

宇宙の進化と素粒子模型

宇宙線研理論グループ

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Positron and Neutrino Signatures of Dark Matter Annihilation and Big-Bang Nucleosynthesis

arXiv:0810.1892 [hep-ph]

arXiv:0812.0219 [hep-ph]

東大宇宙線研：川崎、久野、中山

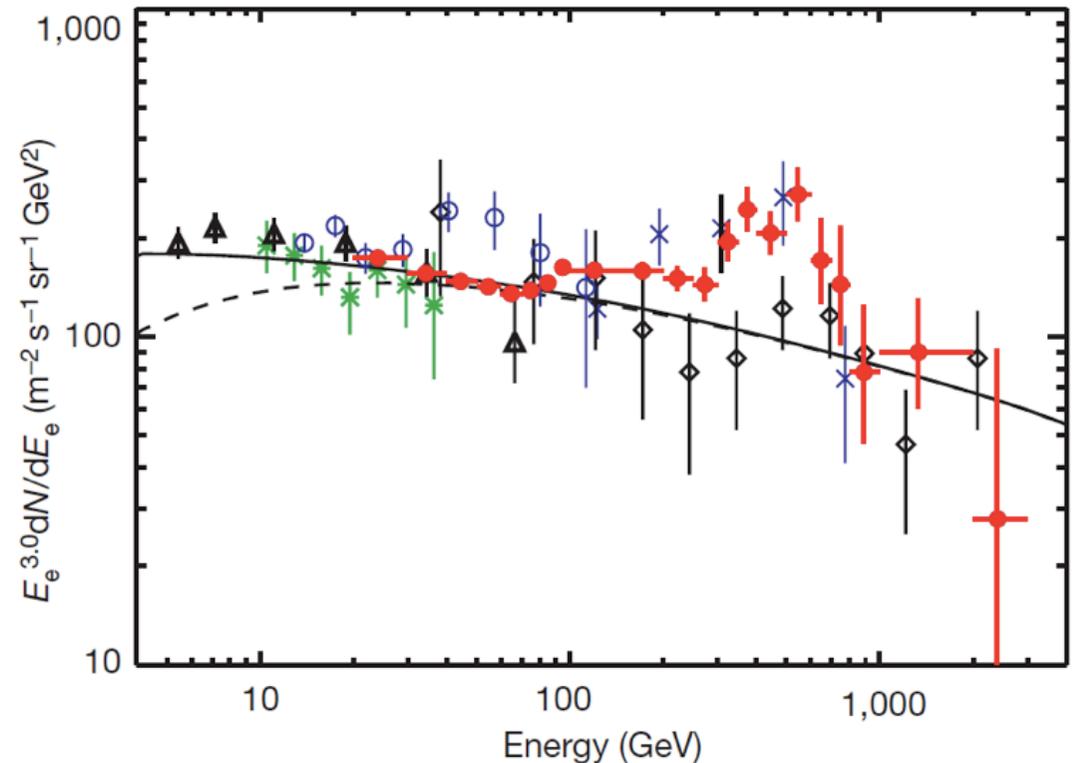
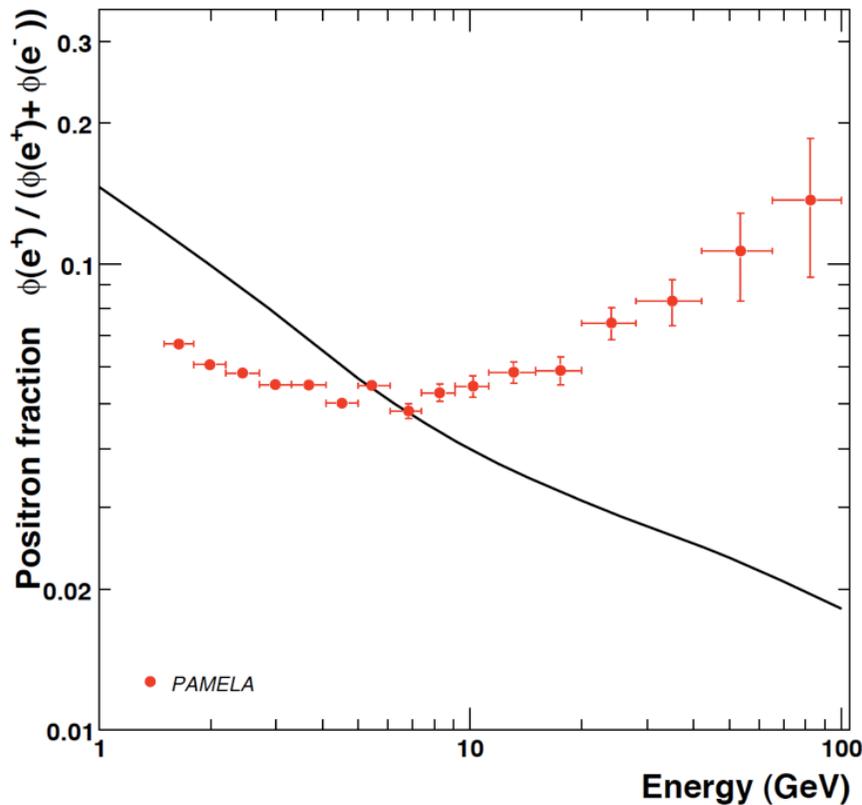
ランカスター大：郡

