AGNs and MeV Gamma-ray Background

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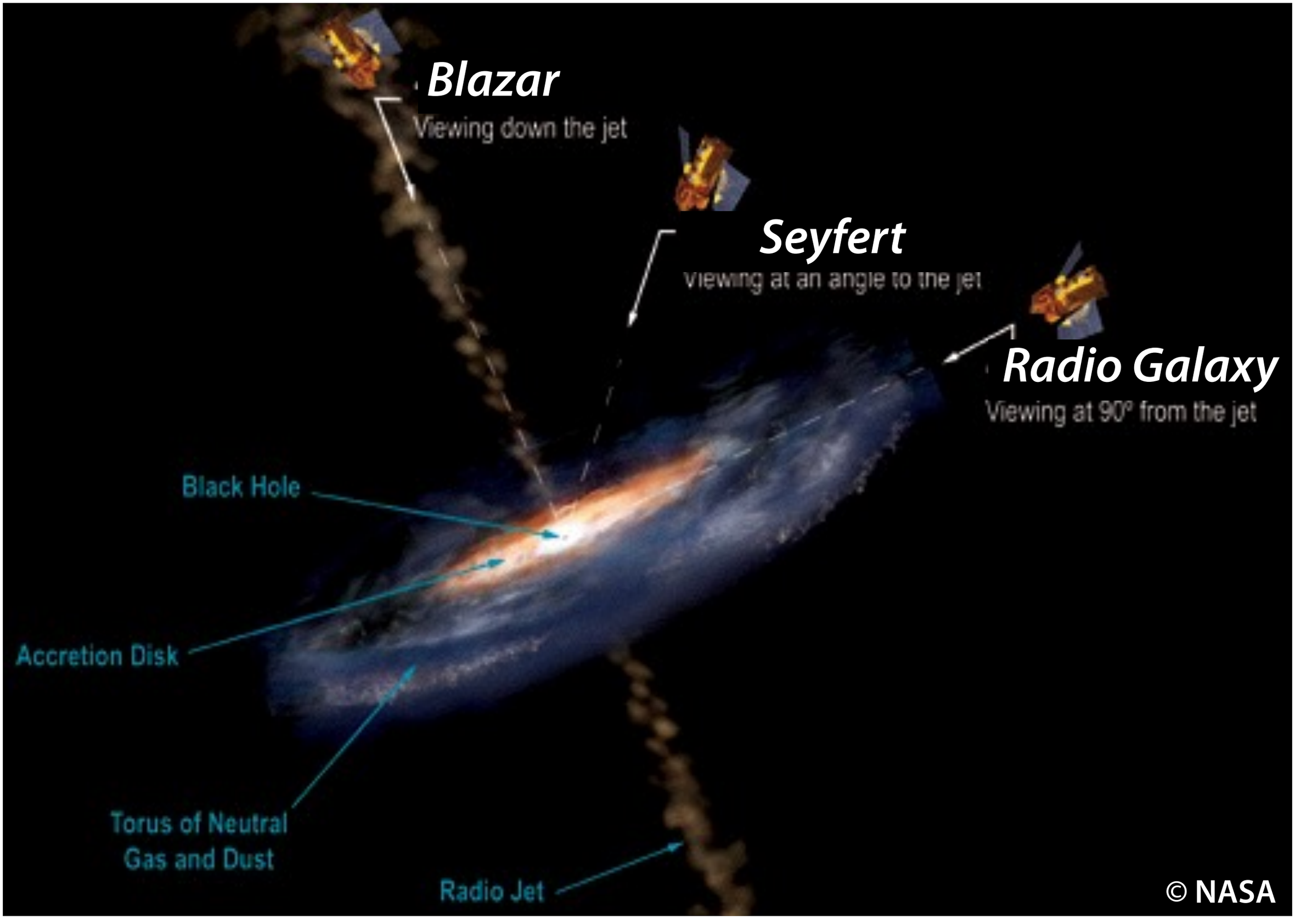
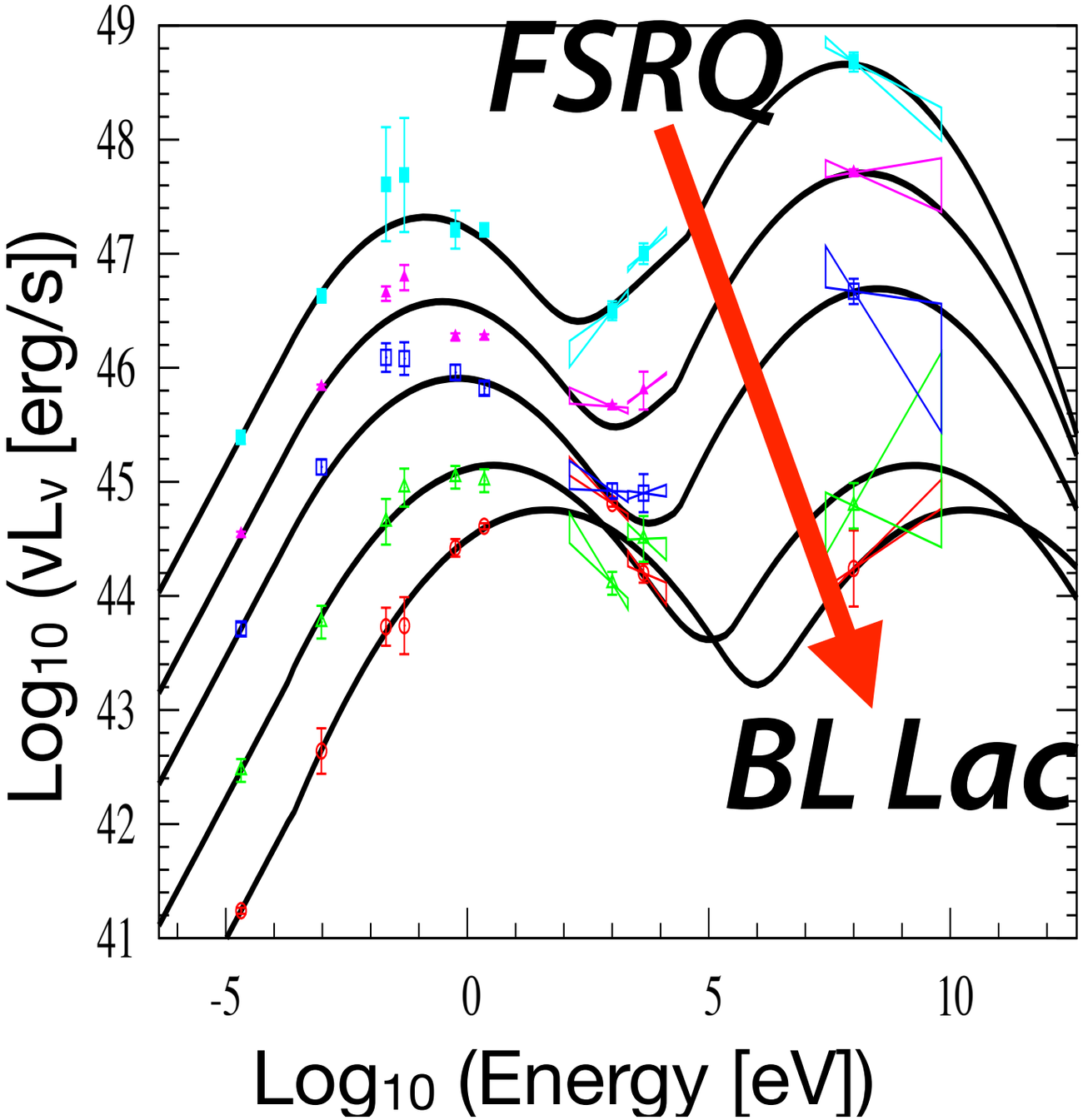
Active Galactic Nuclei (AGNs)



