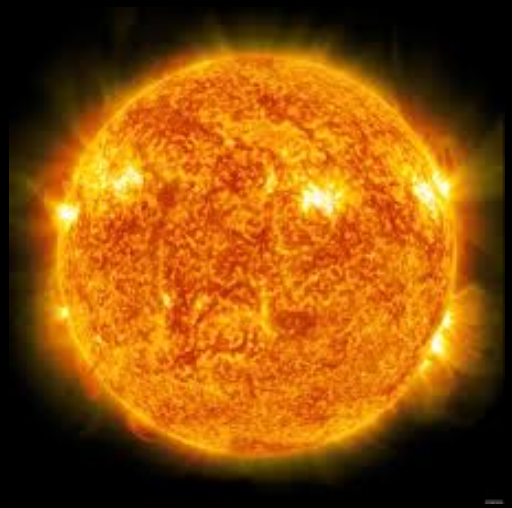
Solar Atmospheric Neutrinos: Another Neutrino Floor

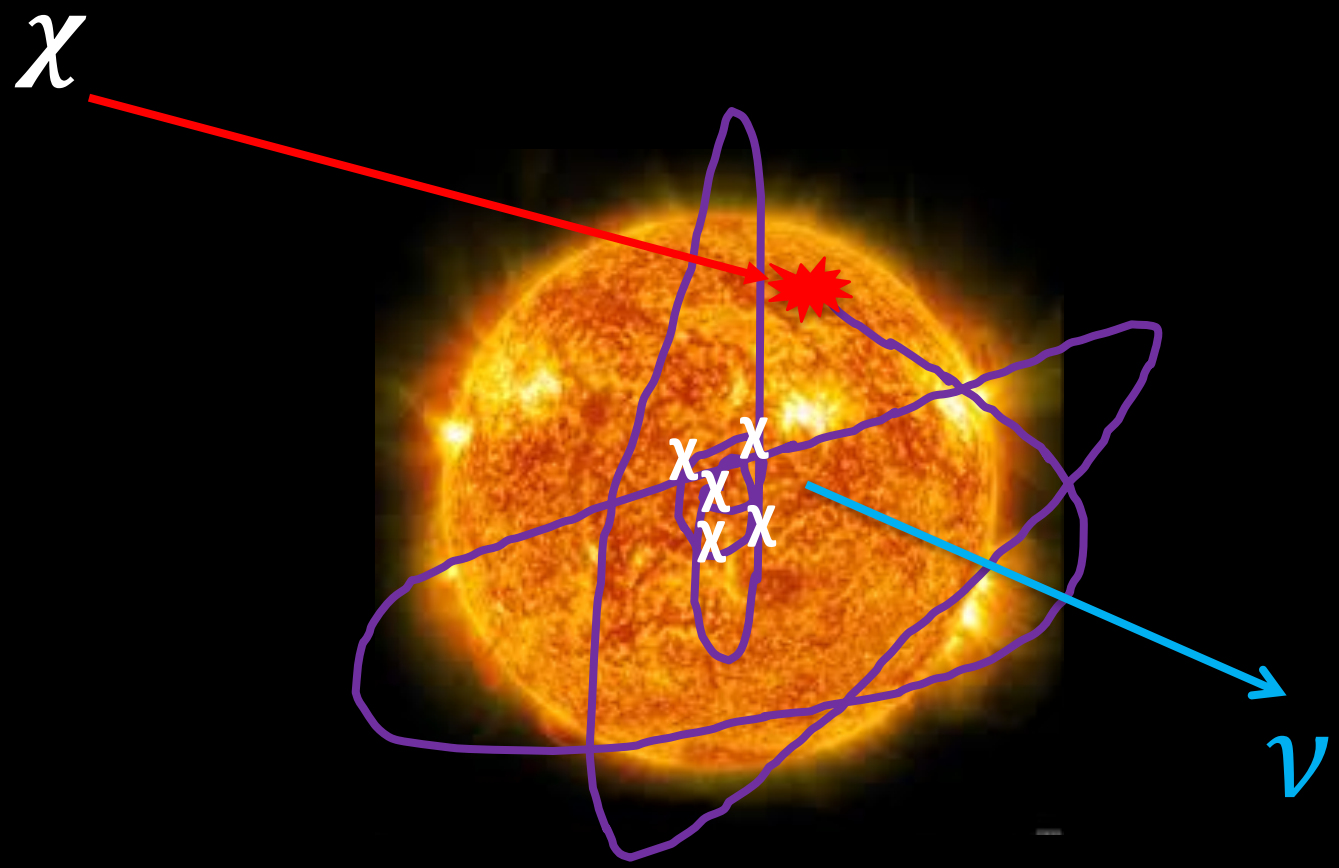


Based on:
1508.06276
1612.02420
1703.04629
1703.10280

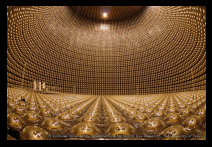
With John Beacom, Annika Peter, Carsten Rott

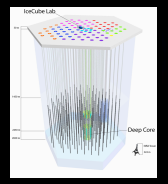
Kenny, Chun Yu Ng
Weizmann Institute of Science