東北大理：諸井

Recent measurement of Cosmic Ray Electron/Positron Fluxes

PMELA arXiv:0810.4995

ATIC Nature 456 (2008)362



Signature of Dark Matter Annihilation/Decay ?

Dark Matter Annihilation/Decay

- PAMERA and ATIC/PPB-BETS results can be explained by annihilation of dark matter with mass $\sim 1\text{TeV}$ and cross section

$$\langle\sigma v\rangle\sim 10^{-23}\text{cm}^{-3}\text{s}^{-1}$$

- This is much larger than expected from thermal relic

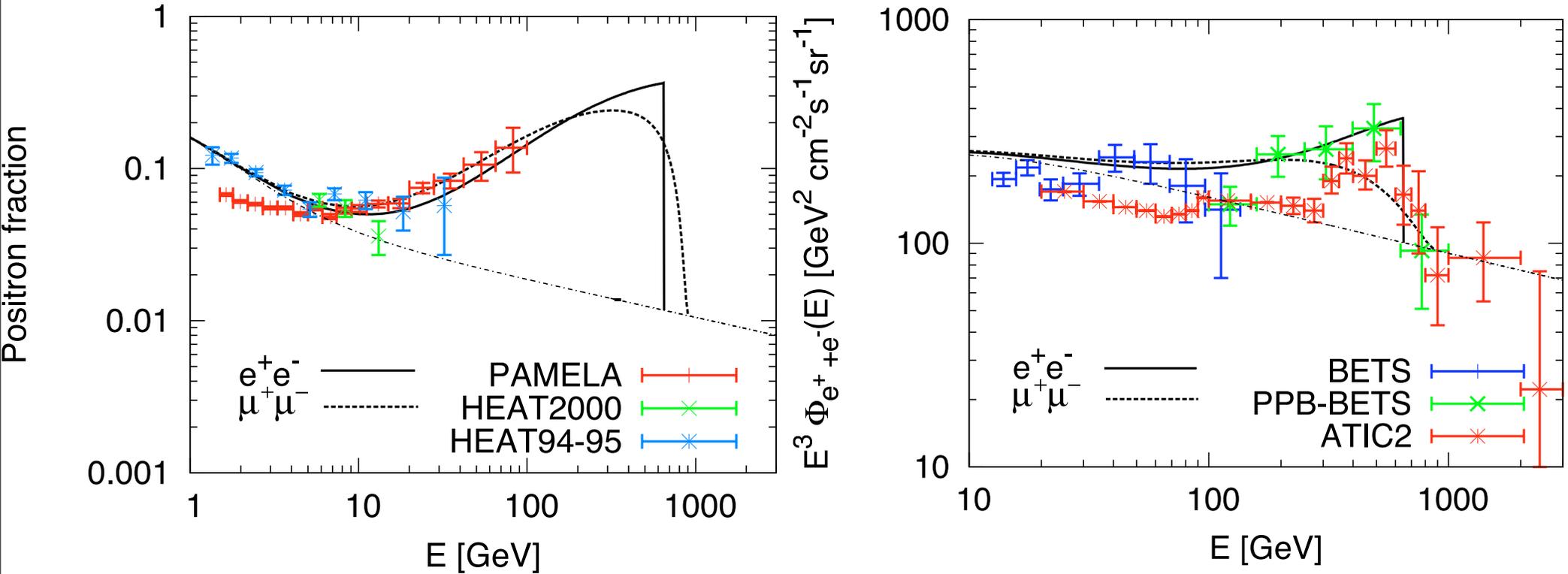
$$\langle\sigma v\rangle_{\text{TH}}\sim 10^{-26}\text{cm}^{-3}\text{s}^{-1}$$

