

Searching for Neutrinos with RNO-G

MMS Annual Meeting

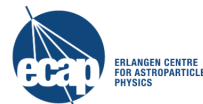
Zack Meyers, 26-08-2020



**HELMHOLTZ WEIZMANN
RESEARCH SCHOOL**
MULTIMESSENGER ASTRONOMY

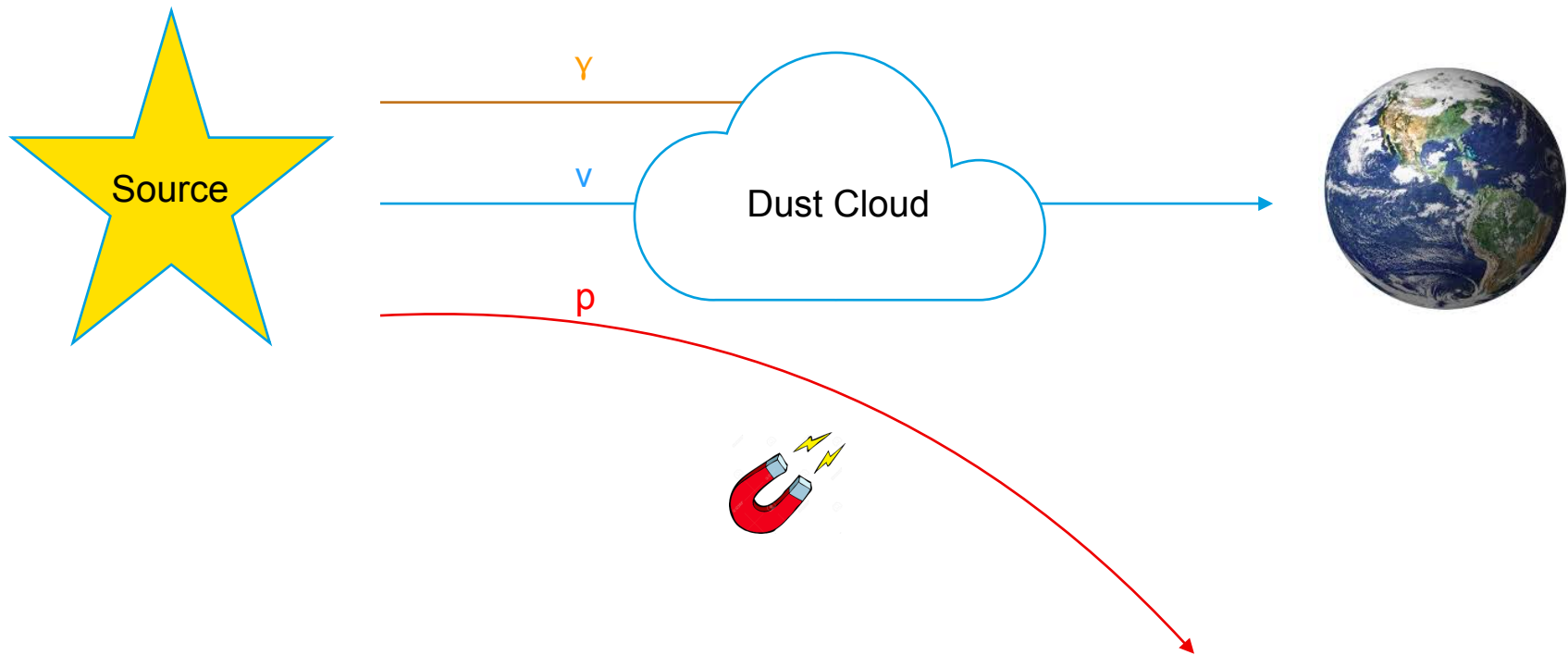
HELMHOLTZ RESEARCH FOR
GRAND CHALLENGES

FAU
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UNIVERSITÄT
ERLANGEN-NÜRNBERG
NATURWISSENSCHAFTLICHE
FAKULTÄT



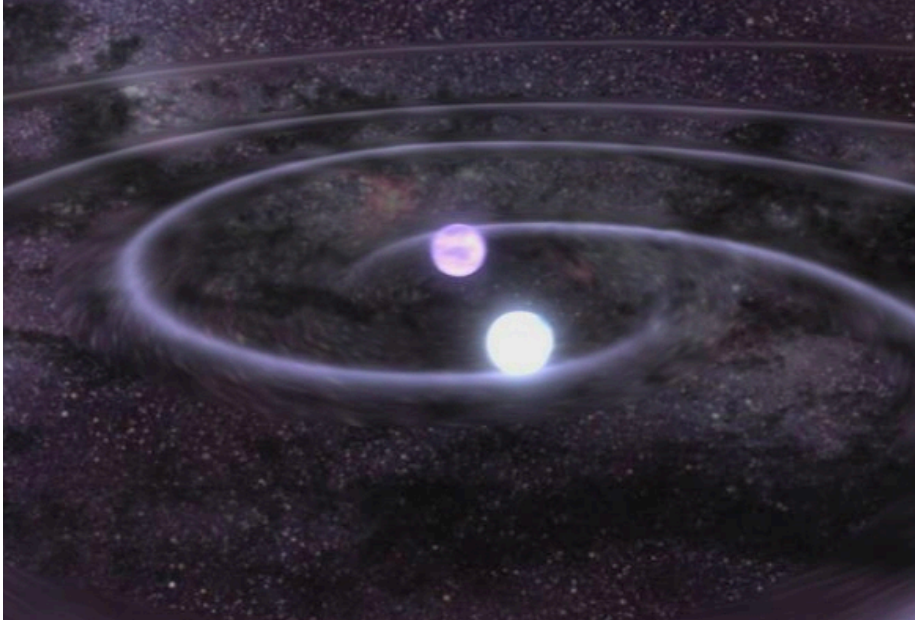
Neutrinos

A cosmogenic and astrophysical messenger



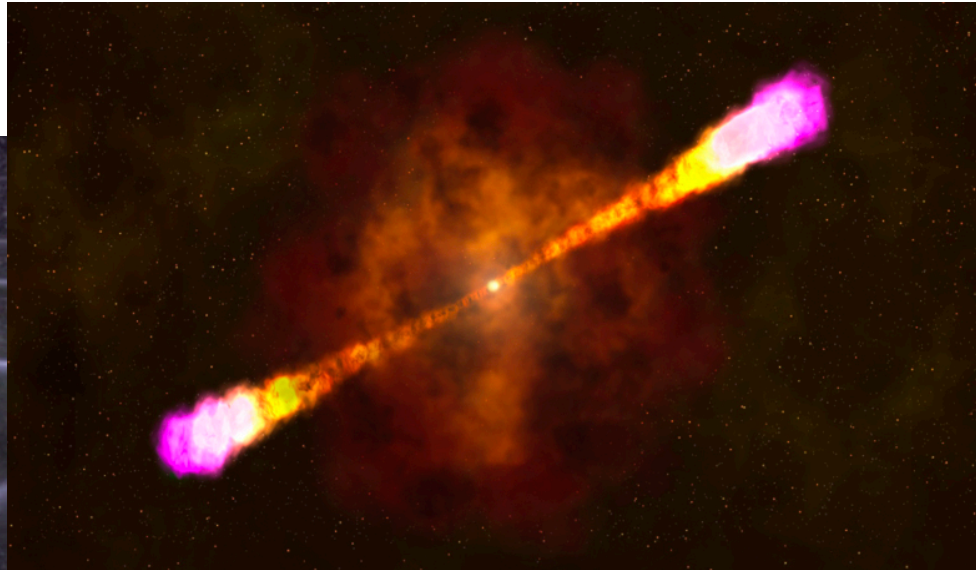
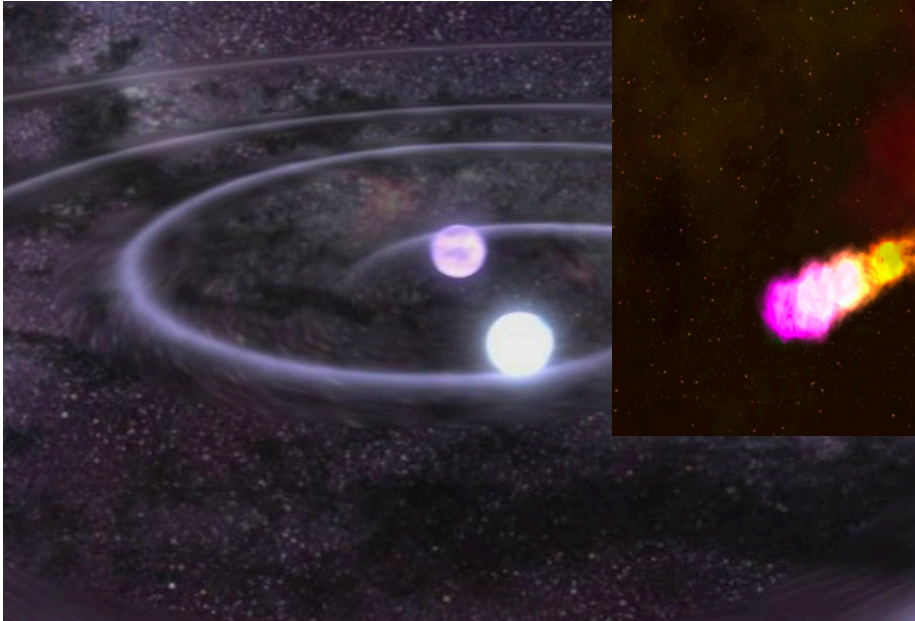
Neutrinos

