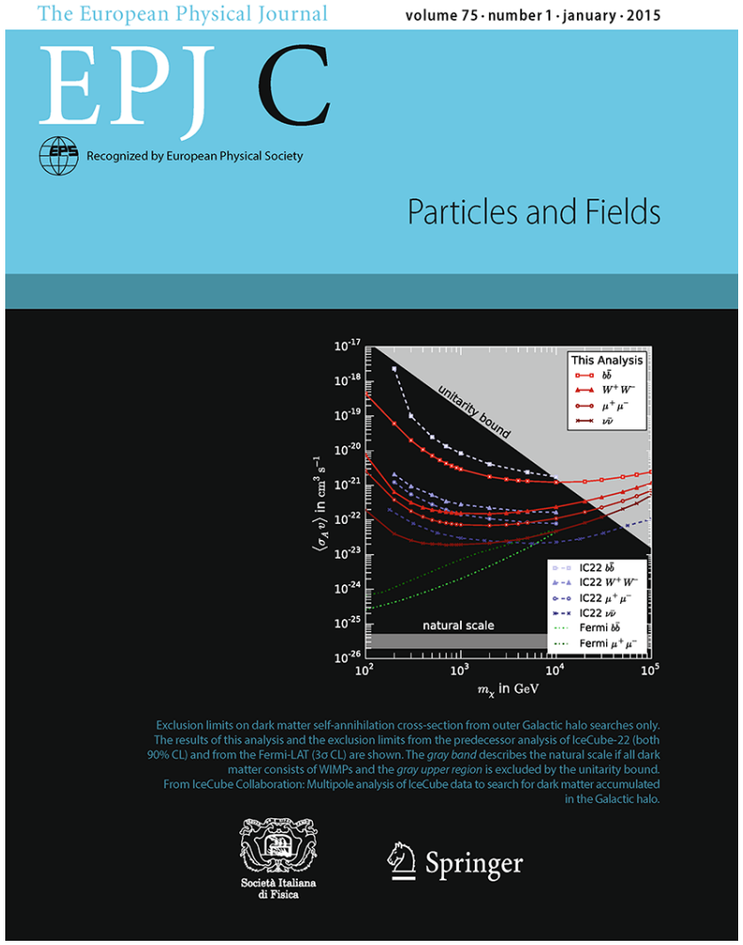
Galactic Halo

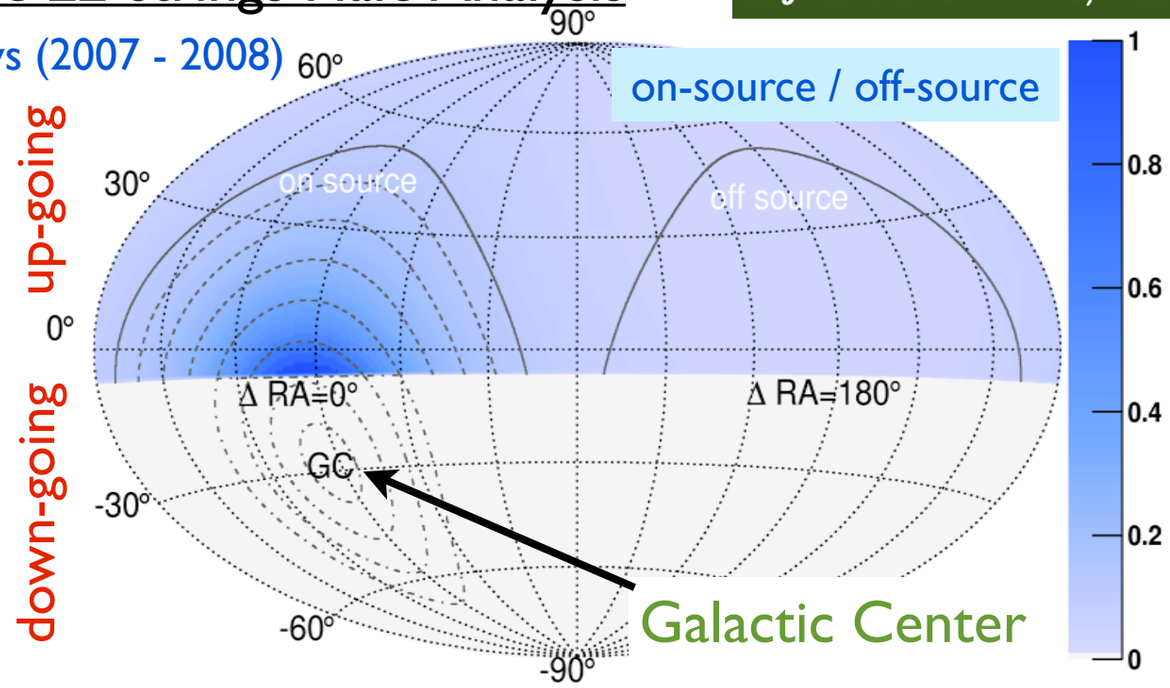
- Galactic Center (GC) on the southern hemisphere
  - large backgrounds from down-going muons
- Search for anisotropy on Northern hemisphere
  - high-purity neutrino sample (up-going muon events)
- Assume annihilation into νν, bb, μμ, ττ, WW