Non-thermal production?

- Decaying dark matter is a good candidate if it has lifetime

$$\tau\sim 10^{26}\text{s}$$

- Annihilation/Decay into charged leptons is favored



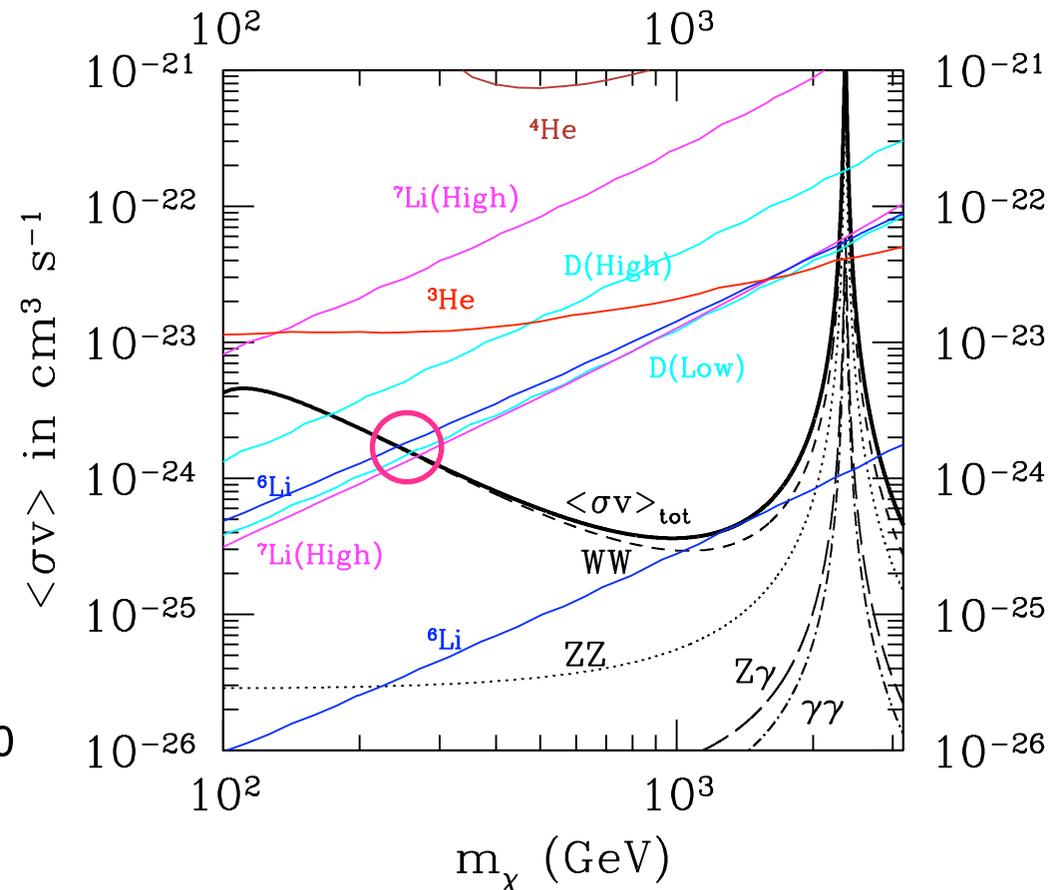
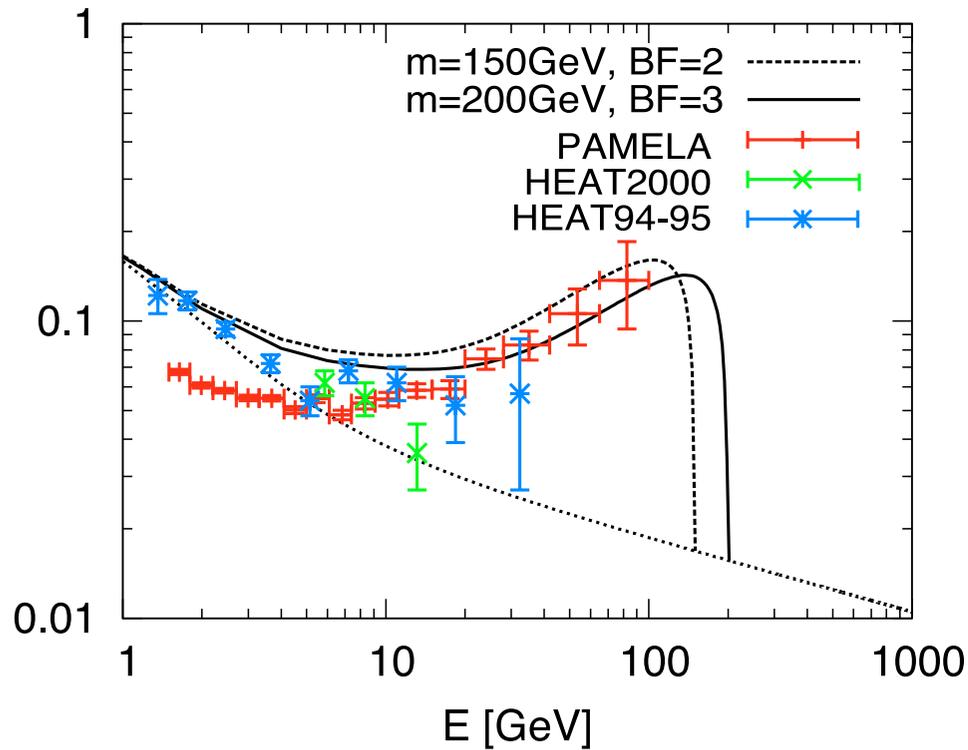
$$\langle \sigma v \rangle = 5 \times 10^{-24} \text{cm}^{-3} \text{s}^{-1}, \quad m = 650 \text{ GeV} \quad \text{for } e^+ e^-$$

$$\langle \sigma v \rangle = 15 \times 10^{-24} \text{cm}^{-3} \text{s}^{-1}, \quad m = 900 \text{ GeV} \quad \text{for } \mu^+ \mu^-$$

