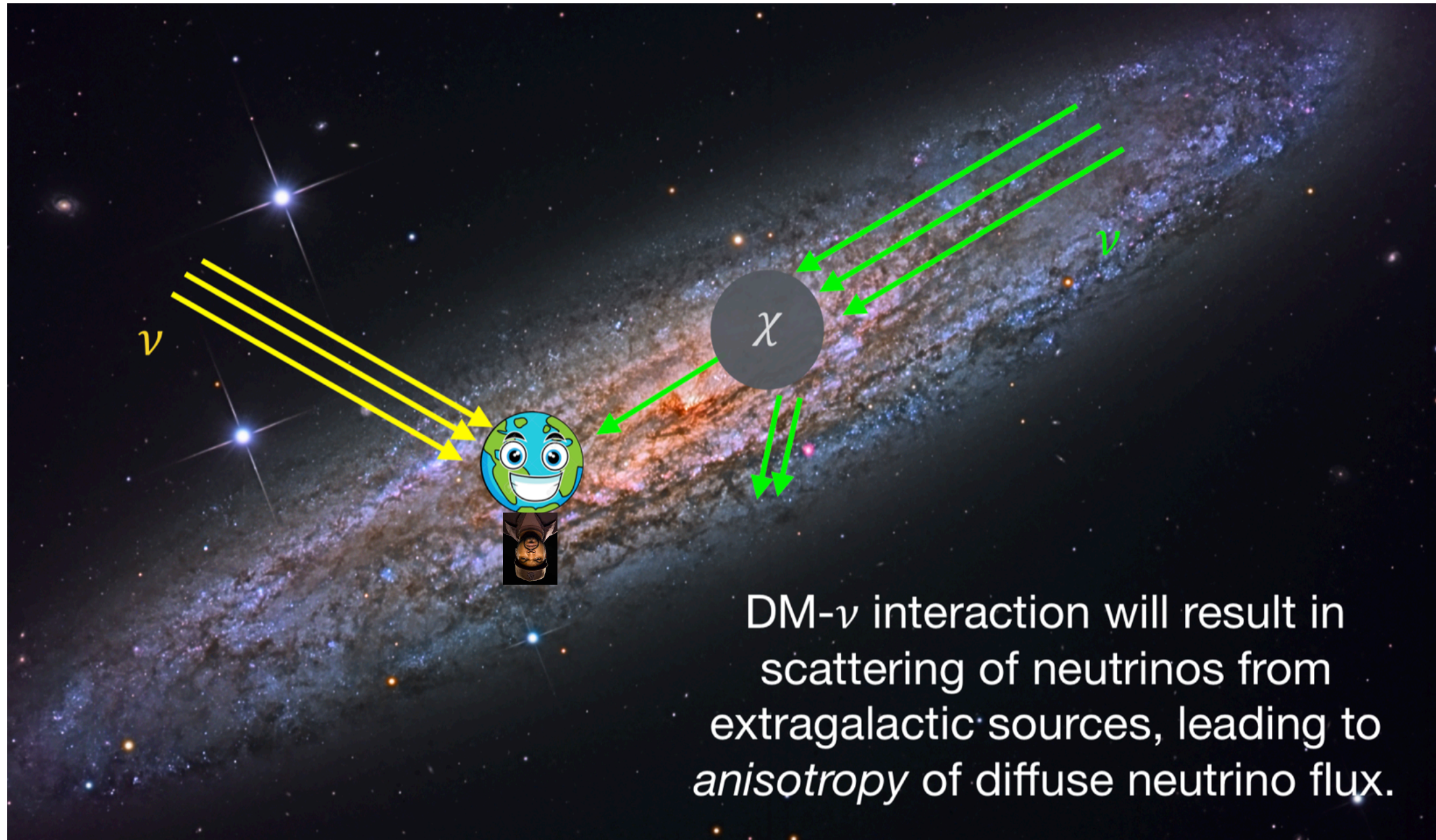


