Constraints on dark matter annihilation and decay from ν_e cascades

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Cosmic rays observed by PAMELA/Fermi

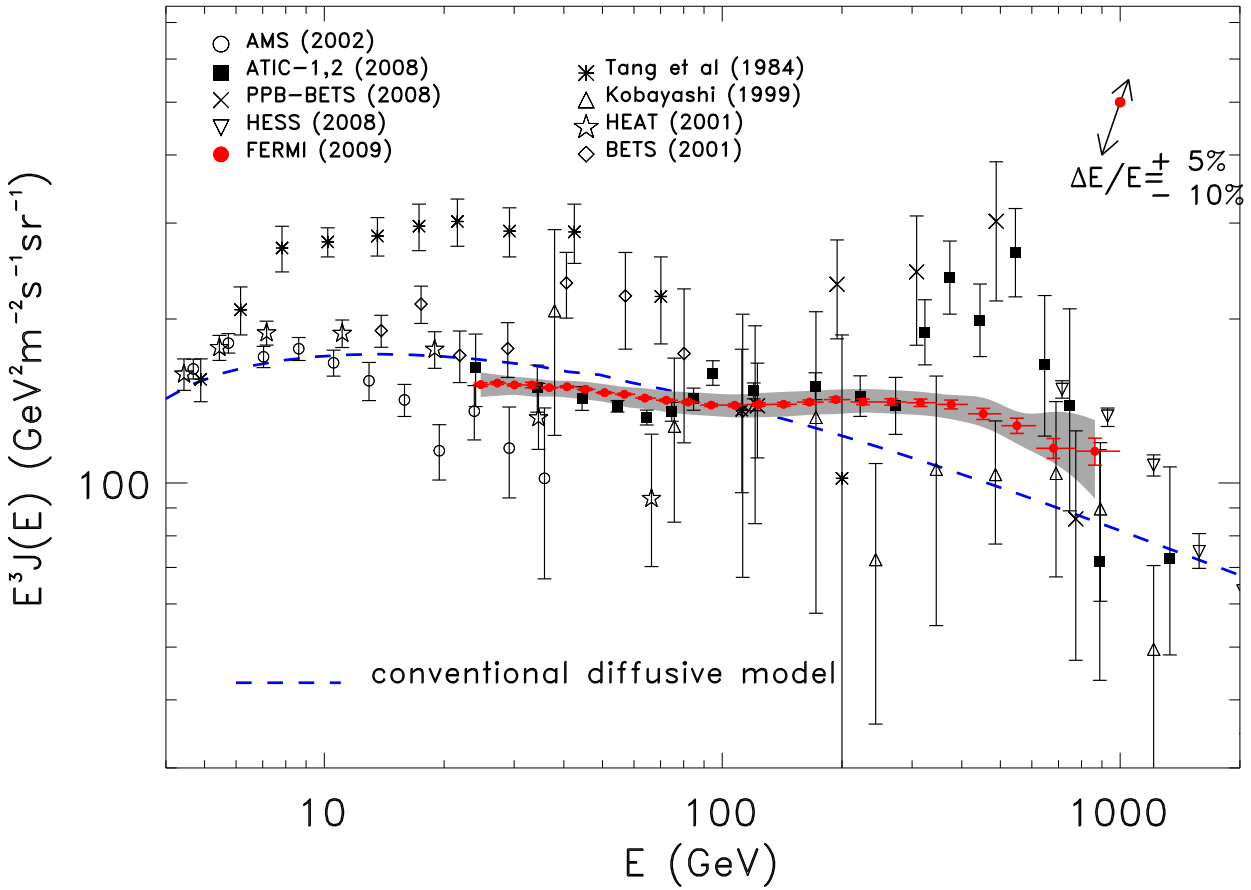

Figure: Fermi/LAT Collaboration, arXiv:0905.0025

Existing galactic constraints (ann.)