Sun – Dark Matter detector



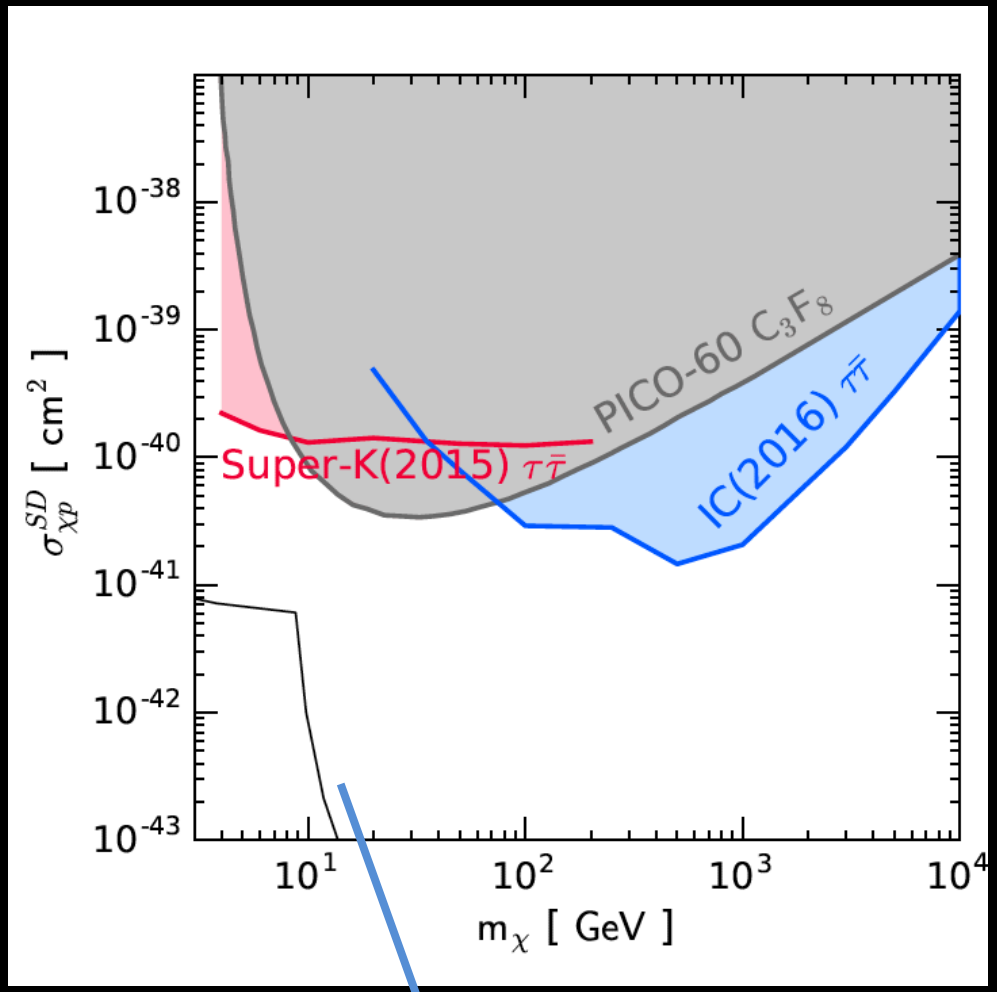
Press, Spergel (1985)
Krauss, Freese, Press, Spergel (1985)
Silk, Olive, Srednicki (1985)





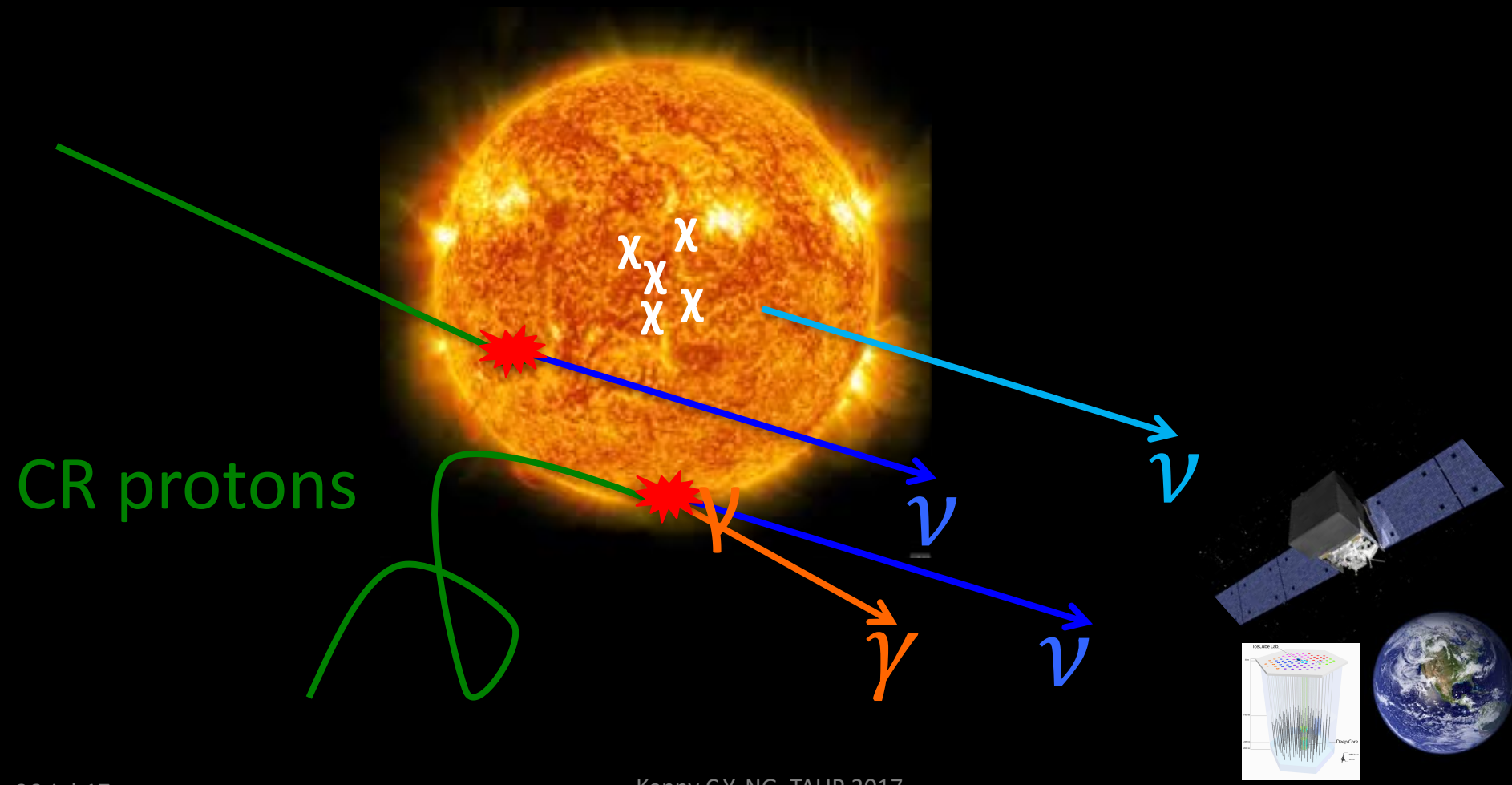
Solar WIMP Search

- Best limit on SD cross sections
  - Hard Channels
- Both scattering and Annihilation !
- How far can neutrino telescopes reach?