IceCube 22-strings Halo Analysis

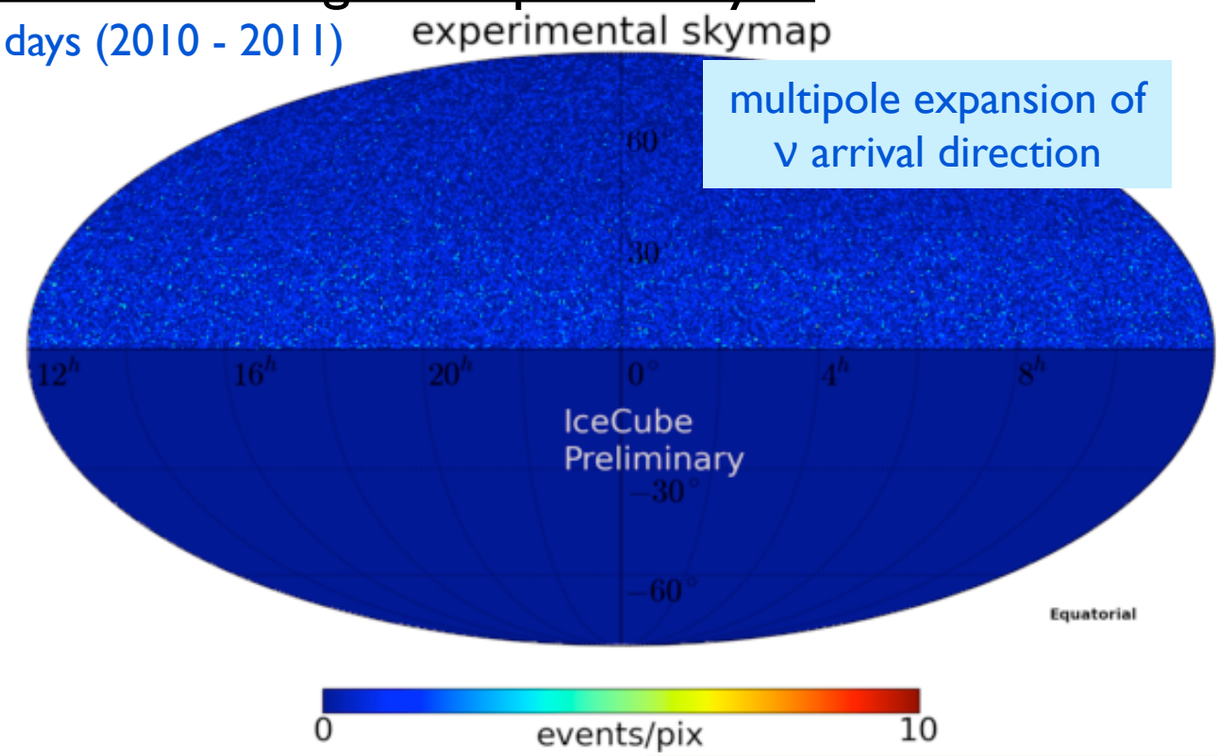
Phys.Rev.D84:022004,2011

276 days (2007 - 2008)



IceCube 79-strings multipole analysis

316 days (2010 - 2011)



Eur. Phys. J. C75, 20 (Jan 2015)

R. Abbasi et al., Phys. Rev. D 84 (2011) 022004.
M. Ackermann et al., Astrophys. J. 761 (2012) 91.

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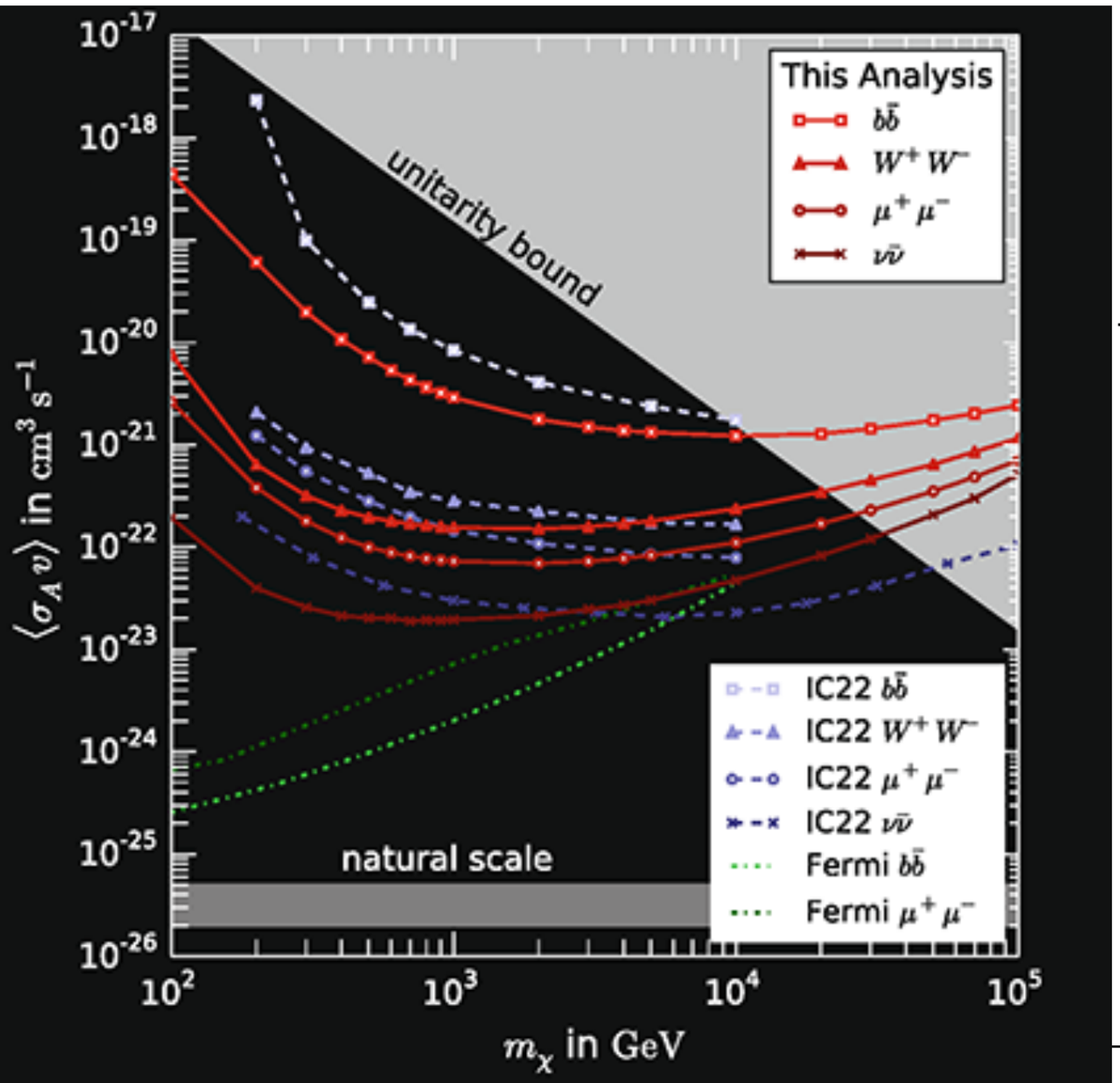