PAMERA and BBN

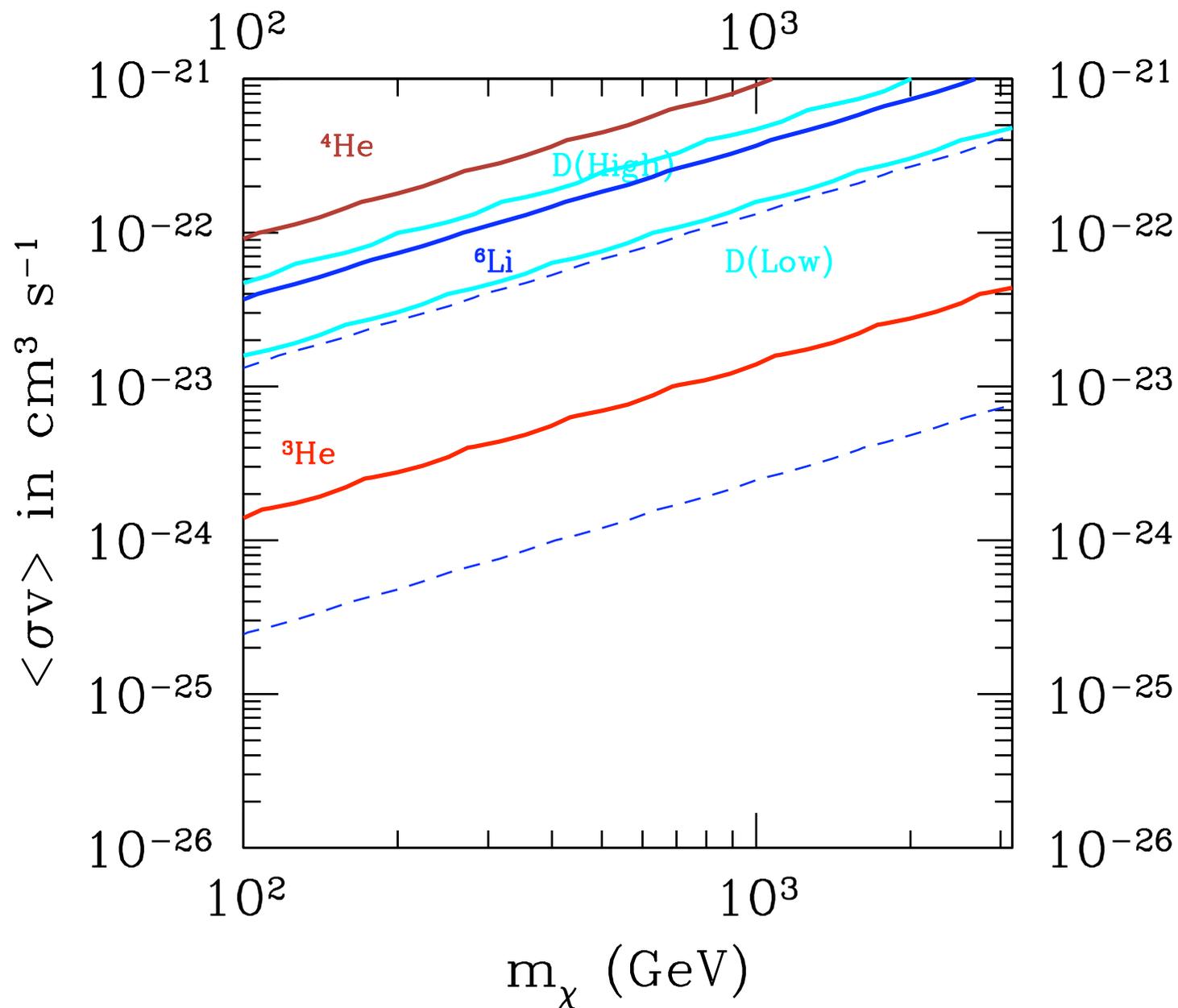
Hisano et al (2008)

- PAMERA result can be explained by annihilation of Wino like dark matter
- Wino annihilation also affects BBN in the early universe, in particular, can solve **Lithium Problem**