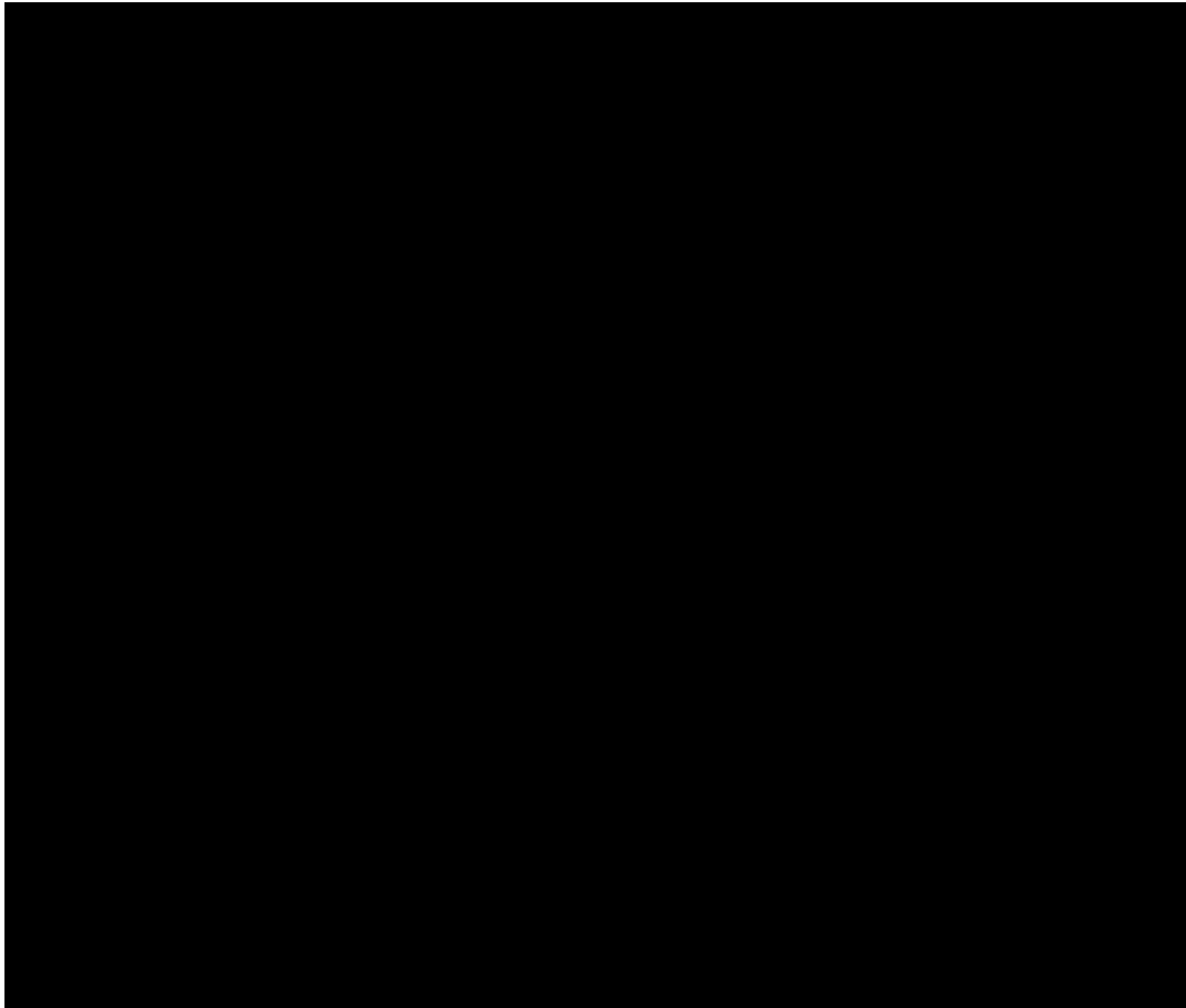
# A 6-Slide “1 Slide Summary”