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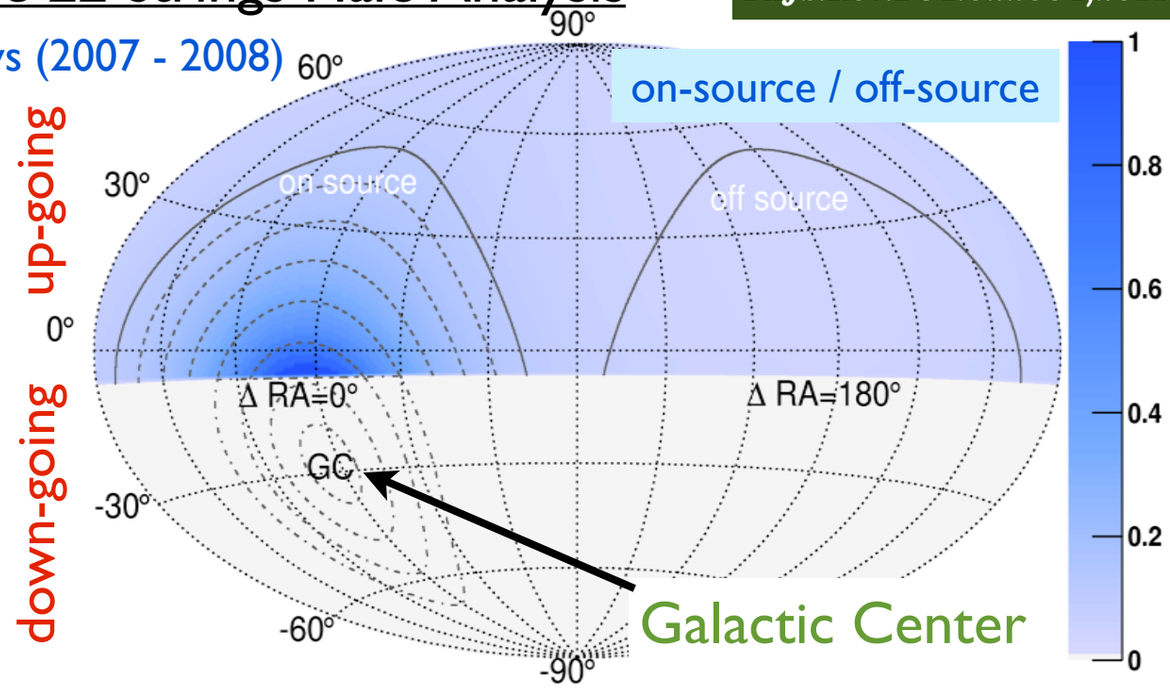

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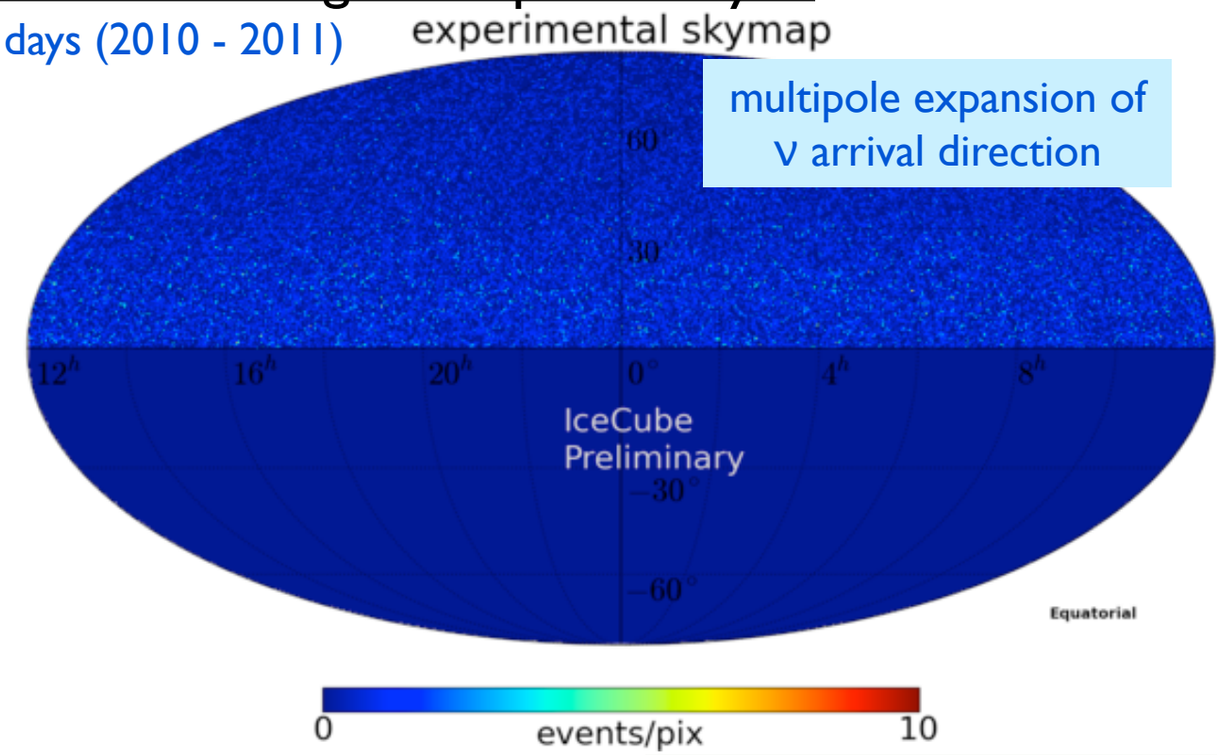
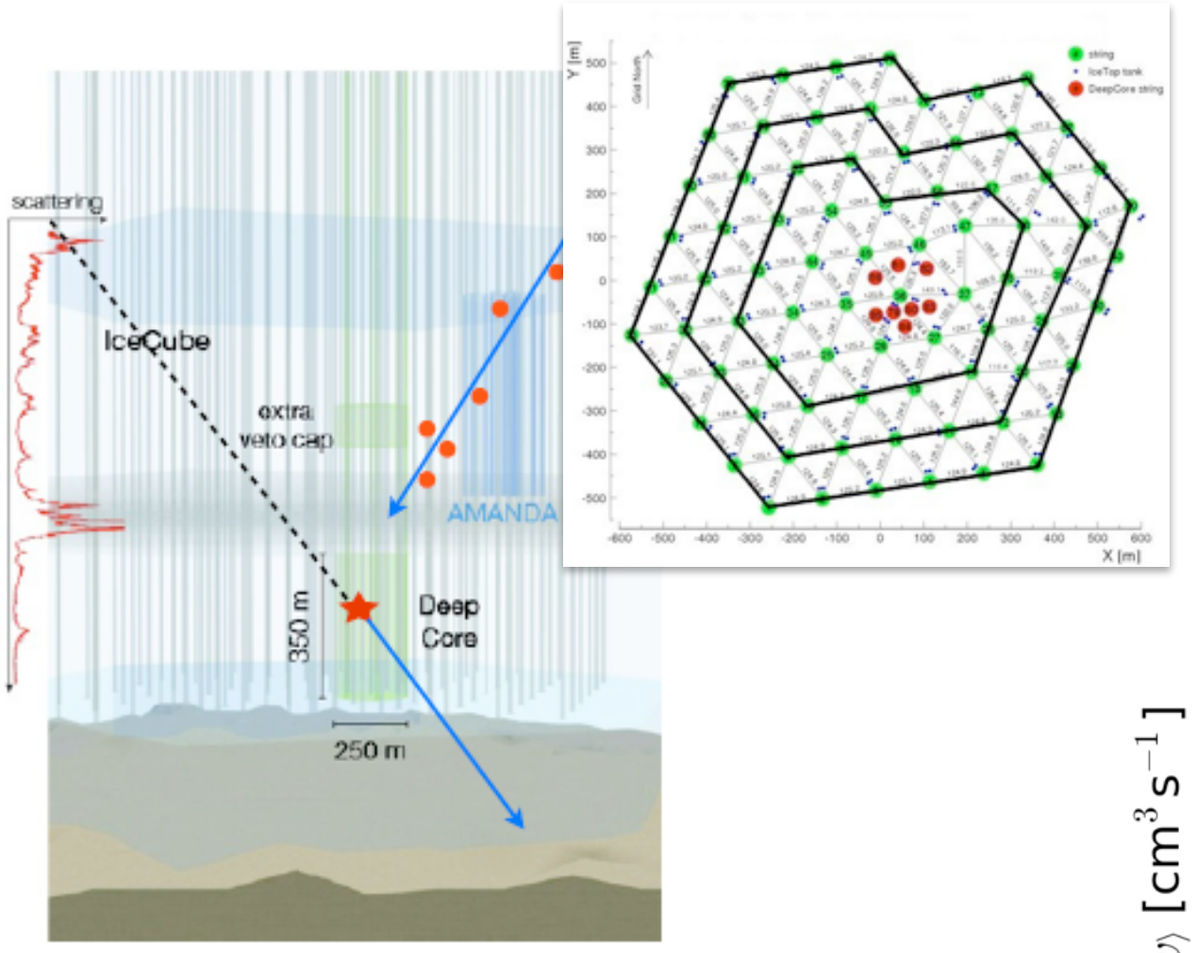
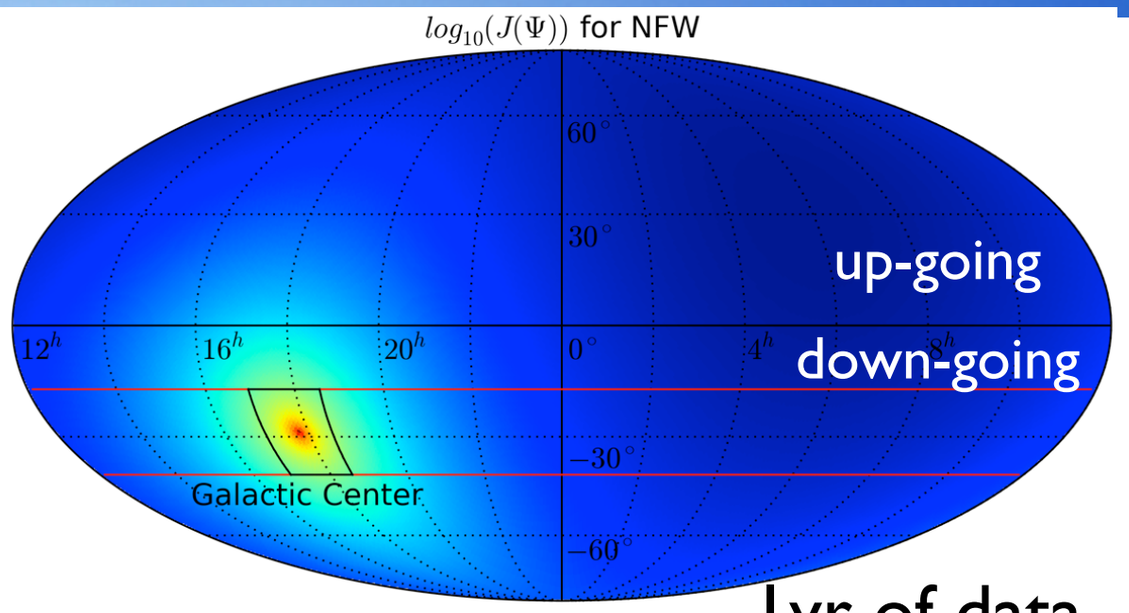