From Transients



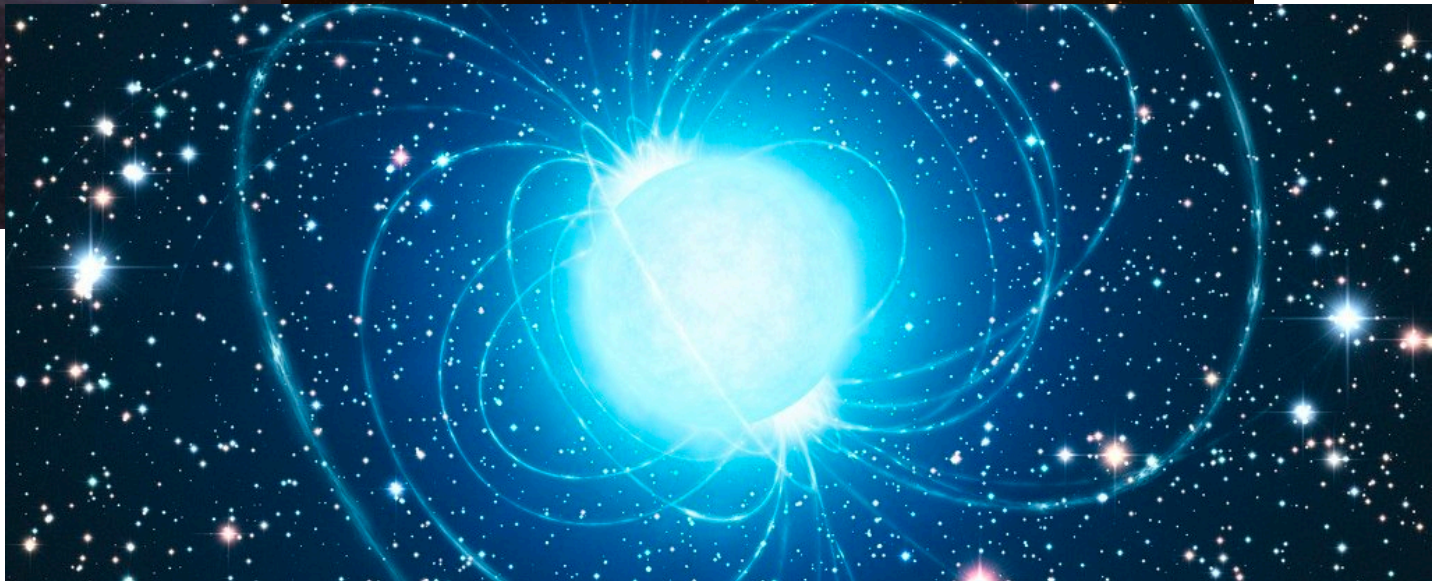
Neutrinos

From Transients



Neutrinos

From Transients



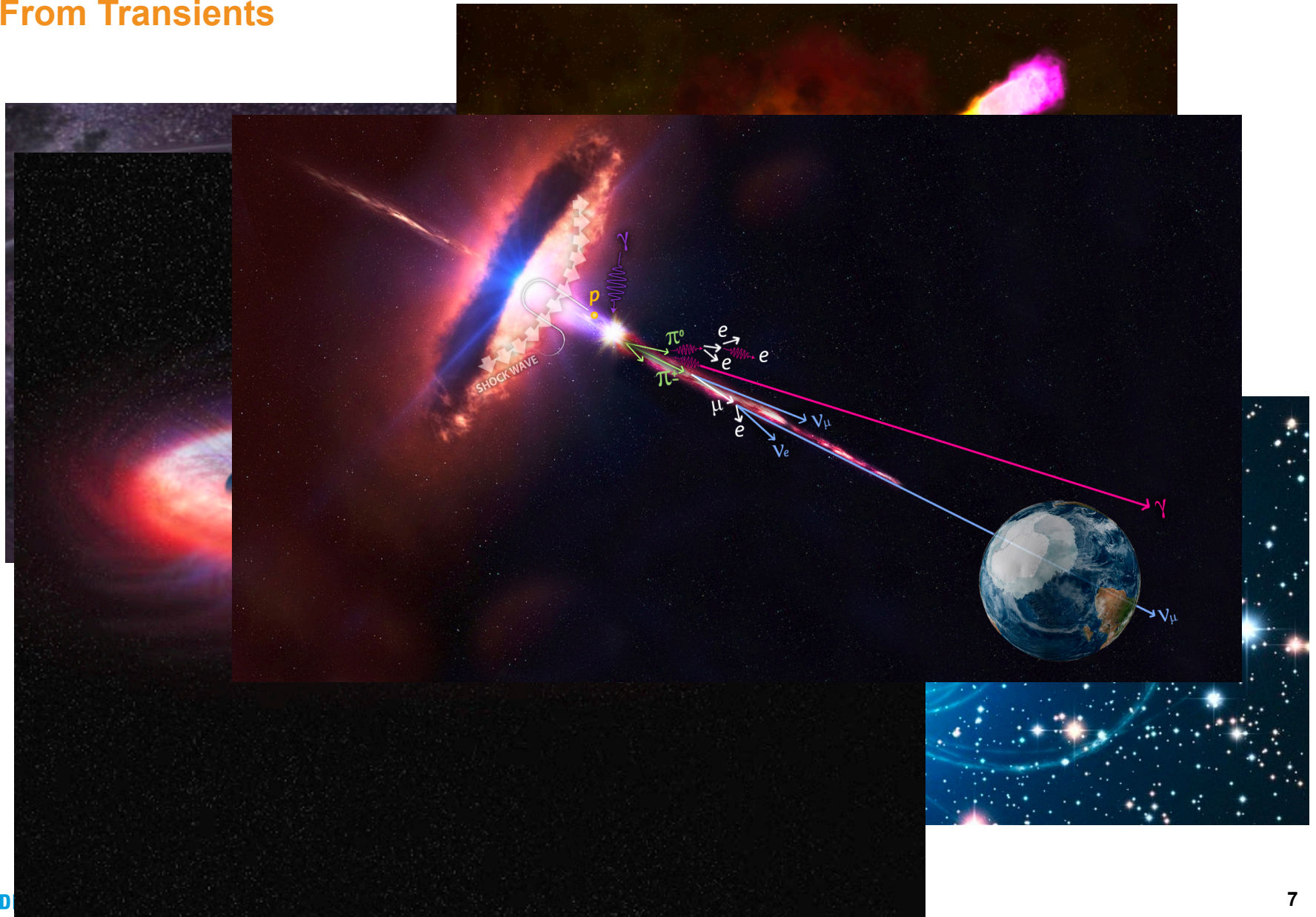
Neutrinos

From Transients



