

Dark Matter Pollution in the Diffuse Supernova Neutrino Background

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in collaboration with

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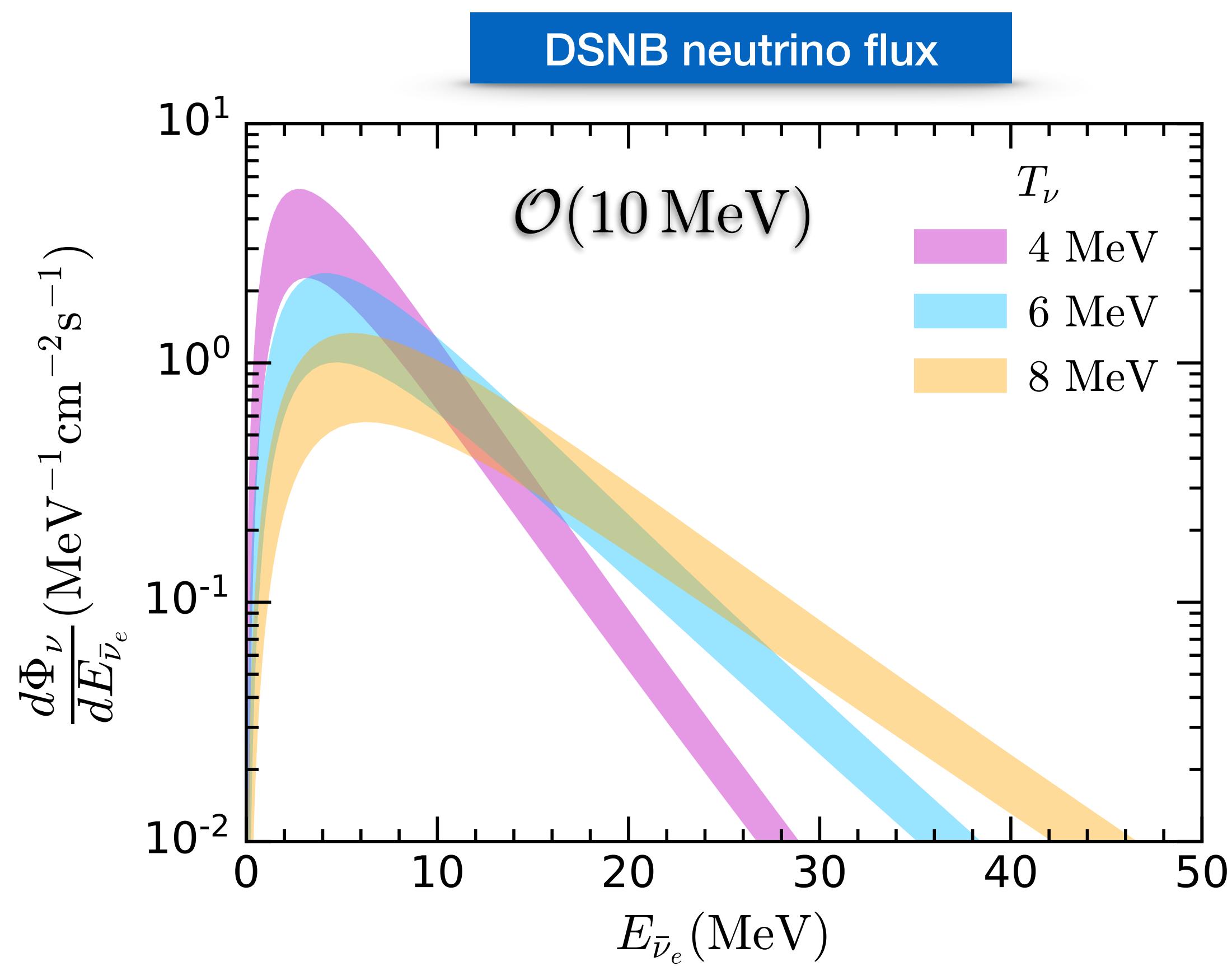
[arXiv: 2205.14123](https://arxiv.org/abs/2205.14123), JCAP 11 (2022) 060



Introduction

Diffuse Supernova Neutrino Background (DSNB)

