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

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and

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TOPICS

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

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

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

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

\[
\tilde{\chi} \tilde{\chi} \rightarrow A A \rightarrow b\bar{b}b\bar{b}
\]

- Freeze-out cross section
  \[
  \langle \sigma v \rangle_{\text{present}} \neq \langle \sigma v \rangle_{\text{decouple}} = 3 \times 10^{-26}\text{cm}^3/\text{s}
  \]

- Mostly \(b\bar{b}\) final state \(\rightarrow\) Quite generic situation in Majorana WIMP model
  Chiral suppression ( P-wave suppression ) ; \[
  \langle \sigma v \rangle_{\text{present}} \sim \left(\frac{m_f}{m_\chi}\right)^2
  \]
Prompt Emission Only Analysis ??

- Gamma-ray signal from WIMP

1) Prompt emission (FSR+VIB)
2) Inverse Compton (IC)
\[ \chi \chi \rightarrow e^- e^+ \rightarrow \text{propagation} \rightarrow \text{IC(CMB + IR + starlight)} \]

- 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 \(|\vec{B}|\)

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

![Graph showing energy dependence of gamma-ray flux](image)

![Graph showing mass dependence of cross-section](image)
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 \( (\gamma\gamma, \gamma Z, \ldots) \)

**Angular resolution**
- DM mass ~ few 10 GeV
- Continuum spectrum