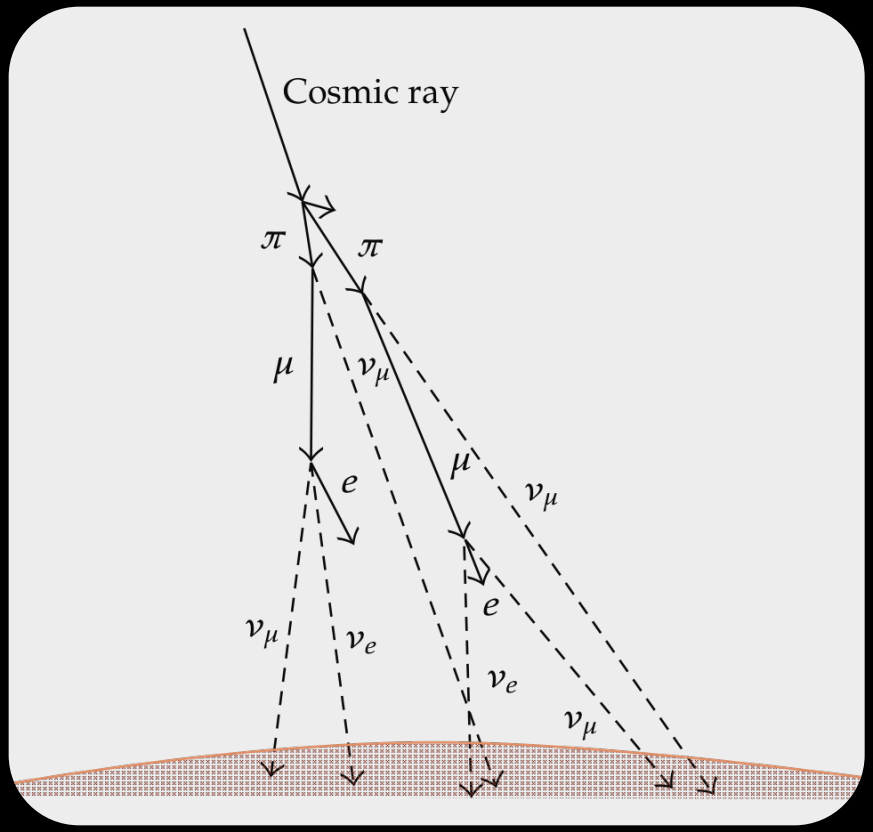


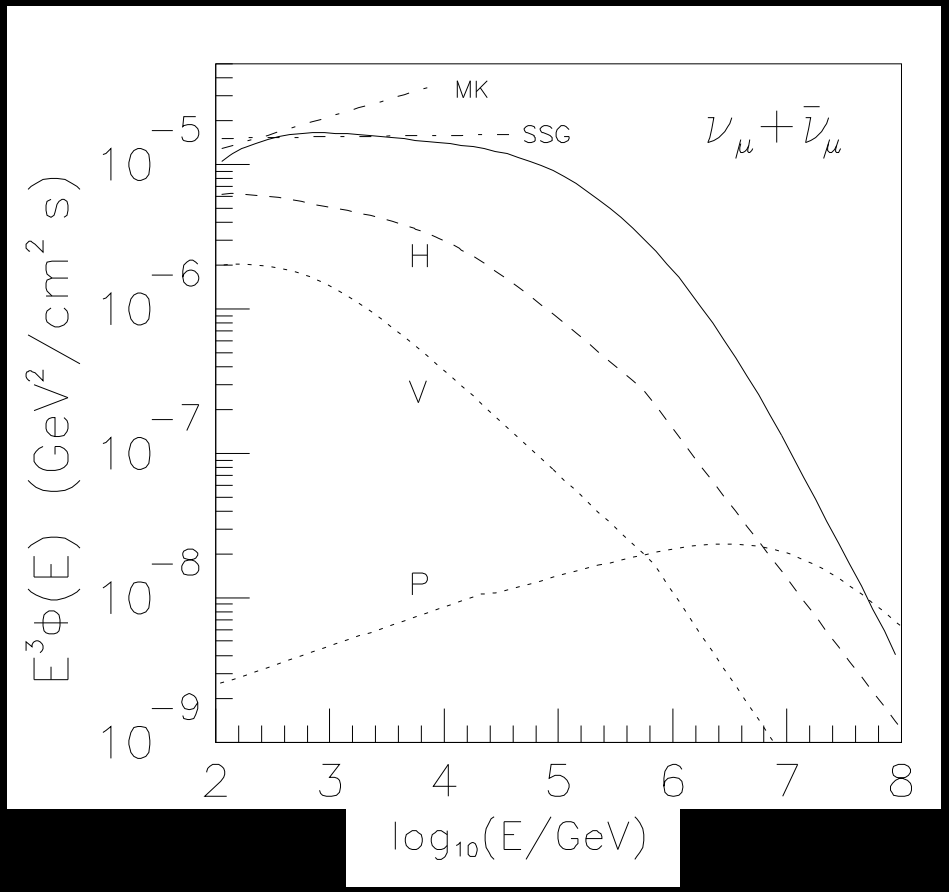
Sun – Cosmic-ray beam dump

Seckel, Stanev, Gaisser (1991),
Moskalenko, Karakula (1993),
Ingelman, Thunman (1996), +



Solar Atmospheric Neutrinos





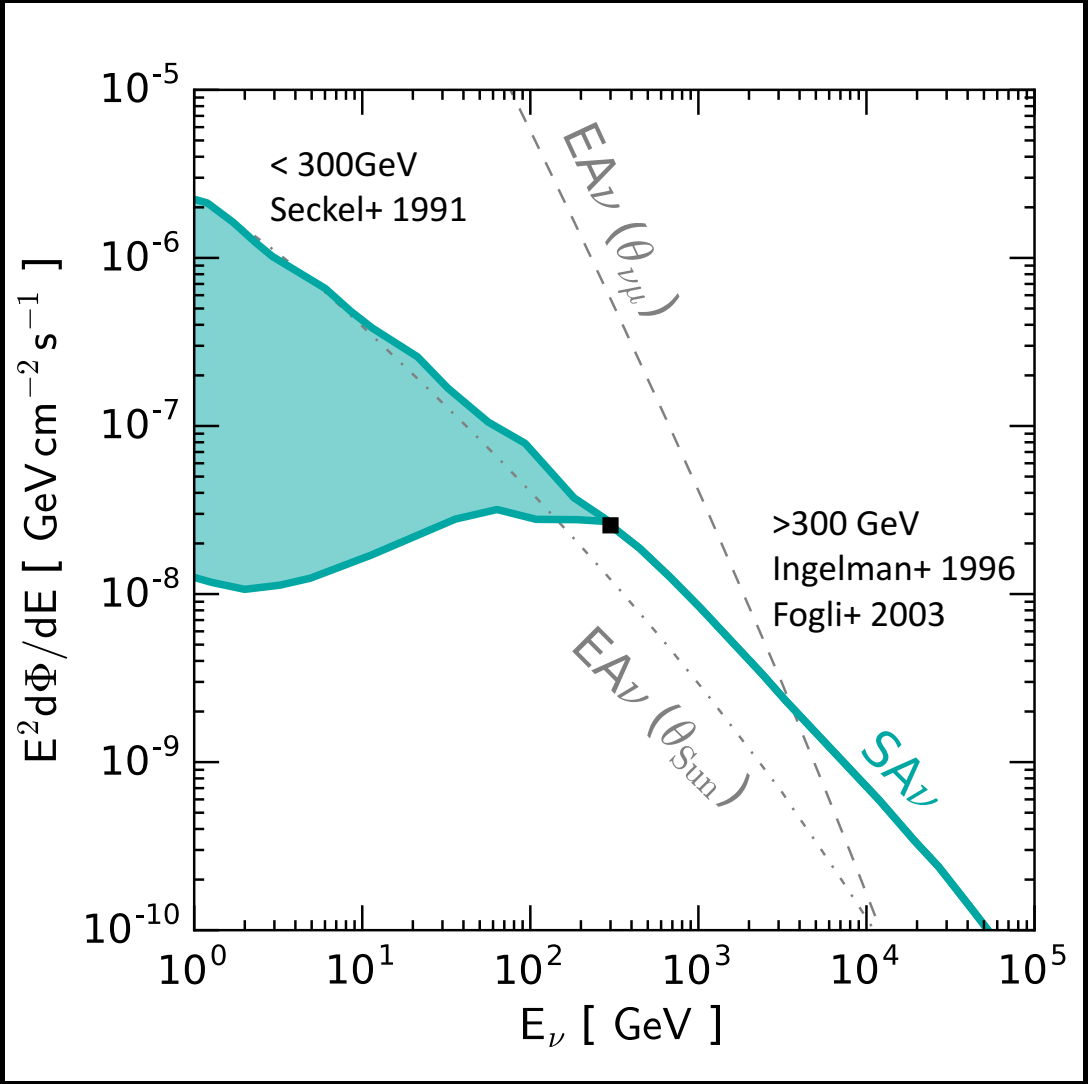
- Dilute atmosphere, larger neutrino flux

