Gamma-ray and Neutrino Emission from Supernova Remnants and Molecular Clouds

CTA-Oz Meeting #1 2023

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Motivation

Are supernova remnants (SNRs) responsible for some of the unidentified high-energy gamma rays and neutrinos in our Galaxy?

- Cosmic rays from SNRs interact with molecular gas to make gamma rays and neutrinos

- We can model SNR and cloud combinations to find regions of interest

- Look at these regions in more detail with other data

partISM
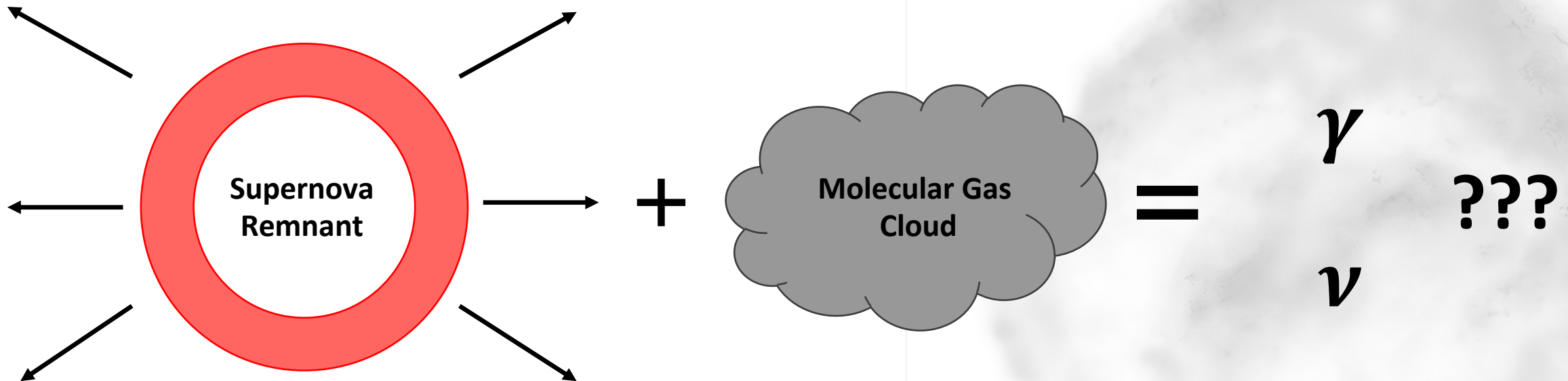
A python framework for modelling **part**icles in the **ISM**

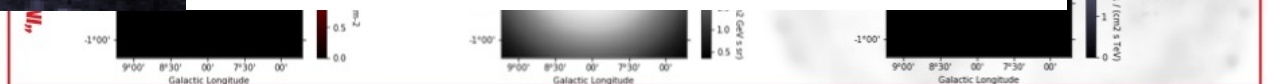■ Refer to Sabrina's talk '*Modelling Particles in the ISM*' from CTA-Oz Meeting #2 2021
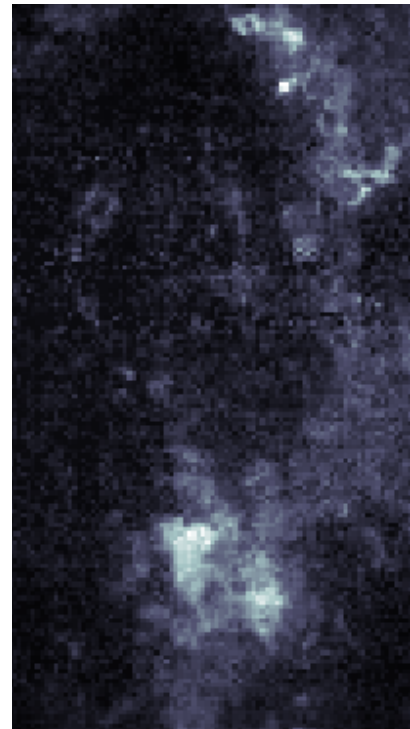
Modeling Particles in the ISM
Hadronic Interactions

