Gamma ray excess in the Galactic Center (for the panel discussion)

Ji-Haeng Huh

UCLA
and
MultiDark Project

DaMaSCIII, Caltech, 17th

TOPICS

1. Remarks on WIMP model
2. Prompt Emission only analysis ??
3. On future detector

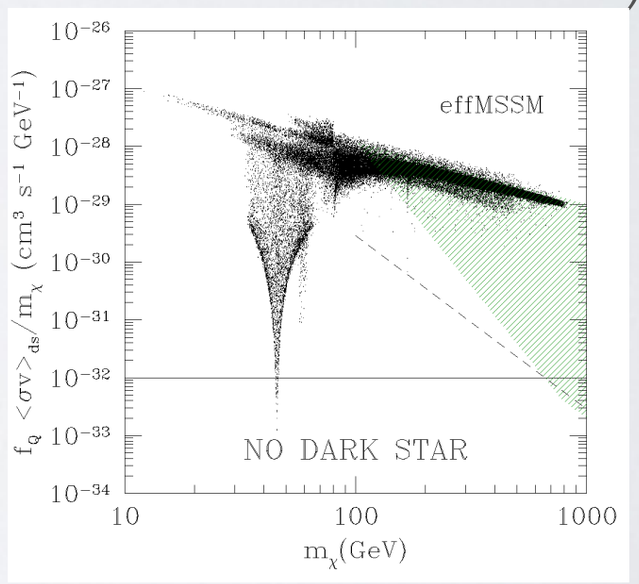
Remarks on WIMP model

- Characterized by two parameters $(m_\chi, \langle\sigma_{\rm ann} v\rangle)$
for a given "2-body" final state ($b\bar{b}$, $\tau\bar{\tau}$, W^+W^-, etc)

- Good ; model independence
- Bad ; presence of other possibilities

- Model dependent Internal Bremstrahlung(IB) (irrelevant for ~10GeV WIMP)
- Models with light neutral particle
(NMSSM+ RN, hidden U(1) gauge boson, …)

$$\tilde{N}\tilde{N} \to AA \to b\bar{b}b\bar{b}$$



-Freeze-out cross section

$$\langle\sigma v\rangle_{\rm present} \neq \langle\sigma v\rangle_{\rm decouple} = 3\times 10^{-26}{\rm cm}^3/{\rm s}$$

- Mostly $b\bar{b}$ final state —> Quite generic situation in Majorana WIMP model
Chiral suppression (P-wave suppression) ; $\langle\sigma v\rangle_{\rm present} \sim \left(\frac{m_f}{m_\chi}\right)^2$

Prompt Emission Only Analysis ??

- Gamma-ray signal from WIMP
  1) Prompt emission (FSR+VIB)
  2) Inverse Compton (IC)

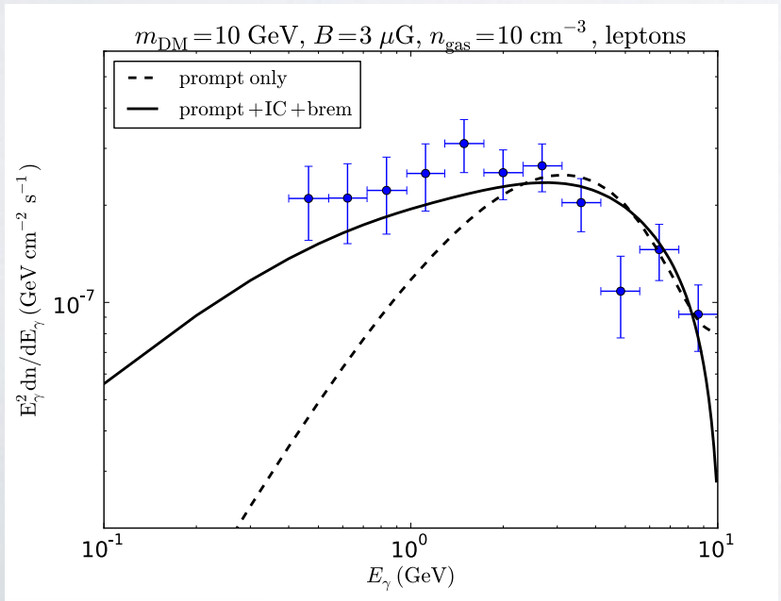
$$\chi\chi \to e^- e^+ \to \text{propagation} \to \text{IC}(\text{CMB} + \text{IR} + \text{starlight})$$

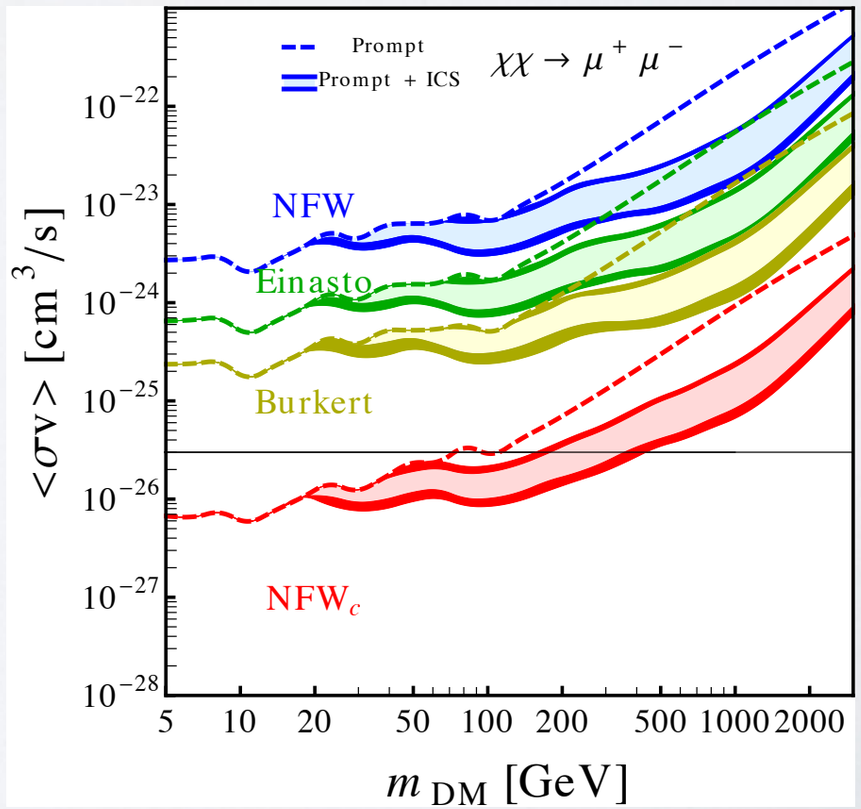
- Lacroix, Boehm and Silk (1403.1987)

"Fitting the Fermi-LAT GeV excess: on the importance of including the propagation of electrons from dark matter"

- IC component ; sensitive to $|\vec{B}|$

$$N_\gamma^{\text{IC}} \sim \frac{b_{\text{IC}}}{b_{\text{IC}} + b_{\text{syn}}} n_e^2$$





On the future detector

- Three ways to improve
  1) Large effective Area
  2) Good energy resolution
  3) Good angular resolution

- Of course, "Large effective Area" cannot be sacrificed.
(Success of Fermi Satellite)
- Energy resolution VS Angular resolution

Energy resolution

- DM mass ~ few TeV
(prominent spectral feature from IB)
- line spectrum $(\gamma\gamma, \gamma Z, \dots)$

Angular resolution

- DM mass ~ few 10 GeV
- Continuum spectrum