BBN Constraint on Annihilation

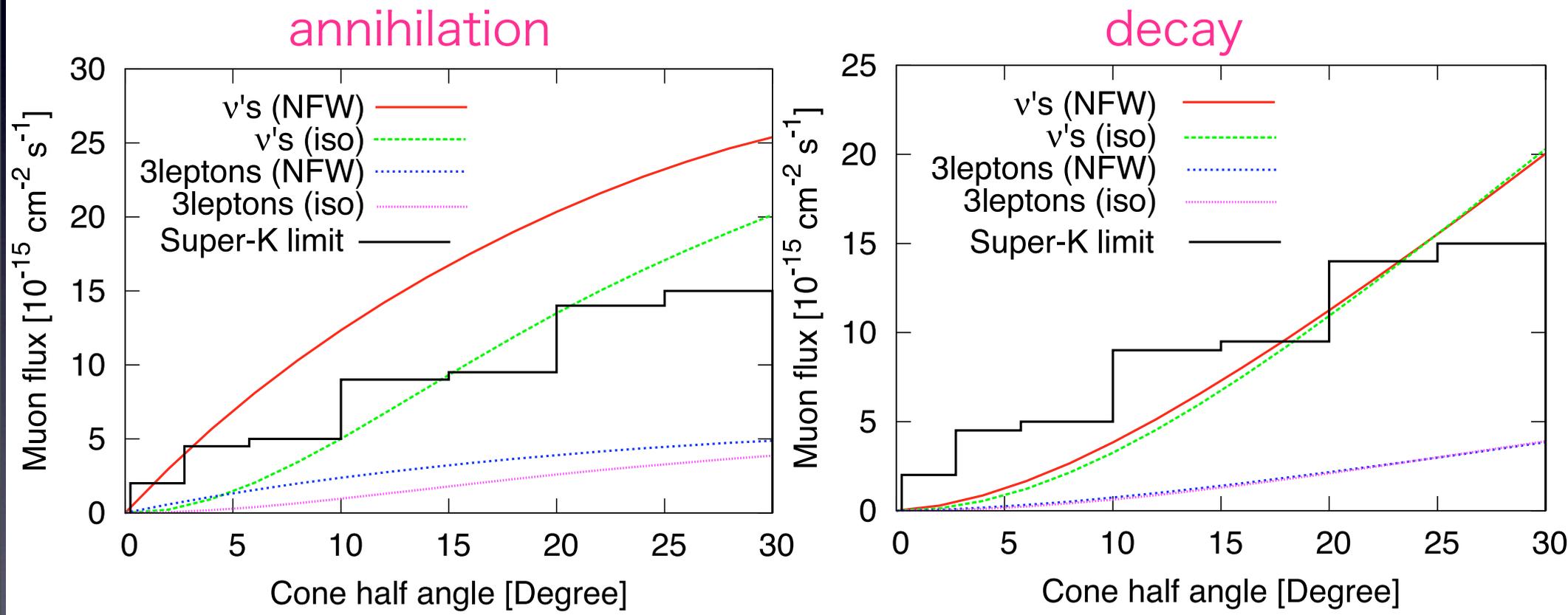
Hisano et al , to appear



Neutrino Flux

Hisano et al (2008)

- ATIC and PPB-BETS results suggests annihilation/decay into **charged leptons**
- Annihilation/decay naturally produces **neutrinos**