Sabrina Einecke
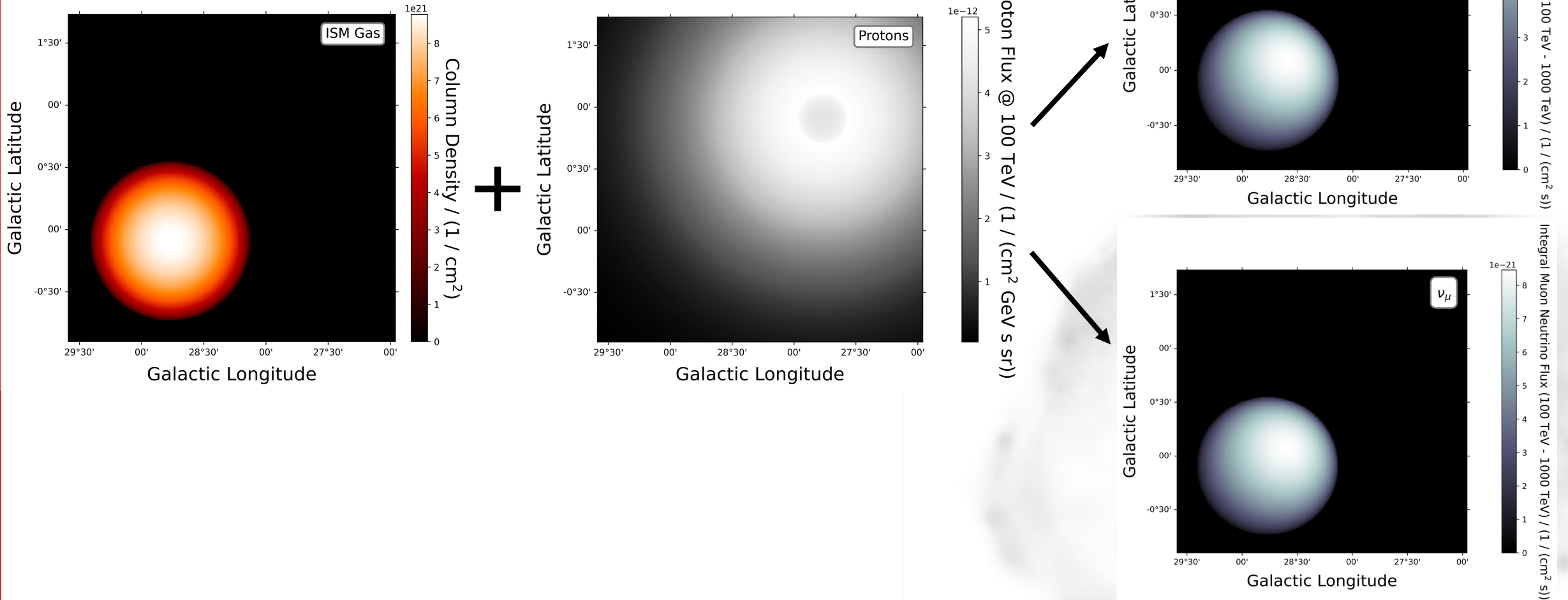