

# The Science white paper

Science Case for a Wide Field-of-View  
Very-High-Energy Gamma-Ray Observatory  
in the Southern Hemisphere

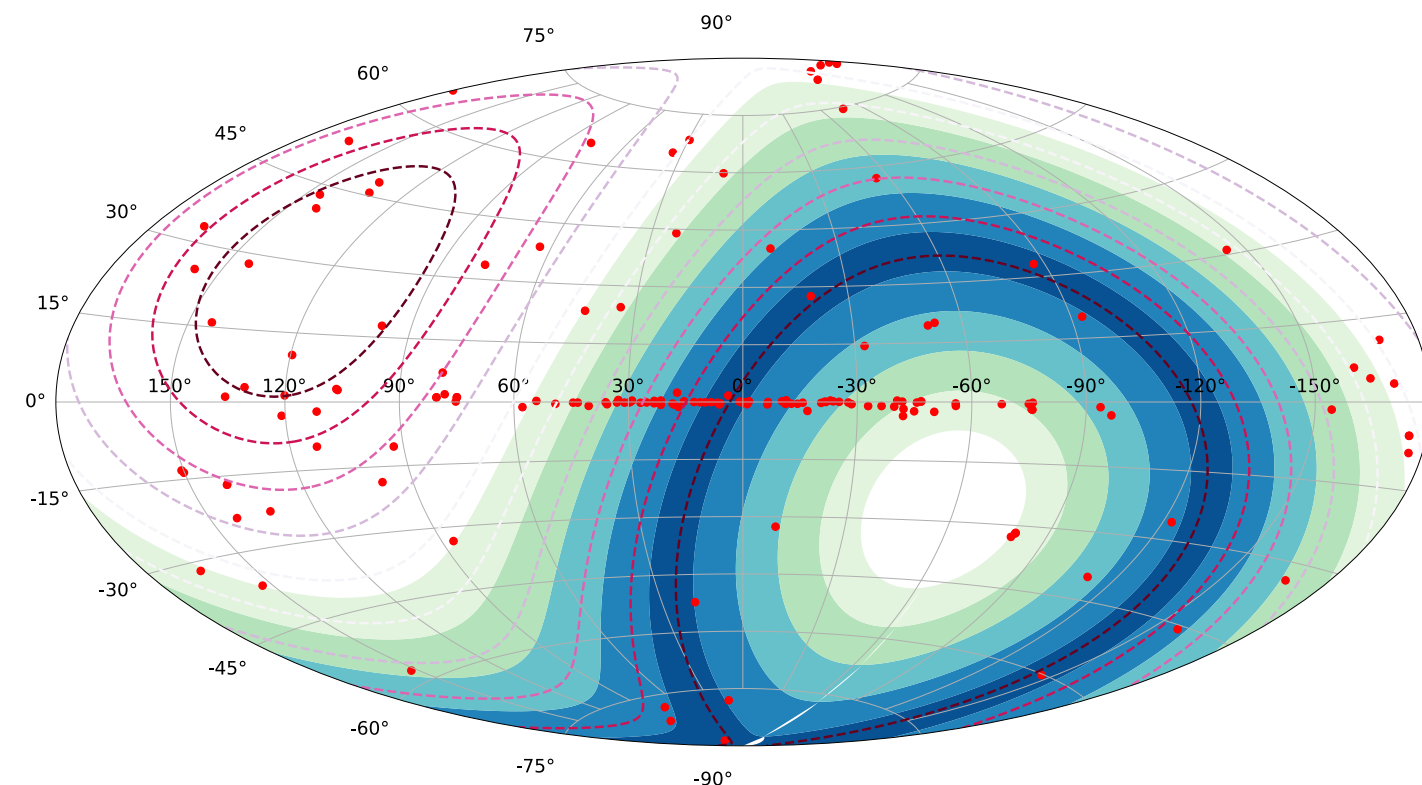
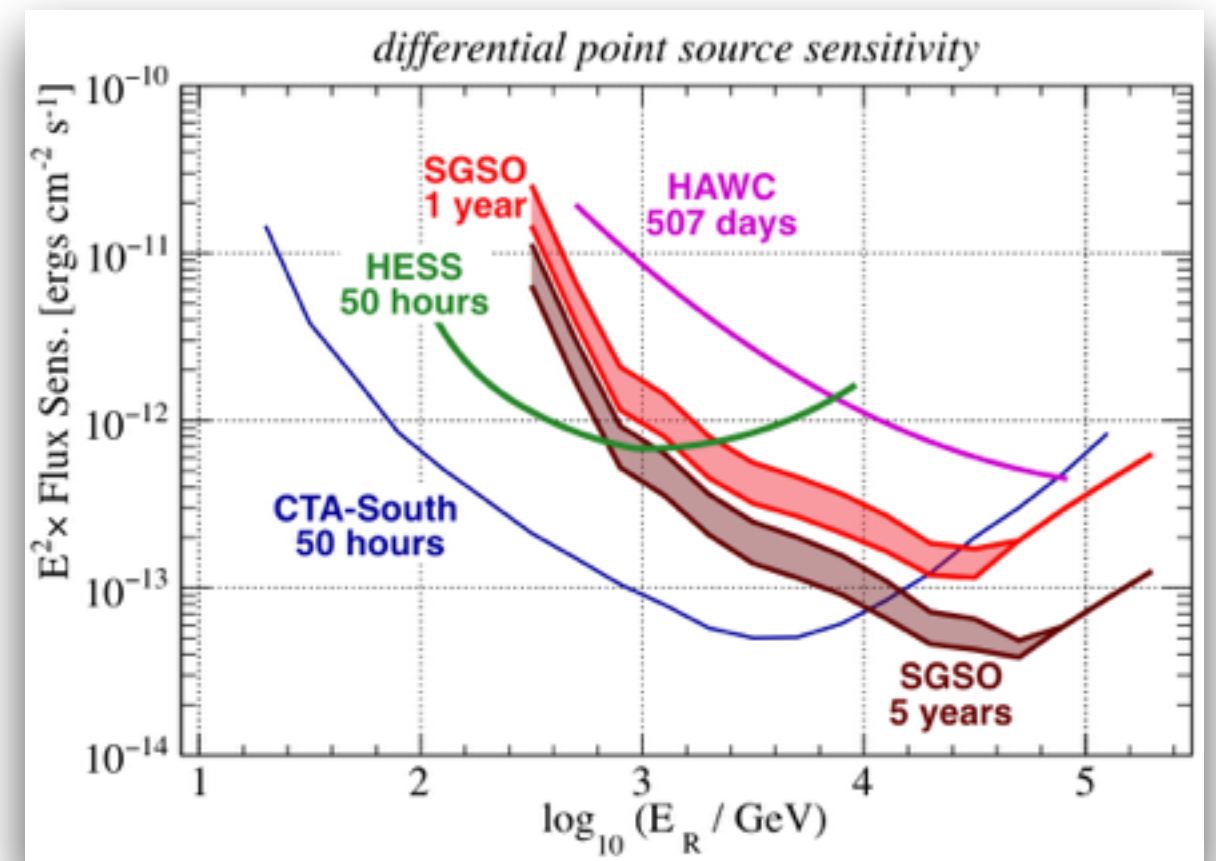
Fabian Schüssler