Eur. Phys. J. C75, 20 (Jan 2015)

Galactic Center

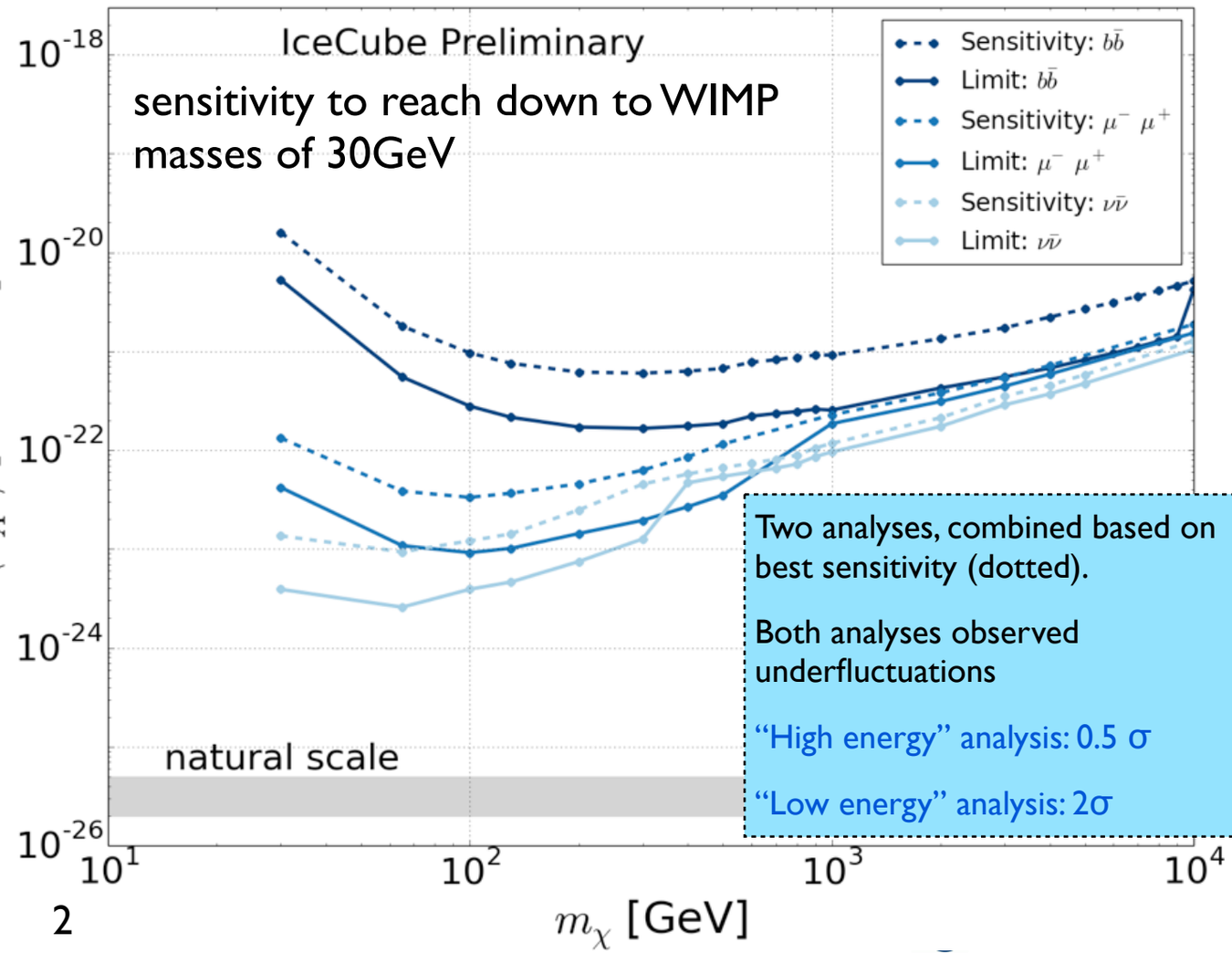
Use IceCube external strings as a veto:
- 3 complete layers around DeepCore (~ 375m)
- Full sky sensitivity: access to southern hemisphere