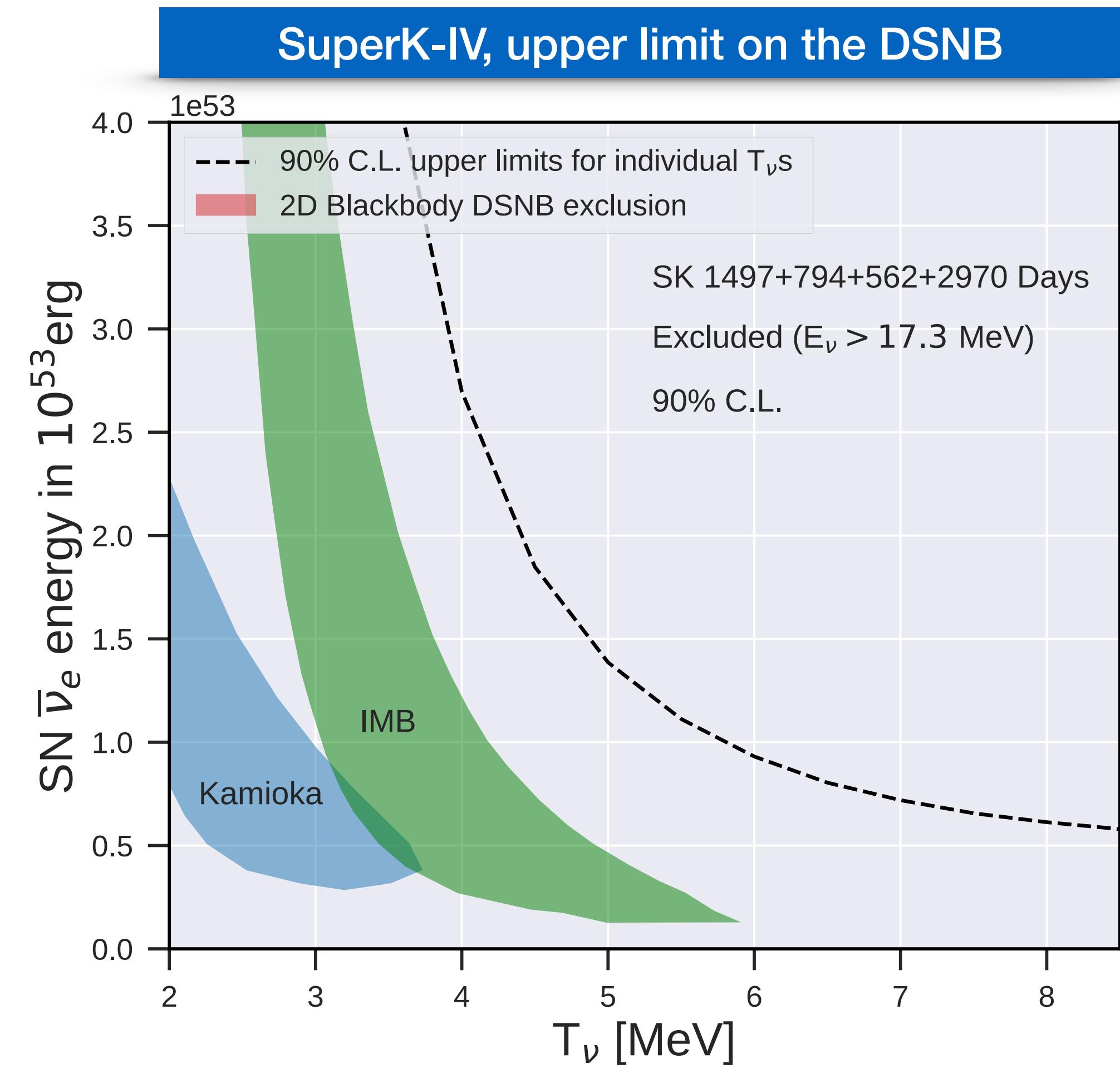
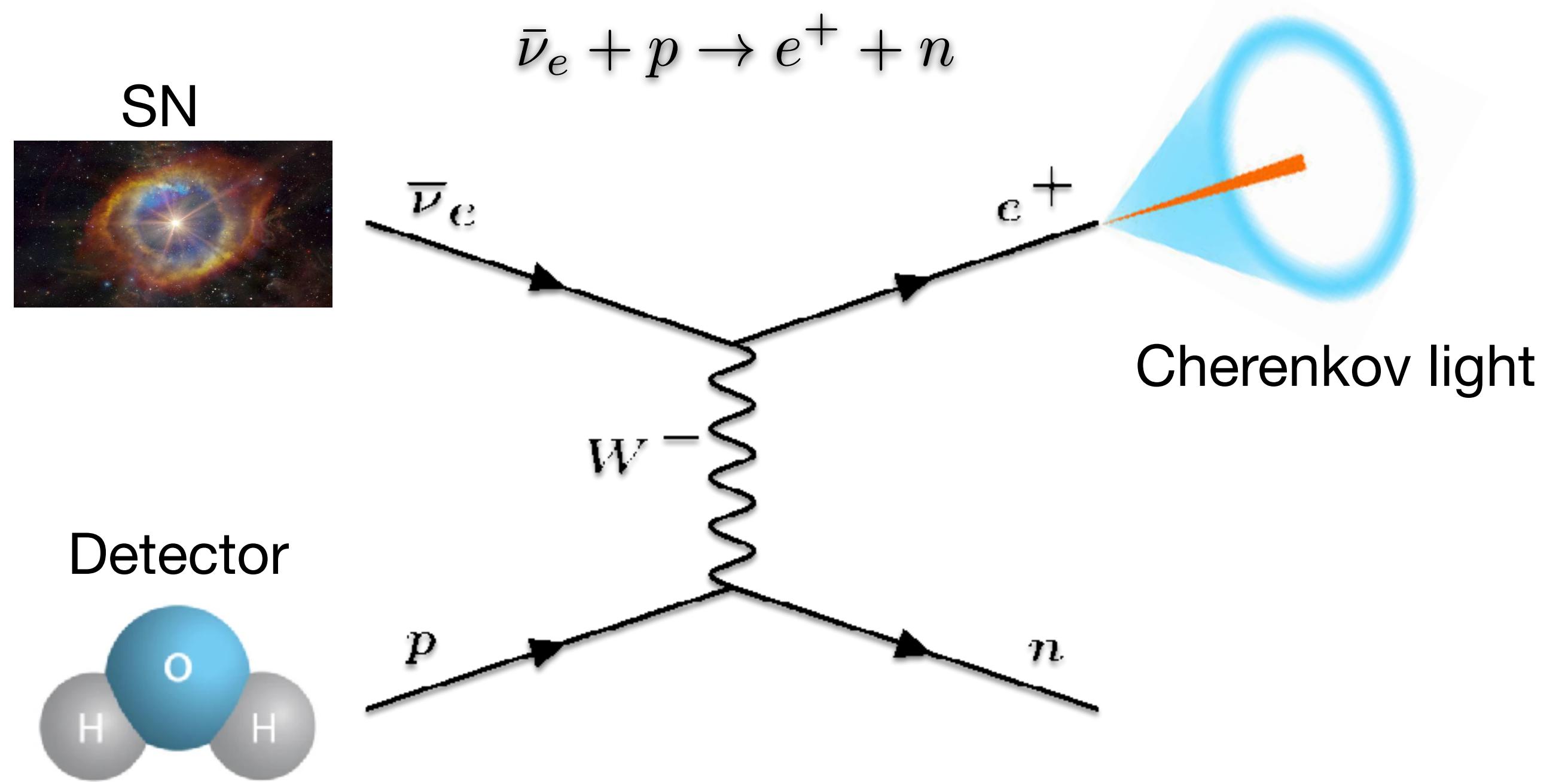
- DSNB: Neutrinos from all previous SNe in the Universe
 - ➡ Isotropic signal, quasi-thermal spectrum
 - ➡ Not discovered yet
 - ➡ In the reach of upcoming neutrino detectors
- Galactic supernovae are rare (~ few per century)



Introduction

DSNB searches

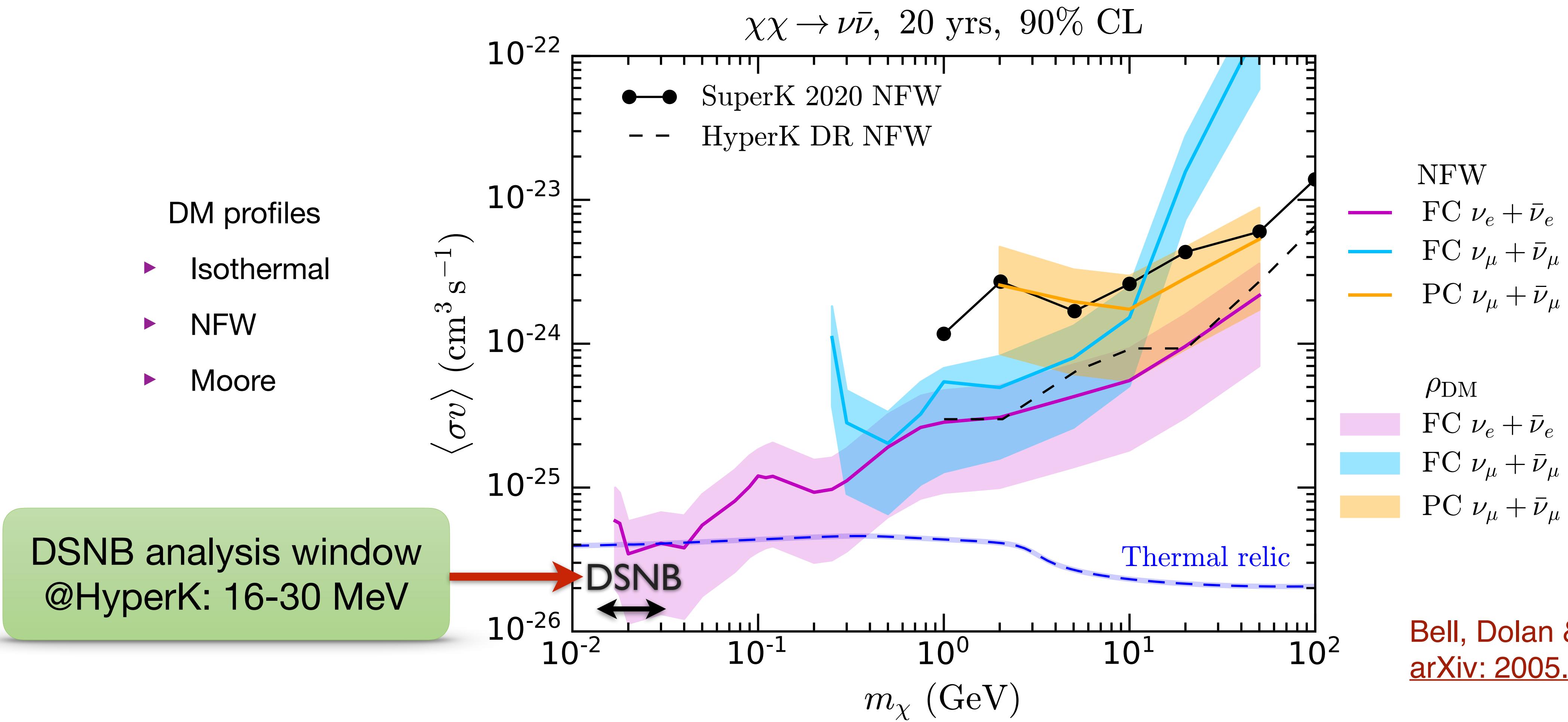
- Water Cherenkov detectors
- ➡ Channel: Inverse beta decay (IBD)