# Main science drivers

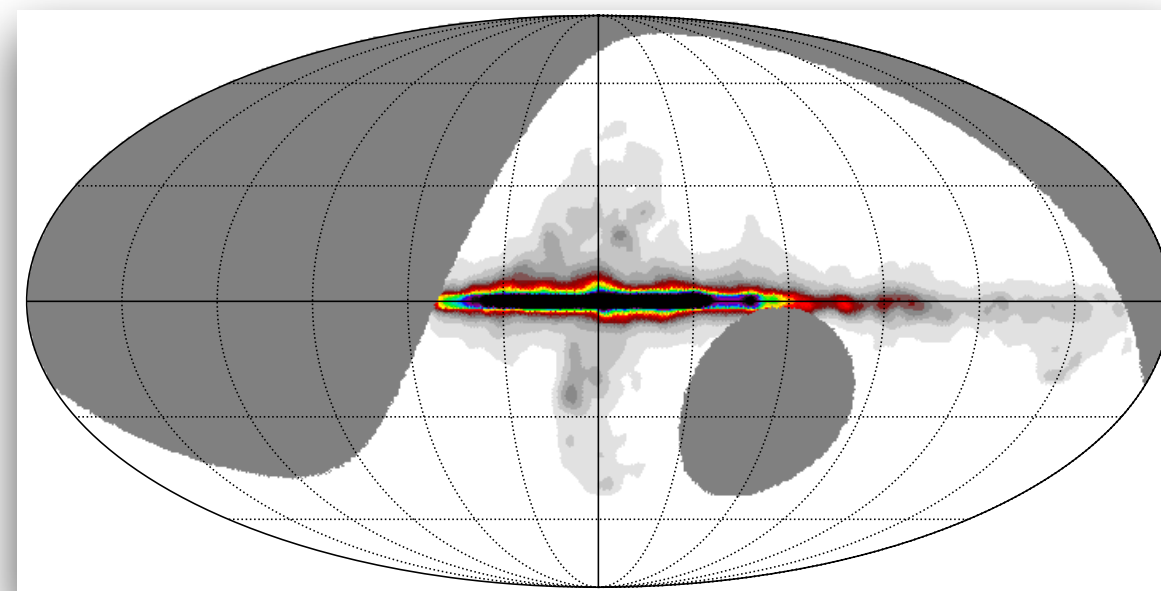
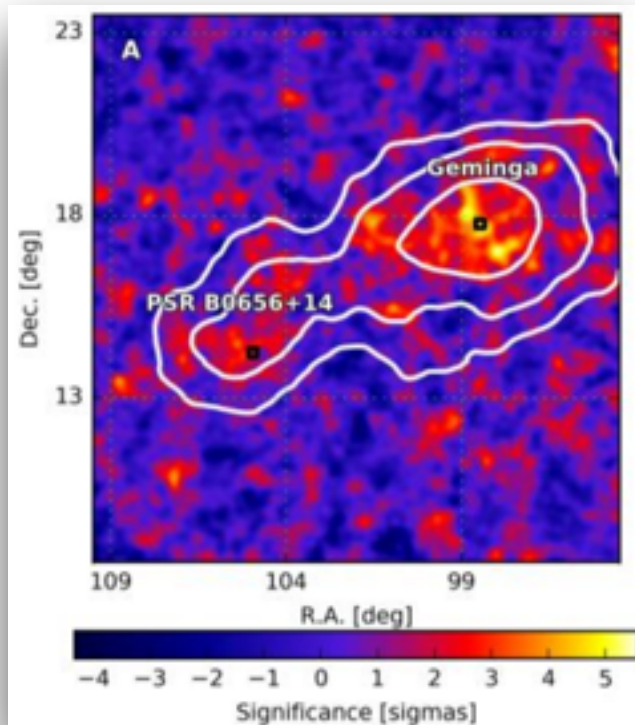
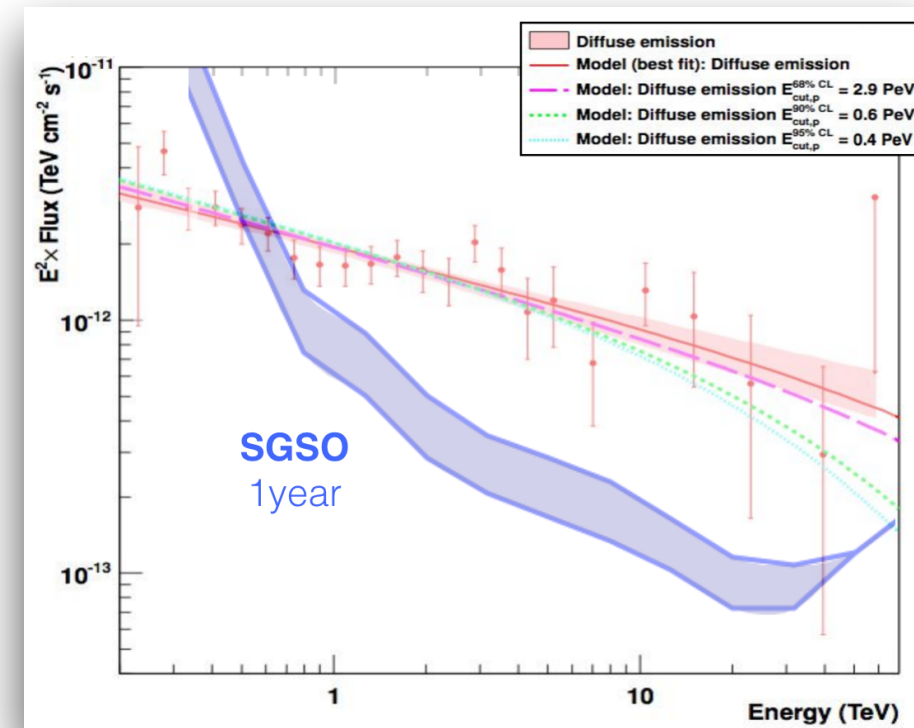
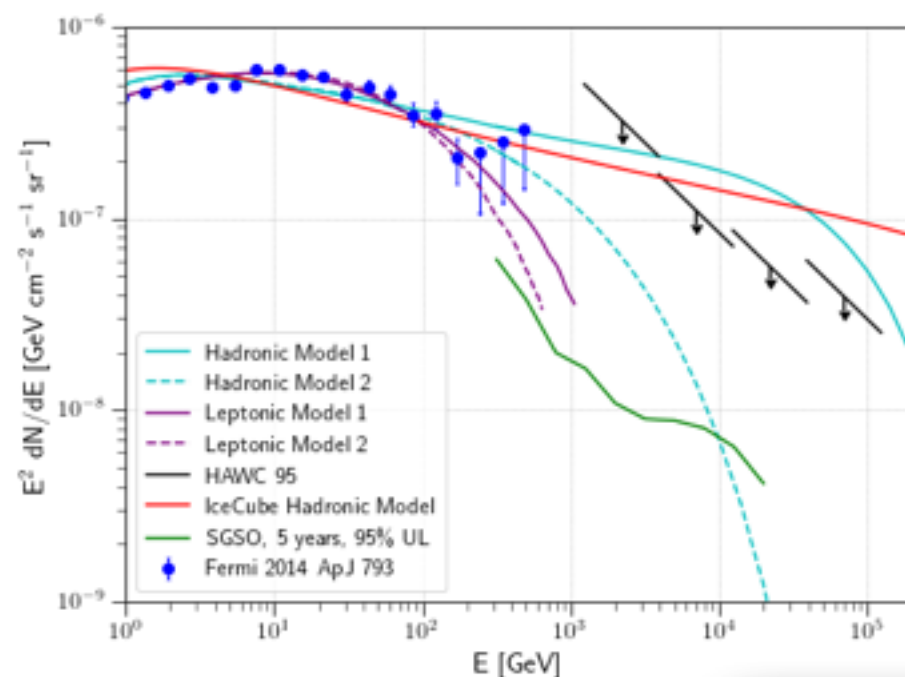
- Galactic accelerators
  - Pevatrons/Galactic Center
  - extended sources
- Transient sources
  - AGNs
  - Multi-messenger transients
- Beyond the SM
  - Dark Matter, LIV, PBHs, ...
- Cosmic rays
  - anisotropies, electron spectrum, ...

[arXiv: 1902.08429](https://arxiv.org/abs/1902.08429)



# (Galactic) particle accelerators

- Pevatron at the Galactic Center
- extended halos around PWNe
- Fermi-Bubbles
- diffuse emission