Ibrahim Safa

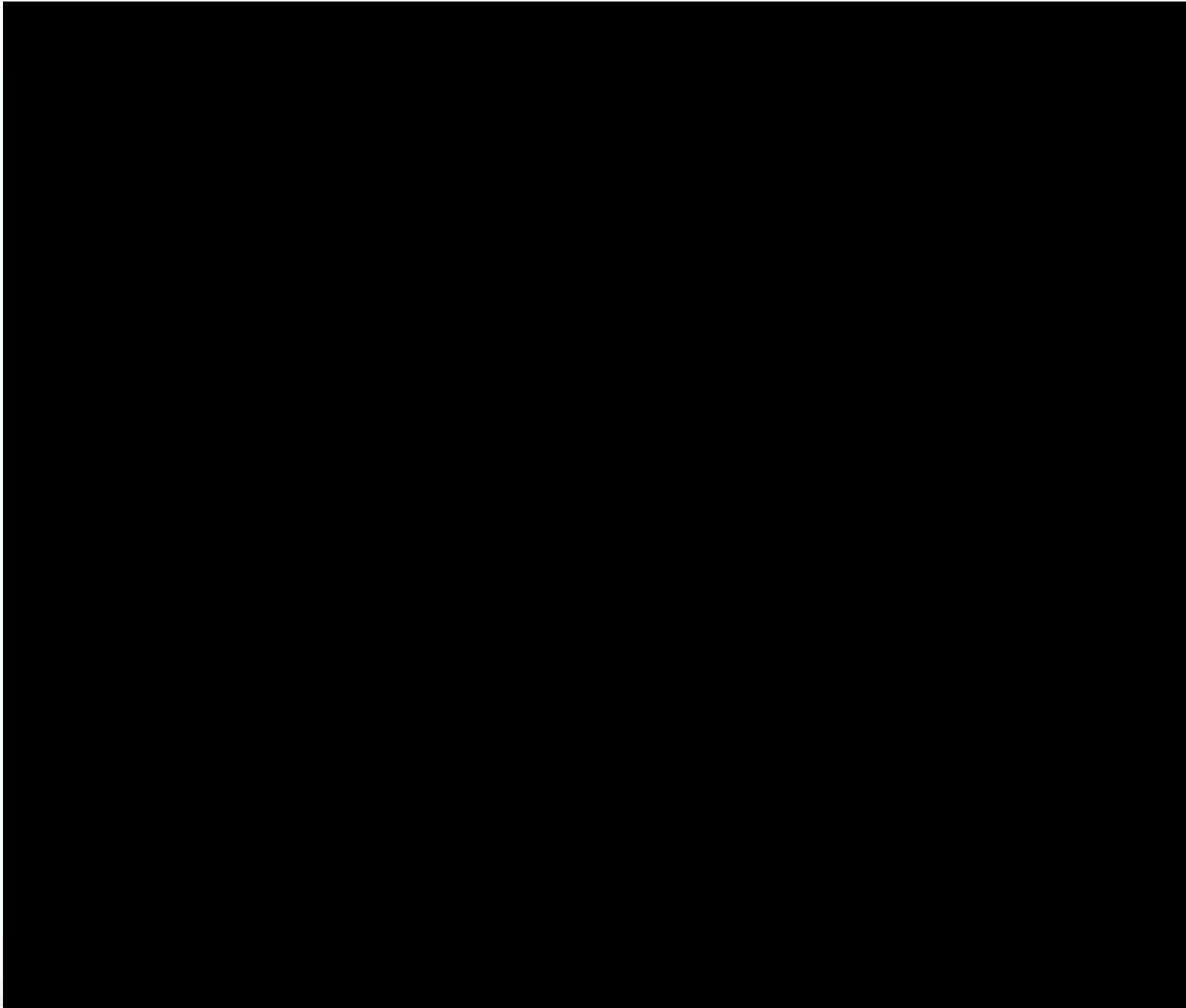
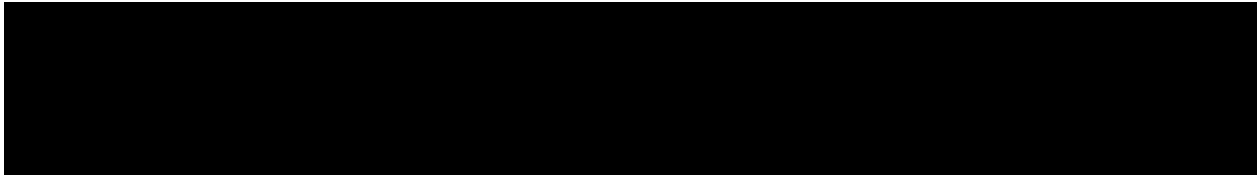
# Imaging Galactic Dark Matter With High Energy Cosmic Neutrinos

An artist's rendition:





**Redacted**



**Redacted**

# Dark Matter “Global Fit”

The basic idea behind any global fit is to combine measurements from different channels/analyses to make a broader statement about the validity of certain models and obtain more stringent constraints to the parameter space.