SuperK Collaboration arXiv: 2109.11174

Introduction

- HyperK should be able to probe thermal annihilation cross-sections for DM of mass $\sim 20 - 40$ MeV for annihilation into neutrinos.



Can neutrinos from DM annihilation
contribute a significant background
to DSNB searches?

next

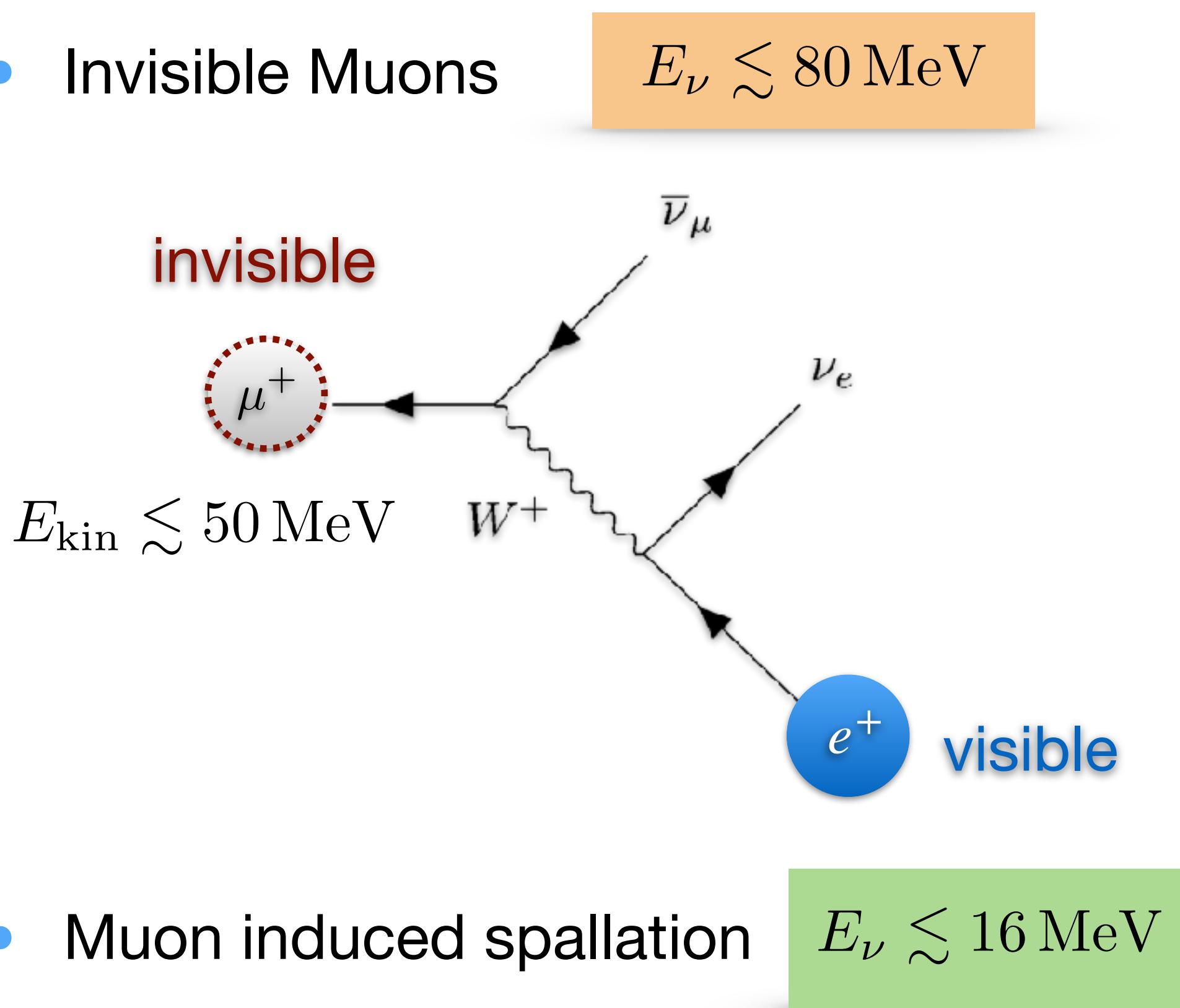
5

Background for DSNB searches

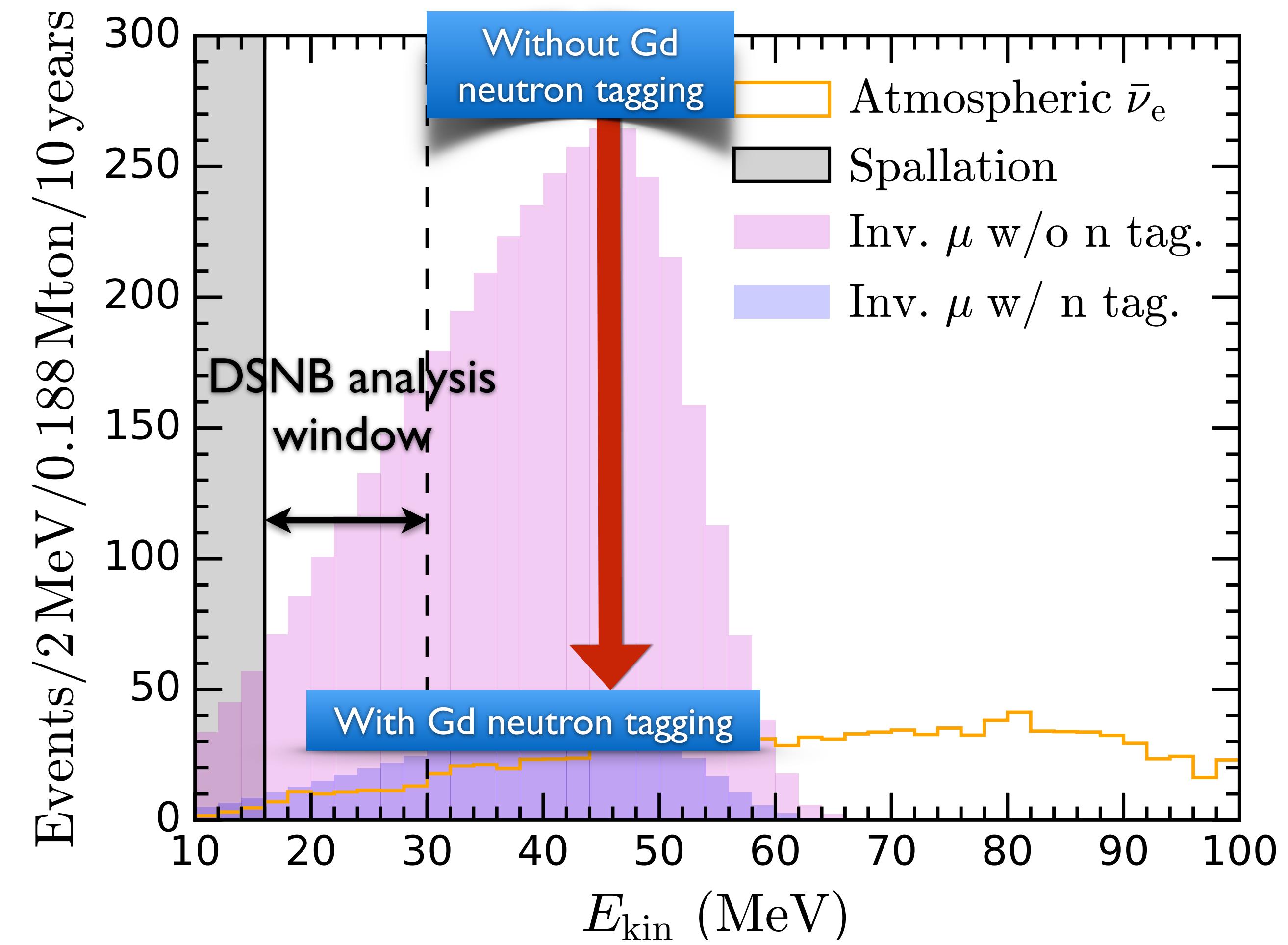
- Atmospheric neutrinos



- Invisible Muons

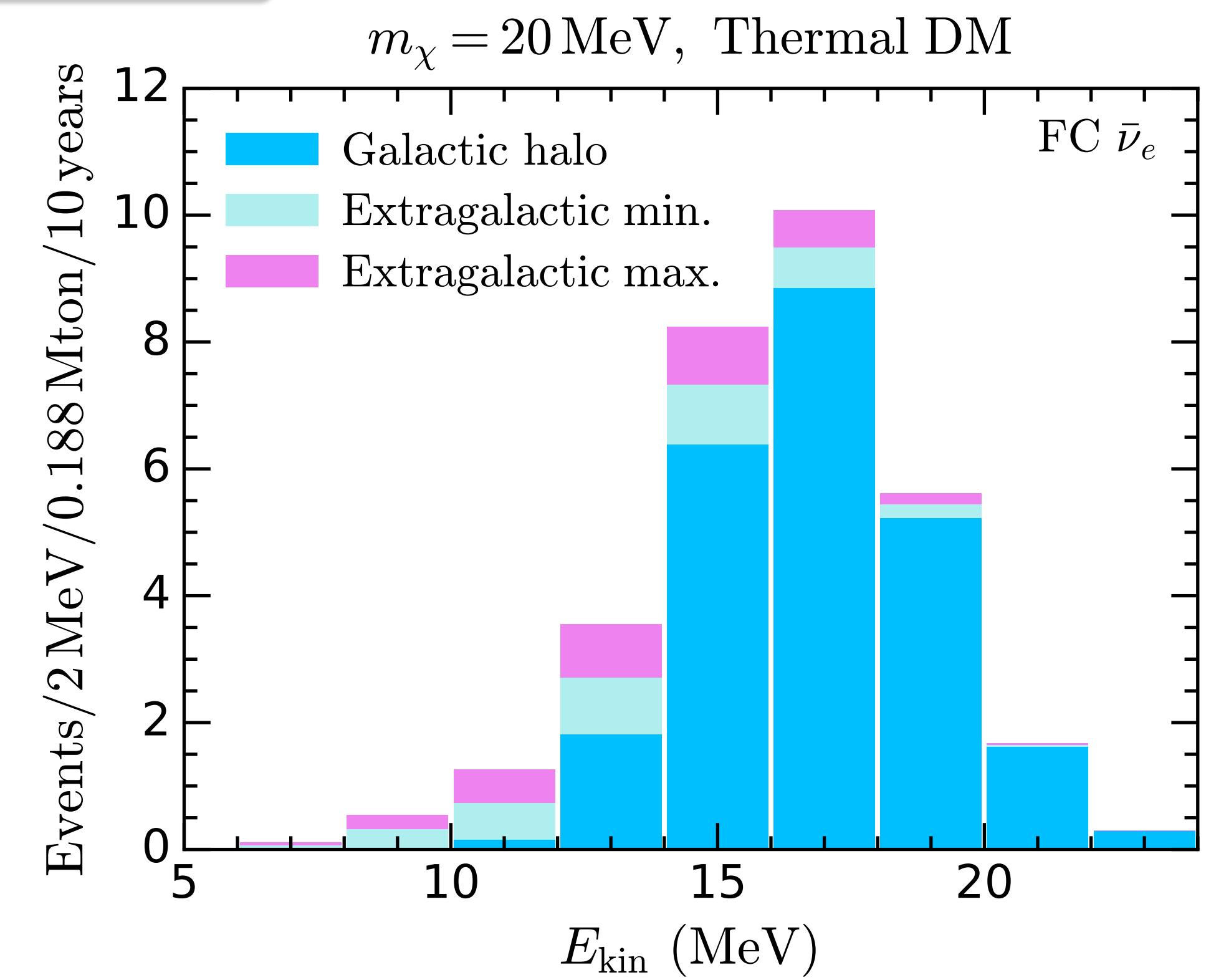
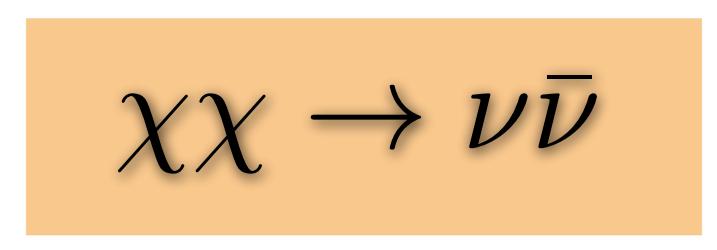
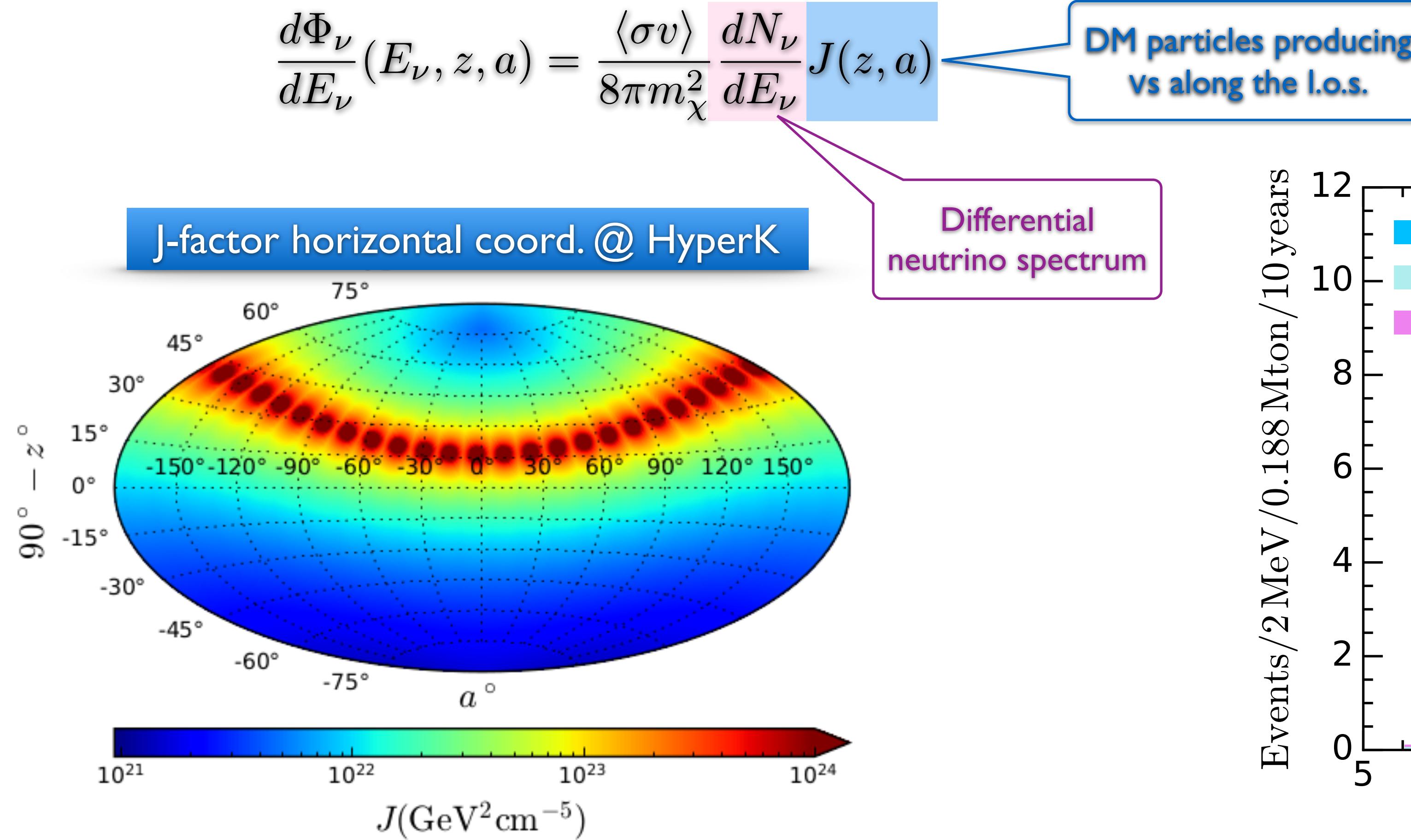