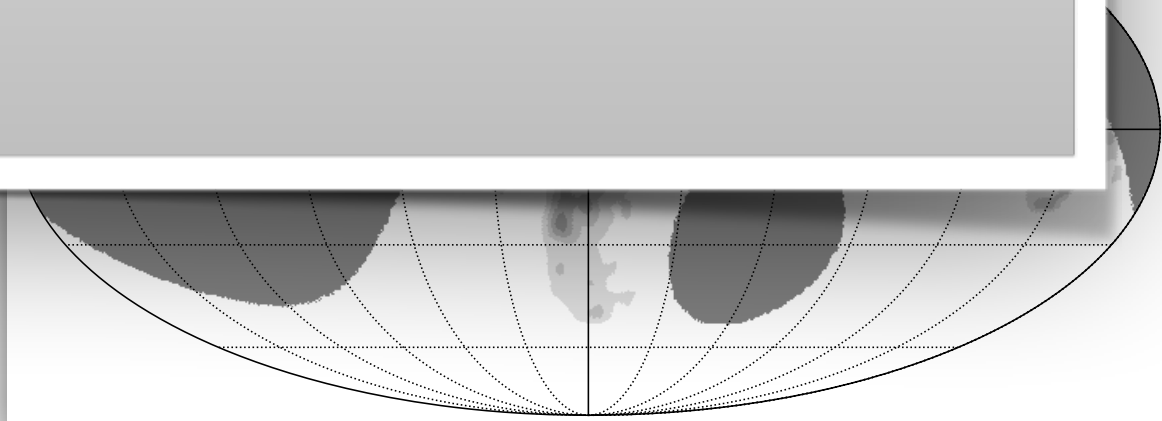
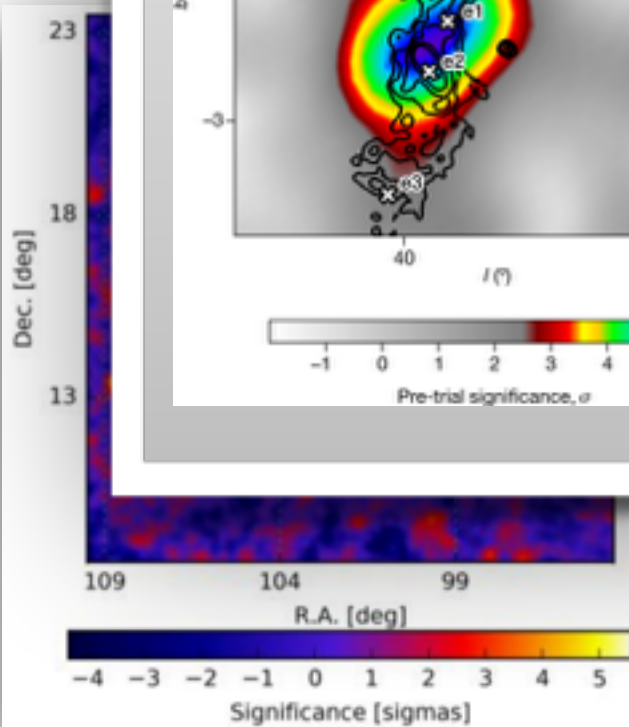
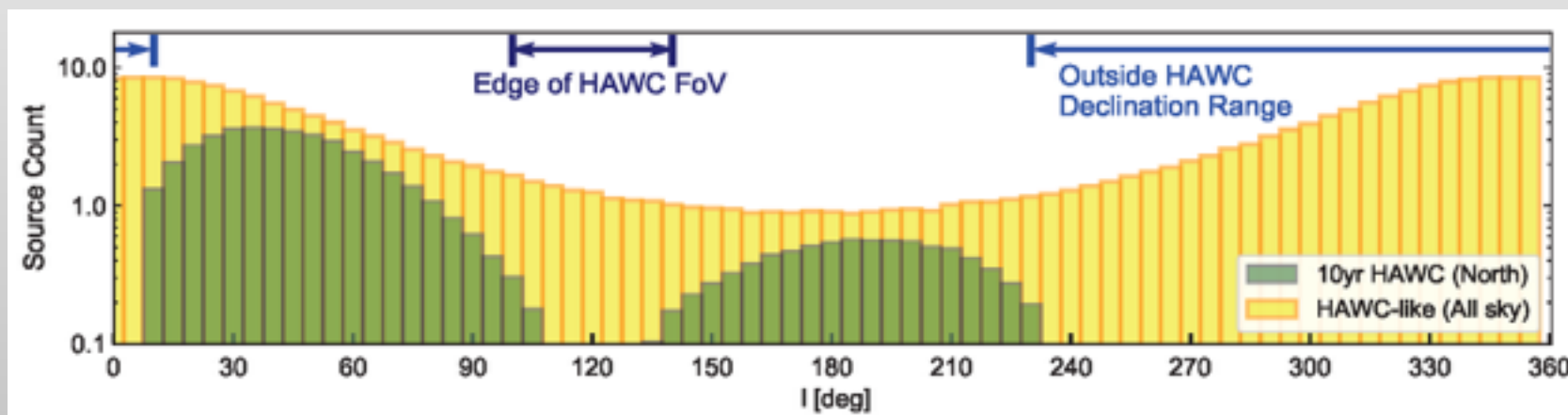
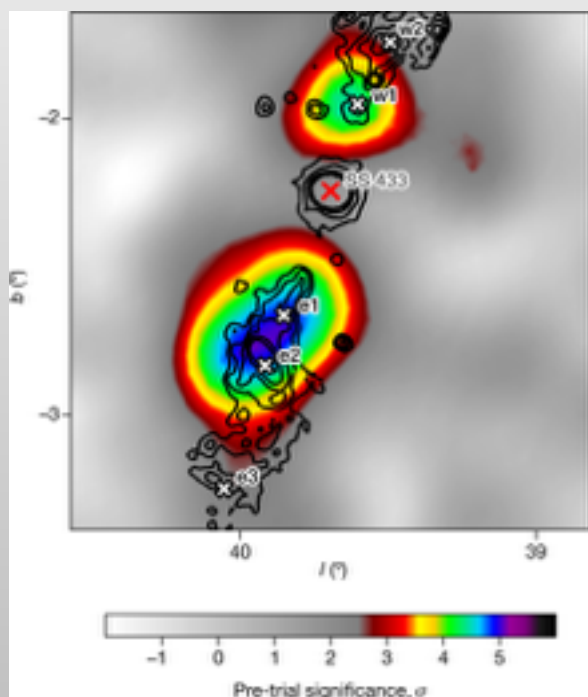
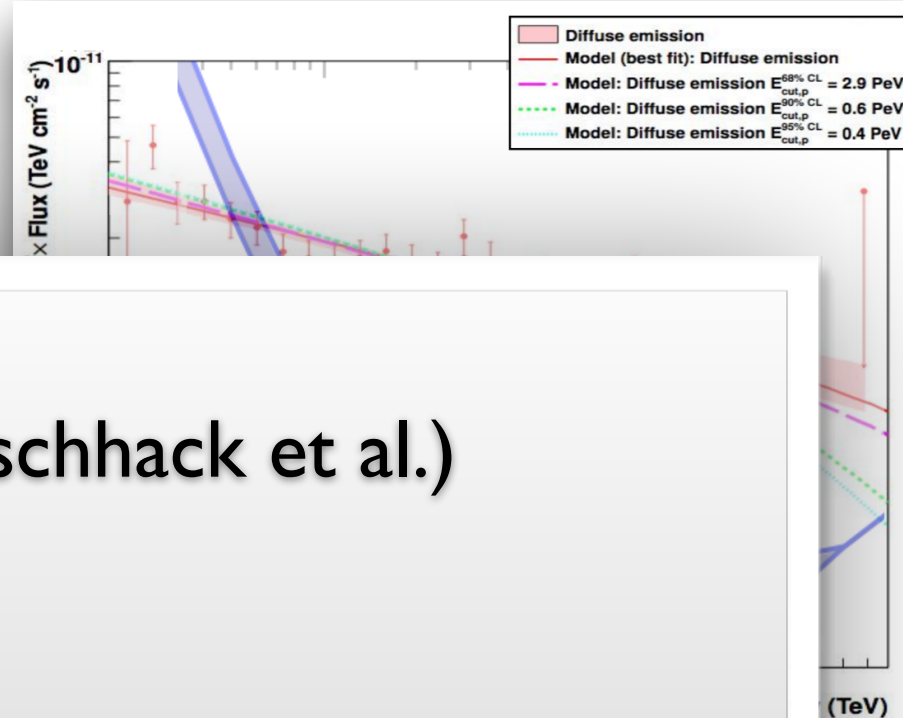


# (Galactic) particle accelerators

Pevatron at the Galactic Center

## Potential updates

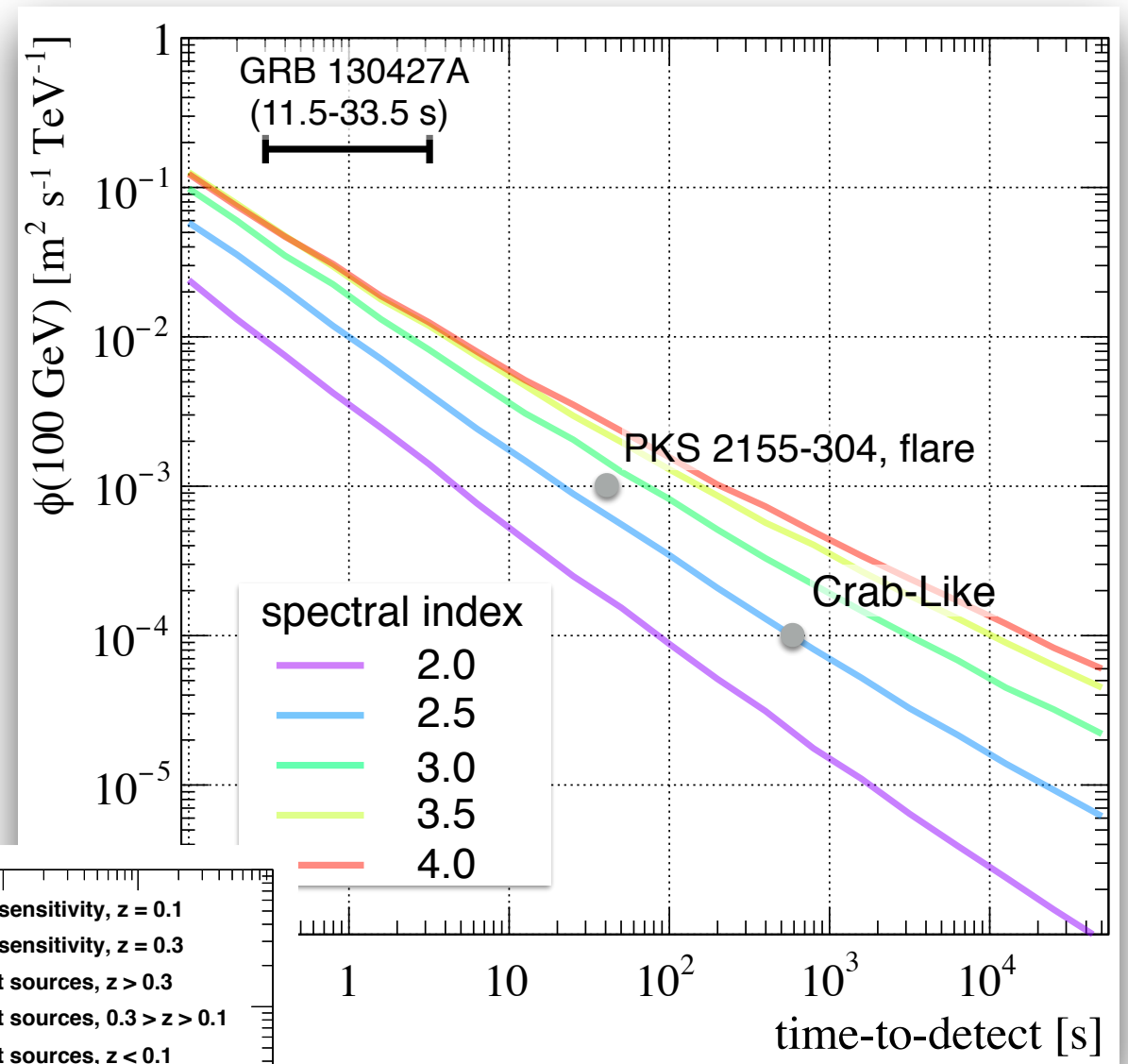
- TeV Halos: dedicated Astro2020 WP (Fleischhack et al.)
- SS433: HAWC results