Typical Spectra of Blazars

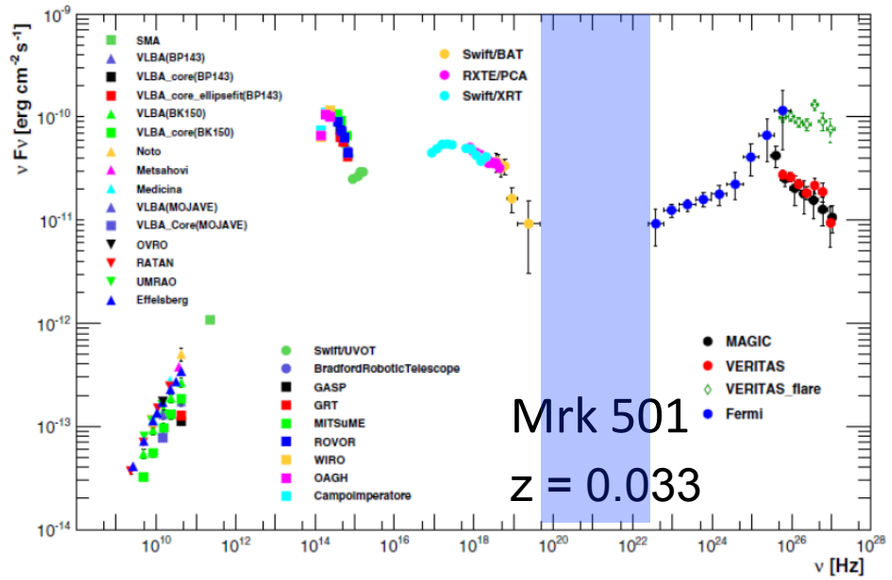


Fossati+'98, Kubo+'98,
YI & Totani '09

- Non-thermal emission from radio to gamma-ray
- Two peaks
  - Synchrotron
  - Inverse Compton
- Luminous blazars (Flat Spectrum Radio Quasars: FSRQs) tend to have lower peak energies (Fossati+'98, Kubo +'98)