- Muon induced spallation



DM Signal

- Primary contribution: Neutrinos from DM annihilation in the Galactic halo



- Secondary contribution: Neutrinos from extragalactic DM annihilation (isotropic)

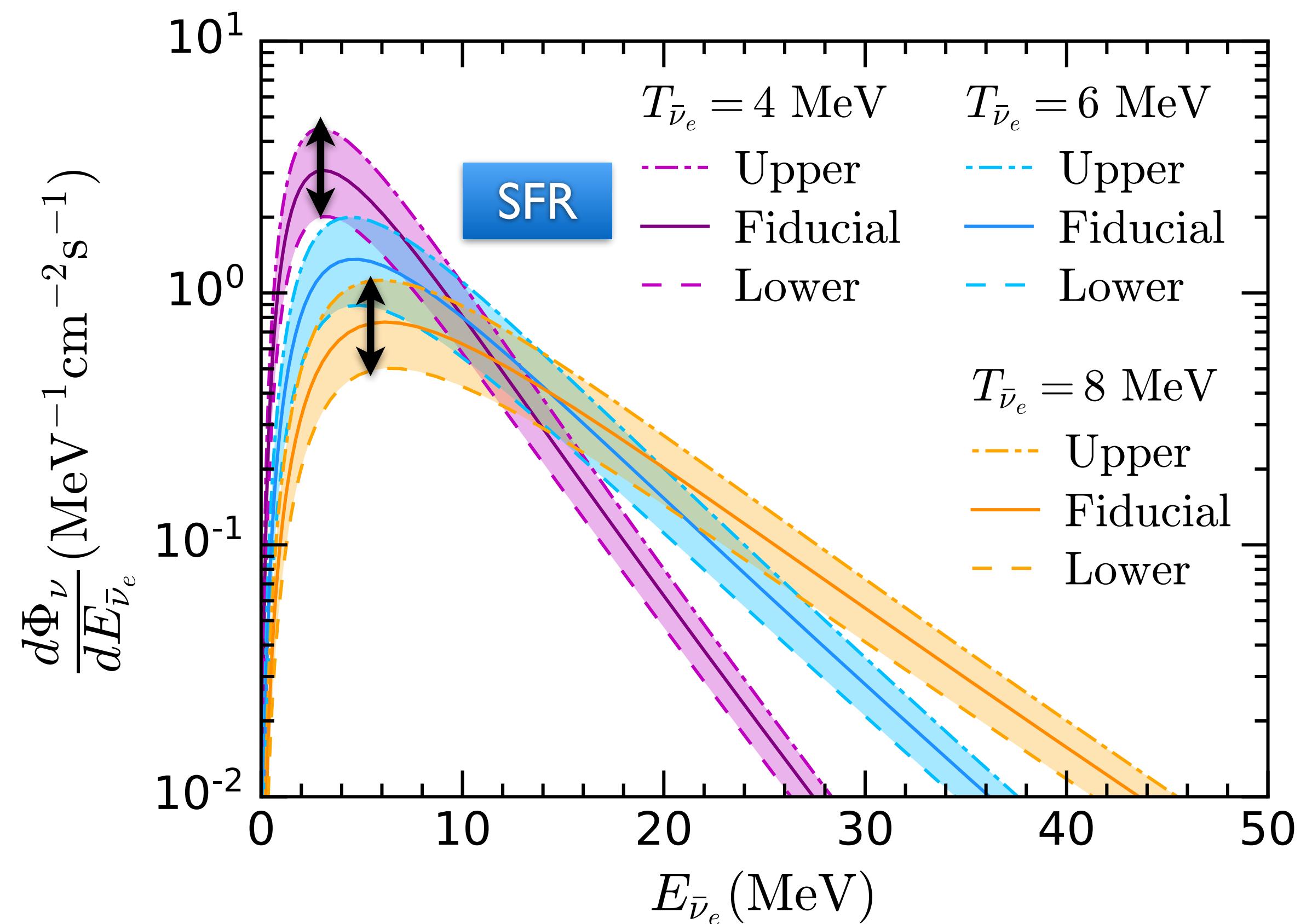
DSNB flux

- DSNB flux
 - obtained by redshifting neutrino spectrum from single SN according to the SN rate

$$\frac{d\Phi_{\bar{\nu}_e}}{dE_{\bar{\nu}_e}} = f(\text{SFR}, T_{\bar{\nu}_e})$$