1yr of data

Separate Low energy and High energy optimizations:
GC is above the horizon
→ Fiducial volume in central strings
→ refined muon veto from surrounding layers
Use scrambled data for background estimation

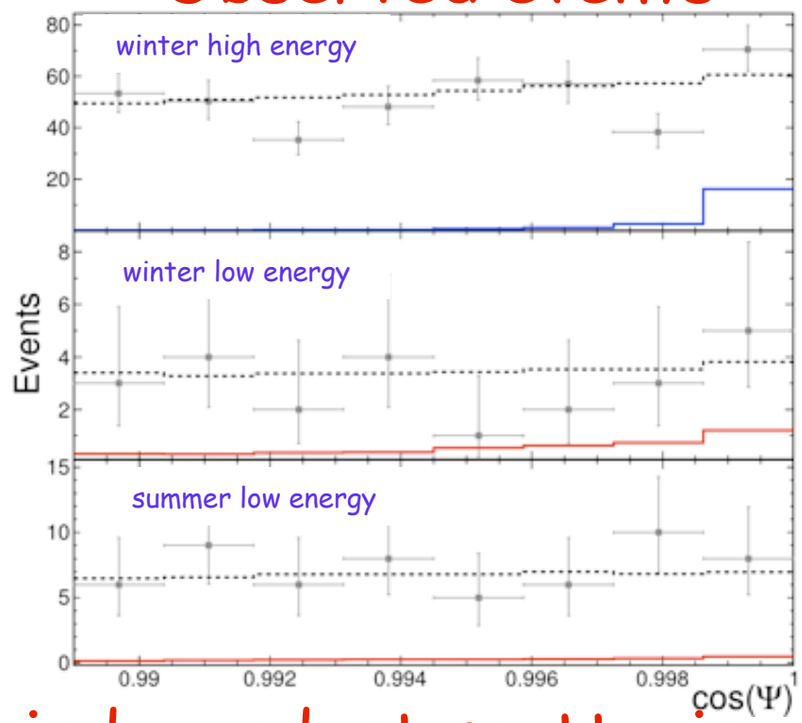


IceCube Solar WIMP Limits

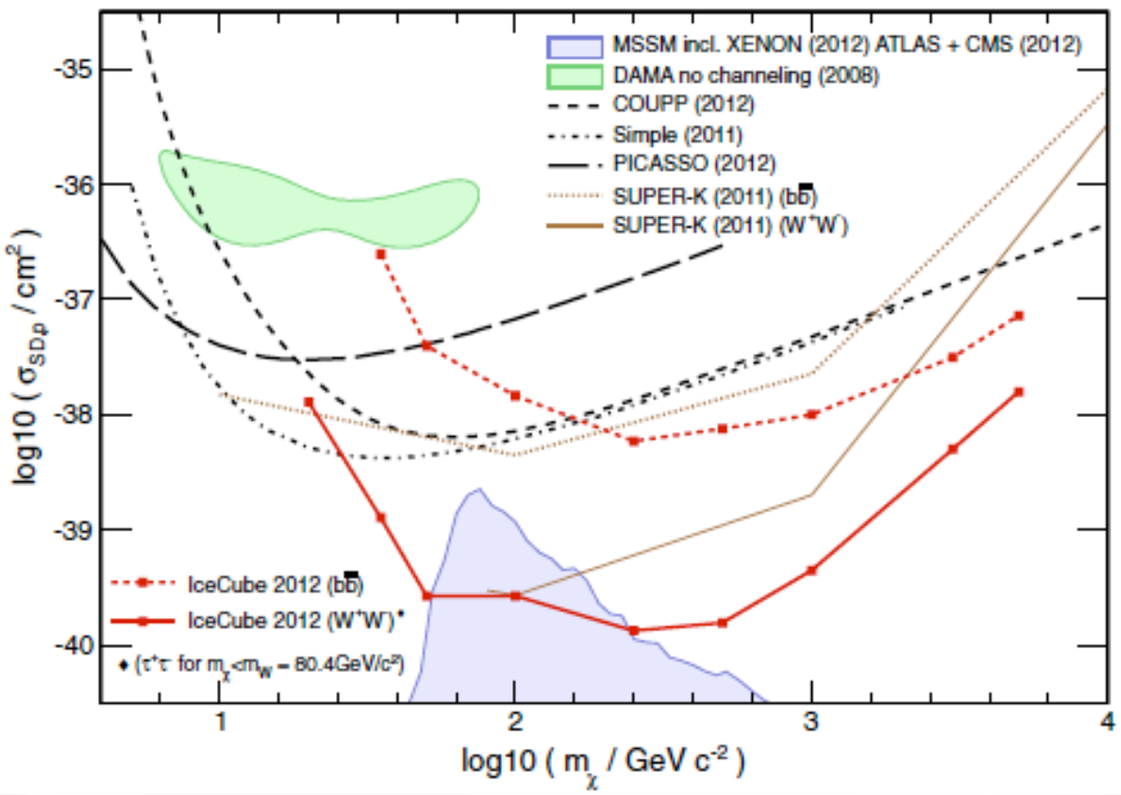
PRL 110, 131302 (2013)

- IceCube 79-strings configuration (partially completed DeepCore)
  - 318 days (May 2010 - May 2011)
- Search for an excess of events from the direction of the Sun
  - use track events for better pointing
- Separate summer and winter analysis
  - use outer detector to veto down-going muons for summer analysis