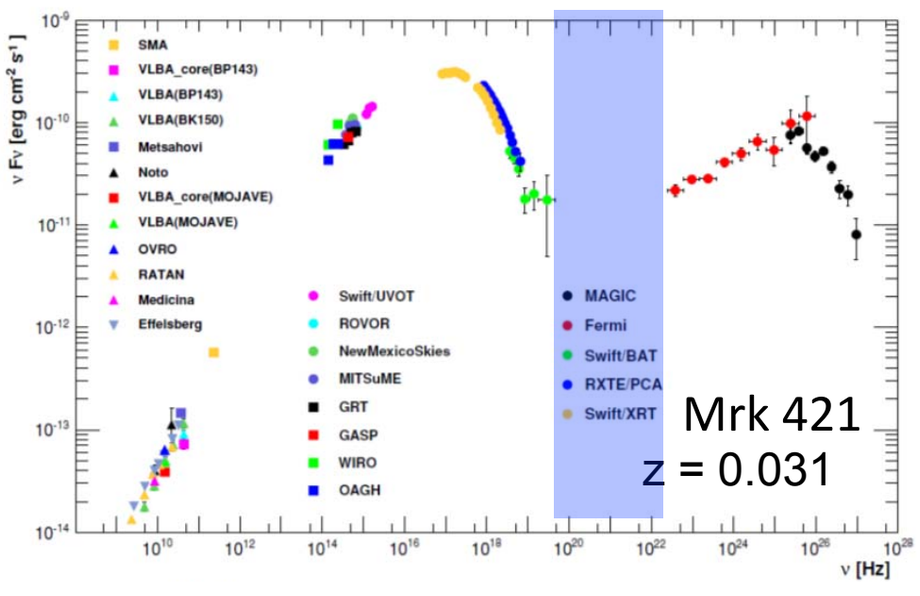
Blazar Spectra

BL Lacs: emission to VHE/TeV energies



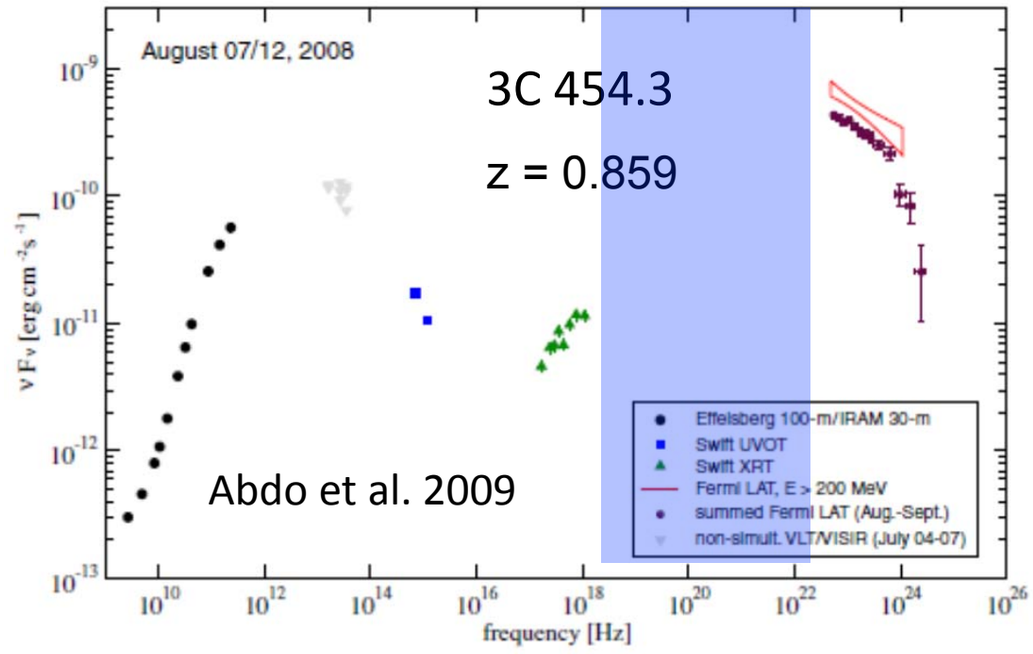
Abdo et al. 2011a

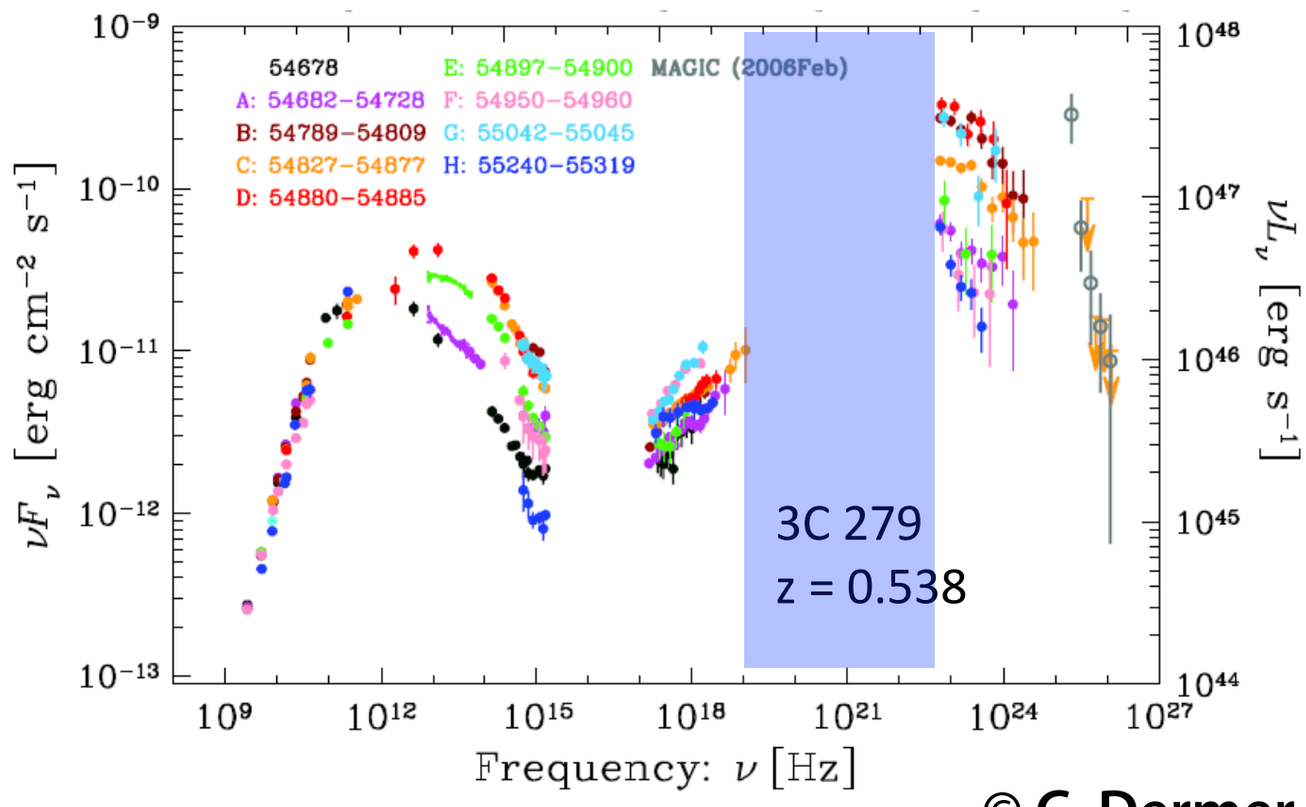
Abdo et al. 2011b



VHE (> 100 GeV)