I think of it as a ‘meta-fit’

We will look at two channels:

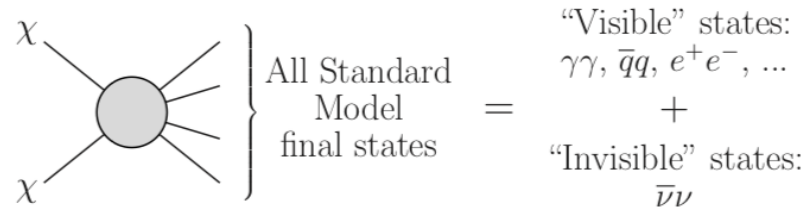
- 1) Dark Matter - neutrino
    - a) Relic Density
    - b) Collisional Damping
    - c) Indirect detection signals
  - 2) Dark Matter - Charged Leptons
    - a) Relic Density
    - b) Collisional Damping
- >
- i) Annihilation
  - ii) Decay
  - iii) Scattering



Collaborators: **Carlos Arguelles; Ali Kheirandish; Andres Olivares; I.S; Aaron Vincent.**



# Constraints on DM Total Annihilation Cross section



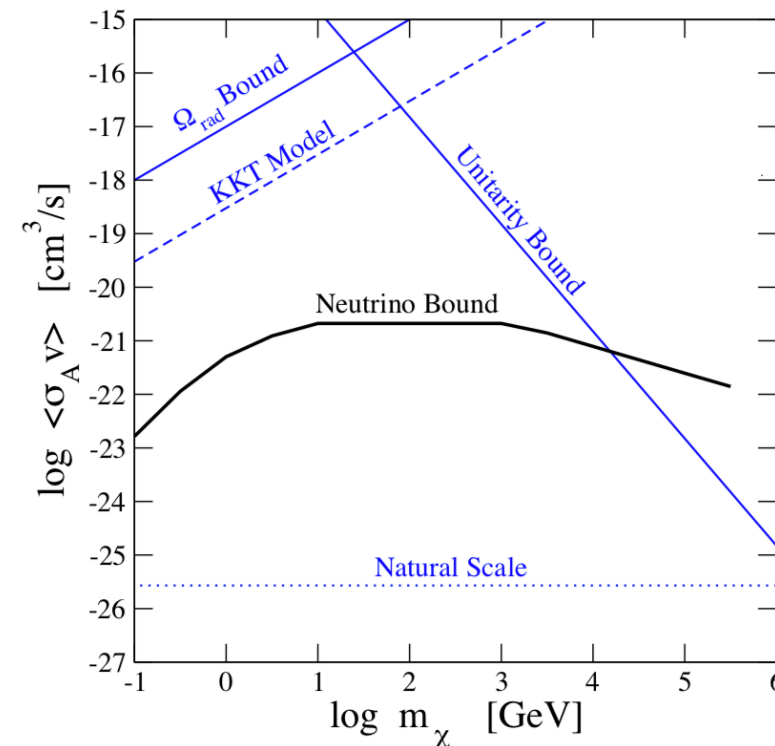
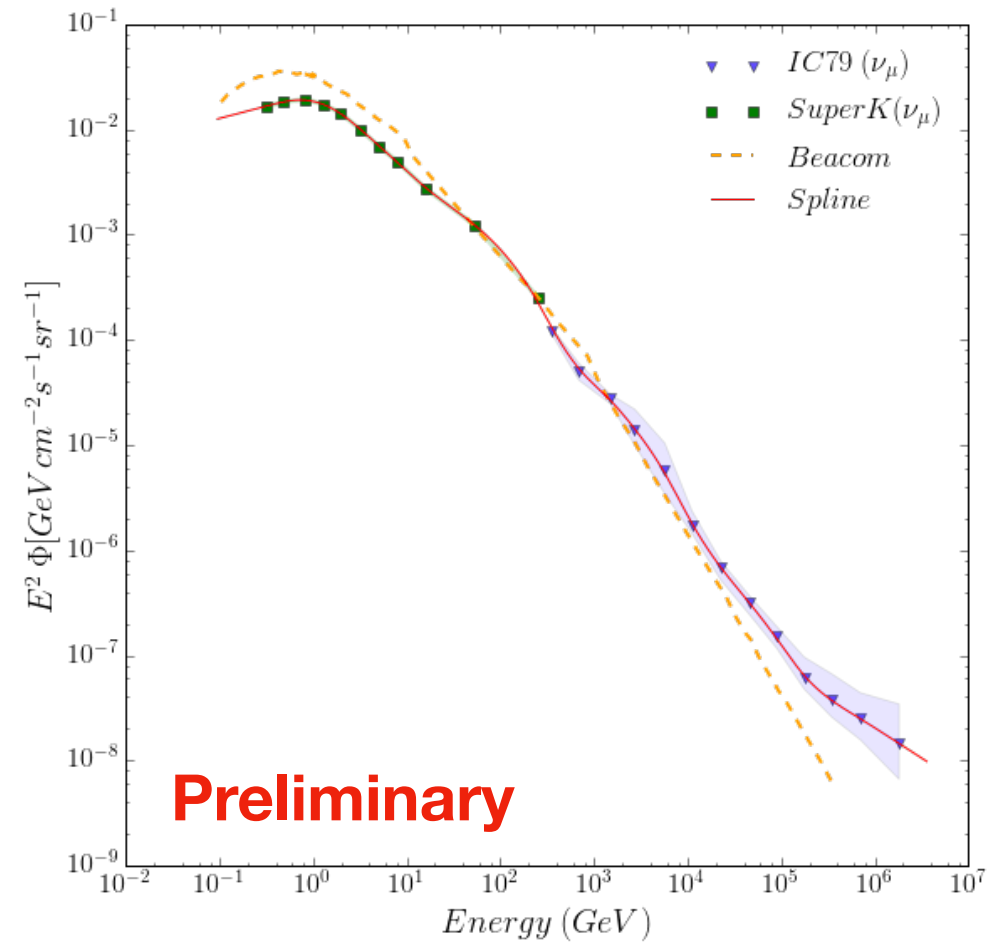
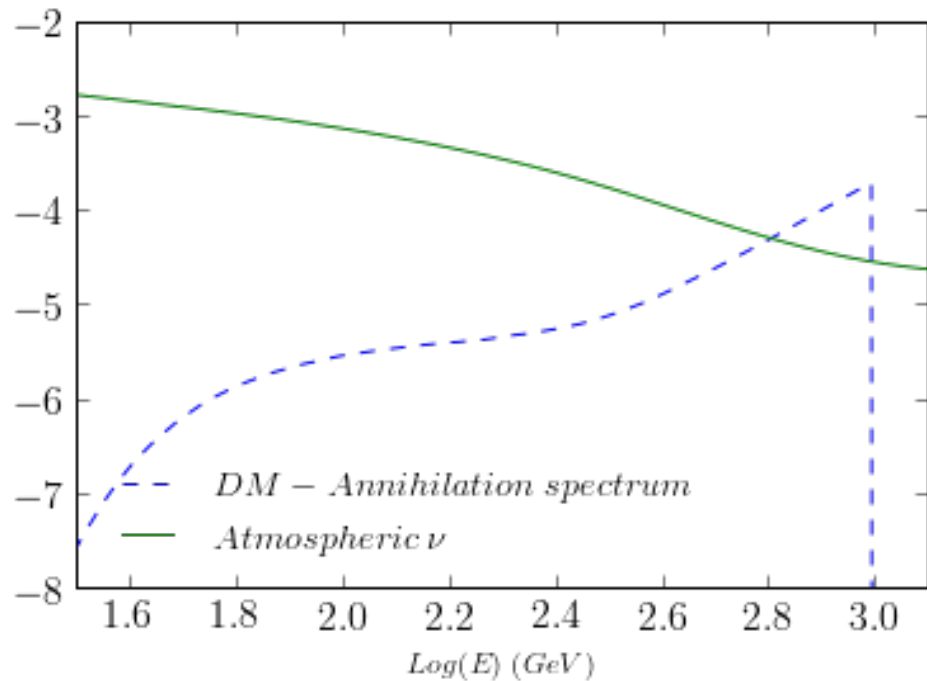
## Neutrino flux from annihilation

$$\frac{d\Phi_\nu}{dE} = \frac{\langle\sigma_{Av}\rangle}{2} \frac{c}{4\pi H_0} \frac{\Omega_{DM}^2 \rho_{crit}^2}{m_\chi^2} \int_0^{z_{up}} dz \frac{\Delta^2(z)}{h(z)} \frac{dN_\nu(E')}{dE'} \quad (3)$$