  Seckel+ 1991, Moskalenko+, 1993, Ingelman+ 1996, Hettlage+ 2000, Fogli+ 2003

  C.A. Argüelles+ 1703.07798
  Joakim Edsjo+ 1704.02892

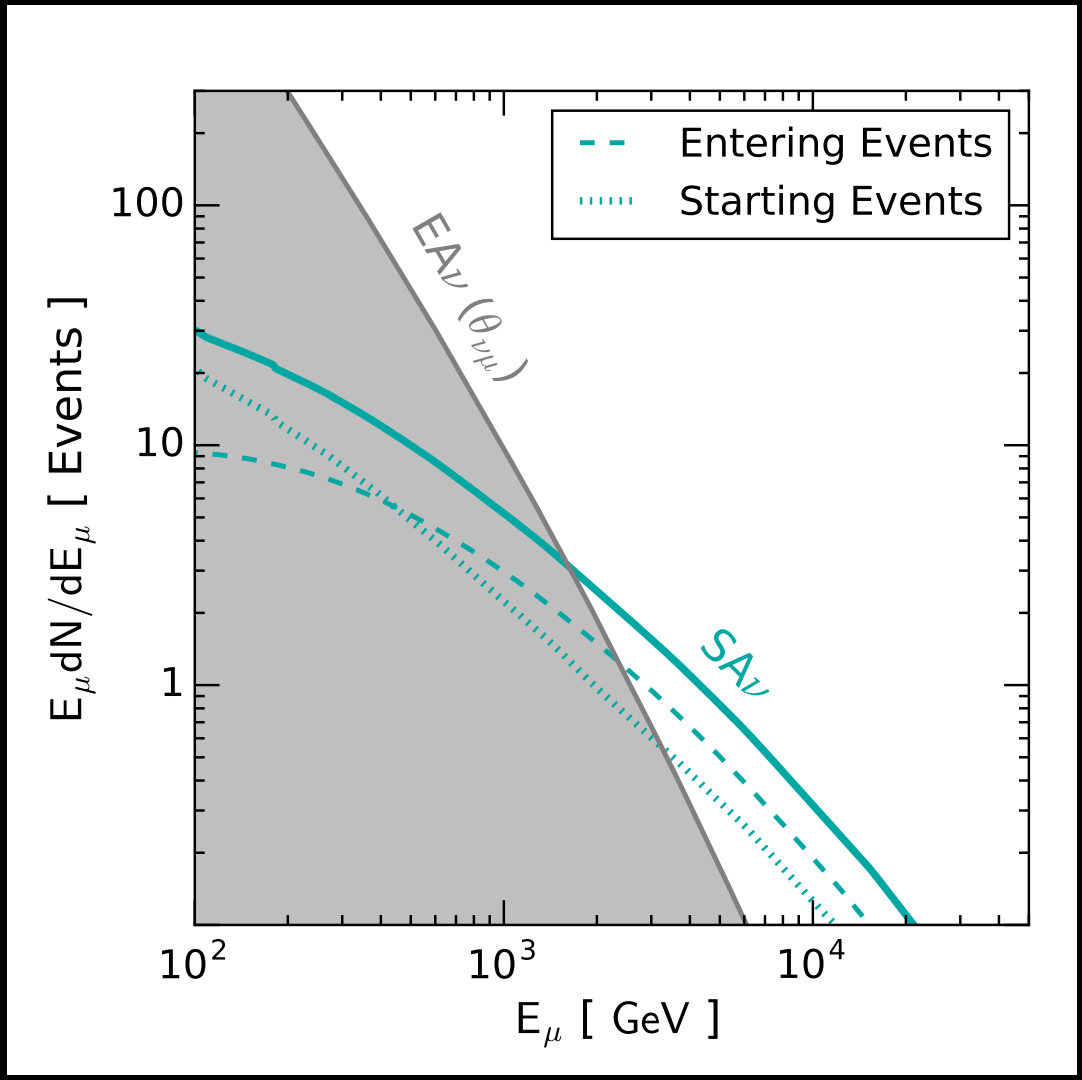
Neutrino Flux

- Muon neutrino for directionality
- Above ~3 TeV, greater than Earth ATM background