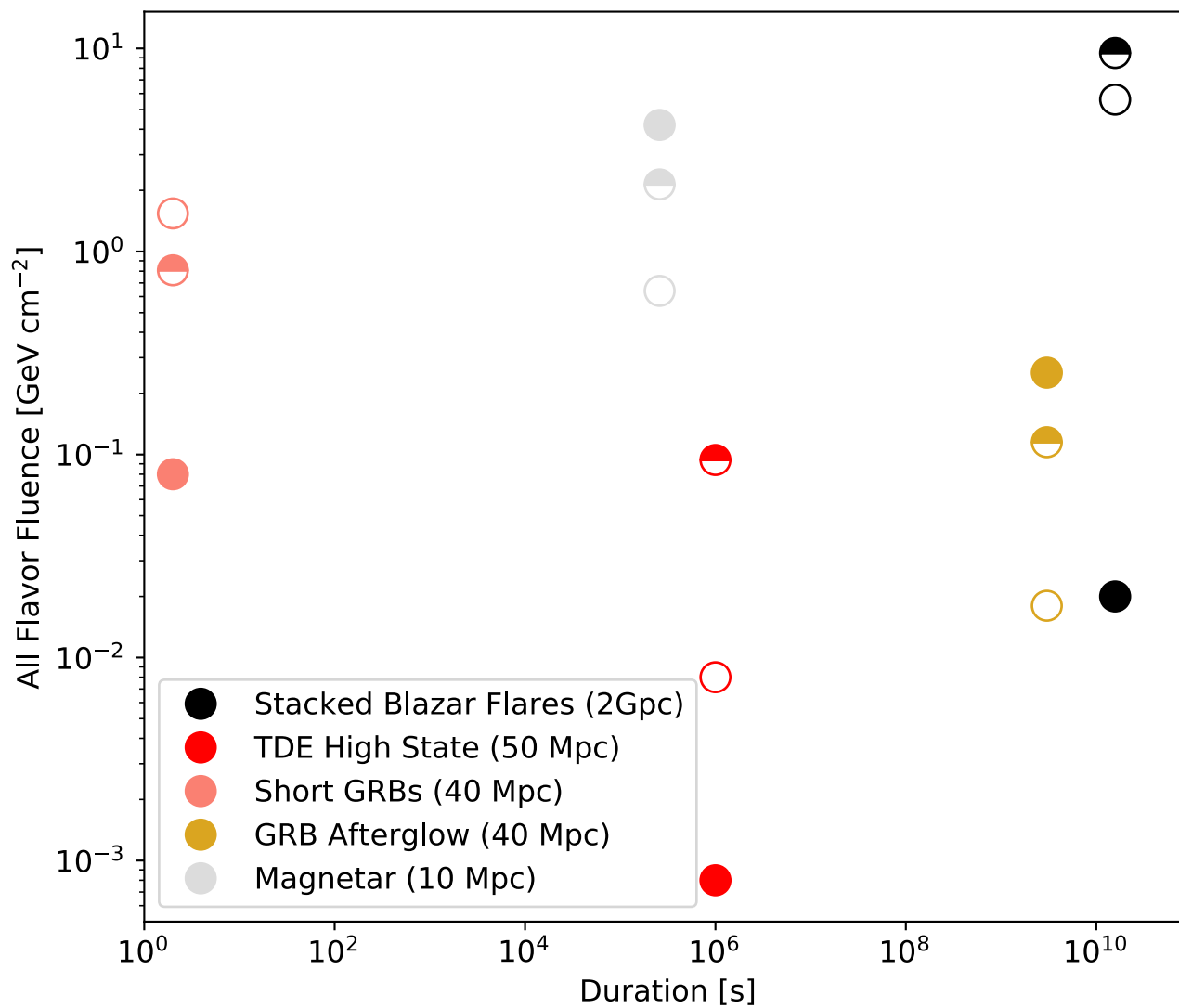
Neutrinos

From Transients



Neutrinos

From Transients

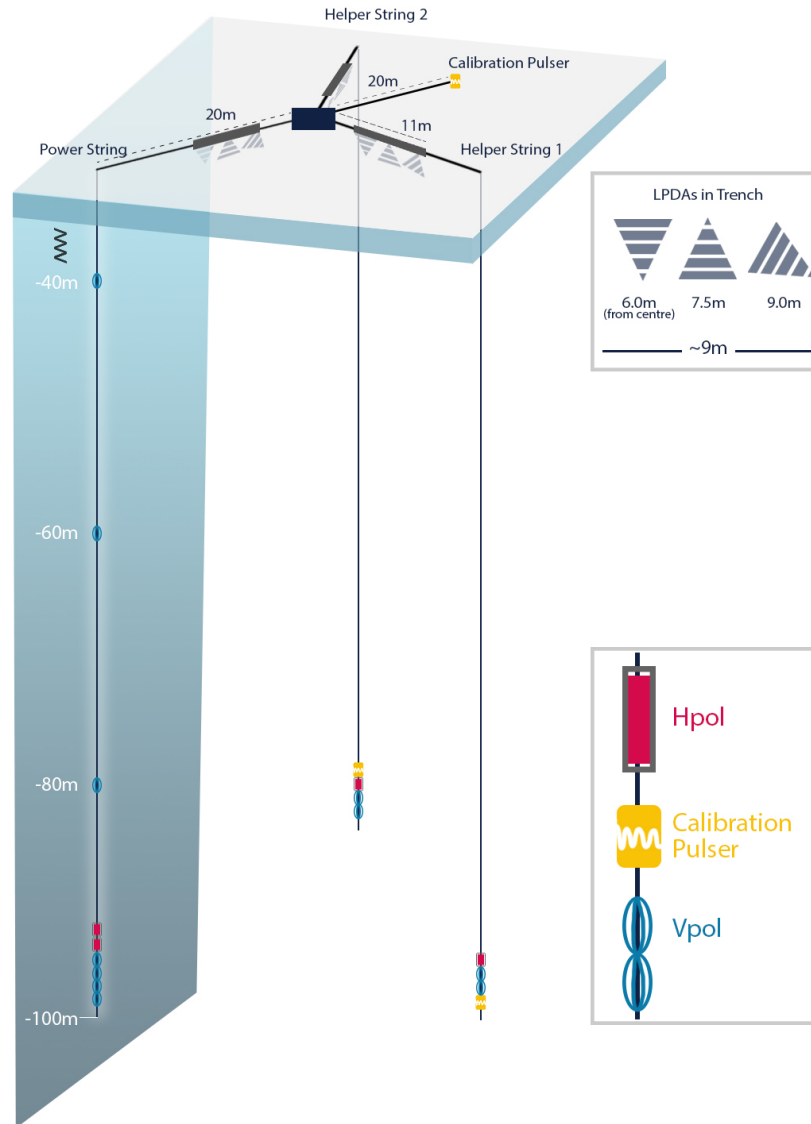
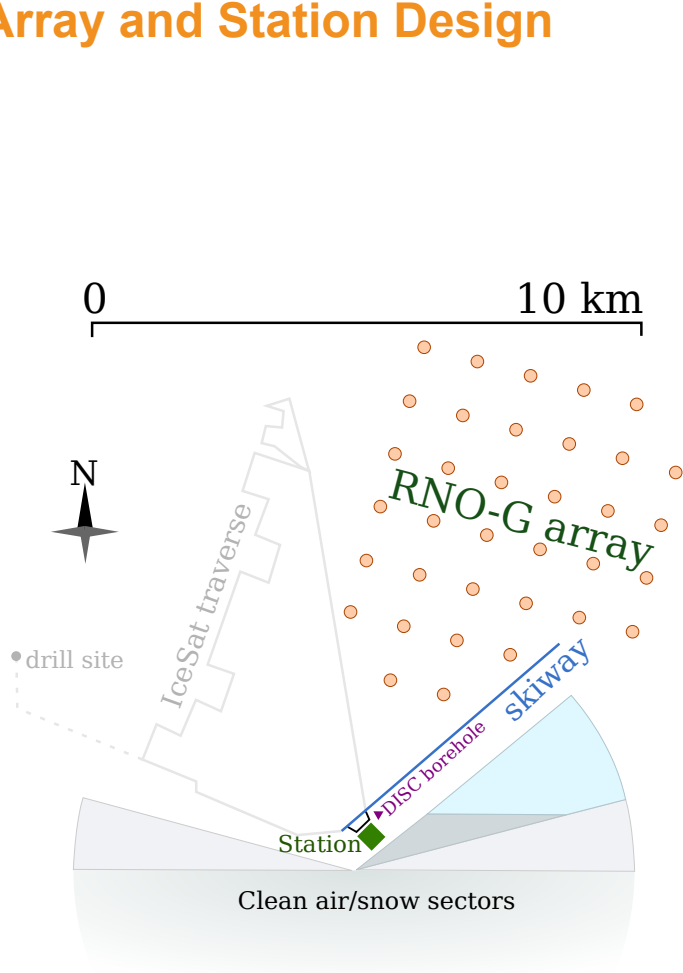