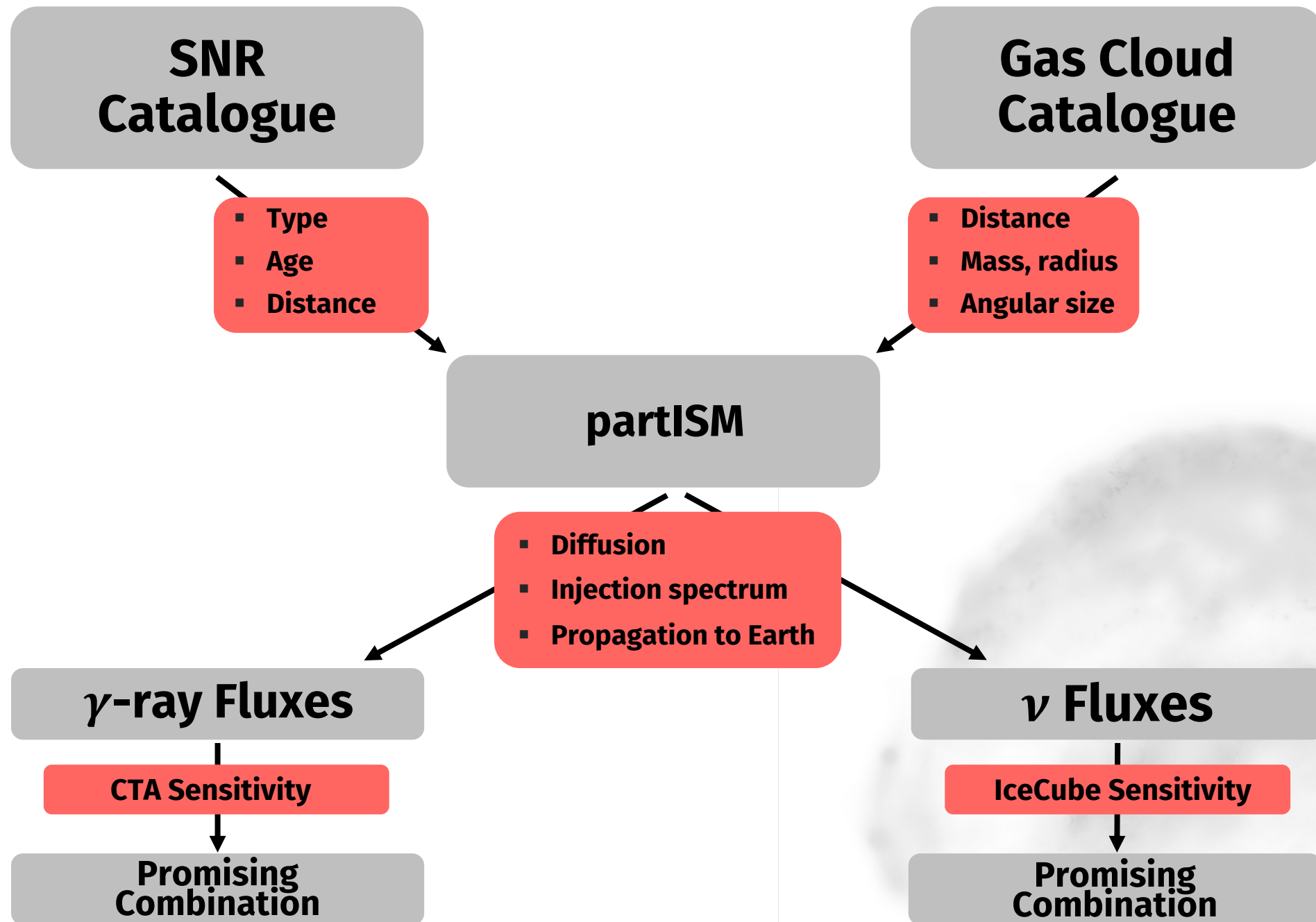Gavin Rowell, Kirsty Feijen, Ryan Burley, Robert König