FSRQs: cutoffs at GeV with VHE episodes





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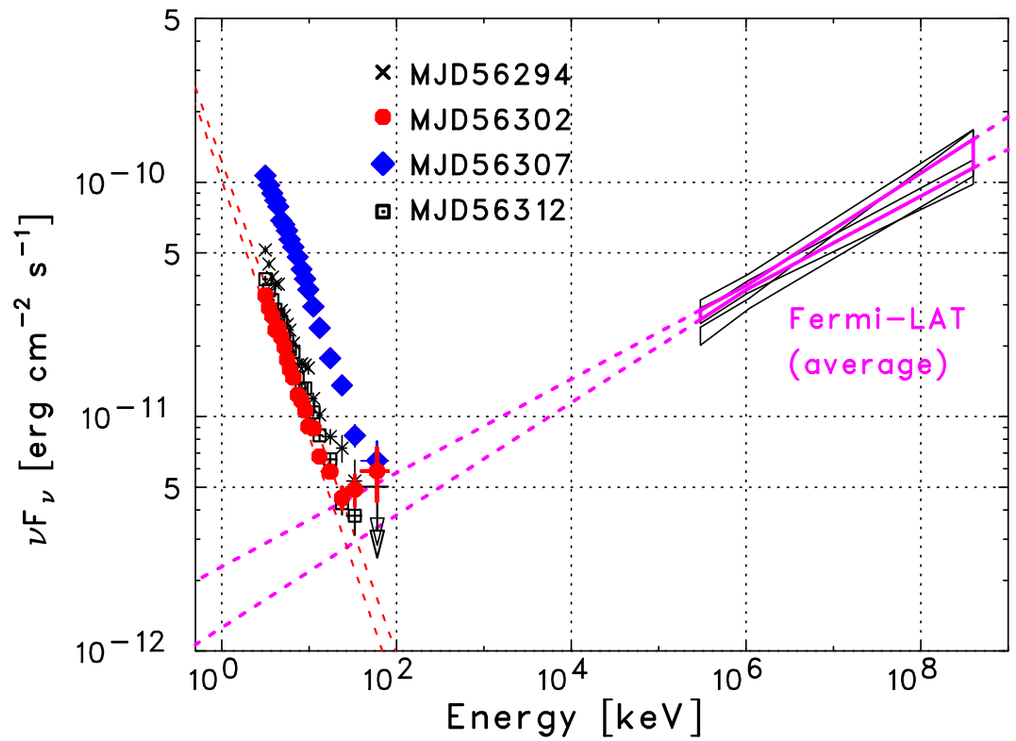
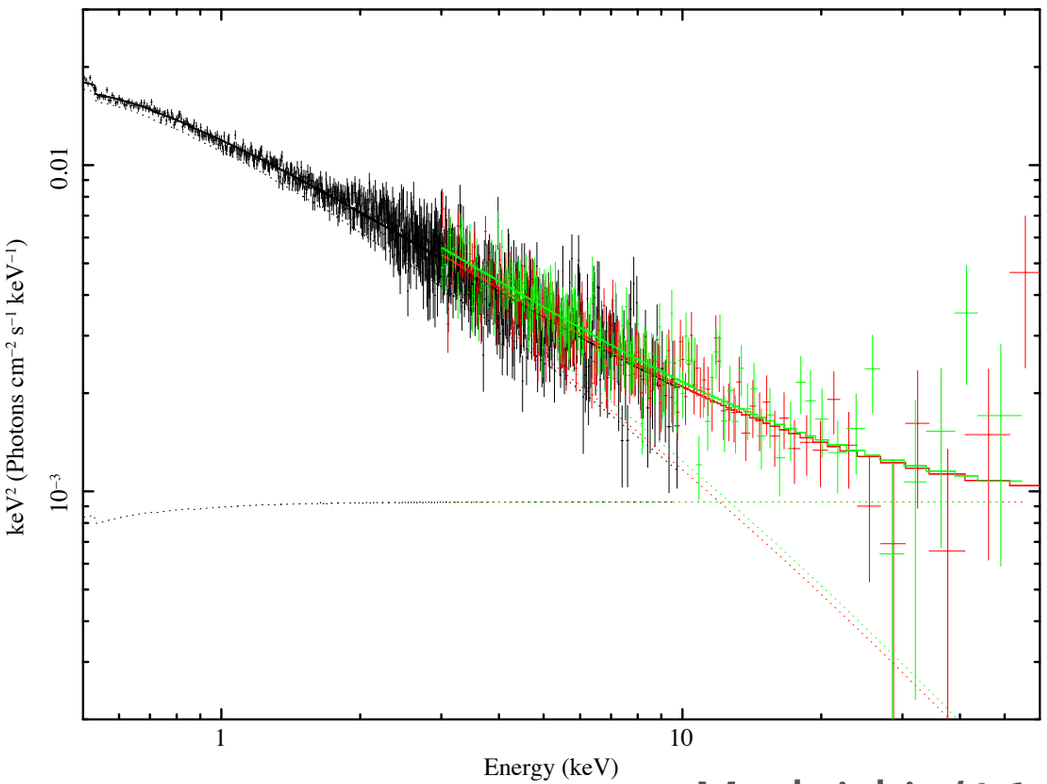
BL Lacs