The Radio Neutrino Observatory in Greenland



RNO-G

Array and Station Design



RNO-G

Deployment

- 2020 deployment **cancelled**
- 10 stations for 2021
- Drilling? It's complicated.... might end up with bigger holes

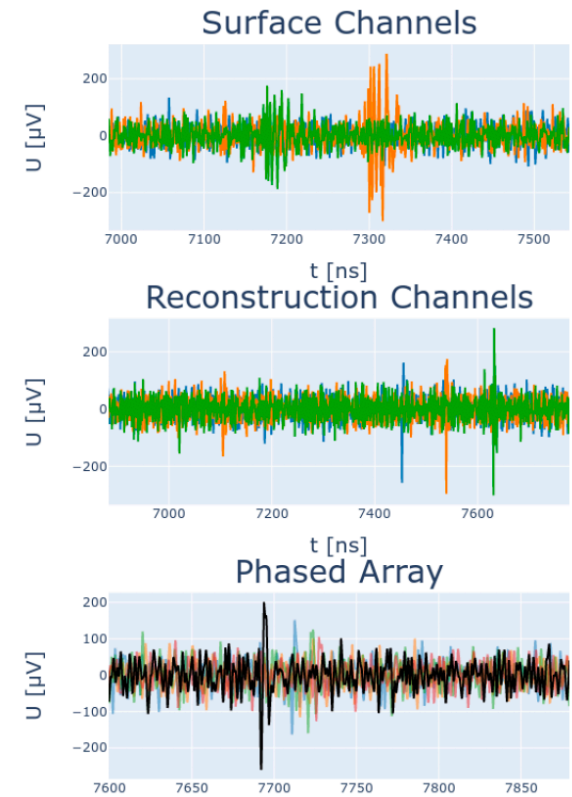
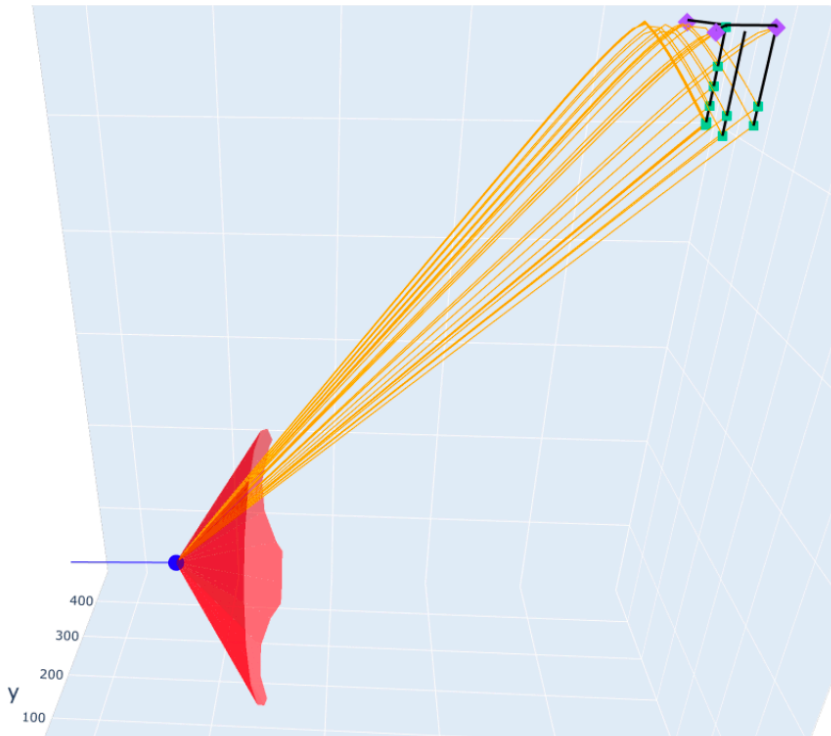