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Nov 22nd, 2021

Modeling Particles in the ISM | S. Einecke

https://indico.cta-observatory.org/event/3712/contributions/31509/

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SNR Catalogue

- Type
- Age
- Distance

Gas Cloud Catalogue

- Distance
- Mass, radius
- Angular size

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- Diffusion
- Injection spectrum
- Propagation to Earth

γ-ray Fluxes

CTA Sensitivity

Promising Combination

ν Fluxes

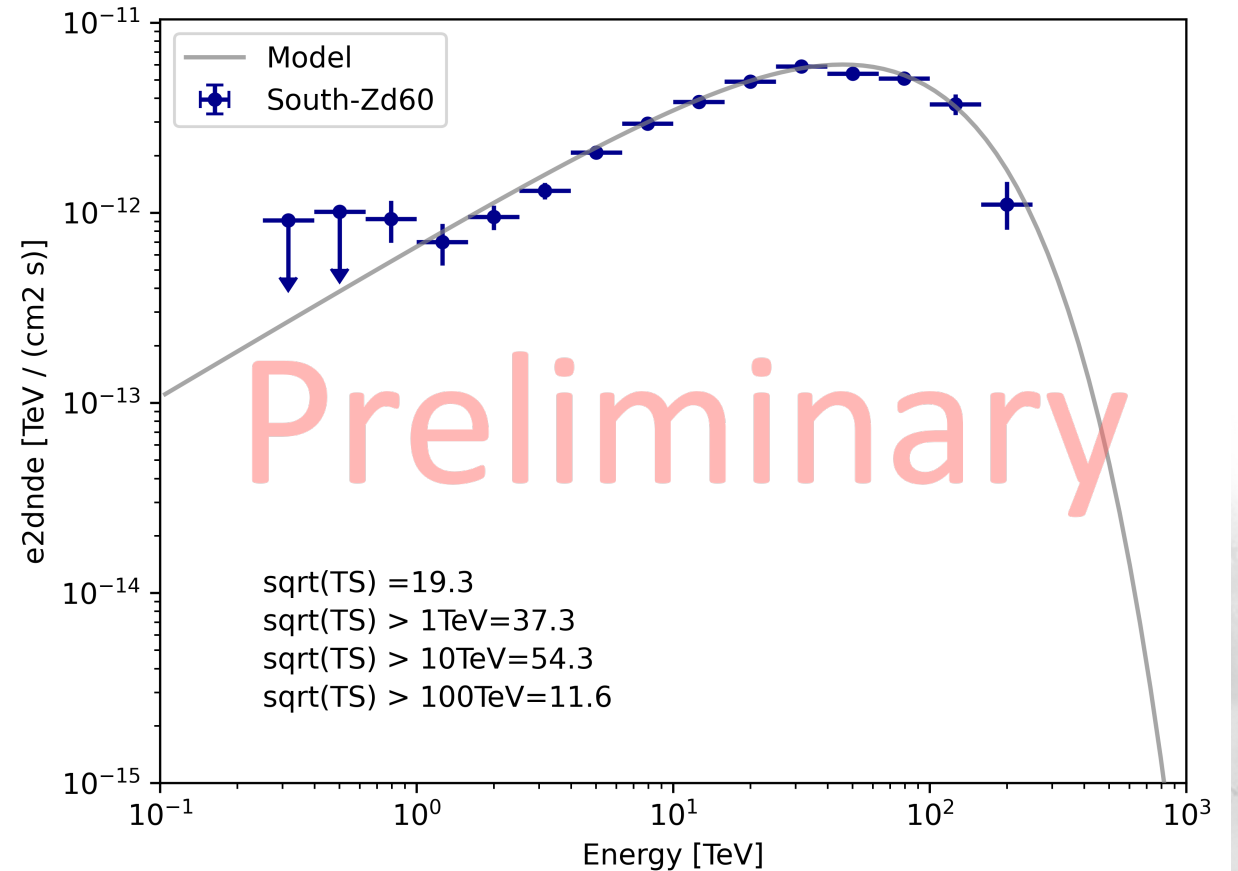IceCube Sensitivity

Promising Combination

CTA Consideration

Simulate how CTA would see our gamma-ray spectra, considering:

- Extension of source
- Zenith dependence
- Source visibility

We use the CTA instrument response functions *(CTA Consortium and Observatory, doi: 10.5281/zenodo5499840 (2021))*

Top Combinations

We are now considering a range of model and system parameters to explore which parameter combinations for a given SNR/cloud pair result in a gamma-ray flux that does not exceed that as reported in the HGPS.

Model parameters include:

- Diffusion coefficient
- Spectral index
- Magnetic field

System parameters include:

- SNR age
- Distance between SNR and cloud

Conclusions and Further Work

Many combinations of supernova remnants and molecular gas clouds could be responsible for unresolved gamma-ray sources and astrophysical neutrinos

- We aim to find the most promising combinations

- This work will provide a selection of promising targets that will be valuable for many studies

- Interesting follow-up opportunities for the top candidates from this study

Diaz & Besel, CTAO (2020)

*IceCube-Gen2 Collaboration, J. Phys. G., **48** (2020)*