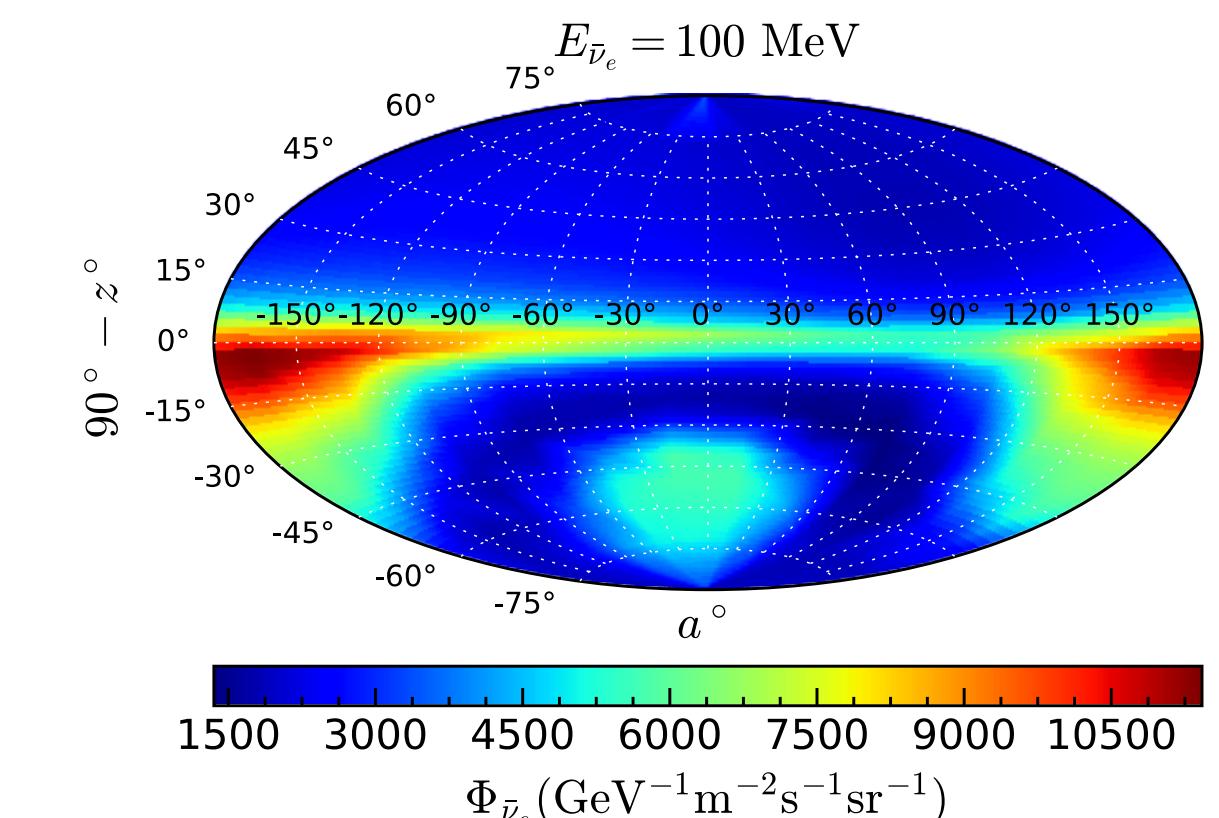
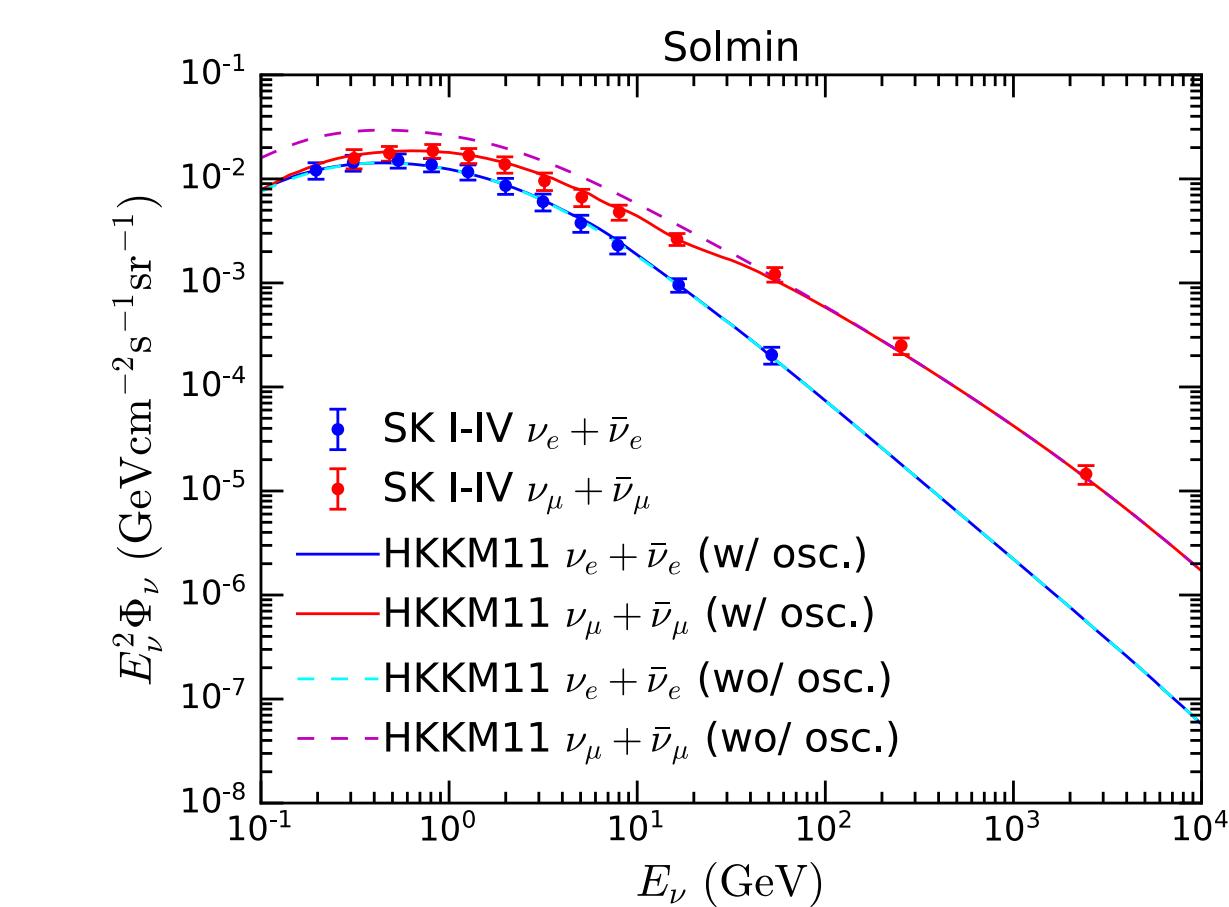
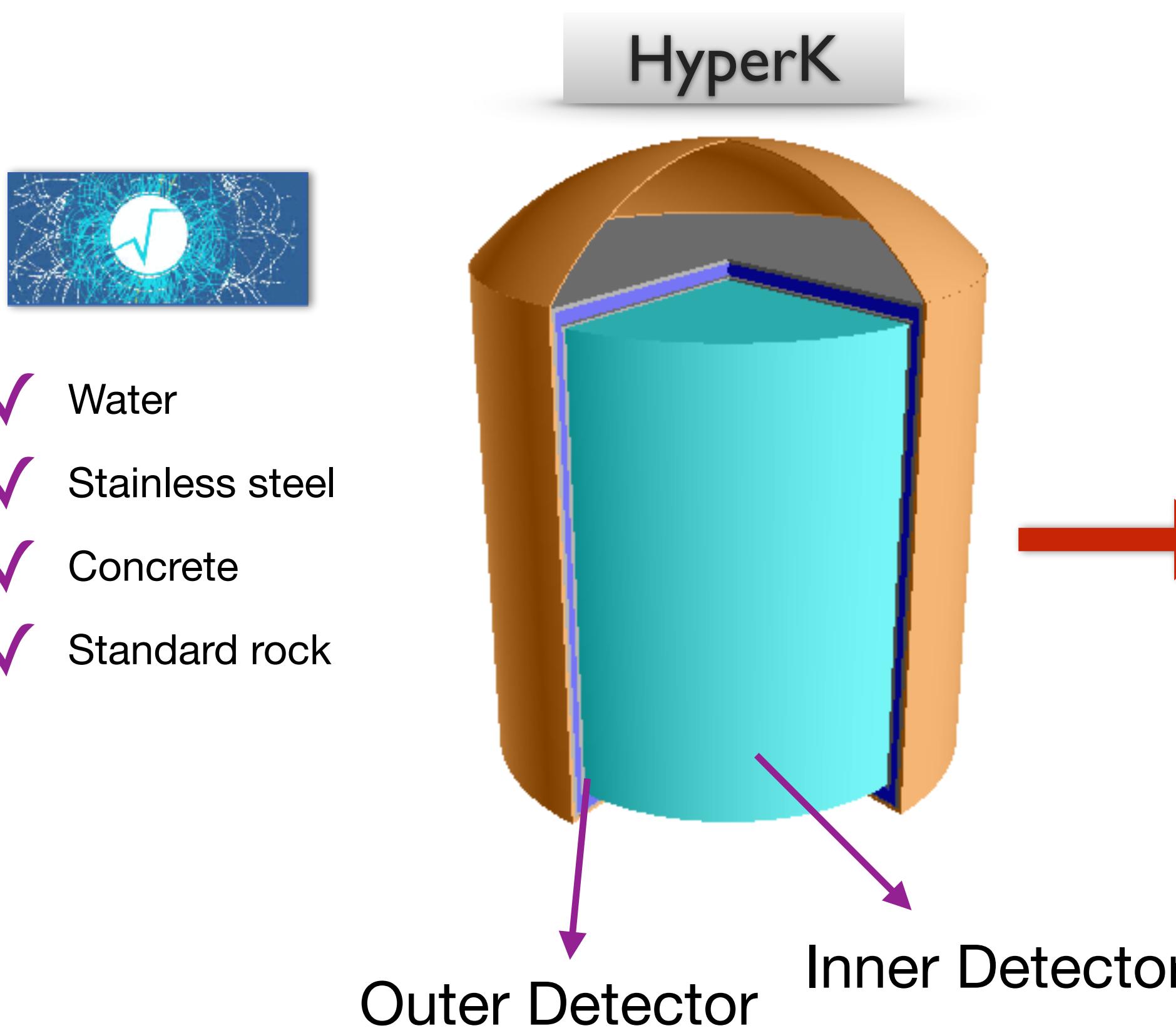
- Parameters for DSNB physics
 - SFR: continuous broken power law
 - Effective temperature for emission:
Fermi-Dirac distribution