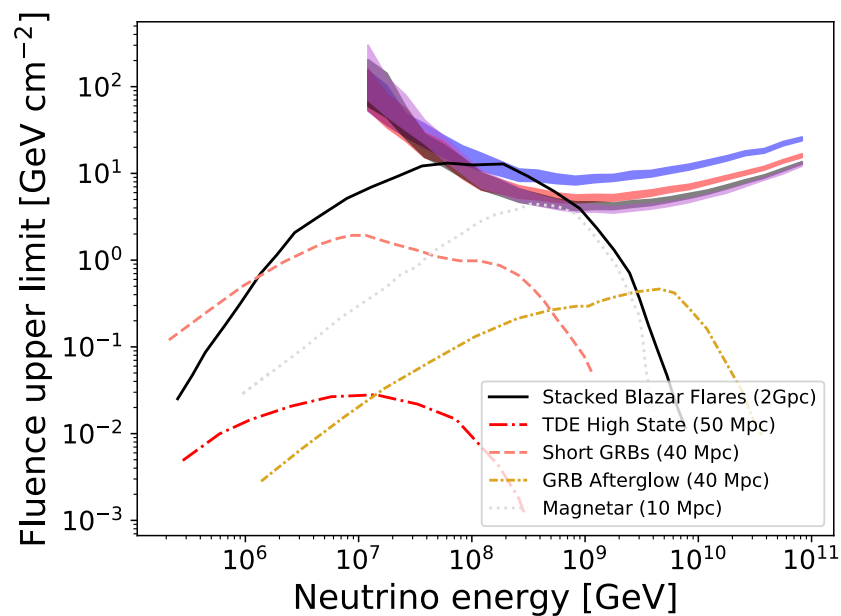
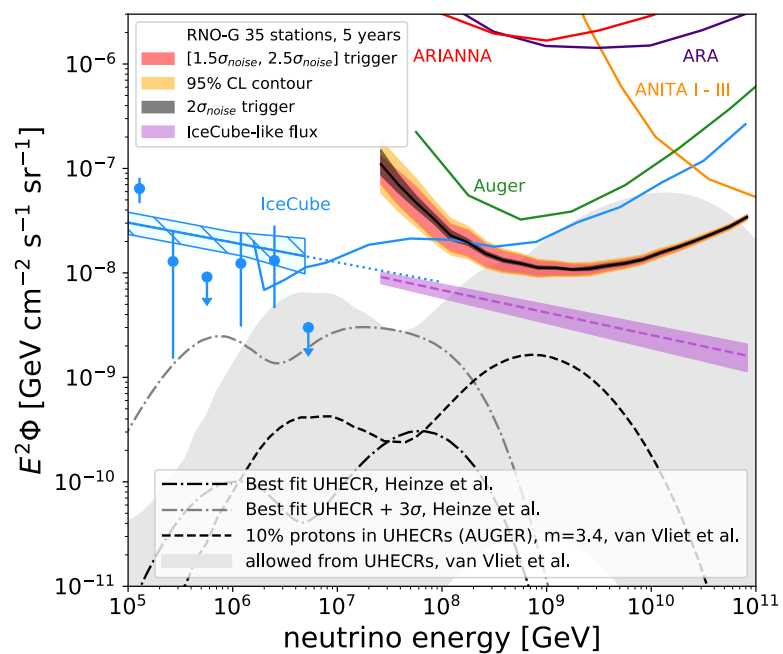
RNO-G