Kataoka & Stawarz '16

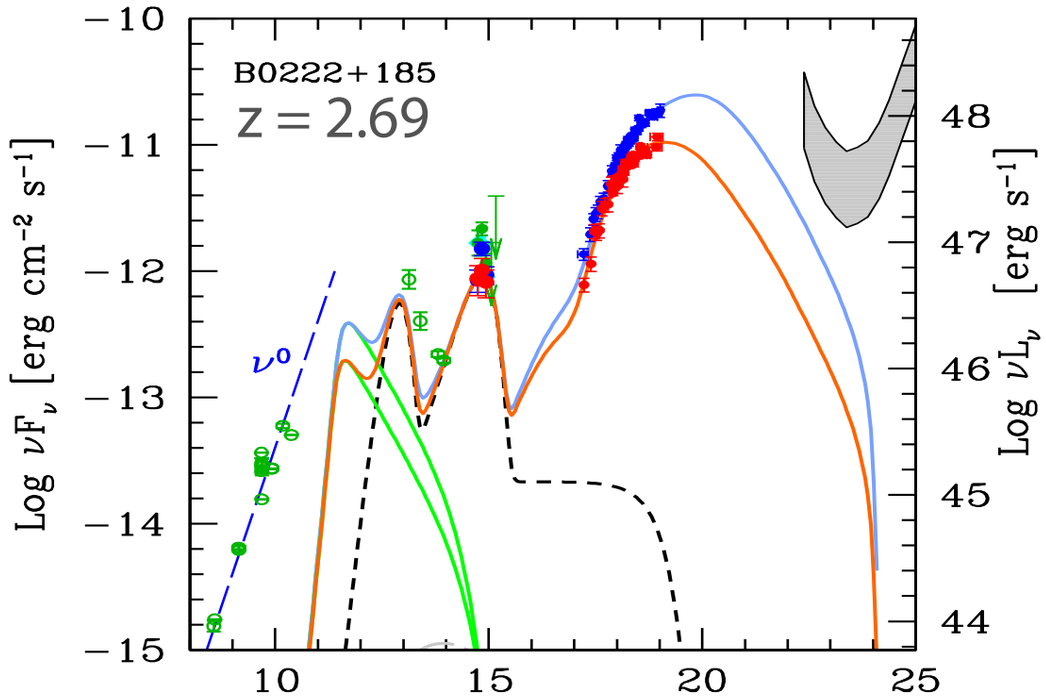
- difficult to study low-energy electron population by radio data
  - crucial for estimate of energetics and baryon loading (e.g. YI&Tanaka'16)

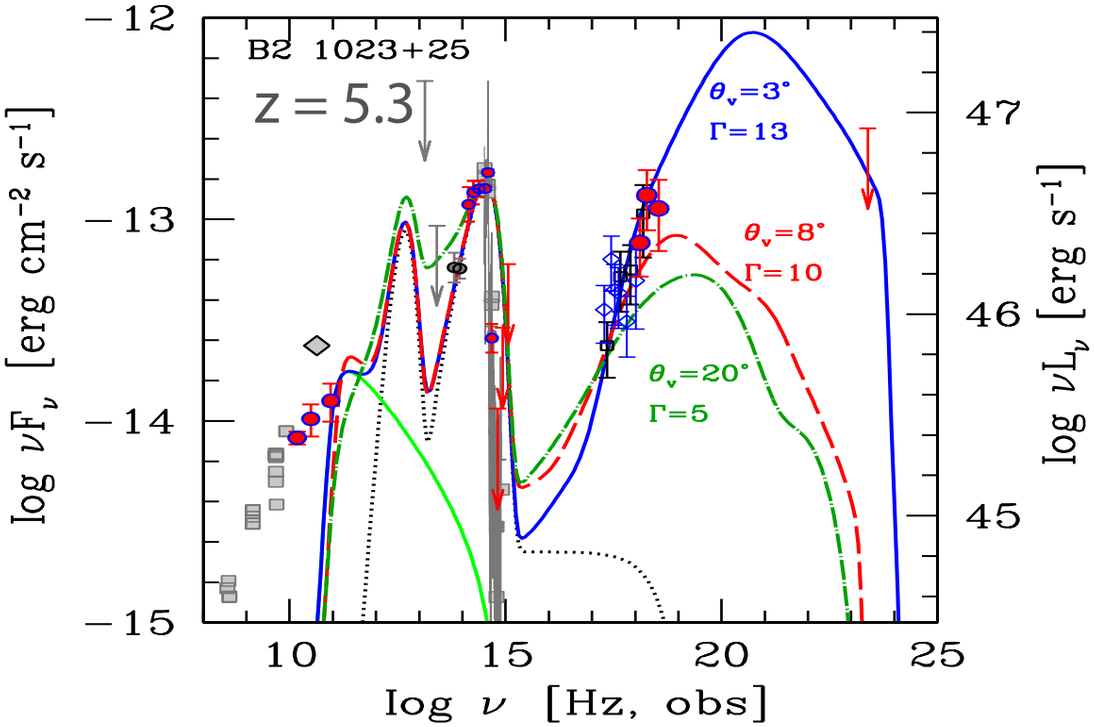


Madejski+'16

- Hard X-ray & MeV data will allow us to study γ ~ 100-1000 (Kataoka & Stawarz '16, Madejski+'16).
  - 10x better than COMPTEL is required.

