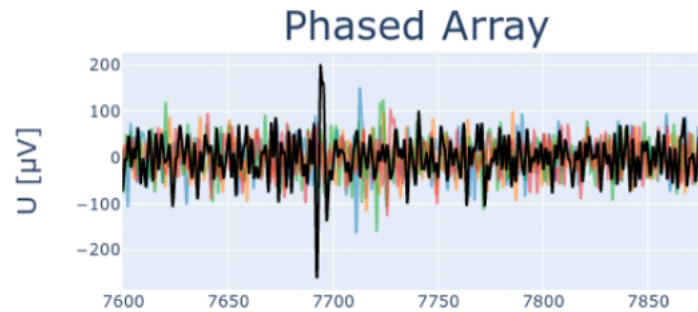
Separate Signal from Noise



Convolution of the input signal with a conjugated time-reversed version of the reference signal

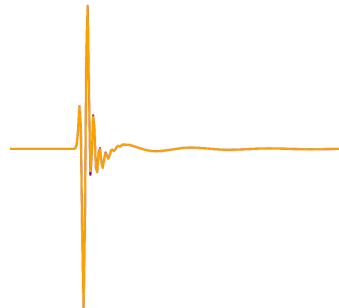
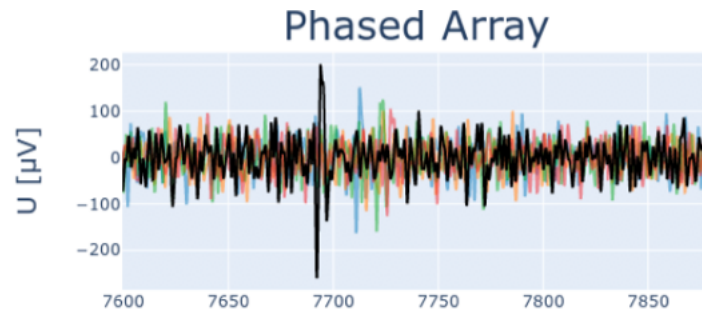
Matched Filtering

Separate Signal from Noise



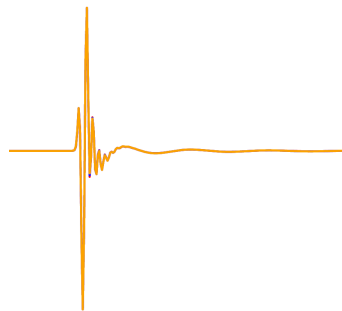
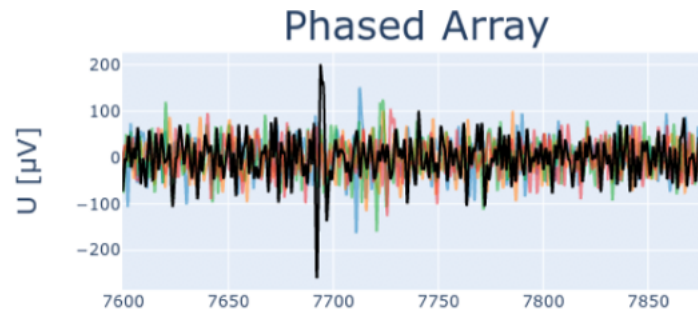
Matched Filtering

Separate Signal from Noise



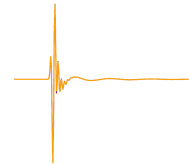
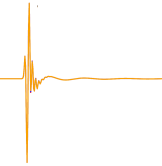
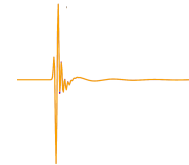
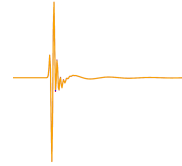
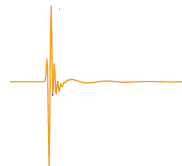
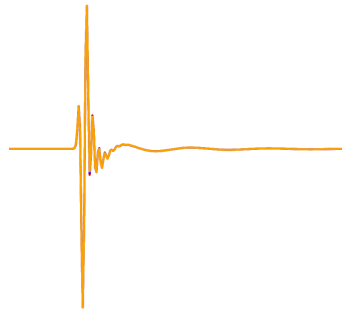
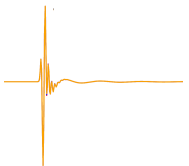
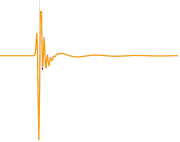
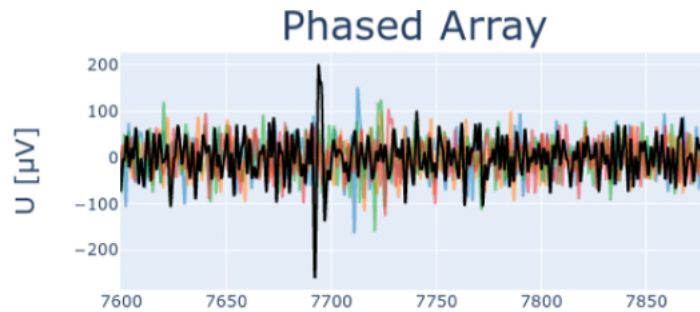
Matched Filtering

Separate Signal from Noise



Matched Filtering

Separate Signal from Noise



Machine Learning

Separate Signal from Noise