Events

- vertex
- ray path
- dipoles
- LPDAs

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

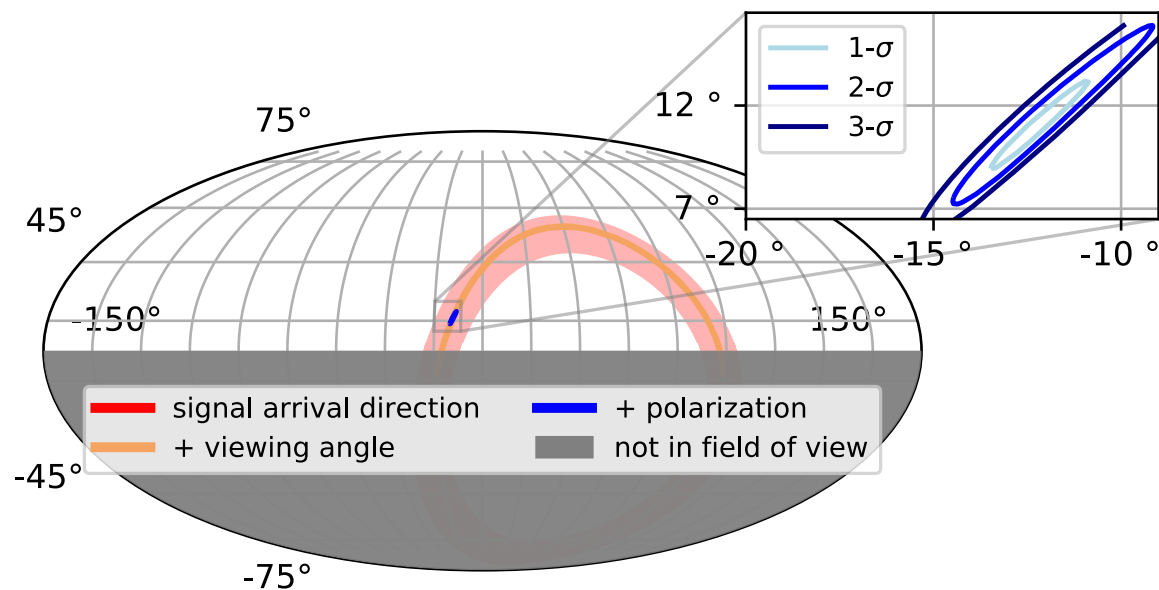




1. Station Trigger - Mostly garbage

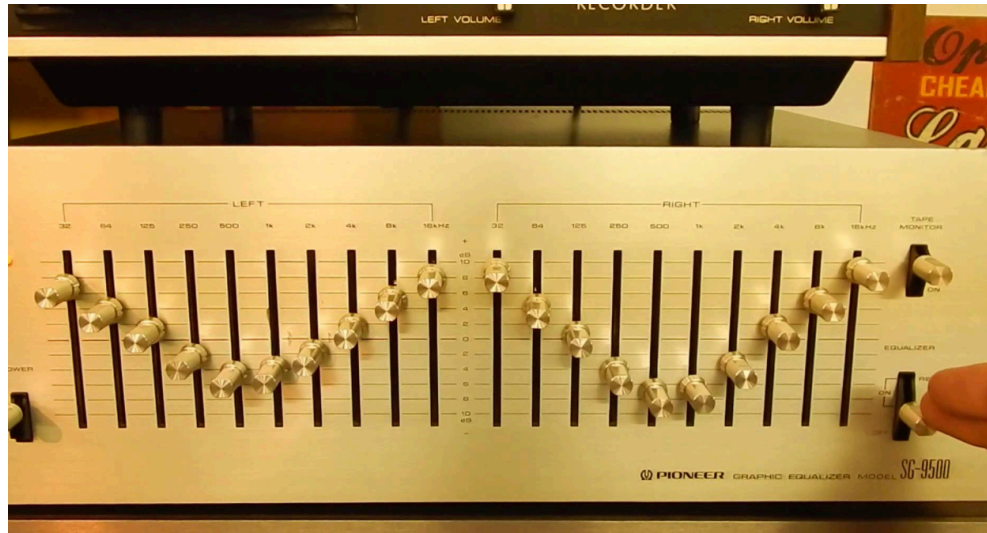
2. Event selection

3. Reconstruction



Matched Filtering

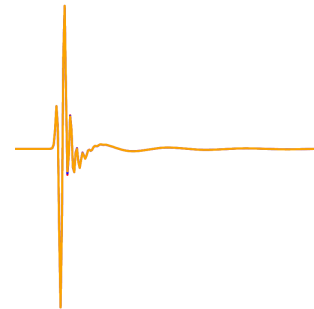
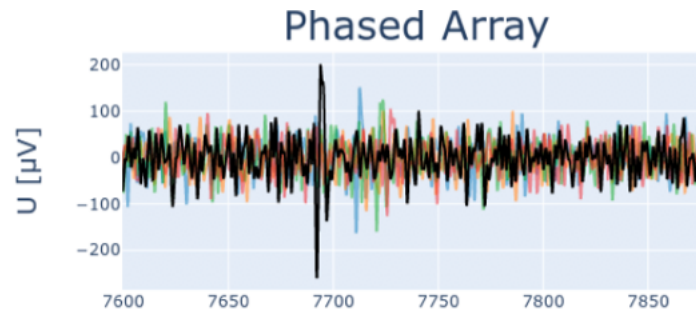
Separate Signal from Noise



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

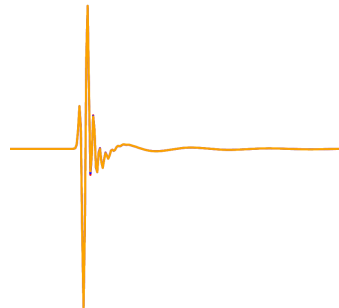
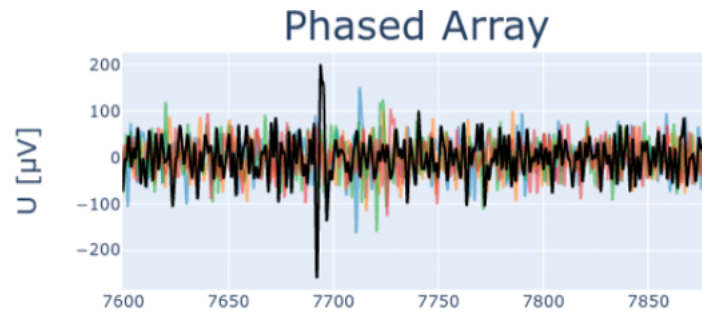
Matched Filtering

Separate Signal from Noise