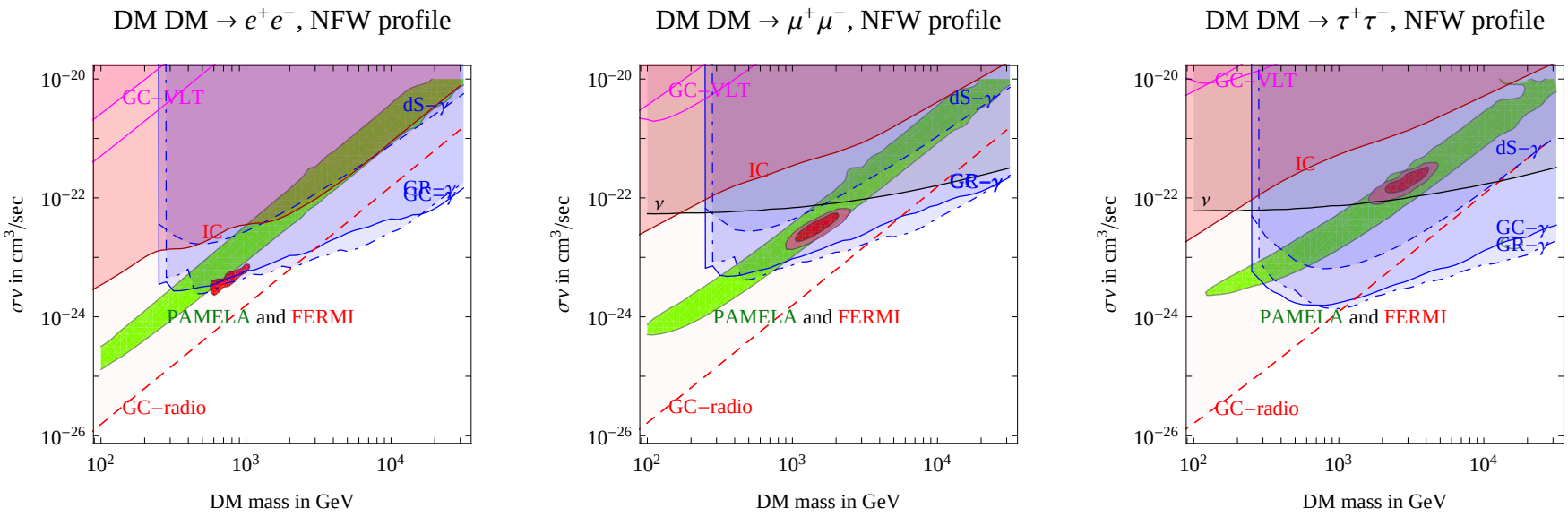

Figure: Meade et al., arXiv:0905.0480

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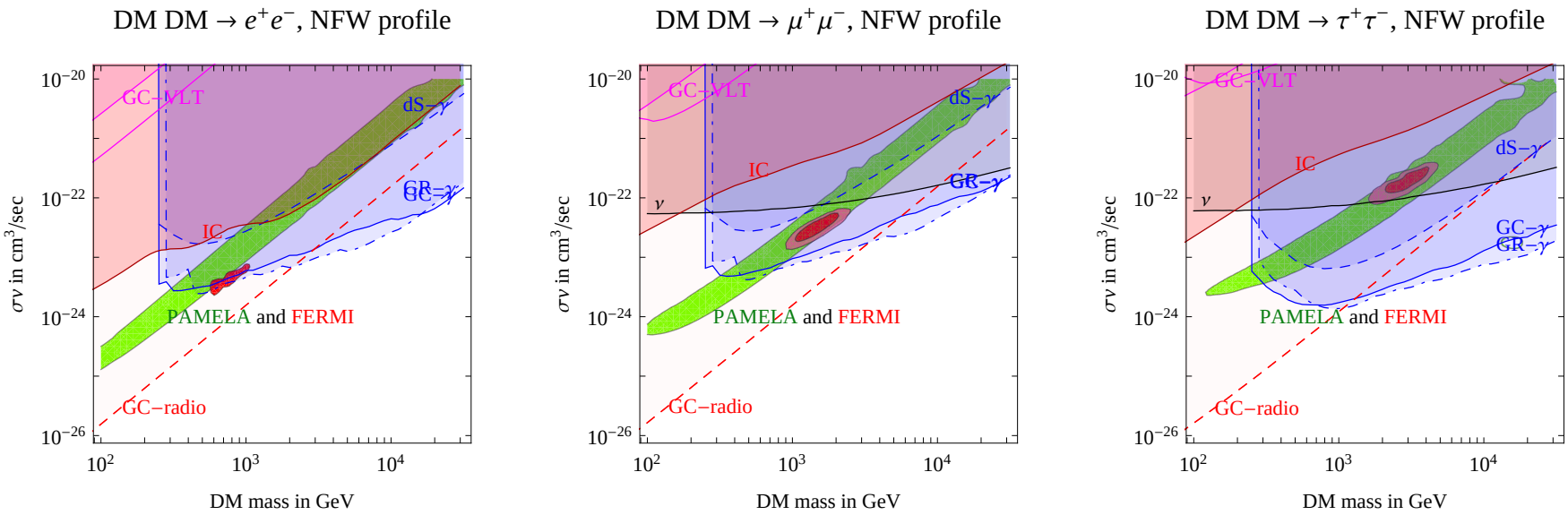
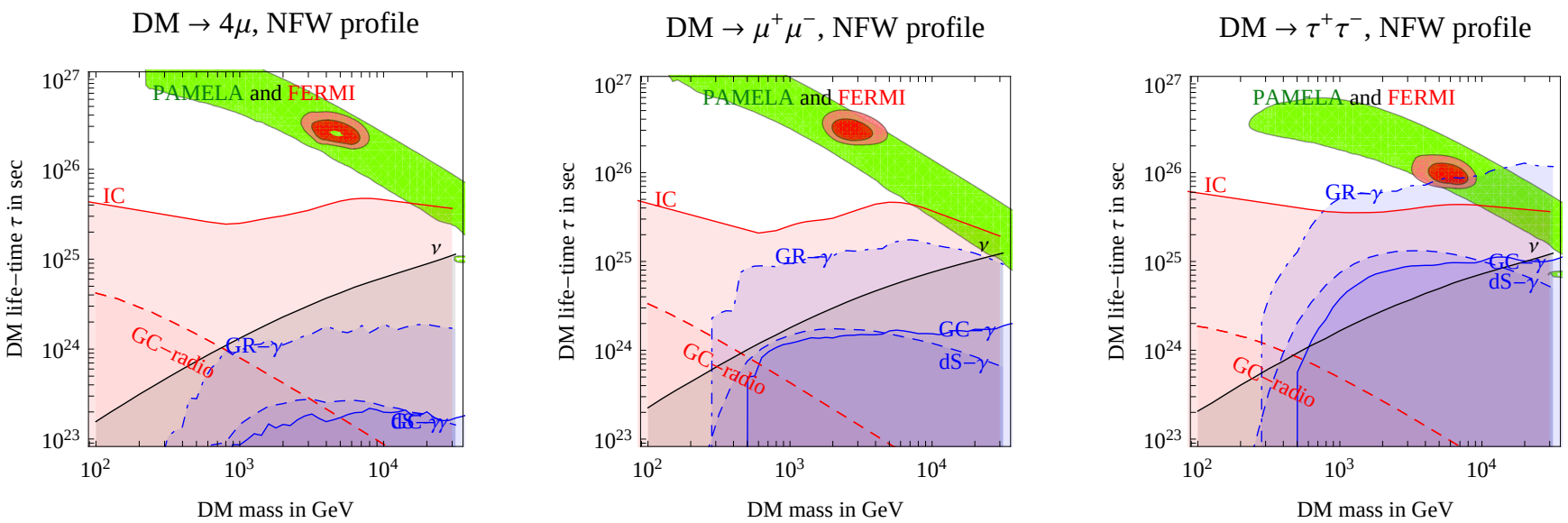