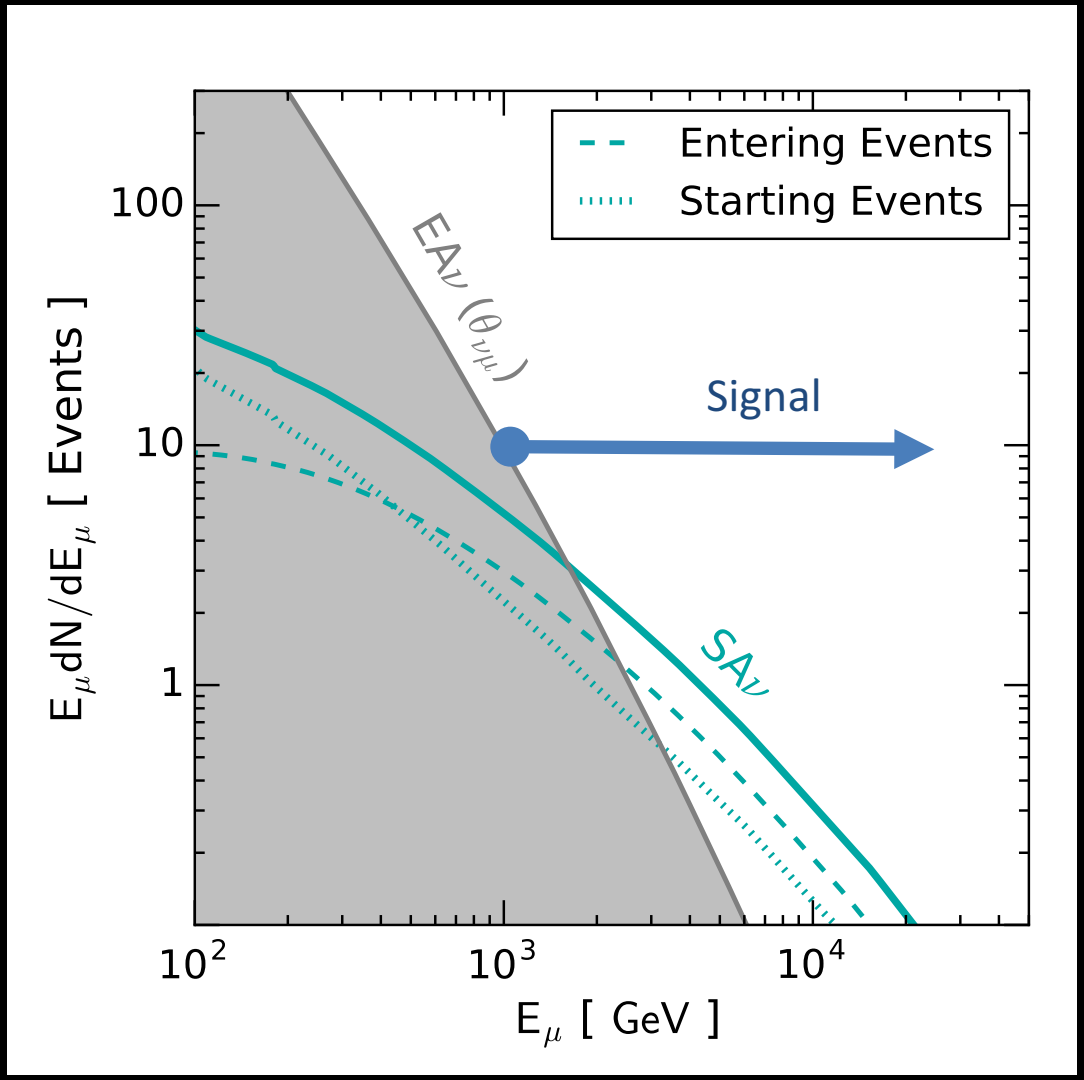
Muon spectrum

- 10 years of 1 Gton
  - IceCube
  - KM3NeT

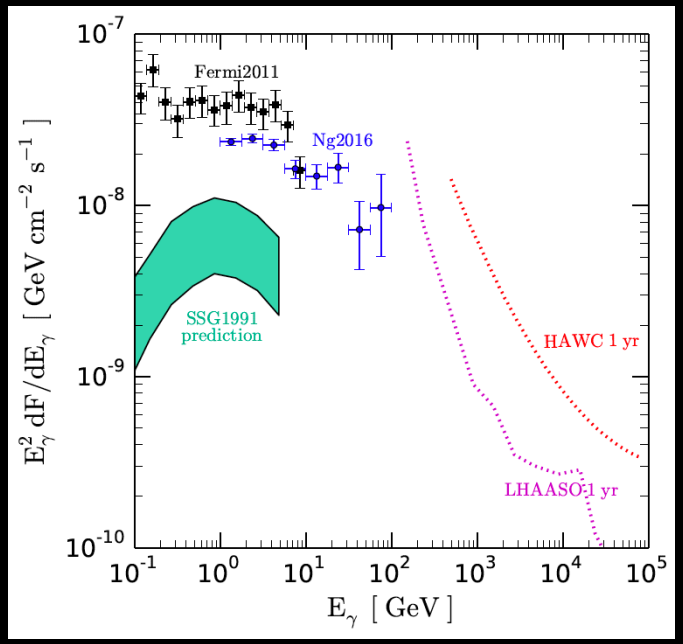


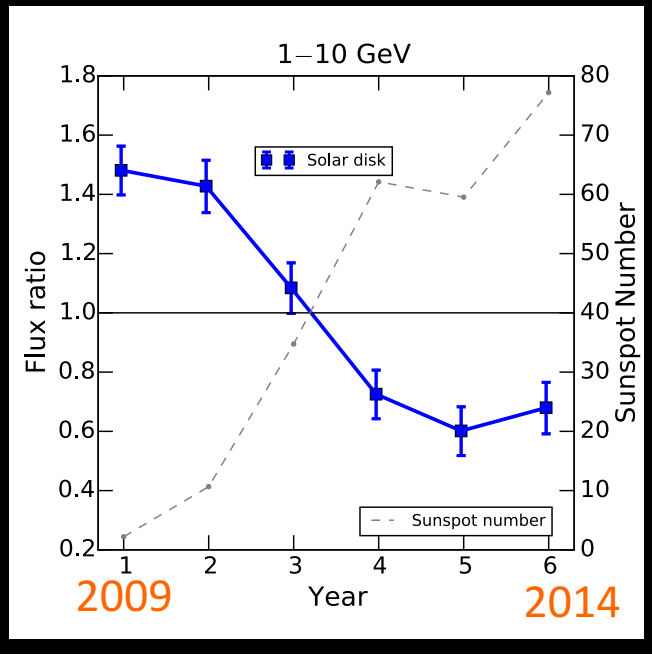
SAν as a Signal

- Muon (>1TeV) energy with energy loss
- ~ 4 : 4 Events in 10 years
- 1st high-energy neutrino source?
- Common source for IceCube + KM3NeT