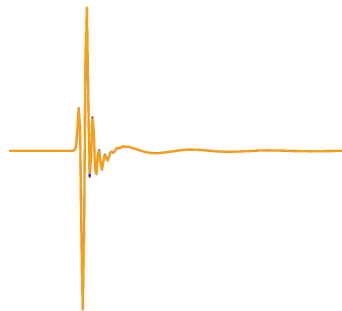
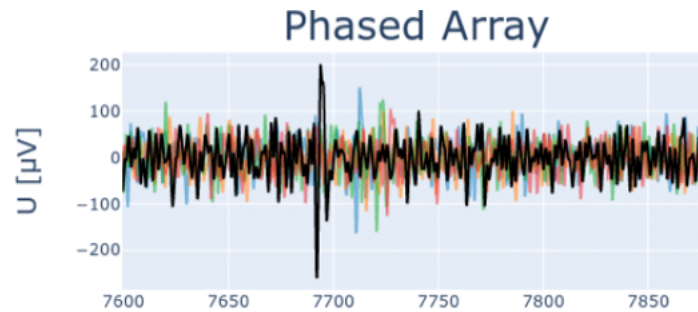
Matched Filtering

Separate Signal from Noise



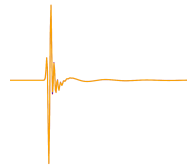
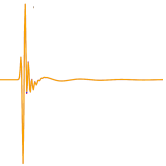
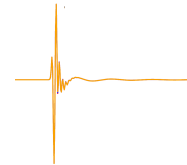
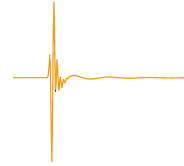
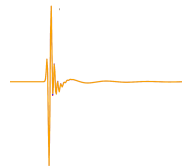
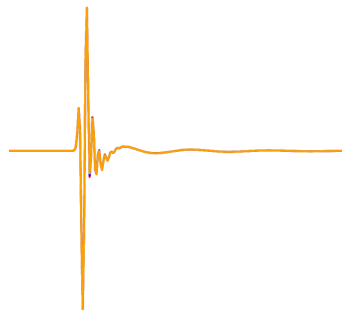
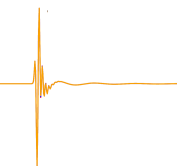
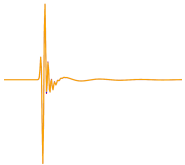
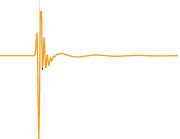
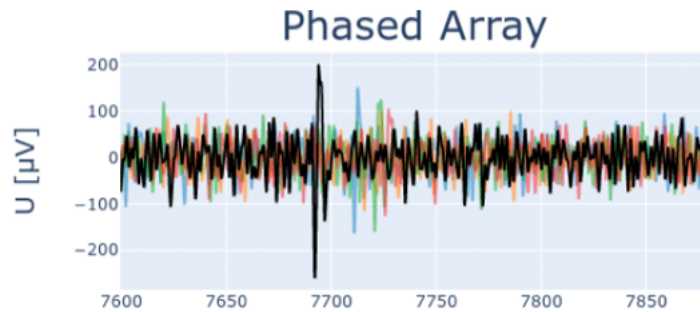
Matched Filtering