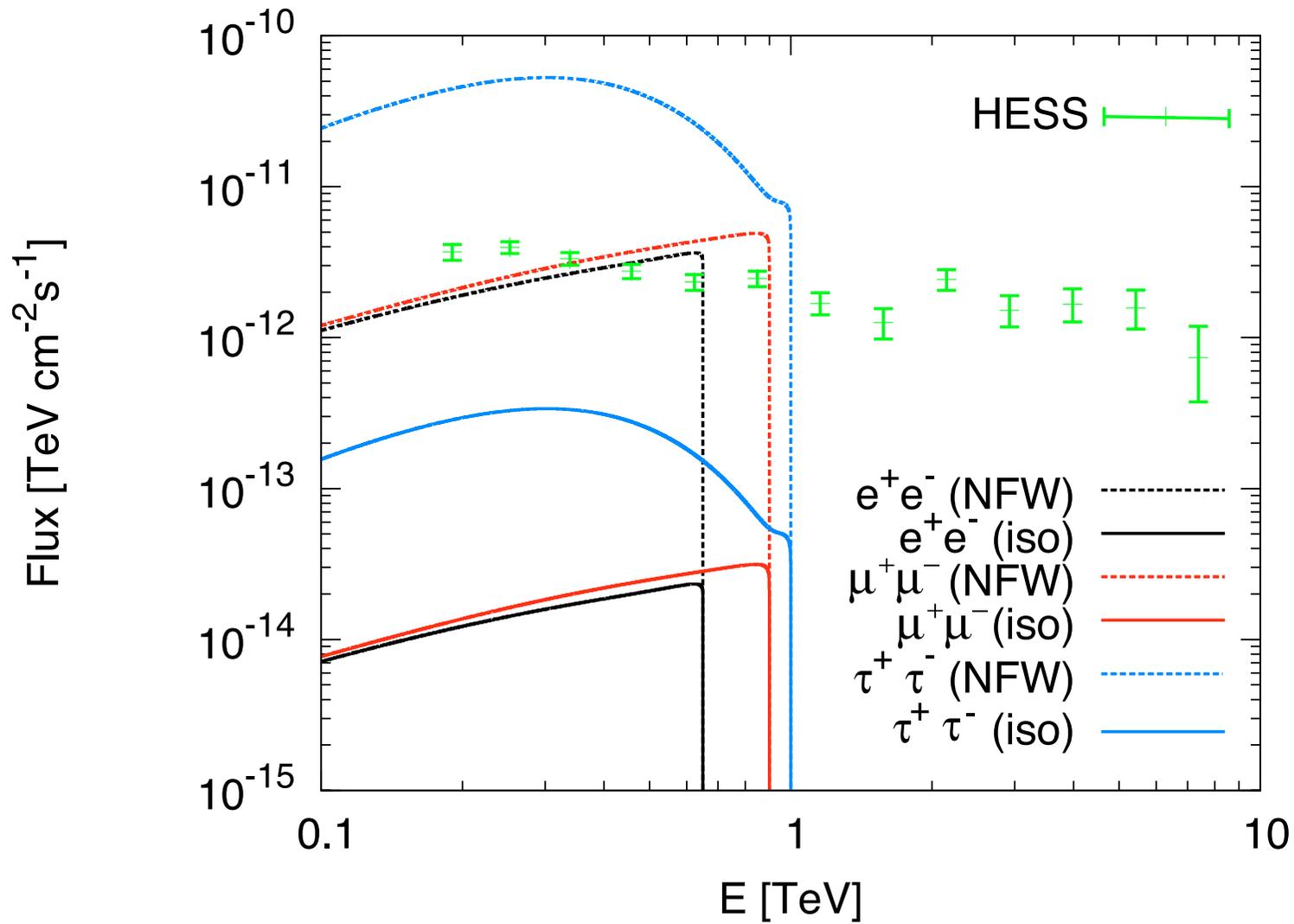


$$\langle \sigma v \rangle = 10^{-23} \text{ cm}^{-3} \text{ s}^{-1}, \quad m = 800 \text{ GeV}$$