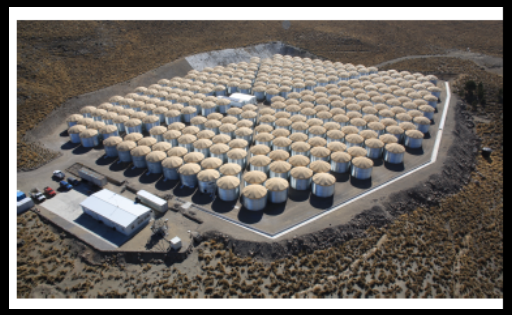


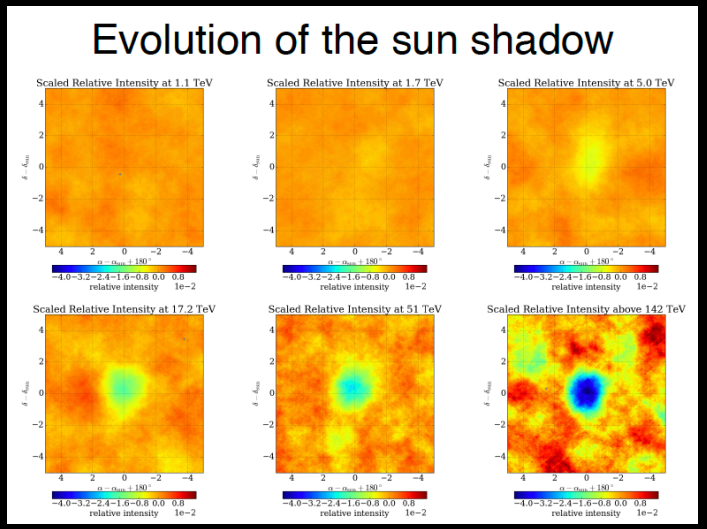
Astrophysical implications



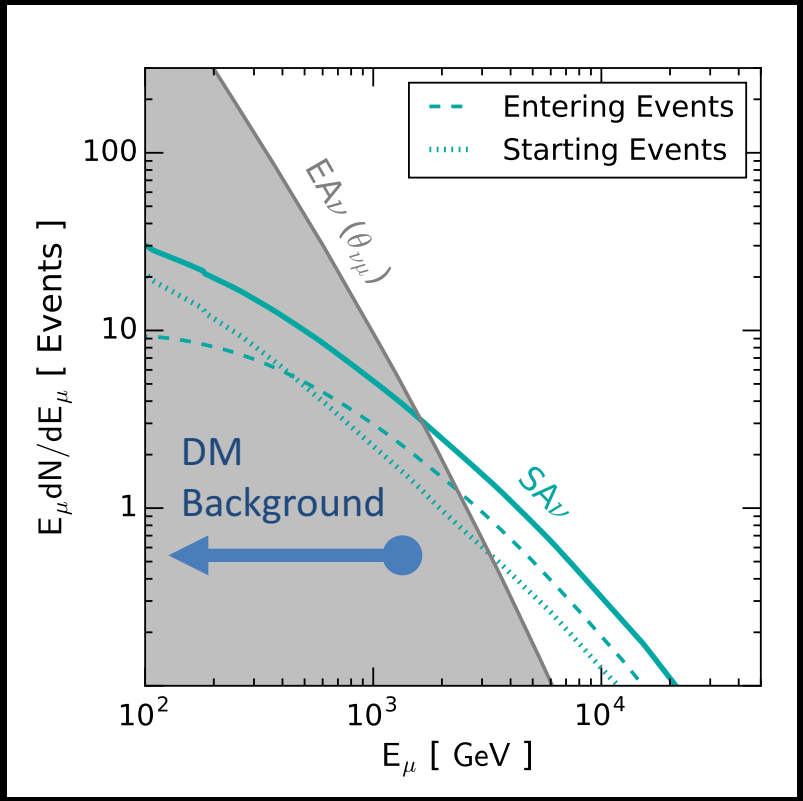


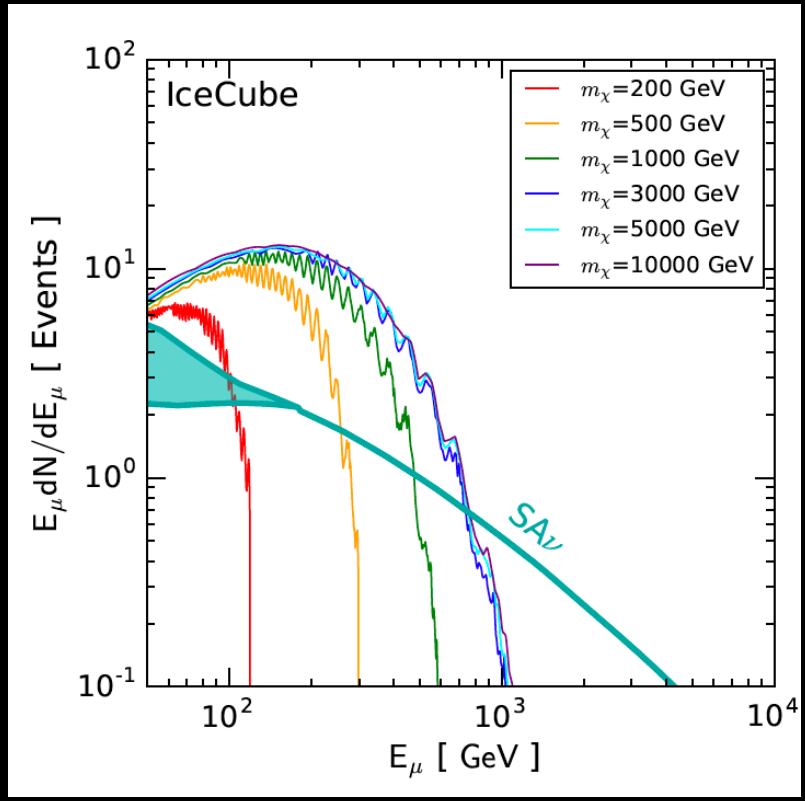
Solar Magnetic Fields ->





SAν as Dark Matter Background