## Neutrino source spectrum

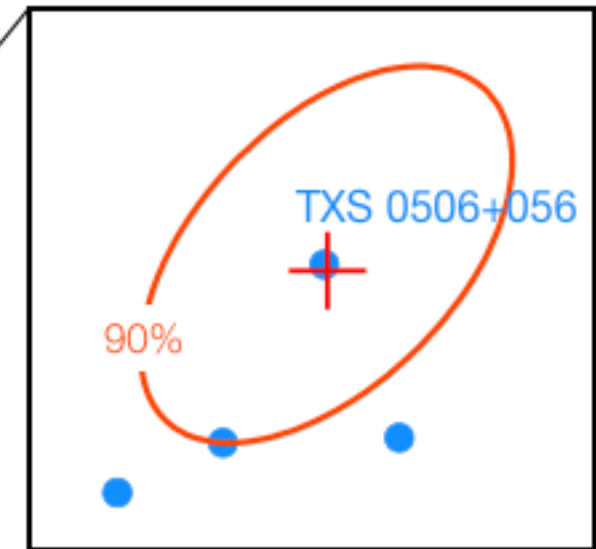
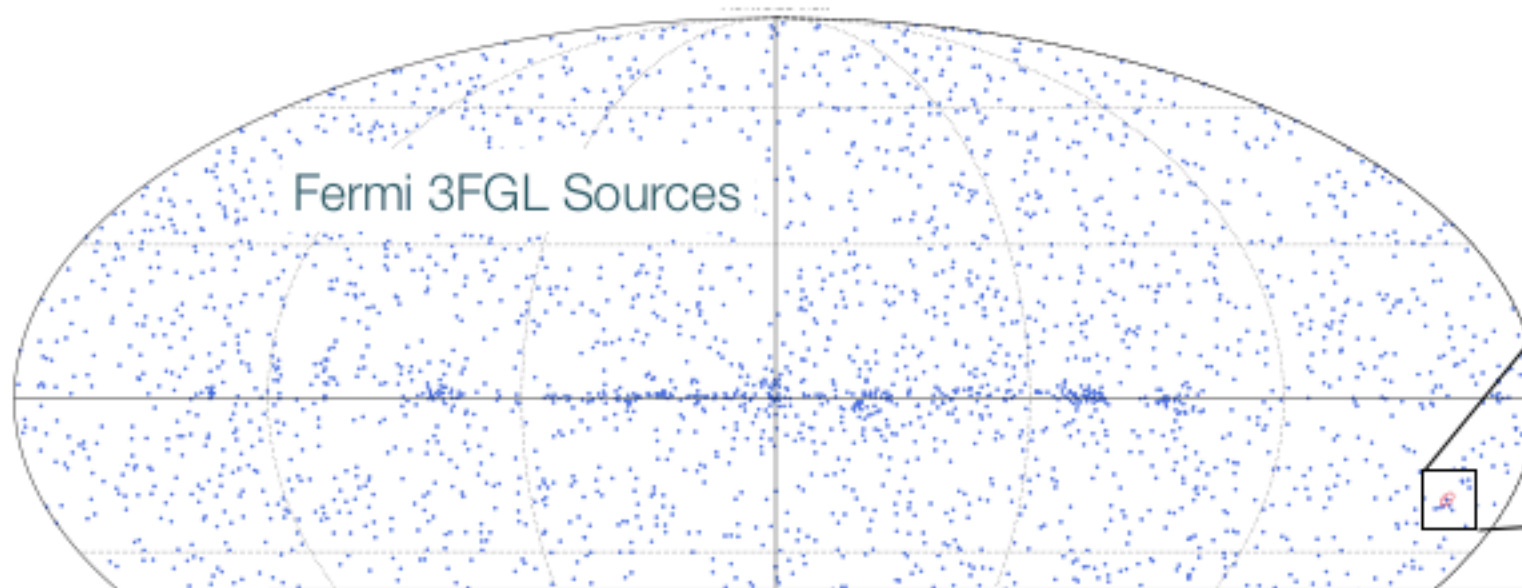
$$\frac{dN_\nu(E')}{dE'} = \frac{2}{3} \delta(m_\chi - E') = \frac{2}{3E} \delta\left[z - \left(\frac{m_\chi}{E} - 1\right)\right]$$