Figure: Meade et al., arXiv:0905.0480

ν_μ-induced upgoing muon at Super-K provides most robust constraint (Hisano, Nakayama, Yang, arXiv:0905.2075)

Existing galactic constraints (decay)



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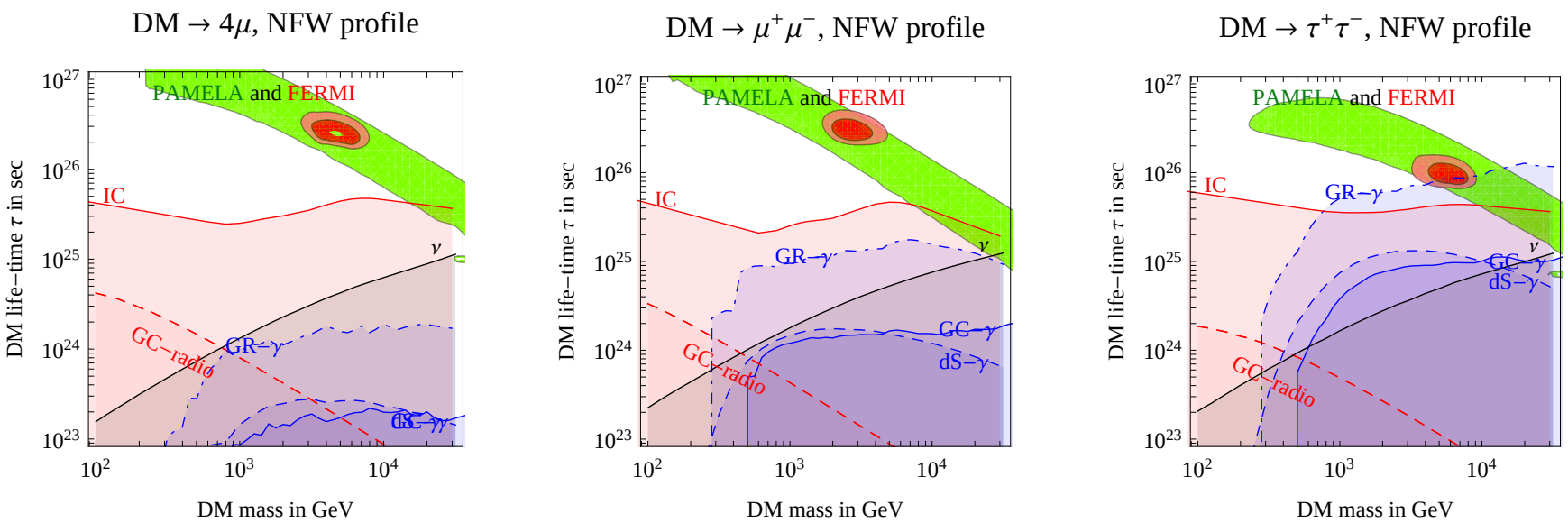