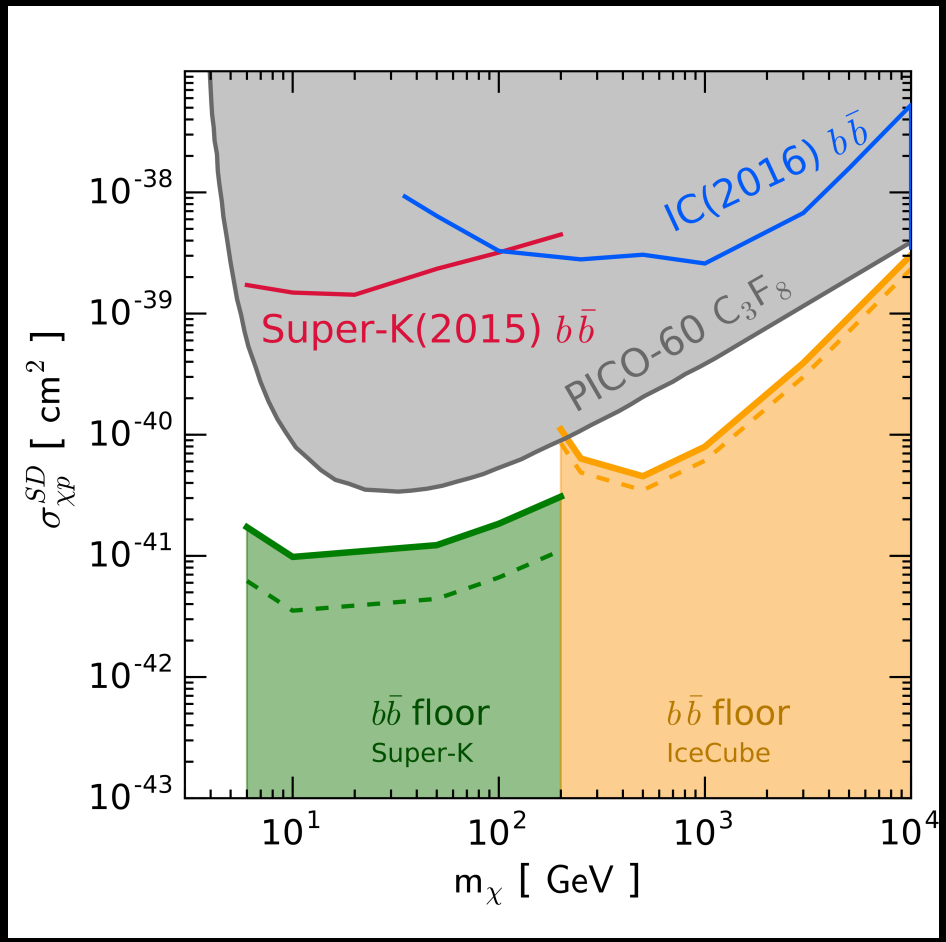


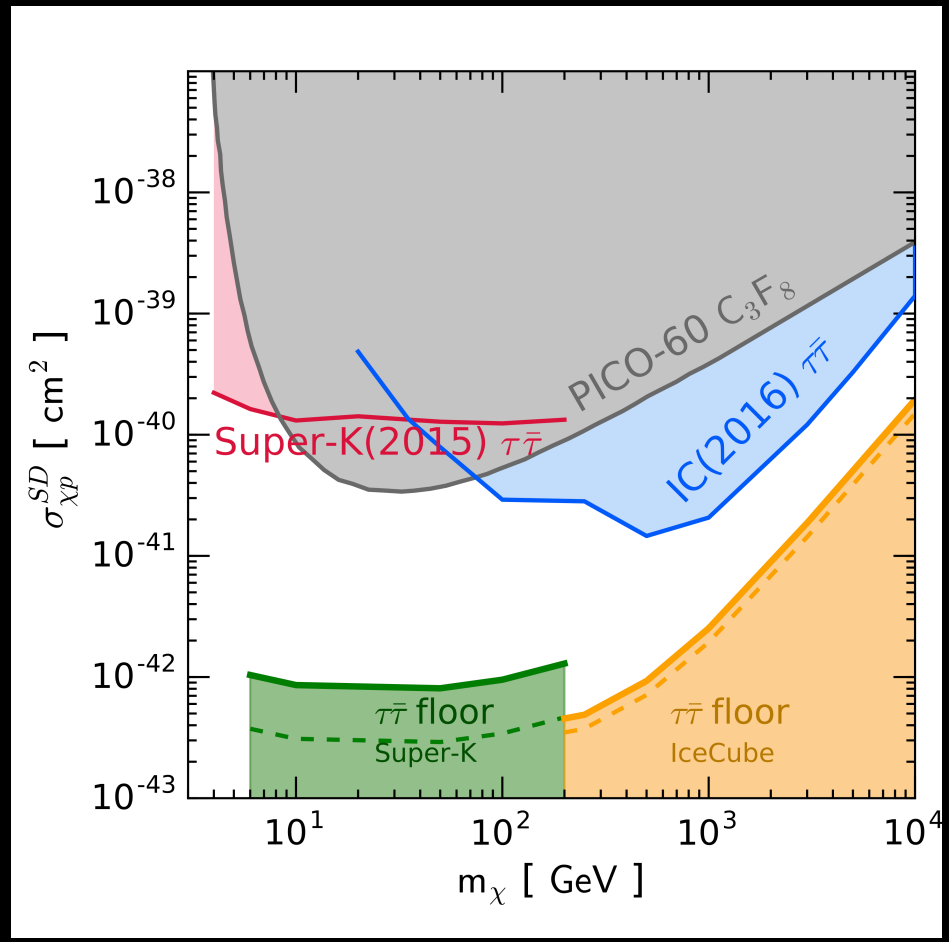


- < TeV muons
- Poor energy resolution

Solar Atmospheric Neutrino Floor

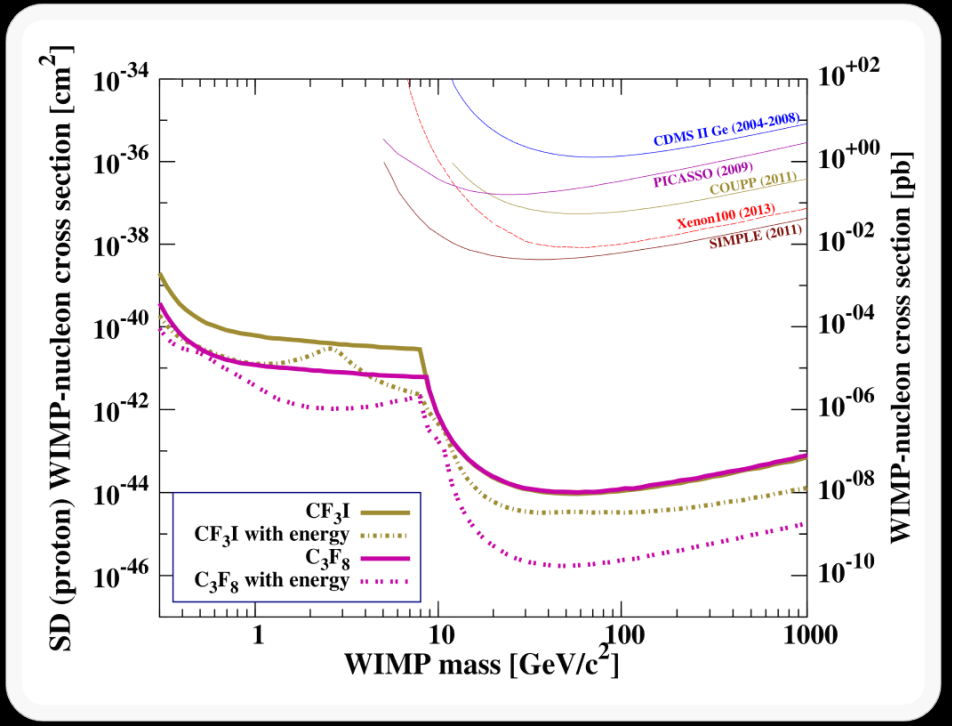
- SAν vs DMν , < TeV muons
- Large model uncertainties -> hard floor