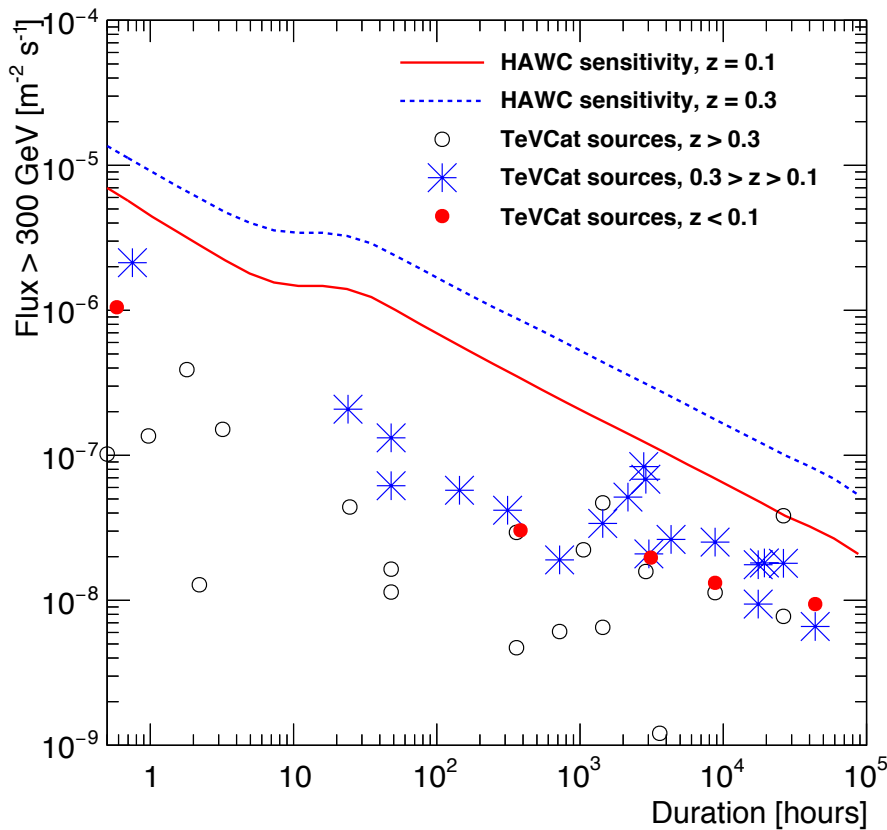


# Transients: AGN

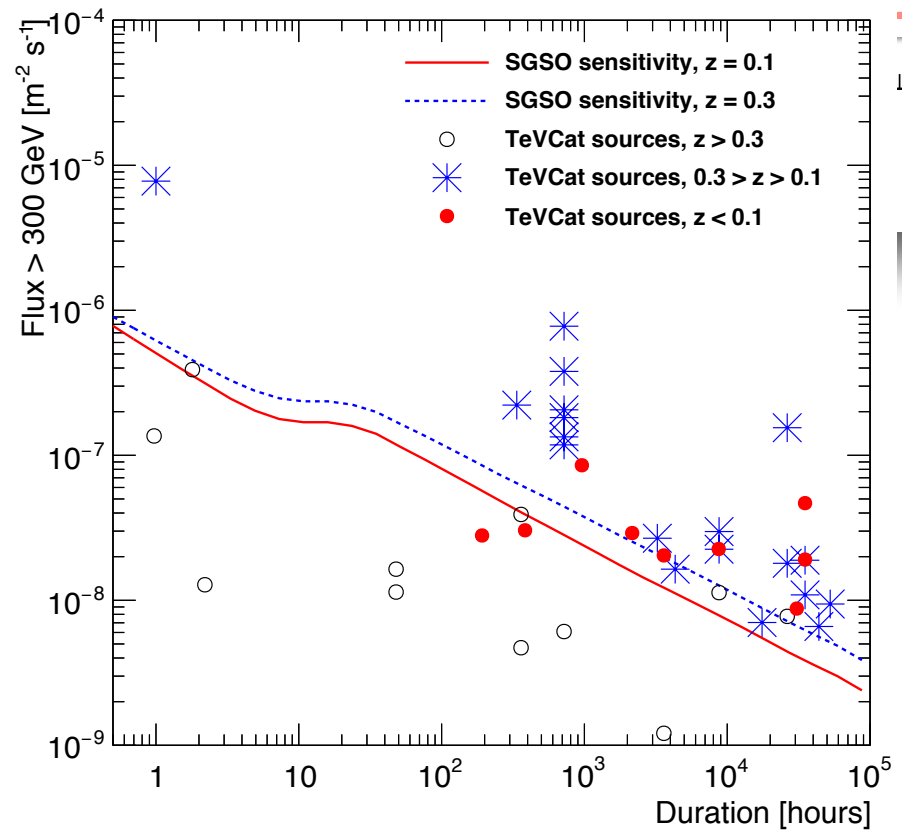
- AGN
  - longterm monitoring
  - flare detection + triggering (e.g. CTA)
- Galactic transients
  - Microquasars et al.



**HAWC**

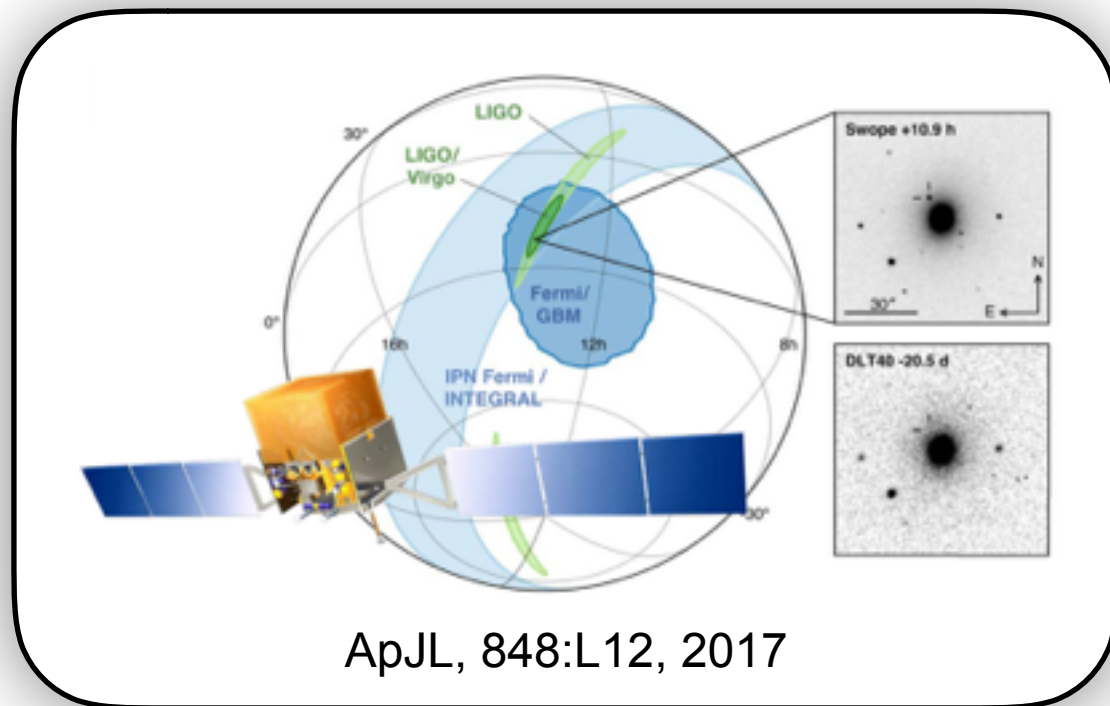


**SGSO**

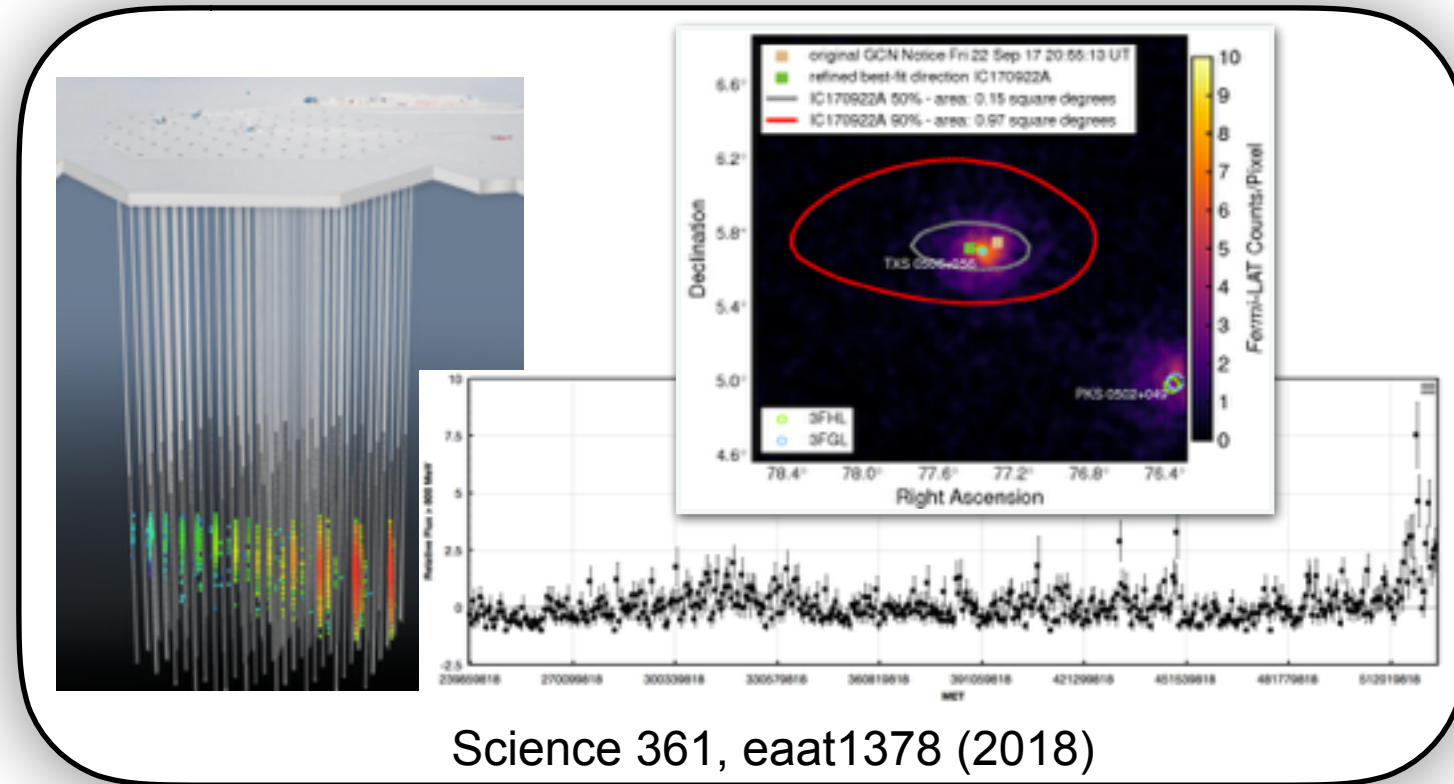


# Transients: multi-messenger connections

## Gravitational waves



## High-energy neutrinos



- large FoV + monitoring capabilities (+ low  $E_{\text{thr}}$ )
  - retro-active and unbiased follow-up of MM alerts
    - high-energy neutrinos (IceCube  $\sim 1 \text{ deg}^2$ )
    - Gravitational Waves (10s-100s  $\text{deg}^2$ )
    - significant increases in the number of alerts expected
      - IceCube-Gen2, Adv.Virgo+/Ligo+, ...