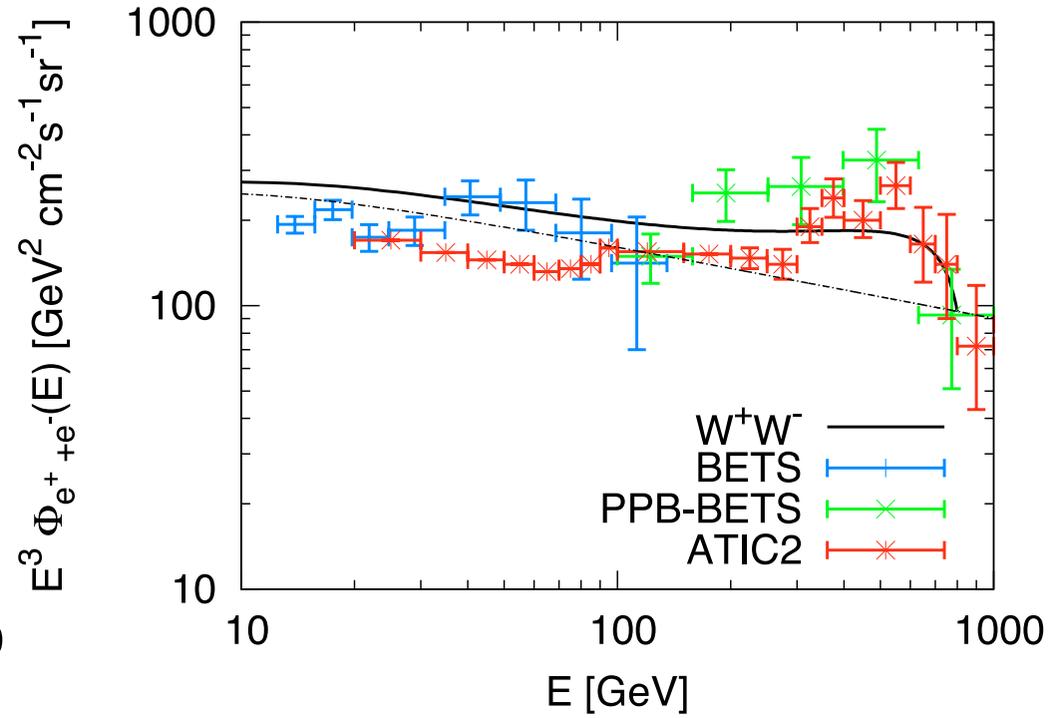
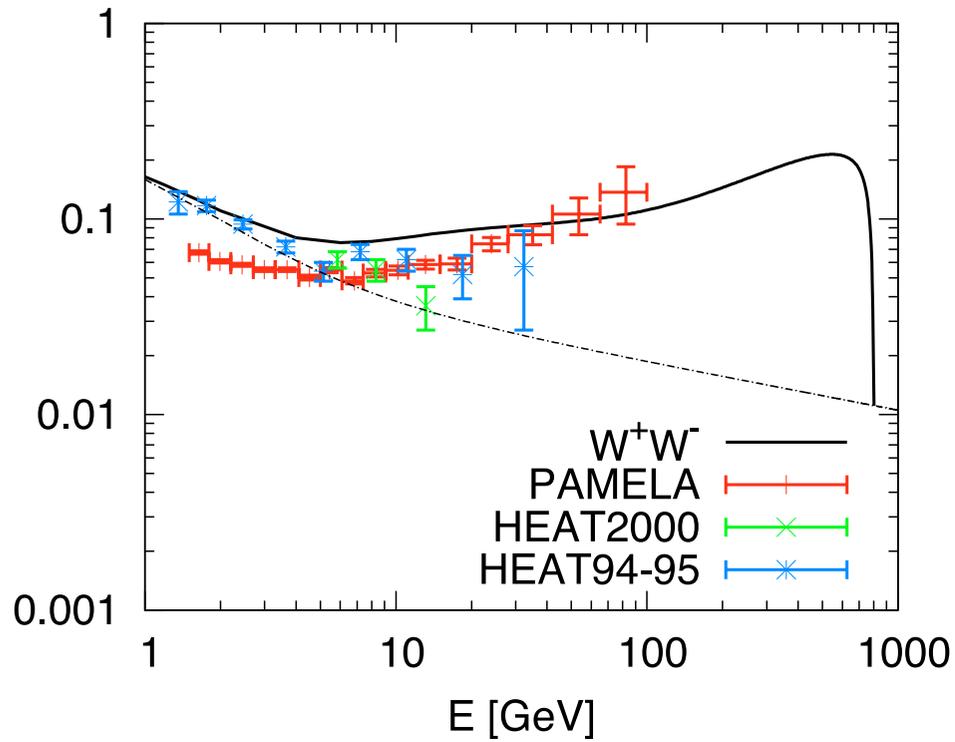
$$\tau = 10^{26} \text{ s}^{-3}, \quad m = 2000 \text{ GeV}$$

Gamma Ray

Hisano et al , to appear



Wino Annihilation



courtesy of Kazunori Nakayama