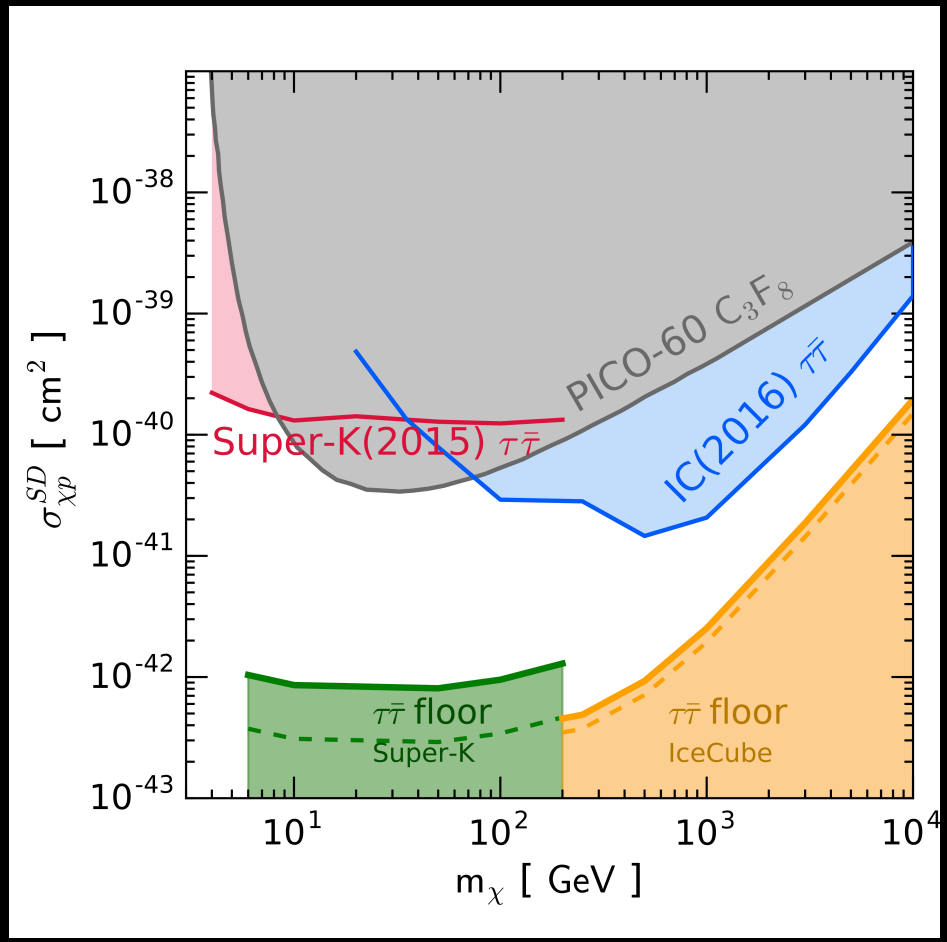


Solar Atmospheric Neutrino Floor

- Large direct detection experiments are needed to reach 10^-44



Ruppin et al. 2014



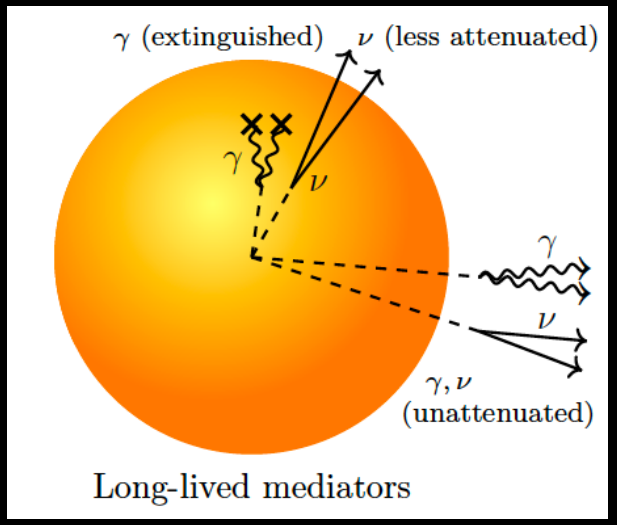
Can Dark Matter give >TeV νs ?

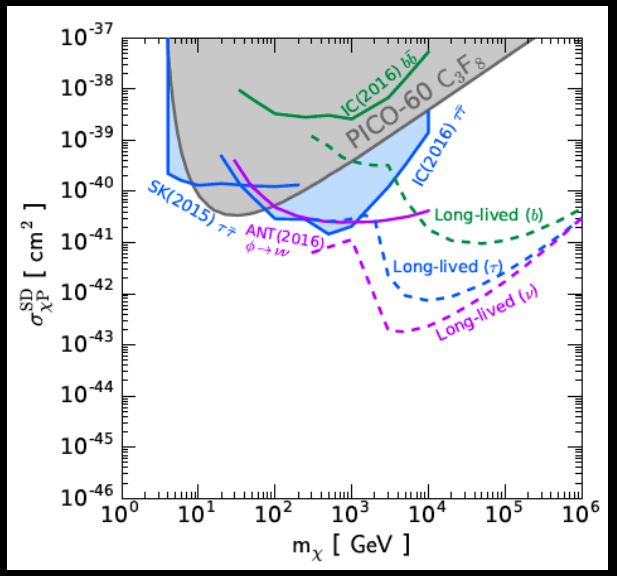
- Long lived Mediators!
  - Unsuppressed neutrino
- Also γ and $e^{\pm}$

Batell, Pospelov, Ritz, Shang: 0910.1567
Feng, Smolinsky, Tanedo: 1602.01465
Arina, Backović, Heisig, Lucente, 1703.08087
+
+

- Low background at high E $(\gamma, e^{\pm})$

Zhou, KCYN, Beacom, Peter, 1612.02420





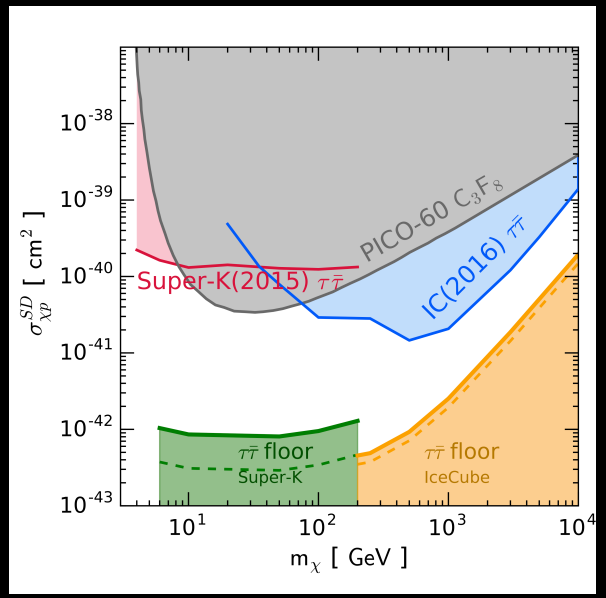
Leane, KCYN, Beacom, 1703.04629

Summary

- SAν as a dark matter background (< TeV μ)
  - Background to solar WIMP search
  - Large model uncertainty -> Hard sensitivity floor

- SAν as a astrophysical signal (> TeV μ)
  - Cosmic-ray interactions in the Sun
  - Reduce the SAν untertinaty

- SAν as a dark matter signal (> TeV μ)
  - Hidden mediator models
  - Multi-messenger constraints



Thanks!