Observed events



Spin-dependent scattering



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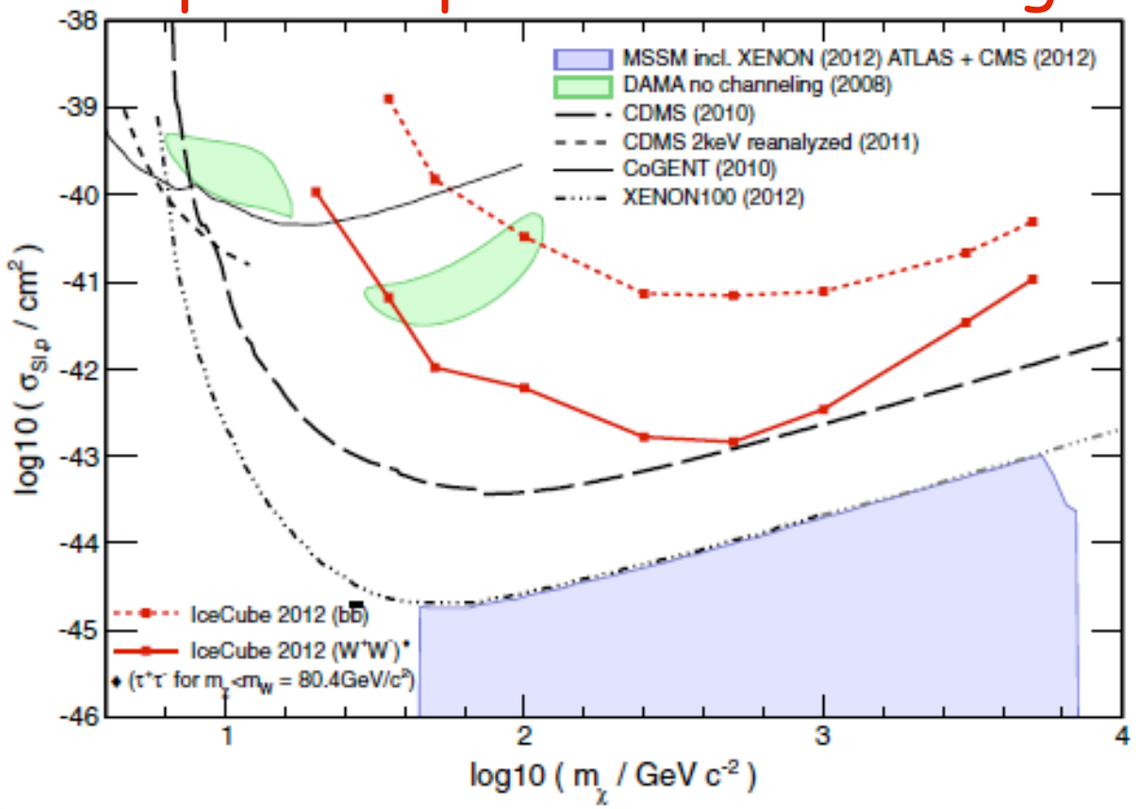
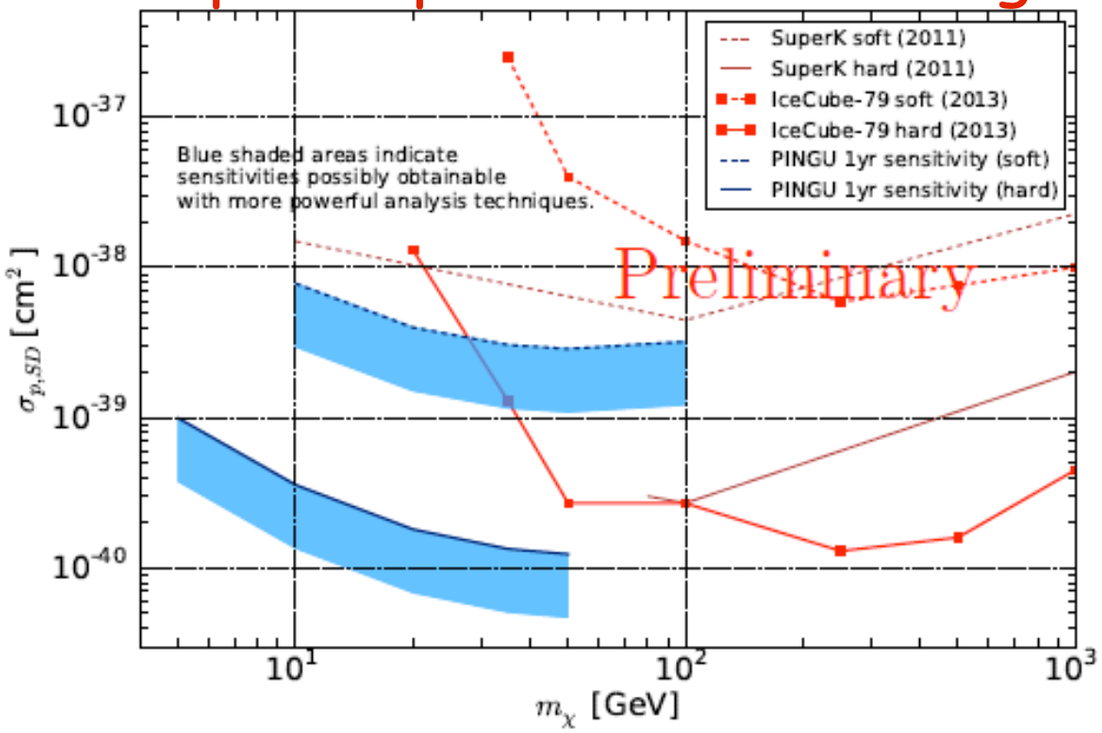


PINGU Dark Matter Sensitivity

- Solar WIMP dark matter
  - Sensitivity reaches to WIMP masses of ~5 GeV
  - World-leading limits for SD WIMPs with one year of data
- Low mass WIMP region testable

Spin-dependent scattering



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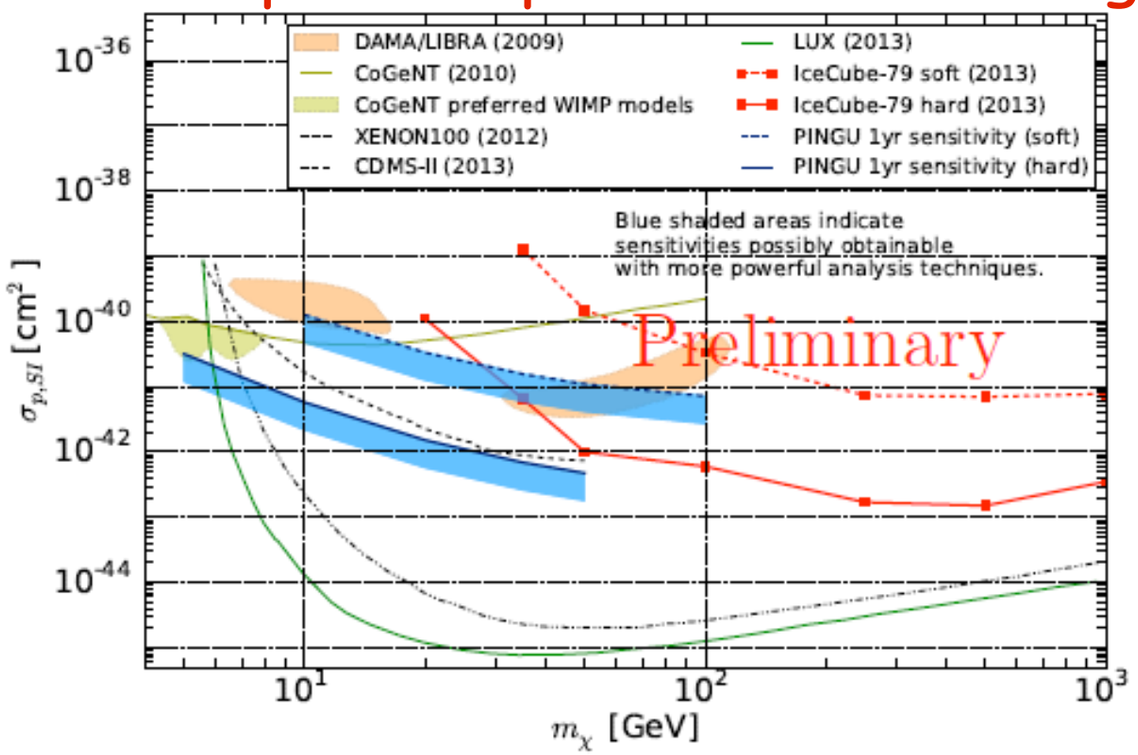