Separate Signal from Noise



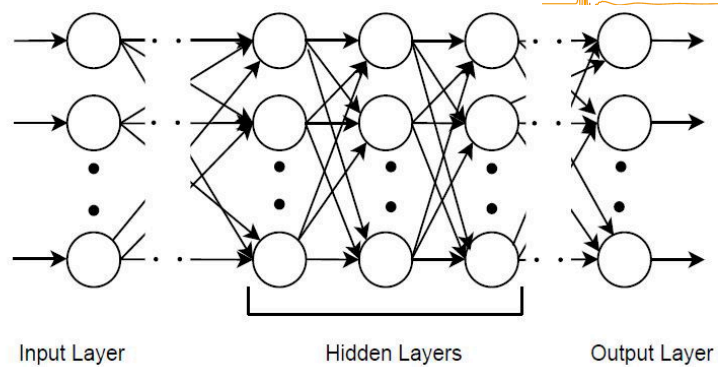
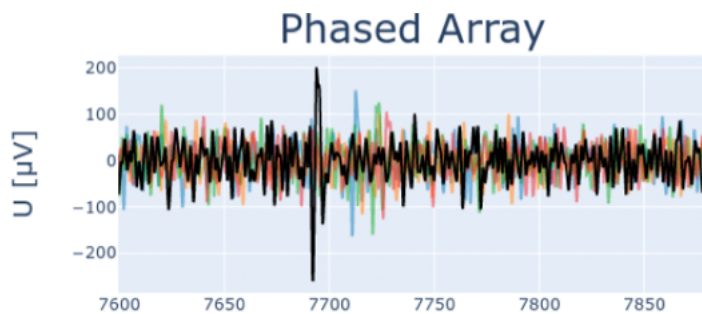
Matched Filtering

Separate Signal from Noise



Matched Filtering

Separate Signal from Noise



Next Steps

Next Steps

Summary



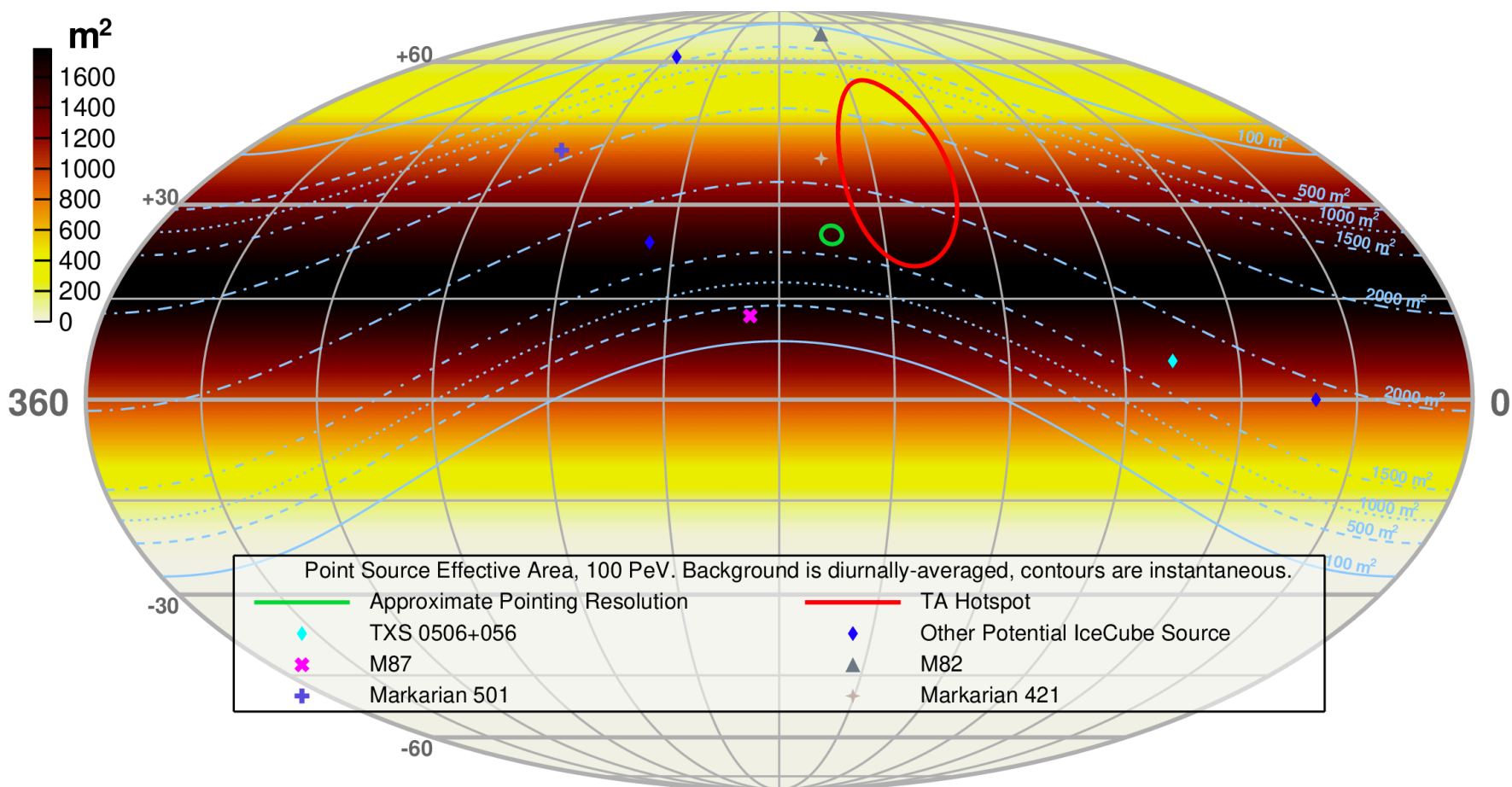
The future of my project

- Deploy! Real data, real noise
- Crucial: develop efficient pulse finding method based on matched filtering / machine learning / something else
- Transient Neutrino Astronomy for the future: R&D looking towards IceCube Gen2 Radio

Bonus

Observations

Transient Response and Source Monitoring



Neutrinos

IceCube-Gen2 Pathfinder