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Rising cross-section and effective volume gives strong constraint at higher masses

Improving ν constraints with DeepCore

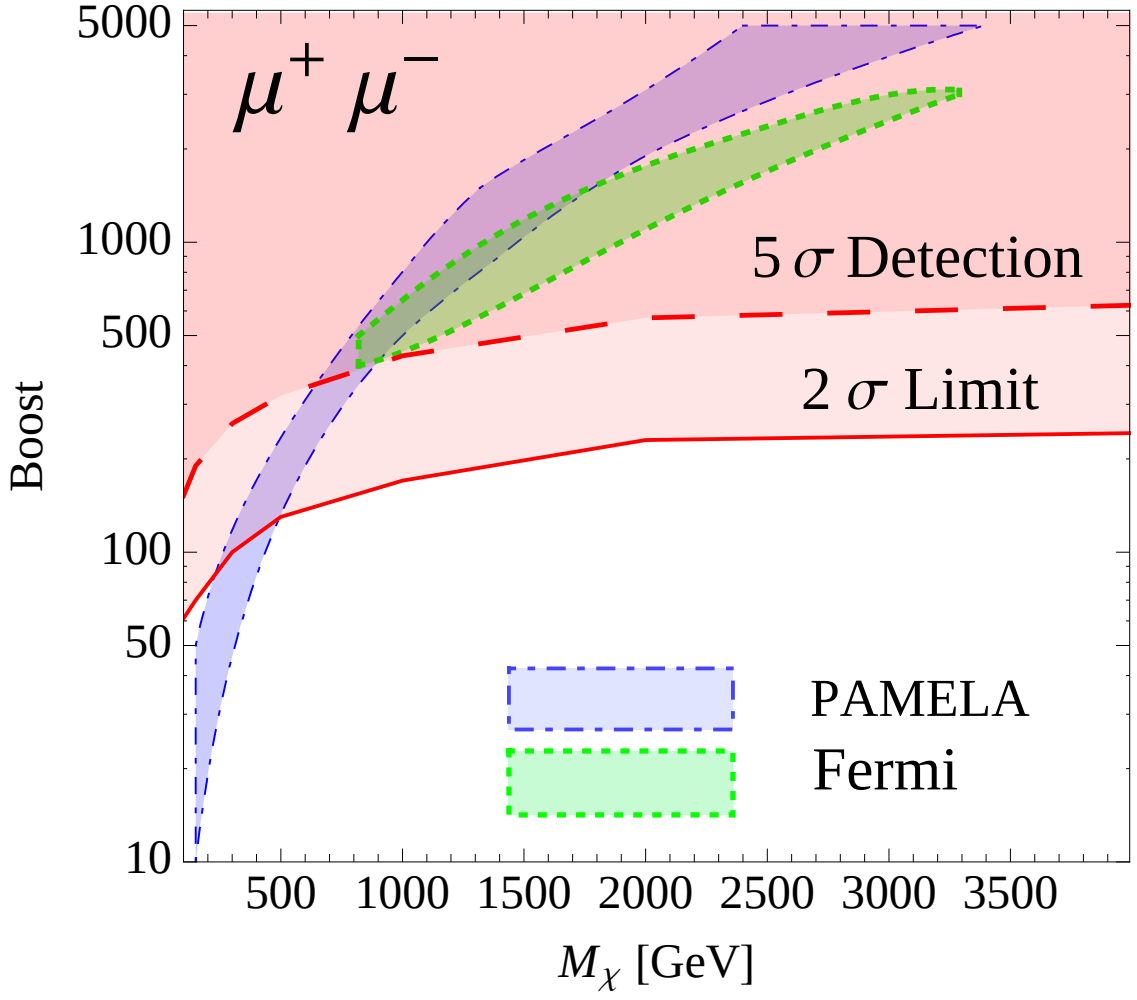

Figure: Spolyar, et al. arXiv:0905.4764

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- Last week at ICRC, IceCube announced ability to reliably identify cascade-type events in simulation (Middell, et al.)