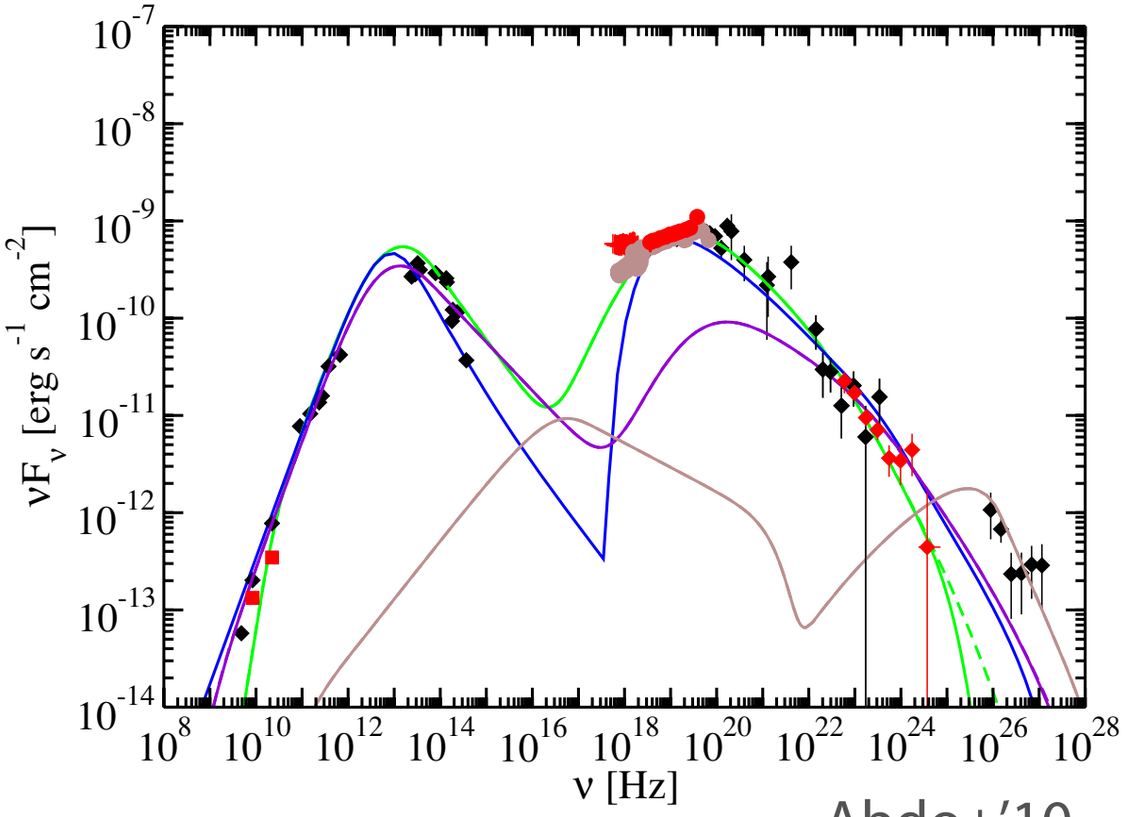
FSRQs



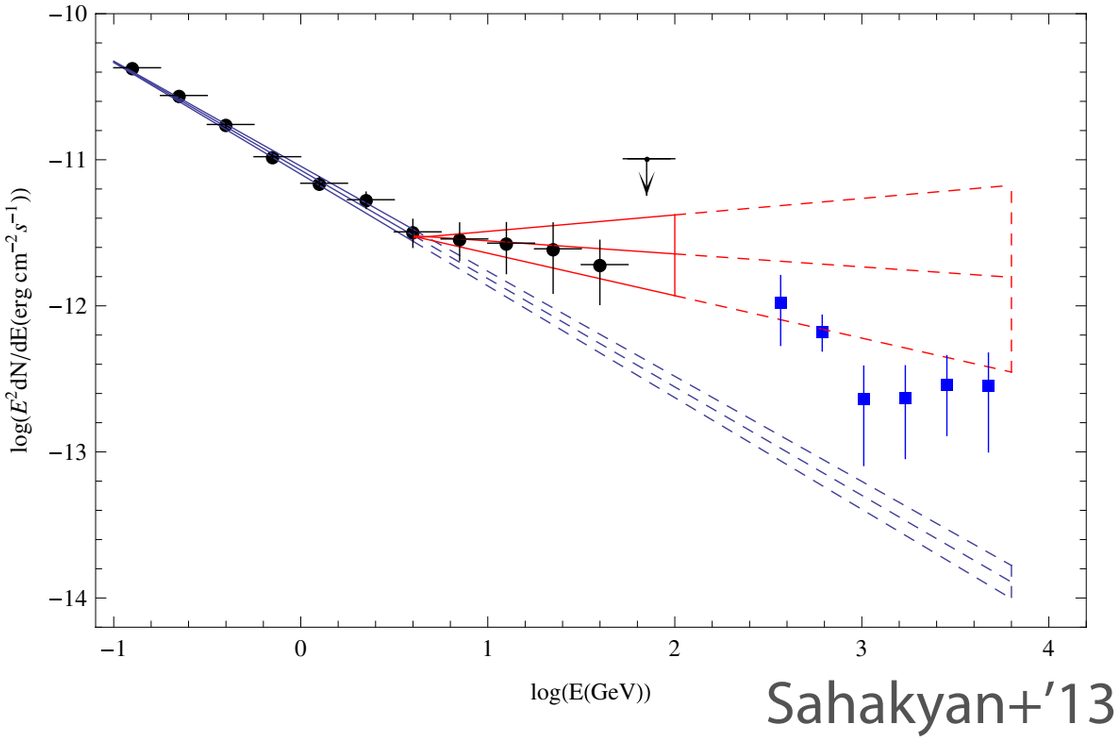


- Peak in the MeV band
  - jet energetics
  - ERC? or ERC + SSC?
- High redshift
