AGNs and their jets through a sensitive MeV eye

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MeV Splinter Session
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AGNs in the MeV

MeV blazars

AGN corona

Marcotulli et al., 2020

Hadronic vs. Leptonic emission

AGNs to be detected
• The more luminous blazars have a IC peak at $\ll 100$ MeV
• We refer to this class as MeV blazars
MeV blazars

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- With large jet power that easily exceeds the accretion disk luminosity. Black hole spin may be important.
- Detected up to very high redshifts (z>2, up to z~4.5, Ajello et al. 2009)
- They host extremely massive black holes ($M_{BH} \geq 10^9 M_\odot$)
Evolution of MeV Blazars

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- Clear that the radio-loud phase may play a very important role in the growing of massive black holes.
- Constraining the number density of extremely massive black holes in radio-loud systems is the easiest with blazars (via $2\Gamma^2$ correction).
Lack of strong absorption in the LAT energy range due to UV BLR photons places the emission region beyond the BLR (Costamante et al. 2018)
Peak location and variability timescale will pinpoint the location of the emission region (BLR vs Torus)
The Cosmic MeV Background (CMeVB)

Ackermann et al. 2015
MeV blazars for the CMeVB

MeV blazars can contribute up to 100%!
MeV blazars are hard to detect despite being bright!
Current status

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- Bright in X-rays ($L_X > 10^{46}$ erg s$^{-1}$)
  - Tens detected by Swift/BAT (Ajello et al., 2009, Paliya et al. 2019)
  - Few discovered (via follow up) with NuSTAR (Ghisellini, Sbarrato etc) and Fermi-LAT (Ajello, Paliya, Marcotulli etc.)

Need an all-sky MeV mission!!!
How many blazars can be detected?

More than 100 blazars at z>3!!!

Marcotulli et al. in prep
HADRONIC vs. LEPTONIC MODELS

Leptonic

Hadronic

TXS 0506+056 (lepto-hadronic model)

Ojha et al. Astro 2020, adapted from Cerruti et al. 2018

Böttcher et al. 2013
HADRONS vs. LEPTONIC MODELS

Leptonic → pure IC

Hadronic → proton synchrotron + hadronic cascades

Rani B. et al. Astro 2020, adapted from Zhang et al. 2019
Possible peak in MeV band from IC of pairs with accretion disk photons

Johnson et al. 1997
OTHER AGNs to be detected

- γ-NLSys

Paliya et al. 2020
OTHER AGNs to be detected

- $\gamma$-NLSys
- Radio Galaxies
OTHER AGNs to be detected

- $\gamma$-NLSys
- Radio Galaxies
- Compact Steep Spectrum Objects
An MeV mission (like AMEGO) will:
1. Detect hundreds of MeV blazars up to z~5 and maybe beyond
2. Help us constrain supermassive black hole growth theories
3. Explore the disk-jet connection beyond z=3
4. Constrain the location of the blazar emission region (BLR vs. Torus)
5. Understand blazar contribution to the the MeV background
6. Discern hadronic vs. leptonic emission processes in blazars
7. Untangle physics of corona emission
8. Detect 10ths to 100ths of gamma undetected AGN sources that peak in MeV

AND MORE!!!