Rationale for cascade search (cont'd)

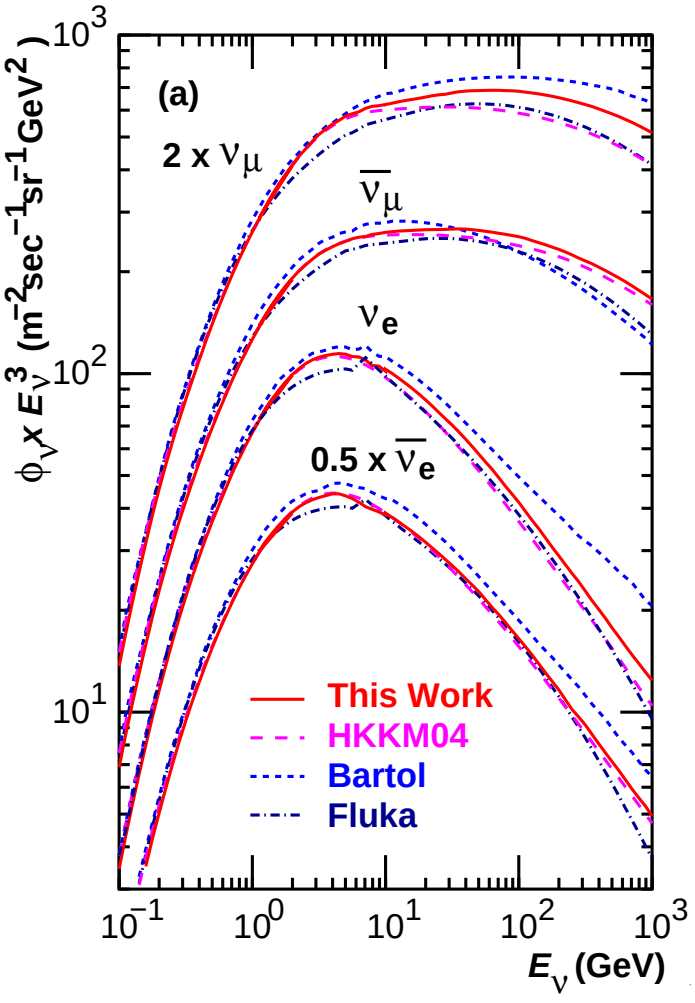

Figure: Honda et al., arXiv:astro-ph/0611418

Simulation

Follow prescription of Spolyar, et al.:

- Observe half-sky ($\Omega = 2\pi$) towards galactic center w/ NFW profile
- Assert atmospheric ν background
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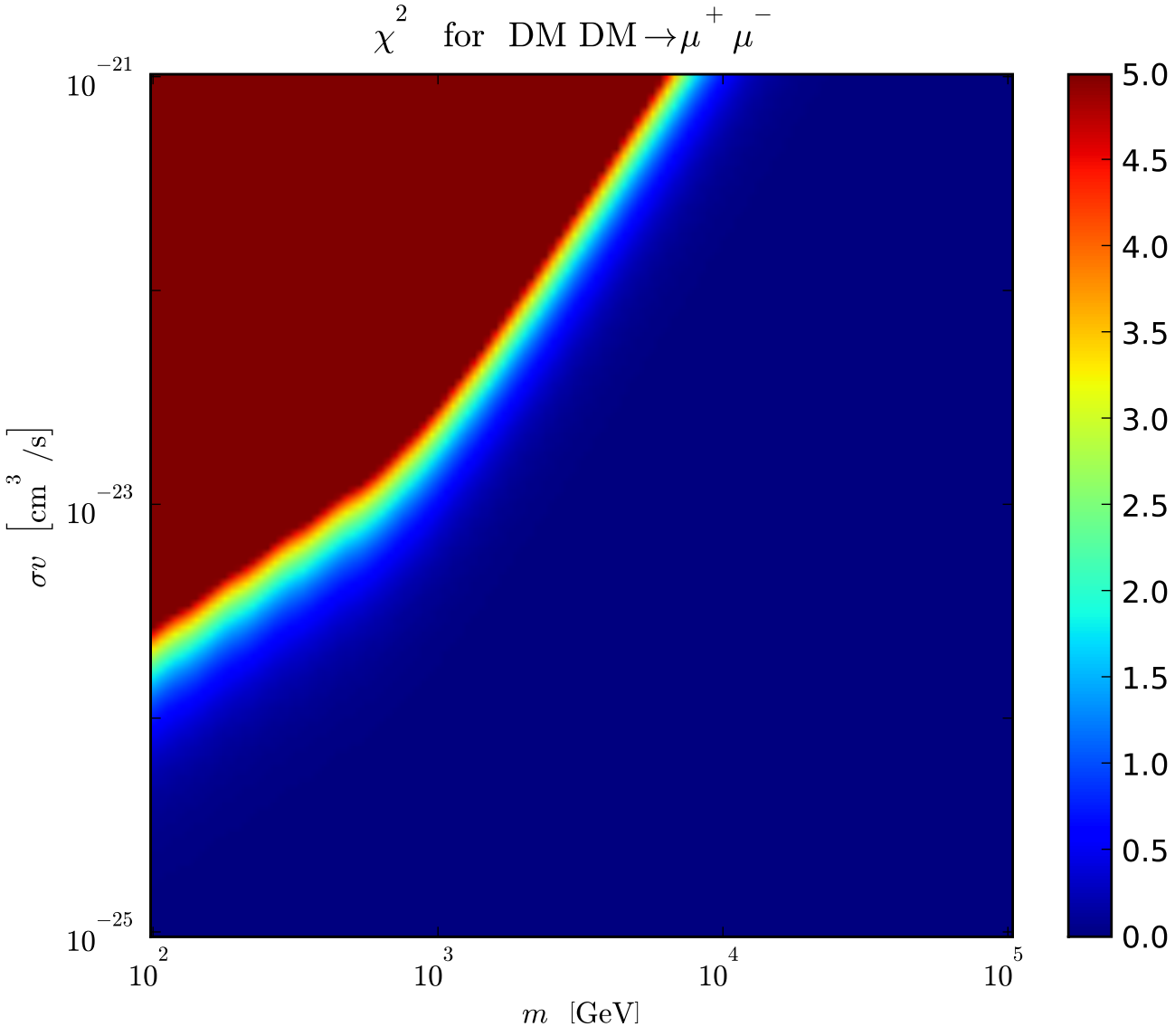
- Observe half-sky ($\Omega = 2\pi$) towards galactic center w/ NFW profile
- Assert atmospheric ν background
- Simulate final states with PYTHIA, track products down to 10 GeV
- Use geometric volume of DeepCore as effective volume (smaller than effective volume for contained muon)
- Also consider diffuse flux limit approaching unitarity limit ($\approx$100 TeV), useful for certain SUSY models (e.g., GMSB hidden sector)