Horiuchi, Beacom & Dwek, arXiv: 0812.3157



Detector simulation

- GENIE neutrino Monte Carlo event generator
[Andreopoulos et al. arXiv:1510.05494](#)
- ROOT geometry package - detector geometry



Atmospheric ν 4D flux
HKKM11: arXiv:1102.2688

$\Phi_\nu(E_\nu, z, a)$



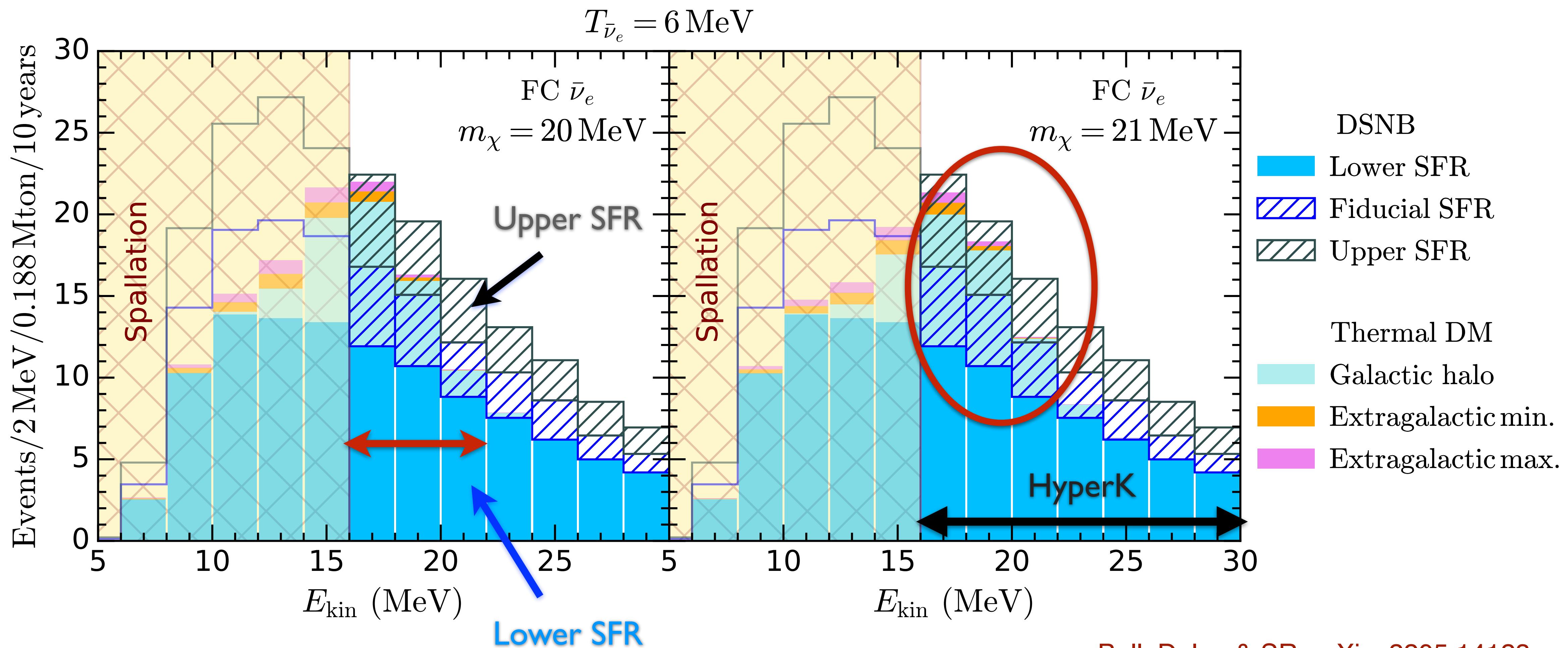
- ✓ Kinematics
- ✓ Vertex of the interaction