# Transients: multi-messenger connections

Gravitational waves

High-energy neutrinos

## Recent results on GRBs

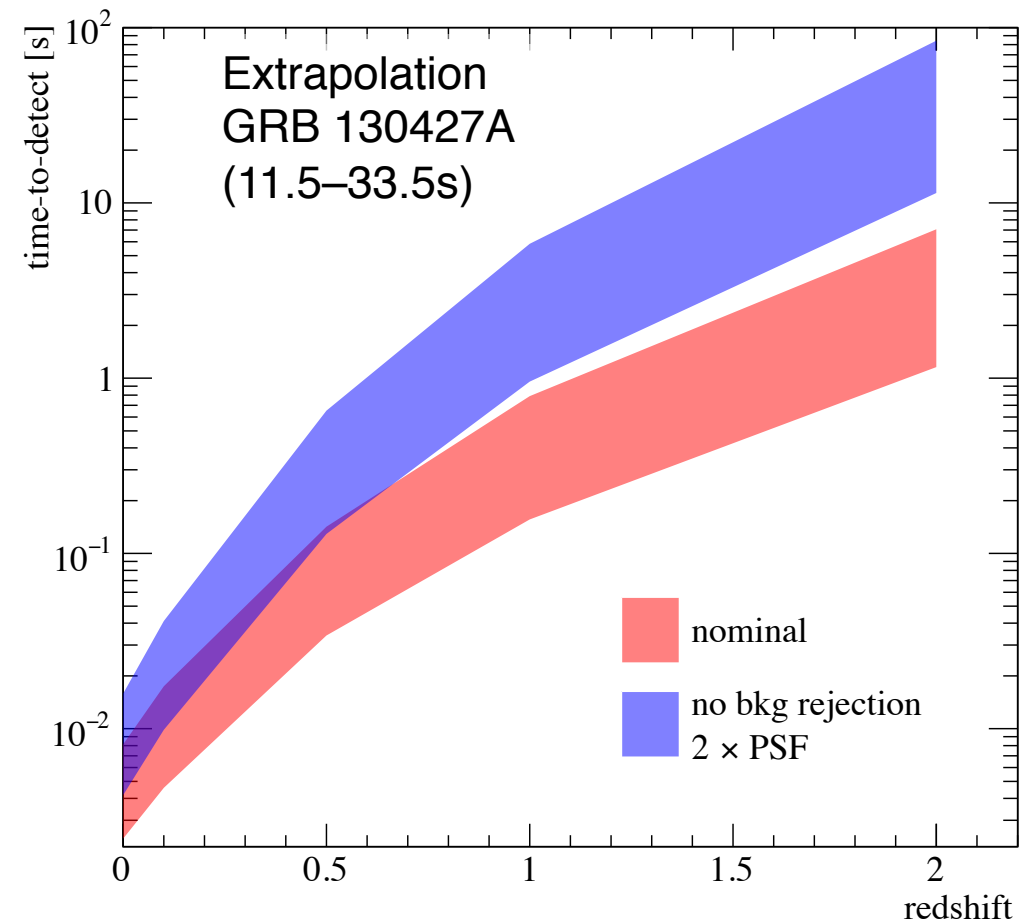
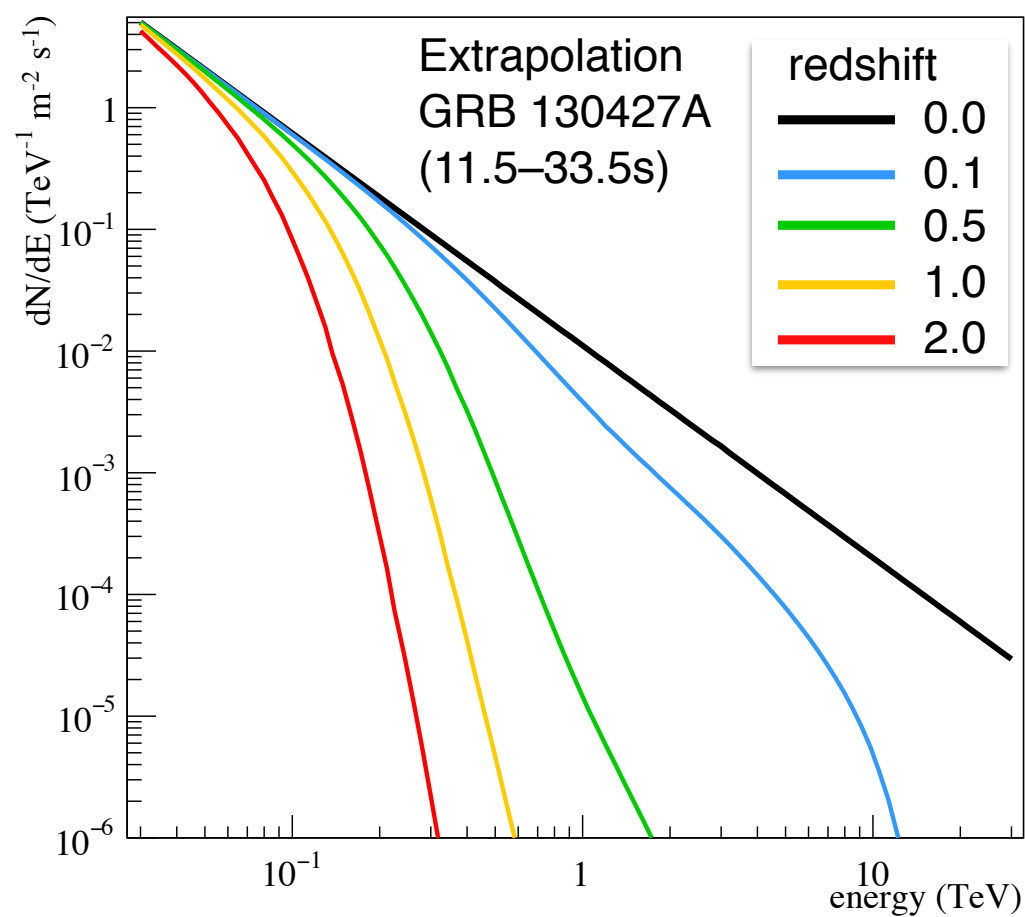
- first detections by IACTs
  - GRB190114C @ MAGIC
    - early afterglow (>50s) emission above 300GeV
    - ATEL #12390
  - GRB180720B @ H.E.S.S.
    - late afterglow (>10h) emission above 100GeV
    - CTA symposium 2019

significant discovery space for SGSO (duty-cycle, FoV, etc.)

Additional proposed scenario (Kohta Murase): LL-GRBs

# GRBs with SGSO

- GRB130427A: Swift-XRT energy flux similar to GRB180720B detected by H.E.S.S.
  - spectrum extrapolated from Fermi-LAT measurement
  - various assumptions on redshift i.e. EBL absorption
  - nominal performances + worst case scenario: no background rejection + 2x worse PSF