Annihilation @ 5 DeepCore-years



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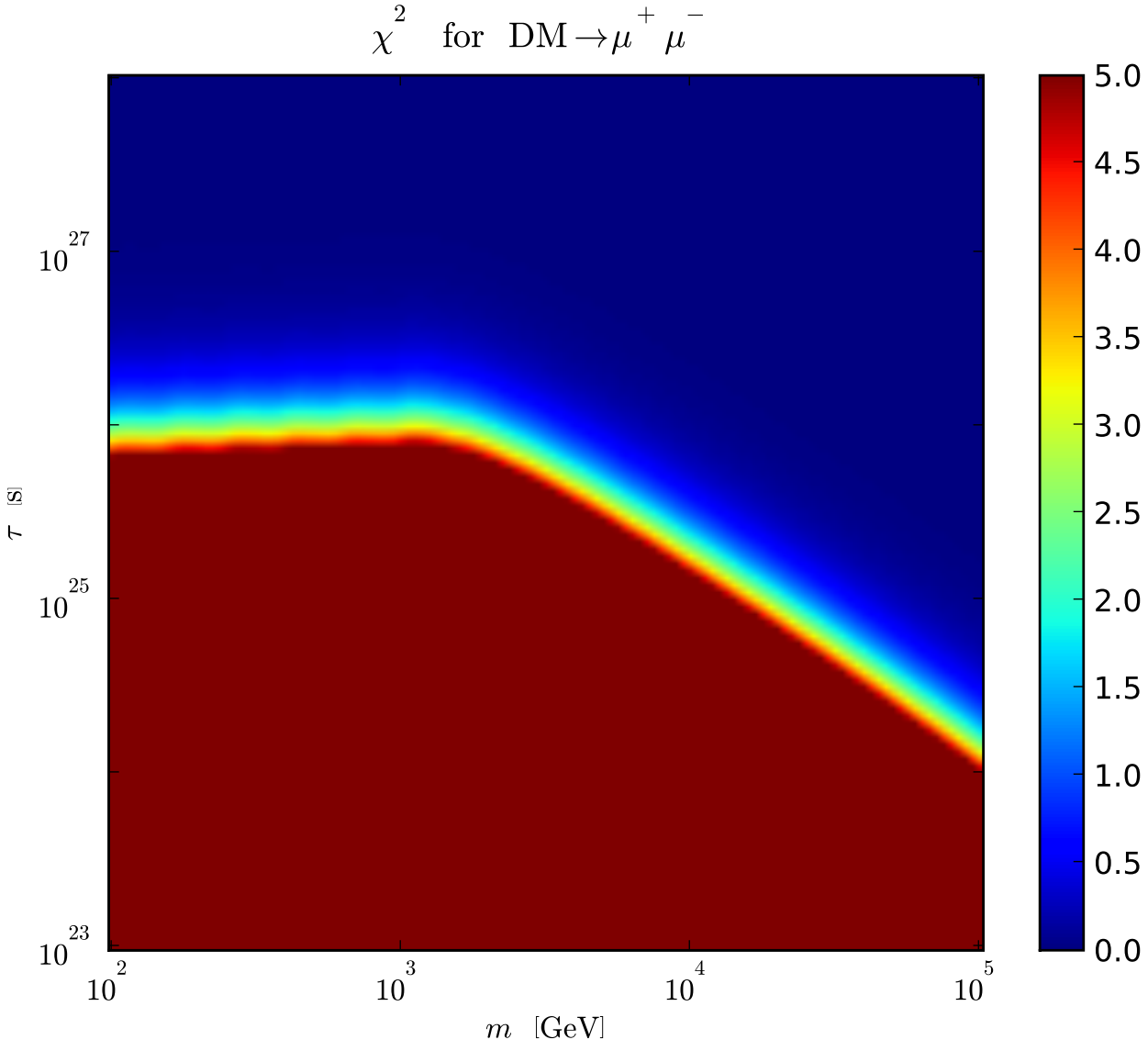