- ✓ Tracking leptons & pions
- ✓ Smearing

✓ Validated against atmo. ν events @ SuperK

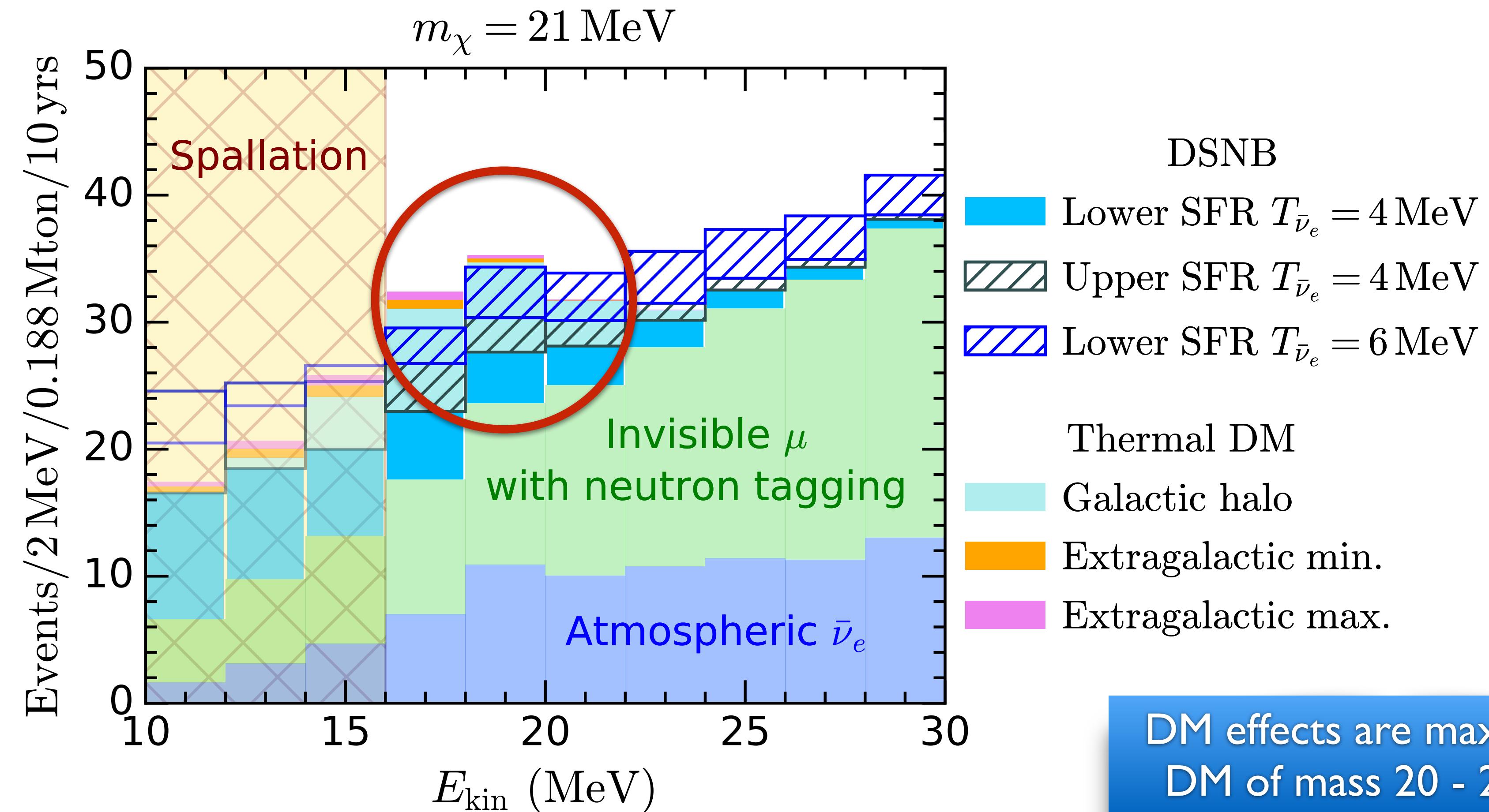
DSNB and DM events @ HyperK

Analysis window: 16 - 30 MeV



Expected signal and background @ HyperK

DSNB + DM with Gd n-tagging → wrong SFR or wrong T_{ν} at 95% CL



Bell, Dolan & SR, arXiv: 2205.14123

Summary

- Pollution from neutrinos from light DM annihilation
 - ➡ could lead to incorrect inferences about the astrophysics behind the DSNB and potentially missing a DM signal.
- Unfortunately, it will be hard to discriminate between both signals due to the lack of angular information.
- Conclusions should hold for other experiments sensitive to the DSNB (JUNO and DUNE).

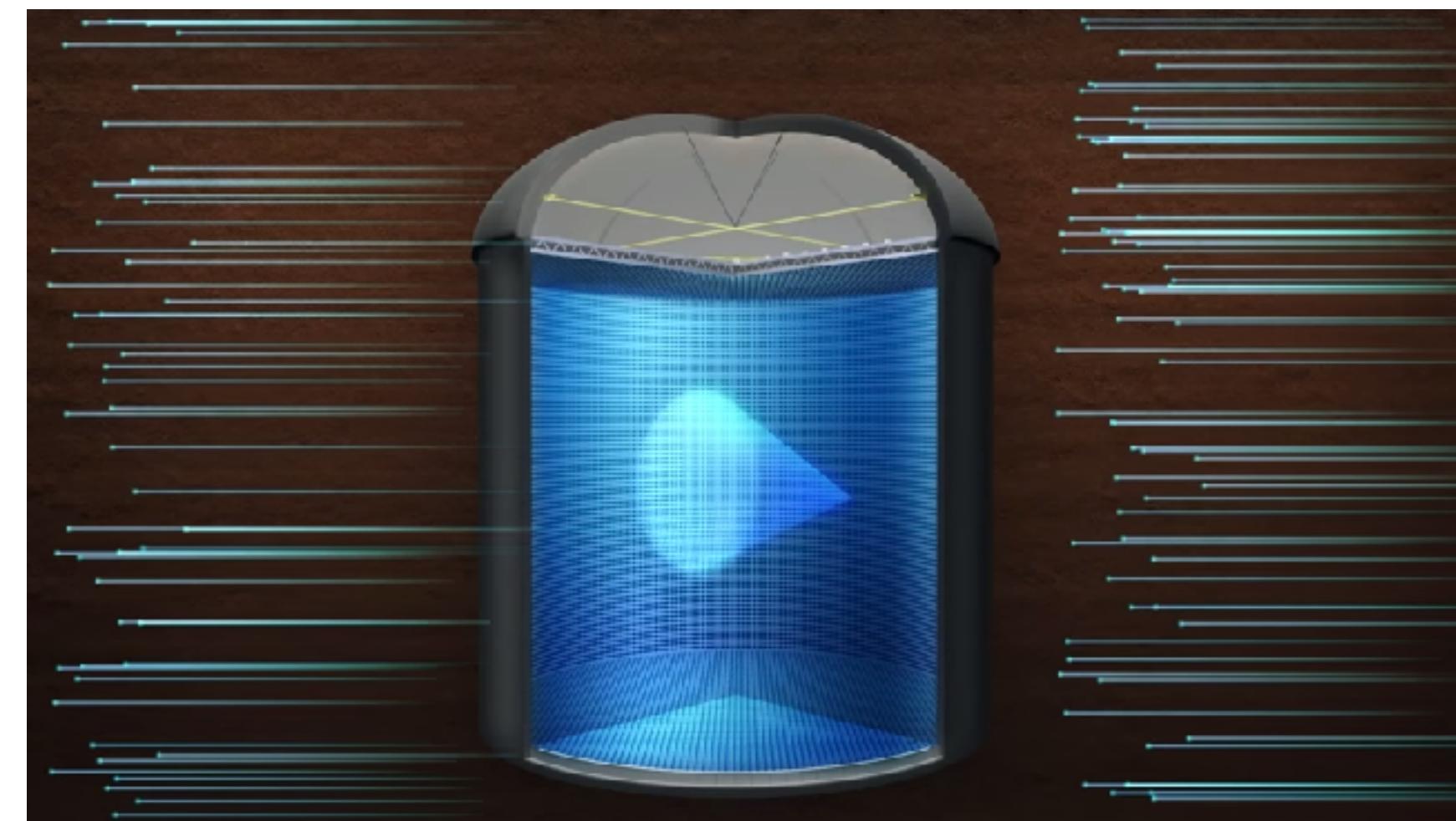


Image credit: ICRR (Institute for Cosmic Ray Research), The University of Tokyo

Thank you!