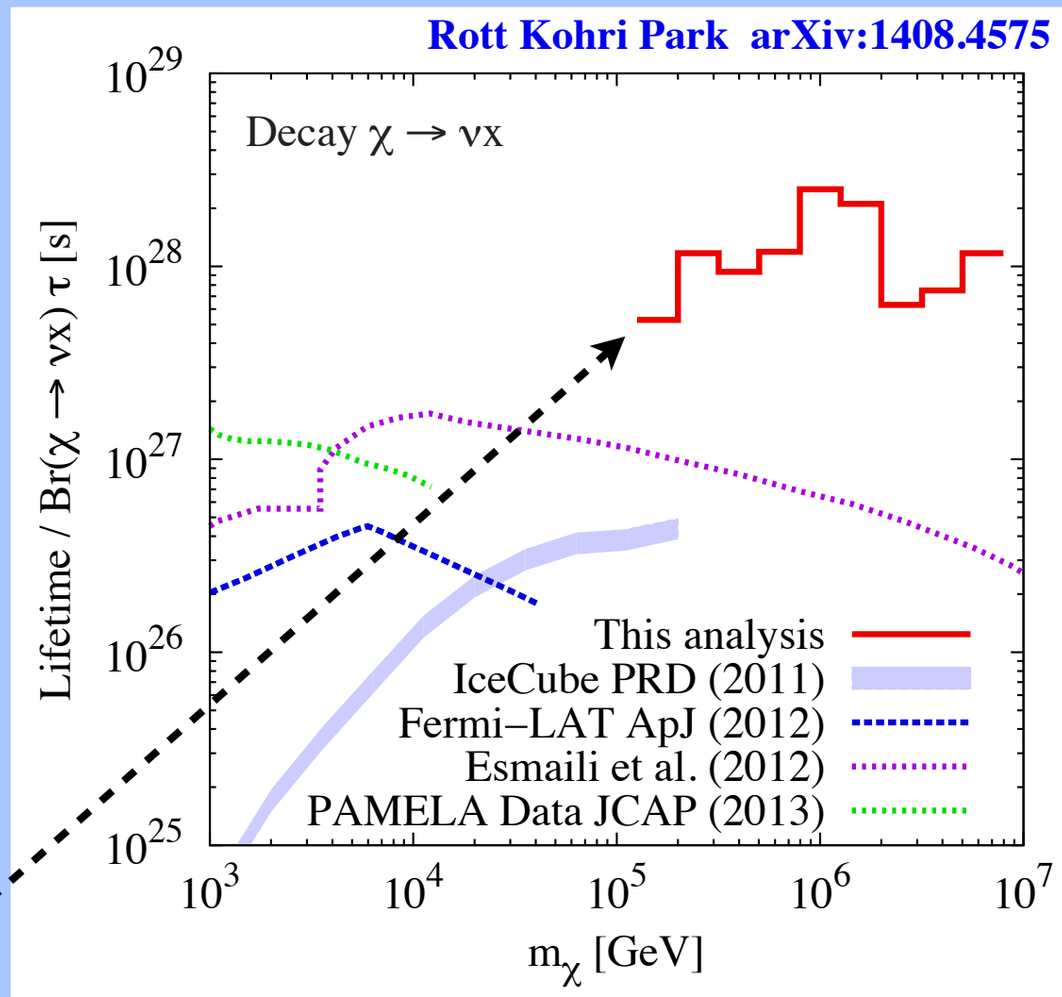
Heavy DM Decay / Motivation Gen2

Heavy Dark Matter

- Heavy Decaying DM (example $\chi \rightarrow \nu h$)
- Focus on most detectable feature (neutrino line)
- Backgrounds steeply falling with energy, highest energy events provide best sensitivity
- Continuum and spacial distribution could help identify a signal
- Bounds from Fermi-LAT and PAMELA derived from search for bb annihilation channel (dominant decay channel of Higgs).