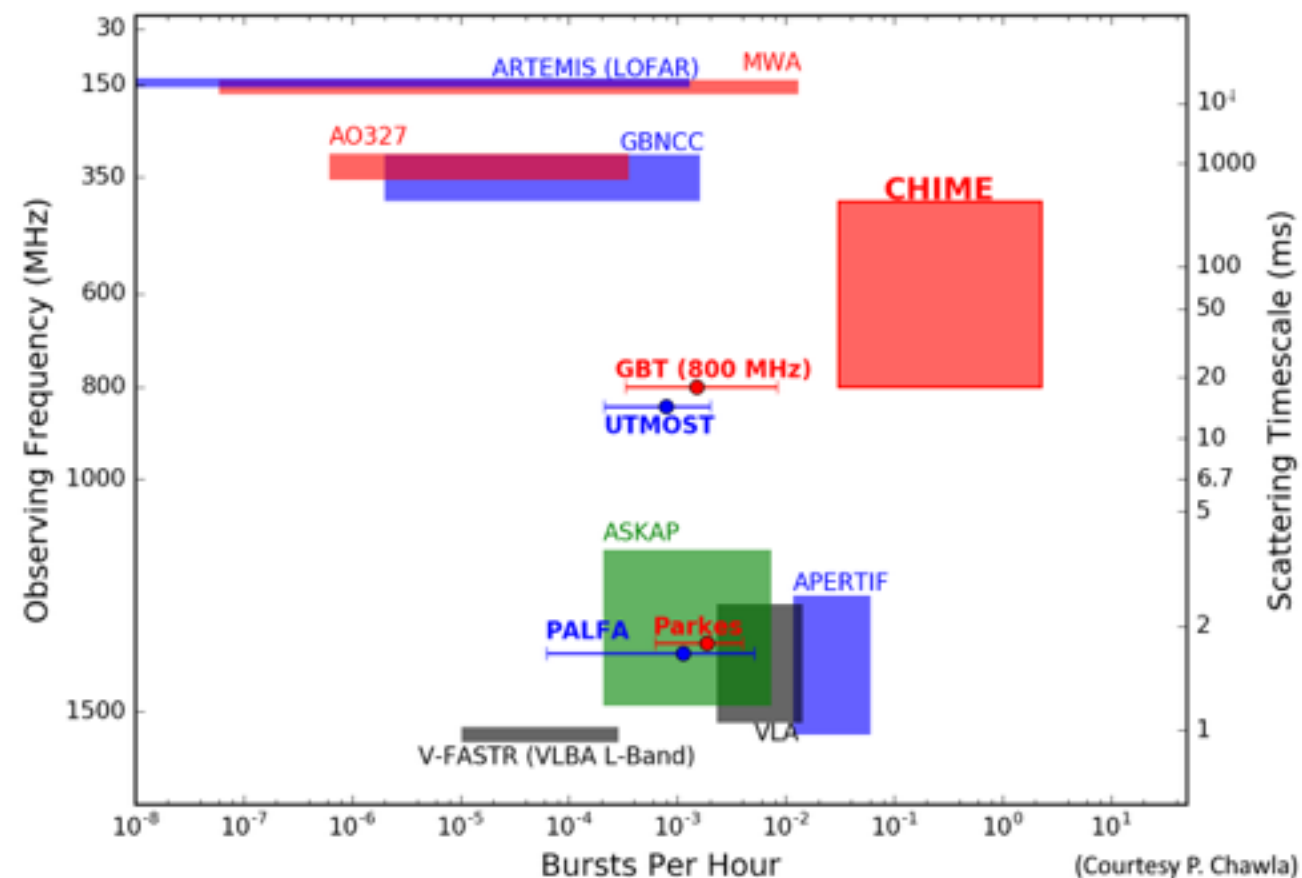
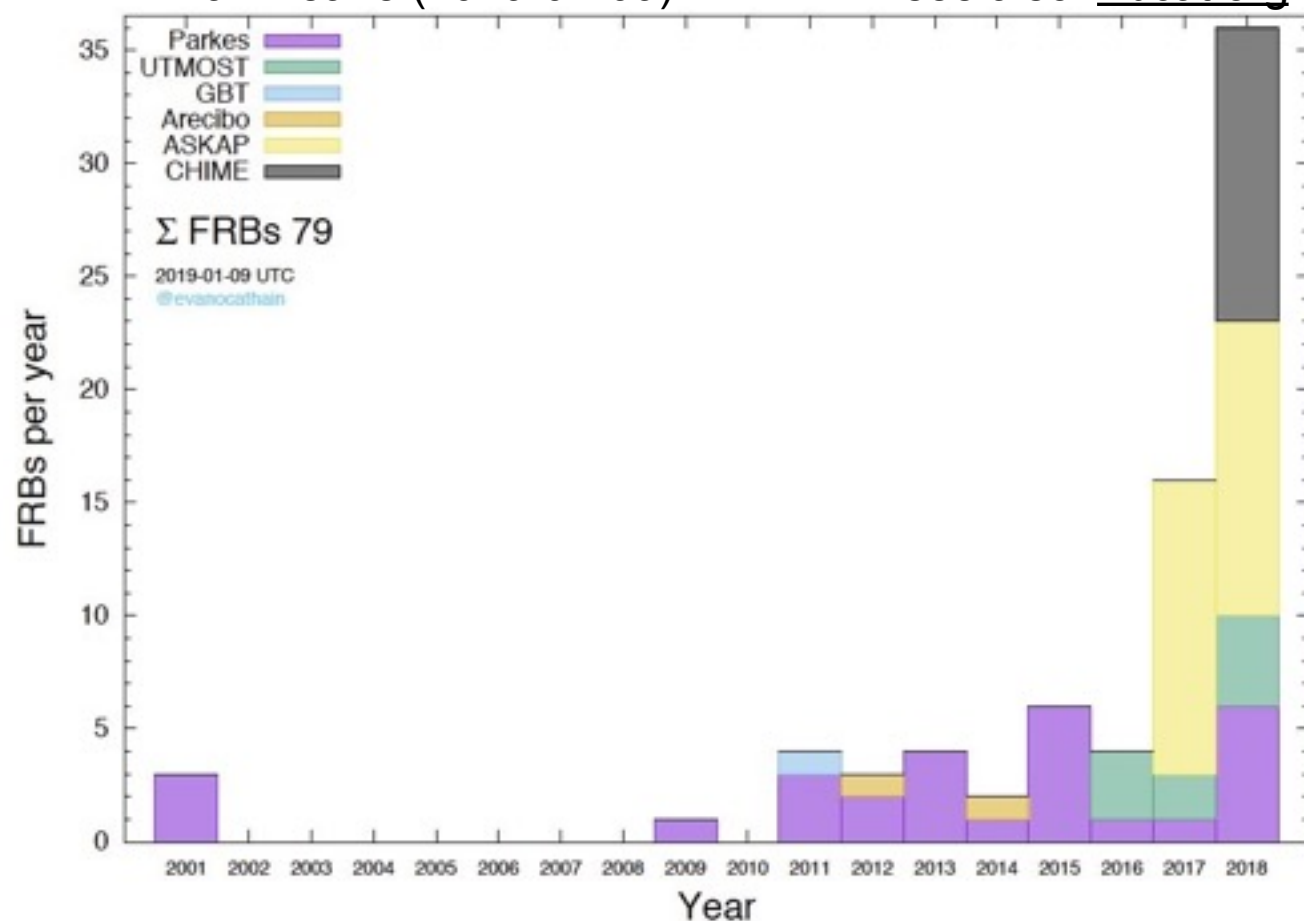


# Other news: Fast Radio Bursts

- Canadian Hydrogen Intensity Mapping Experiment (CHIME)
  - 200 sq deg instantaneous field-of-view
  - 400-800 MHz
- pre-commissioning data => 13 new FRBs (rate 2-50 FRBs/day)
  - including a second repeating FRB (FRB 180814.J0422+73)
  - Nature 566 (2018) 230-234 + Nature 566 52018) 235-238

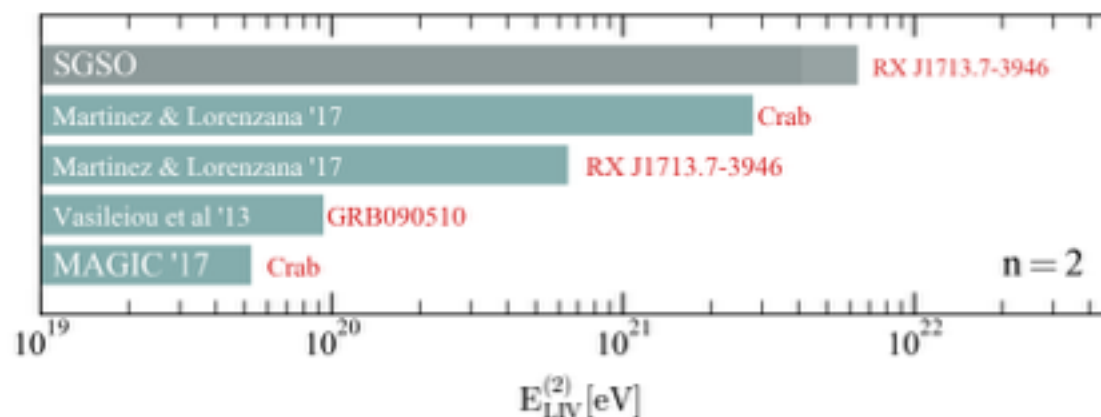
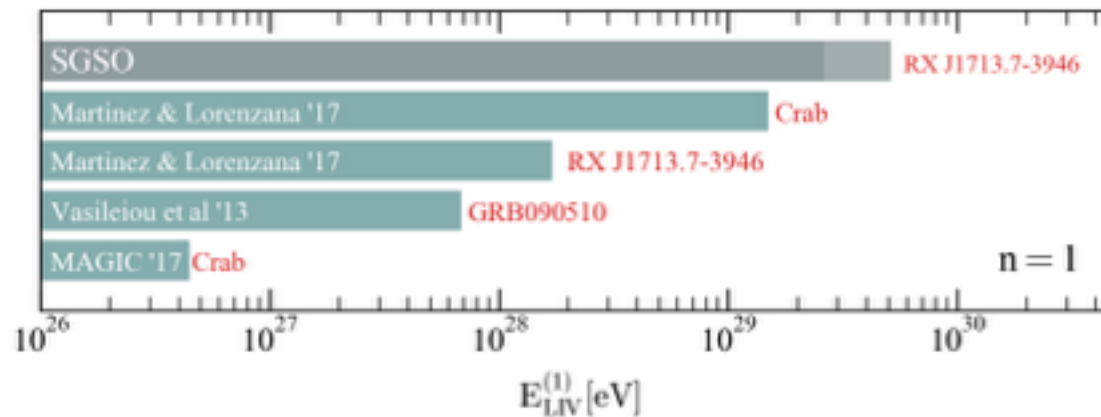
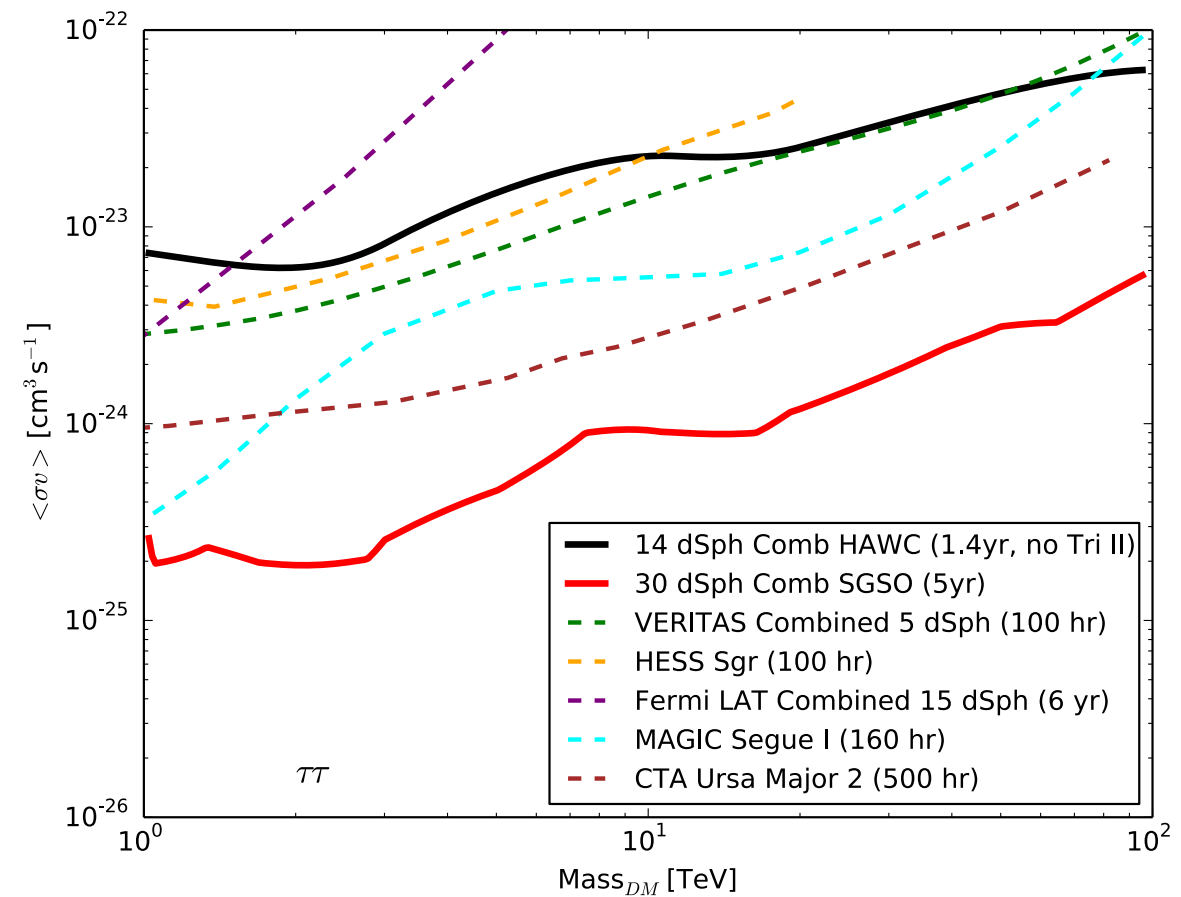
Evan Keane (2019-01-09)