$E = E'/(1+z)$  ← E is observed energy  
E' is energy at source



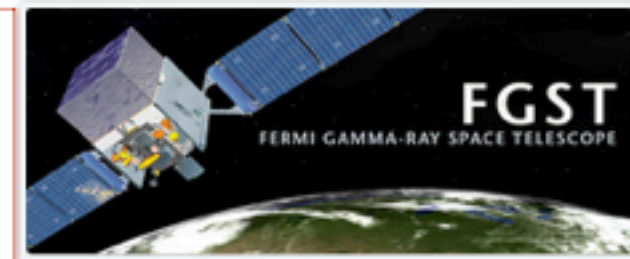
# IC 170922A

- IceCube issued an alert on September 22, 2017.
- Follow up observations by ANTARES, H.E.S.S. , **Fermi-LAT**, **Swift**, AGILE, **MAGIC**, HAWC, VERITAS and ...



**Fermi-LAT detection of increased gamma-ray activity of TXS 0506+056, located inside the IceCube-170922A error region.**

ATel #10791; *Yasuyuki T. Tanaka (Hiroshima University), Sara Buson (NASA/GSFC), Daniel Kocevski (NASA/MSFC) on behalf of the Fermi-LAT collaboration*  
on 28 Sep 2017  
Credential Certification: David J. Thompson



**First-time detection of VHE gamma rays by MAGIC from a direction consistent with the recent EHE neutrino event IceCube-170922A**

ATel #10817; *Razmik Mirzoyan for the MAGIC Collaboration*  
on 4 Oct 2017; 17:17 UT  
Credential Certification: Razmik Mirzoyan (Razmik.Mirzoyan@mpp.mpg.de)



- details coming soon!

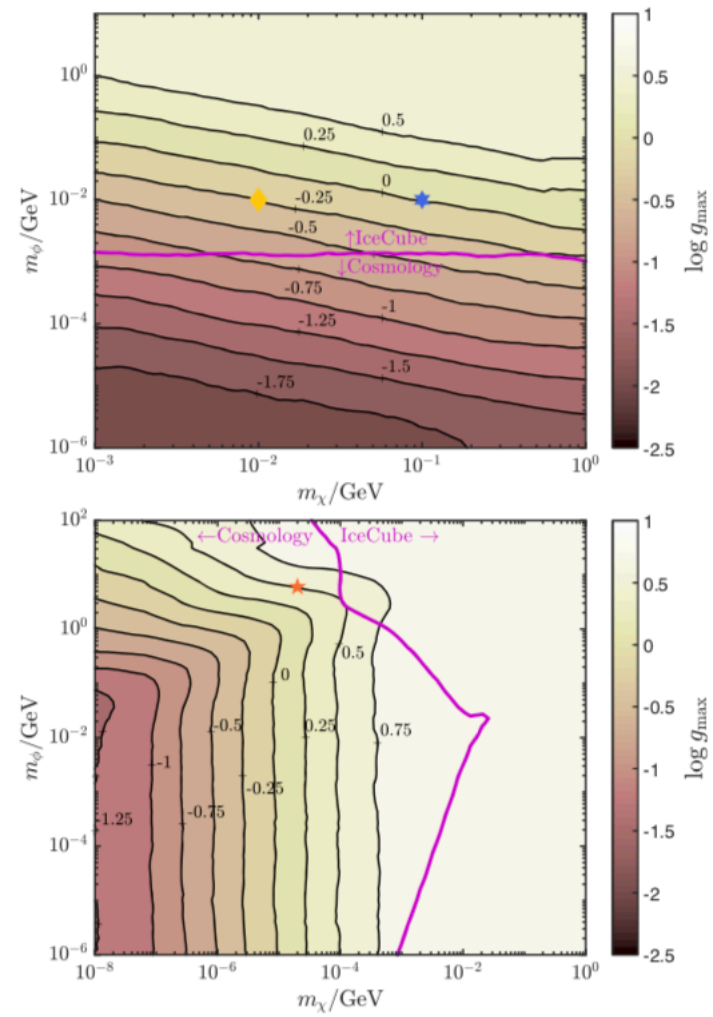
**Thanks!**





**Backup**

# Fermion DM - Vector mediator



# Scalar DM - Fermion mediator