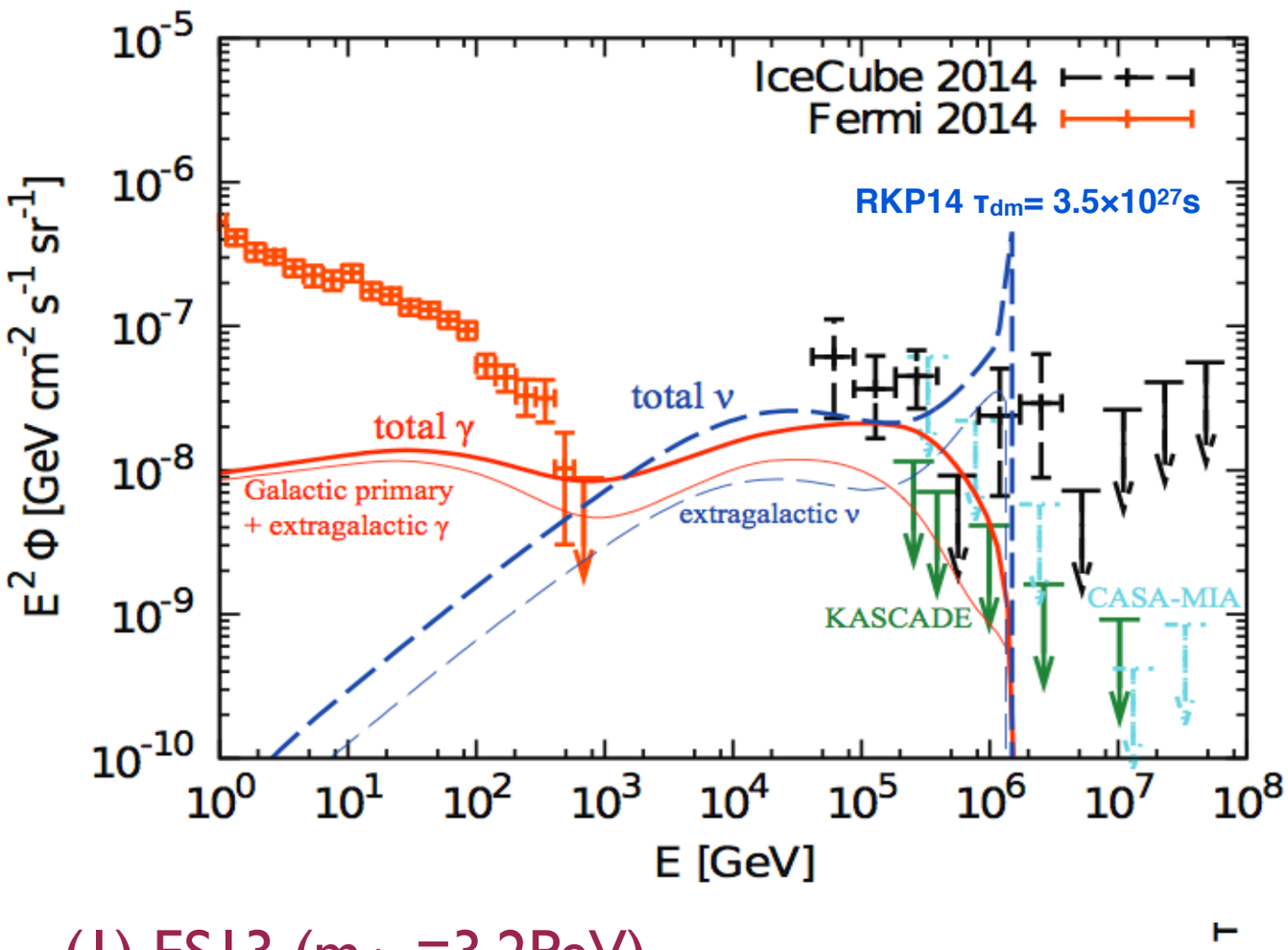
Derived limit with HESE 3yr sample. DedicatedIceCube analysis has started and can improve on this ! Key: Make use of the good energy resolution of high energy cascades

Bounds on Dark Matter Decay



Heavy DM bounds with neutrinos, see also
Murase and Beacom JCAP 1210 (2012) 043
Esmaili, Ibarra, and Perez JCAP 1211 (2012) 034

High Mass DM Sensitivity

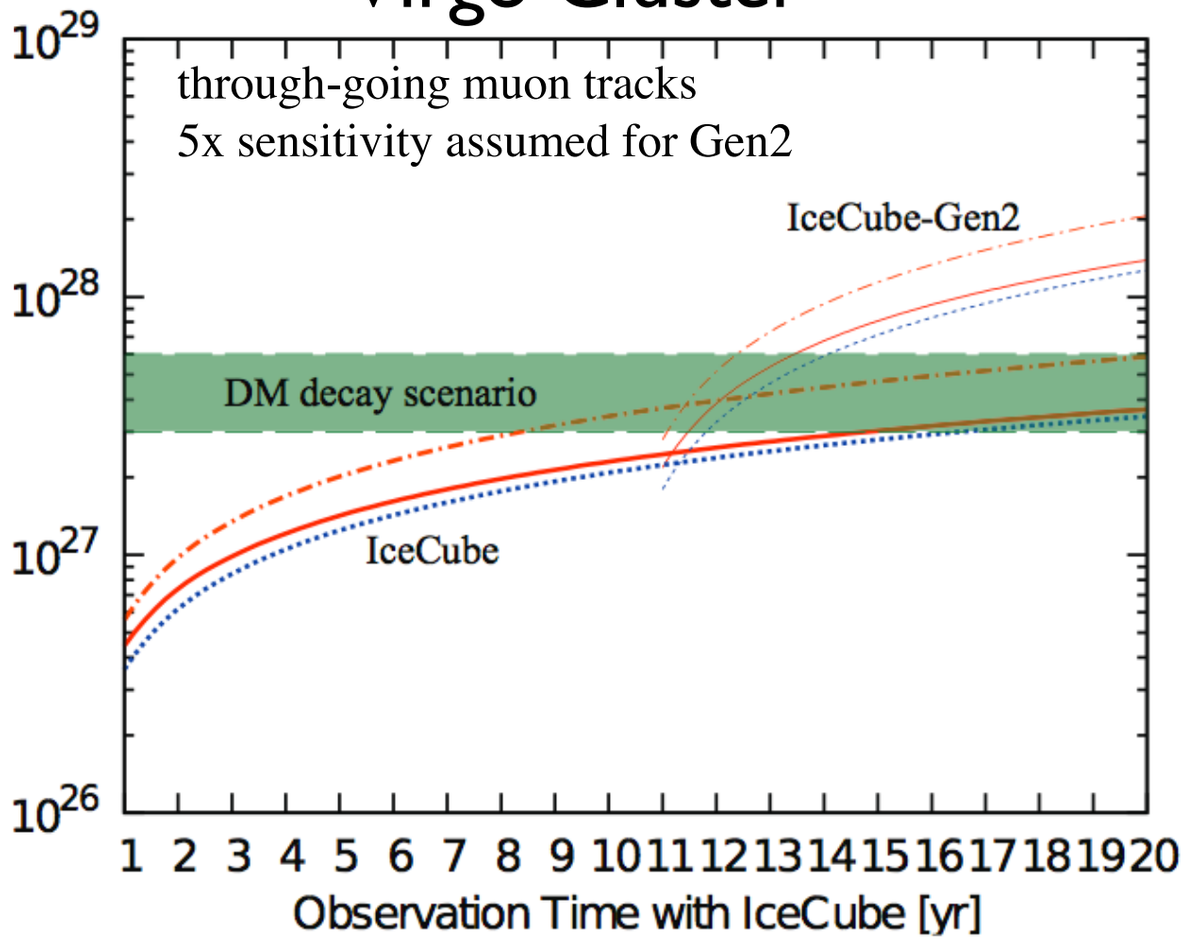


(1) ES13 (m_{dm}=3.2PeV)
DM→$\nu_e\nu_e$(12%) qq(88%)
(2) RKP14 (m_{dm}=2.4PeV)
DM→νh
(3) HKS14 (m_{dm}=2.4PeV)
DM→$l^{\pm}W^{\mp}$ DM→νZ DM→νh≈2 : 1 : 1

A. Esmaili and P. D. Serpico, JCAP1311, 054 (2013)
T. Higaki, R. Kitano, and R. Sato, JHEP1407, 044 (2014), 1405.0013
C. Rott, K. Kohri, and S. C. Park (2014), 1408.4575

Murase, Laha, Ando, Ahlers
http://arxiv.org/abs/1503.04663v1

Sensitivity for M31 + Virgo Cluster



VHDM scenario can be ruled out or in three-to-five years with Gen2