see also: [frbcat.org](http://frbcat.org)



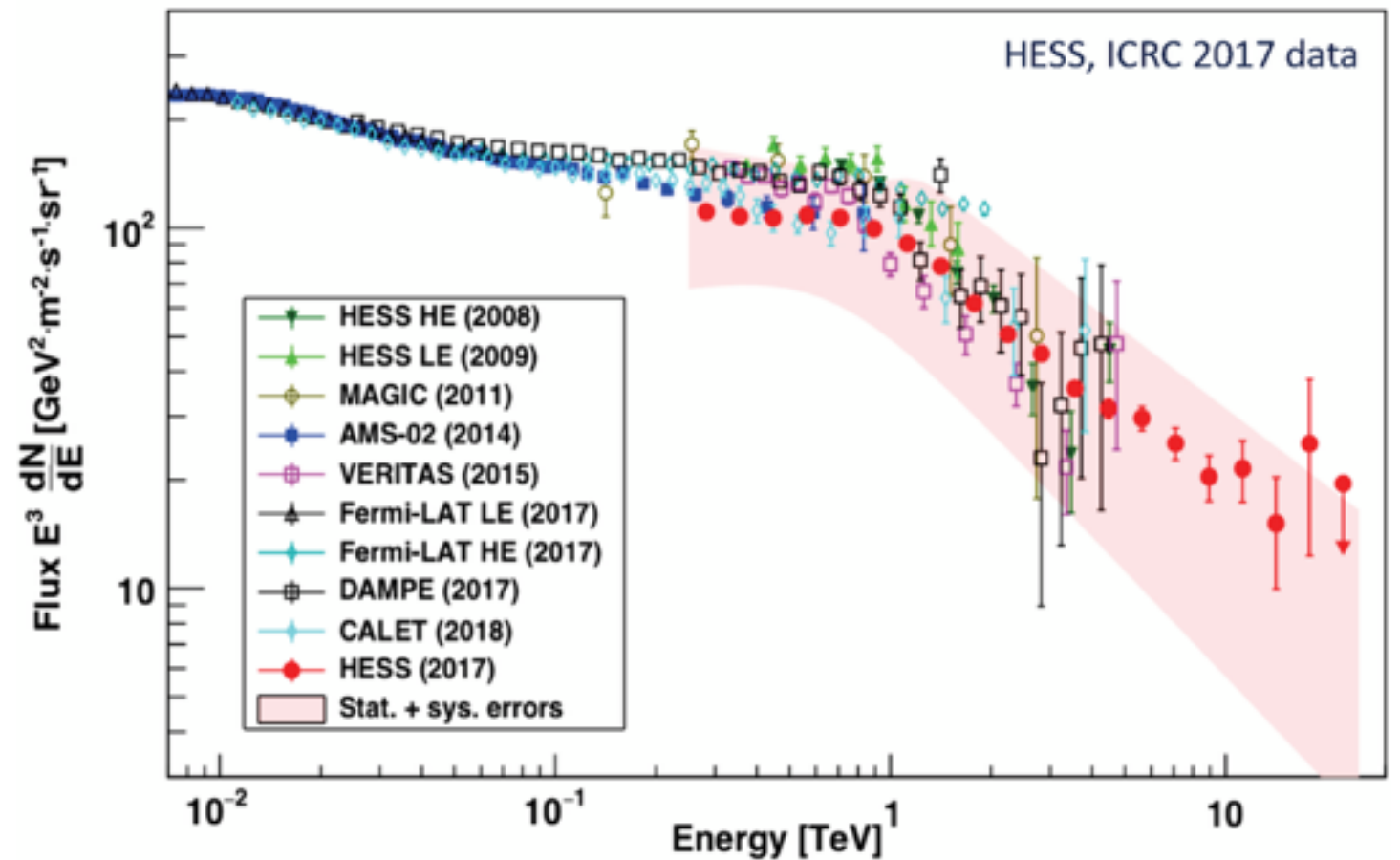
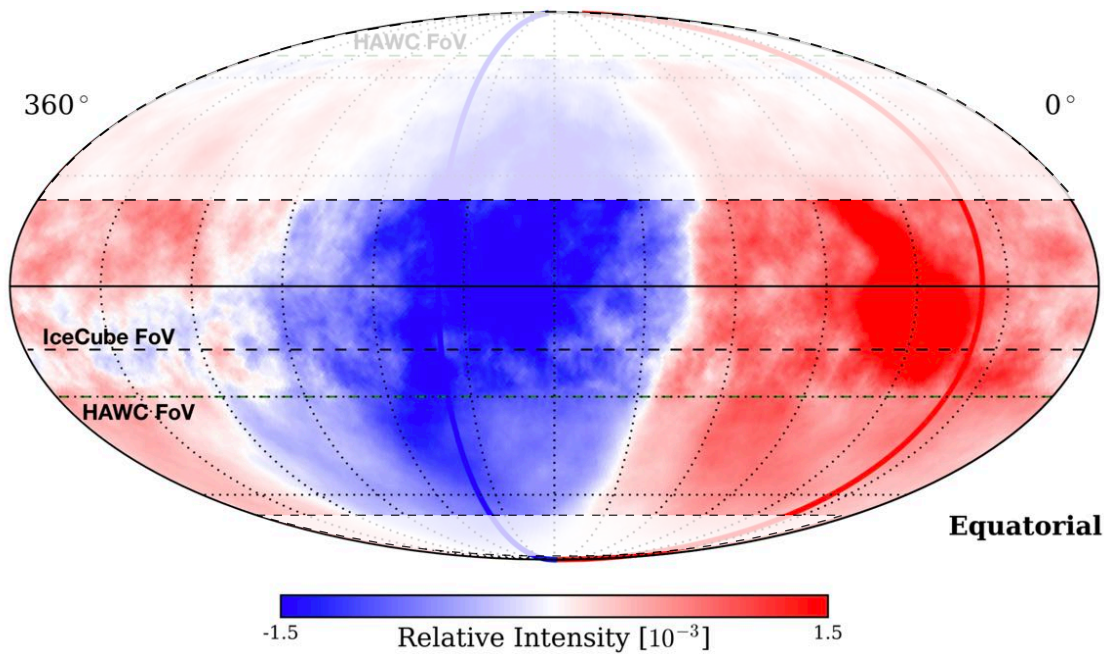
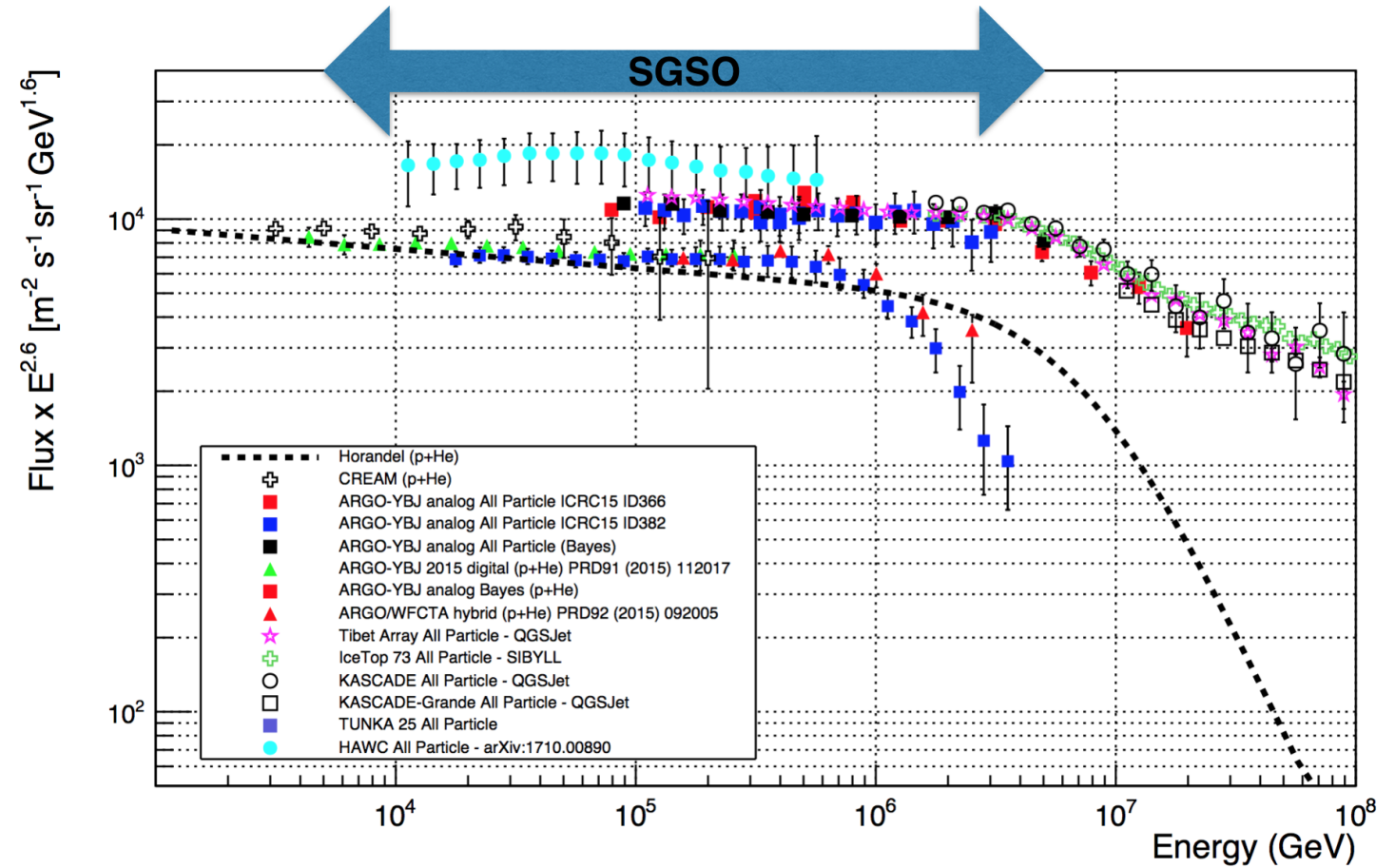
# Physics beyond the SM