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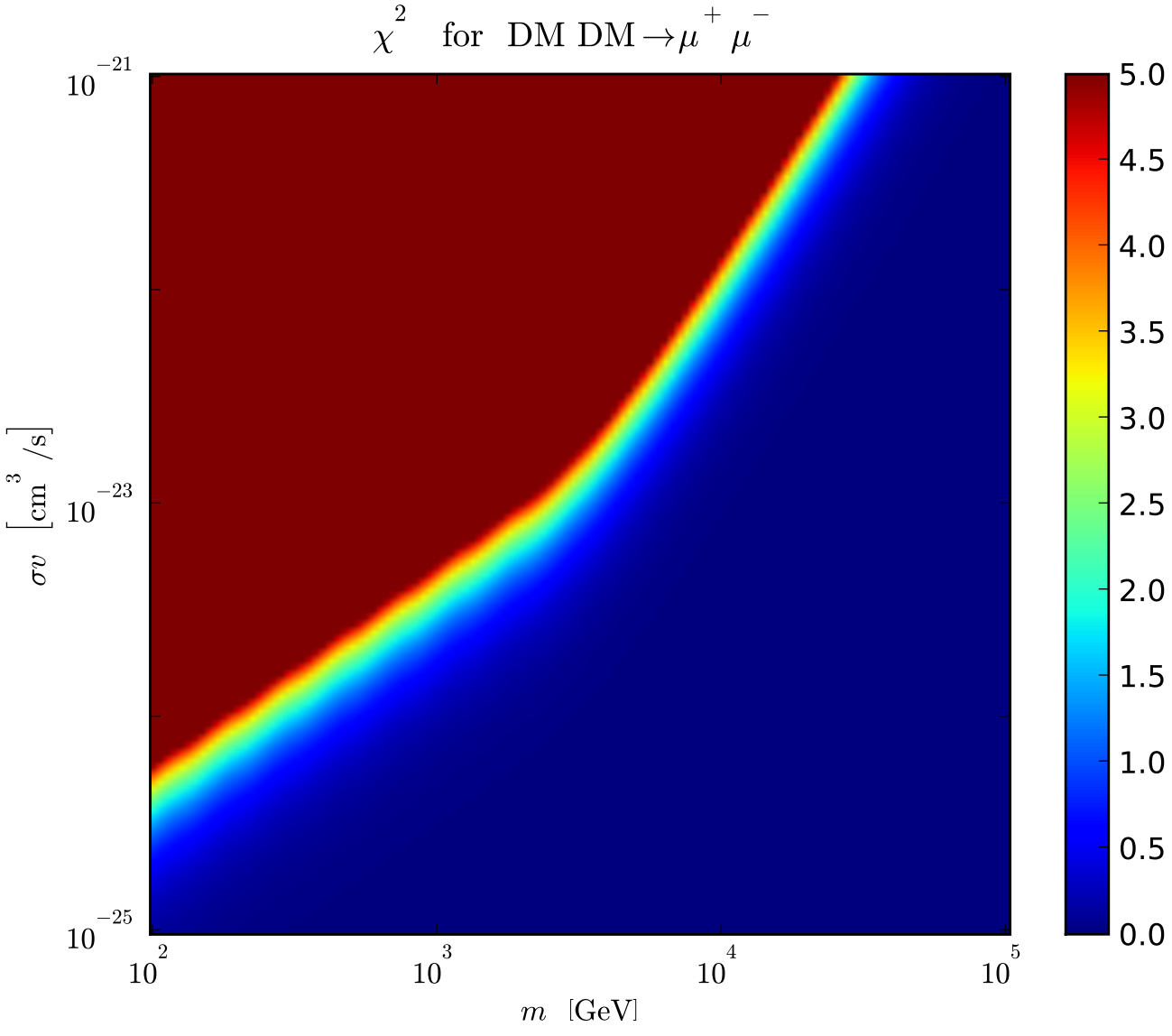
- Shape of χ^2 map changed by accumulation of background, but significance always improves.
- Use same cross-section νN and source flux, so must resolve discrepancy with authors of original paper ...
- For low exposure, still match performance at m =100 GeV