- DM from the GC and dSph
- LIV @ VHE (e.g. photon decay)
- Primordial Black Hole evaporation
- ...



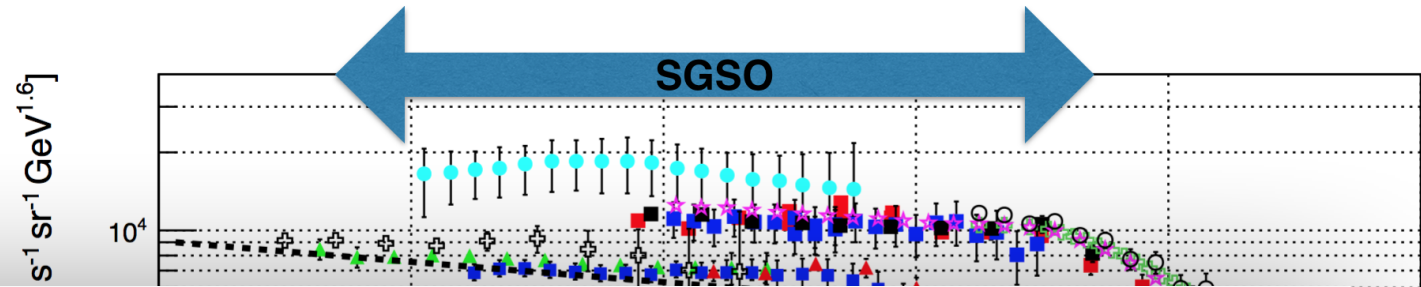
# Cosmic rays

- interesting E range
- mass composition
  - muon tagging (!)
- large scale anisotropies
- electron spectrum



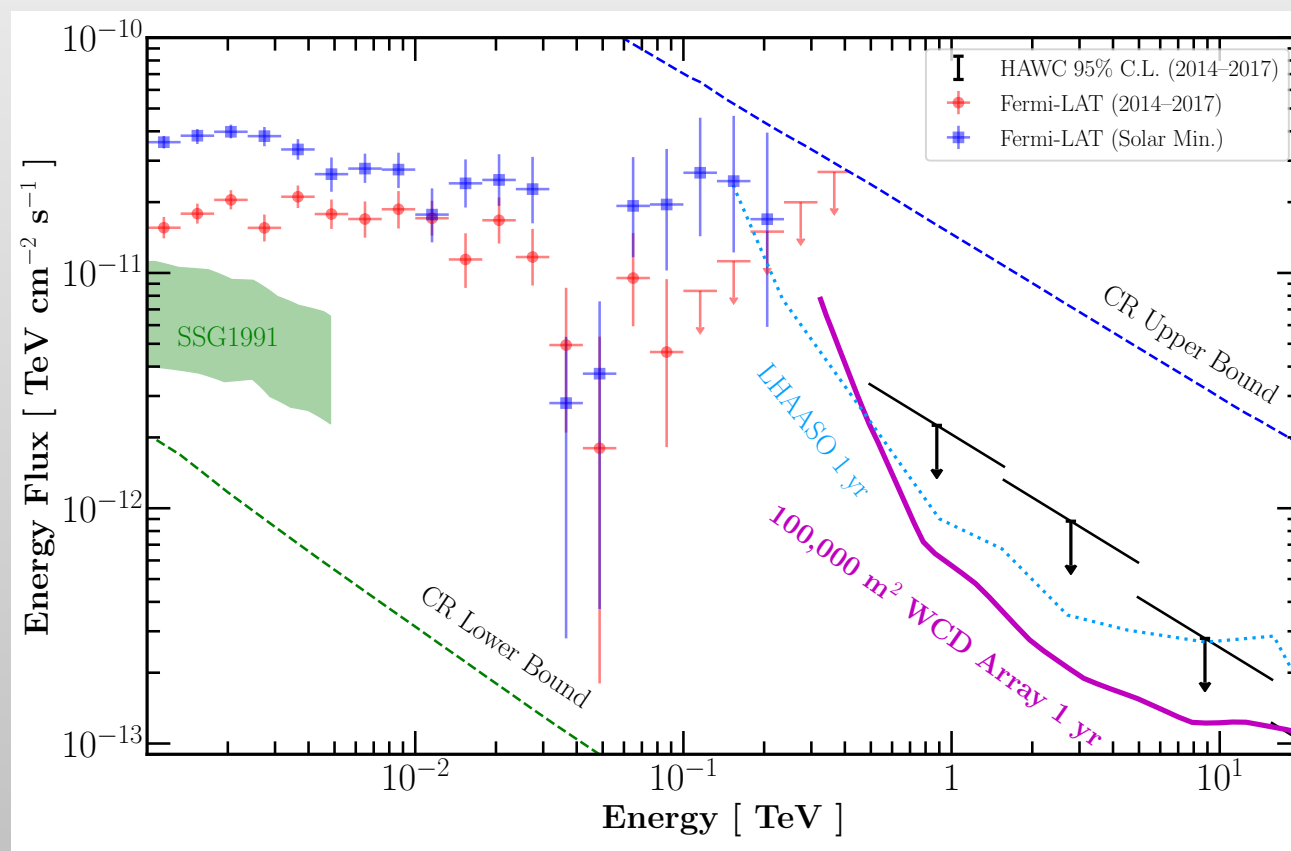


# Cosmic rays



## Potential updates

- Gamma rays from the Sun: dedicated Astro2020 WP (Mehr Un Nisa et al.)



# Summary and outlook

- Extensive white paper submitted (2019/02/25)
  - [arXiv: 1902.08429](https://arxiv.org/abs/1902.08429)
  - 102 authors/endorsers
- Several Astro2020 white papers drawing directly from the main paper + input to french roadmap (CNRS/INSU, 2020-2035) + ...
- Continue to advertise the science case!
  - TevPA2018, CTA symposium 2019, ICRC2019, ...
- White Paper is a living document
  - continuous updates of the authorlist (currently at 111, via [overleaf](#))
  - everybody is invited to provide additions/updates/clarifications/etc.
- timescale for updated version on the arXiv?
  - autumn?