Annihilation @ 100 DeepCore-years



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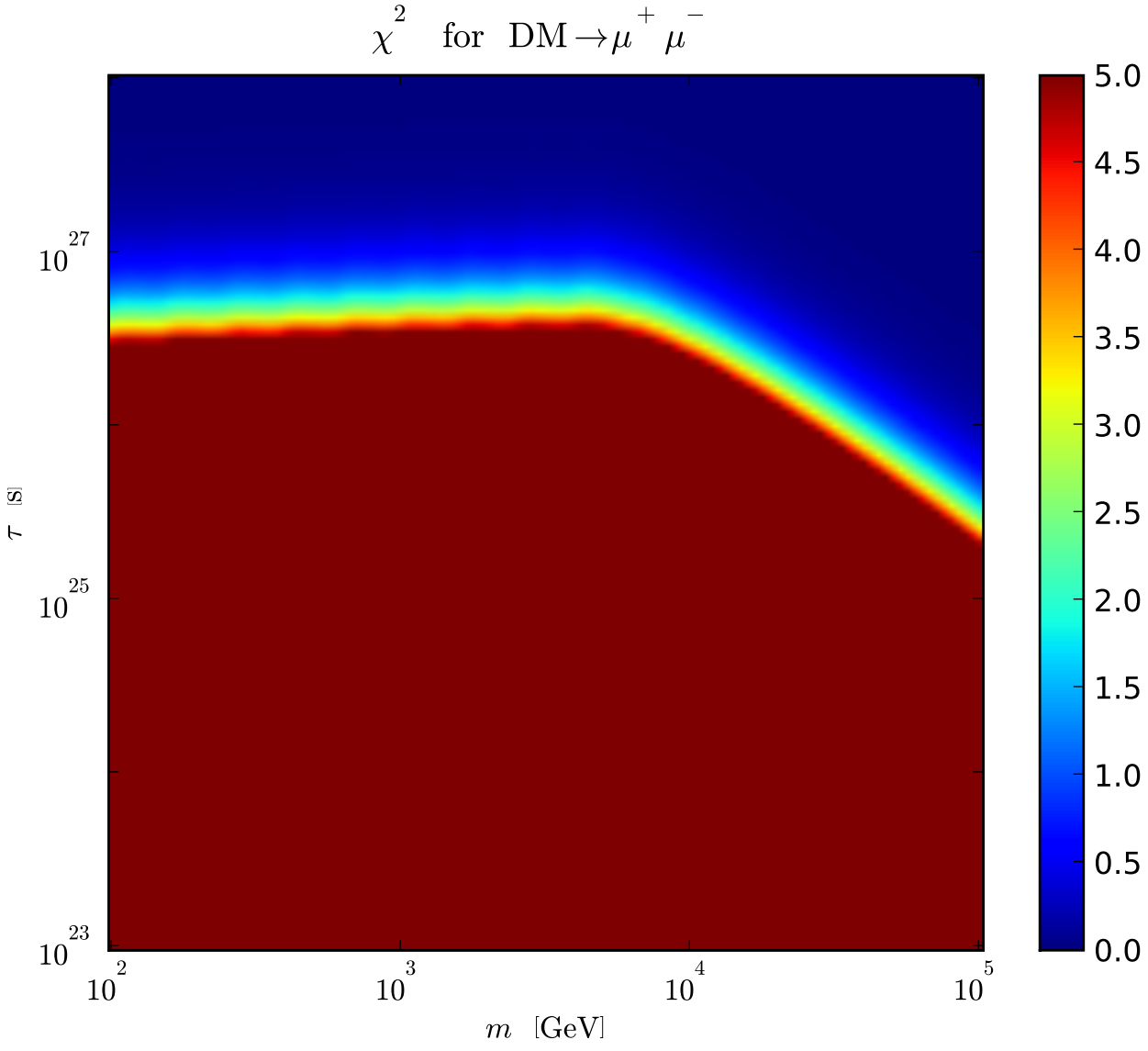

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- Cascade search **should** surpass contained-muon events ...
- Nonetheless, strong overall constraints on DM annihilation and decay
- Diffuse flux limit can put very strong constraint on decays of superheavy DM, but would need much larger volume with muon-veto