  - z~3 blazars w/ 10^{-11} erg/cm^2/s.
  - z~5 blazars w/10^{-12} erg/cm^2/s.

Centaurus A: Disk-Jet Connection



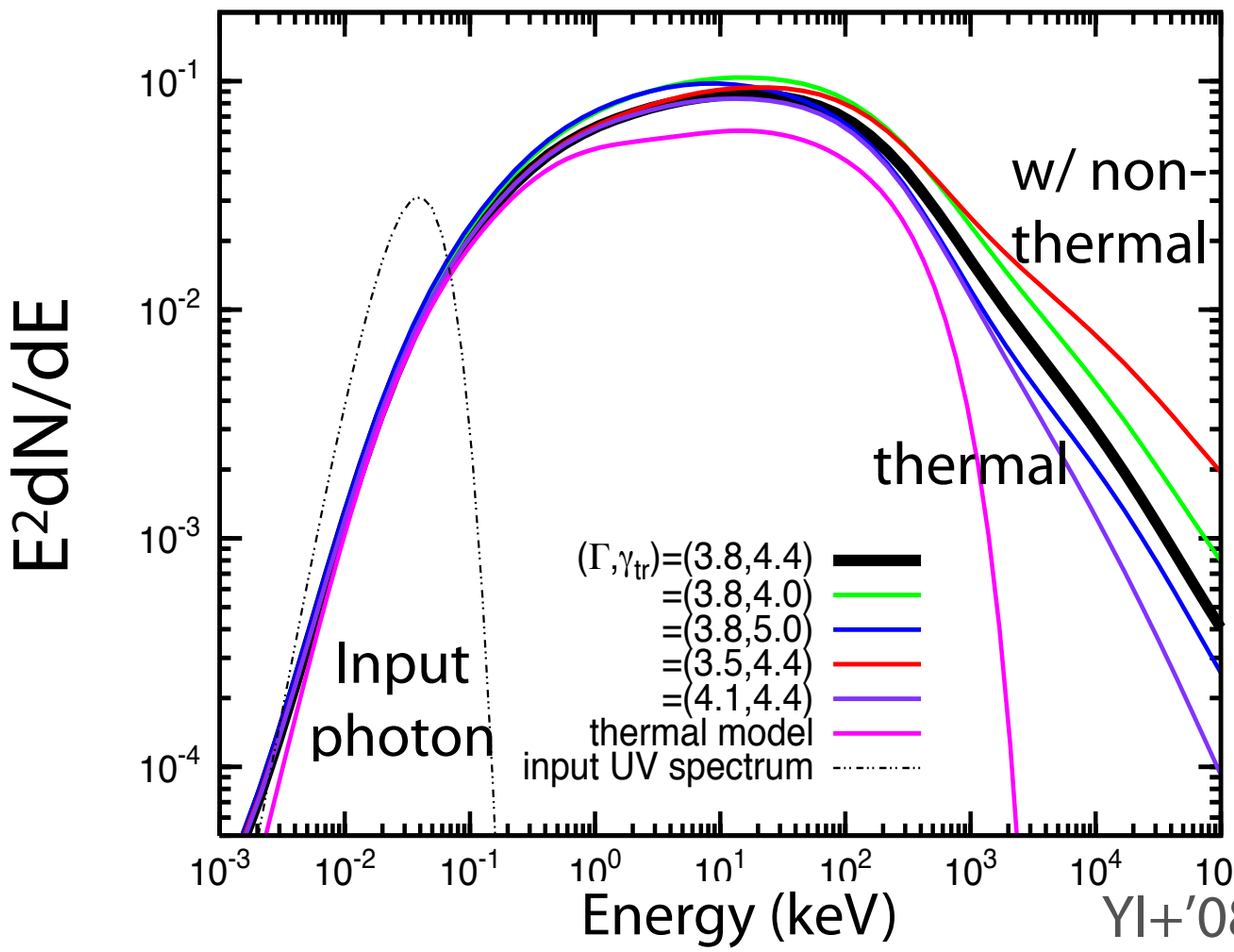
Abdo+'10

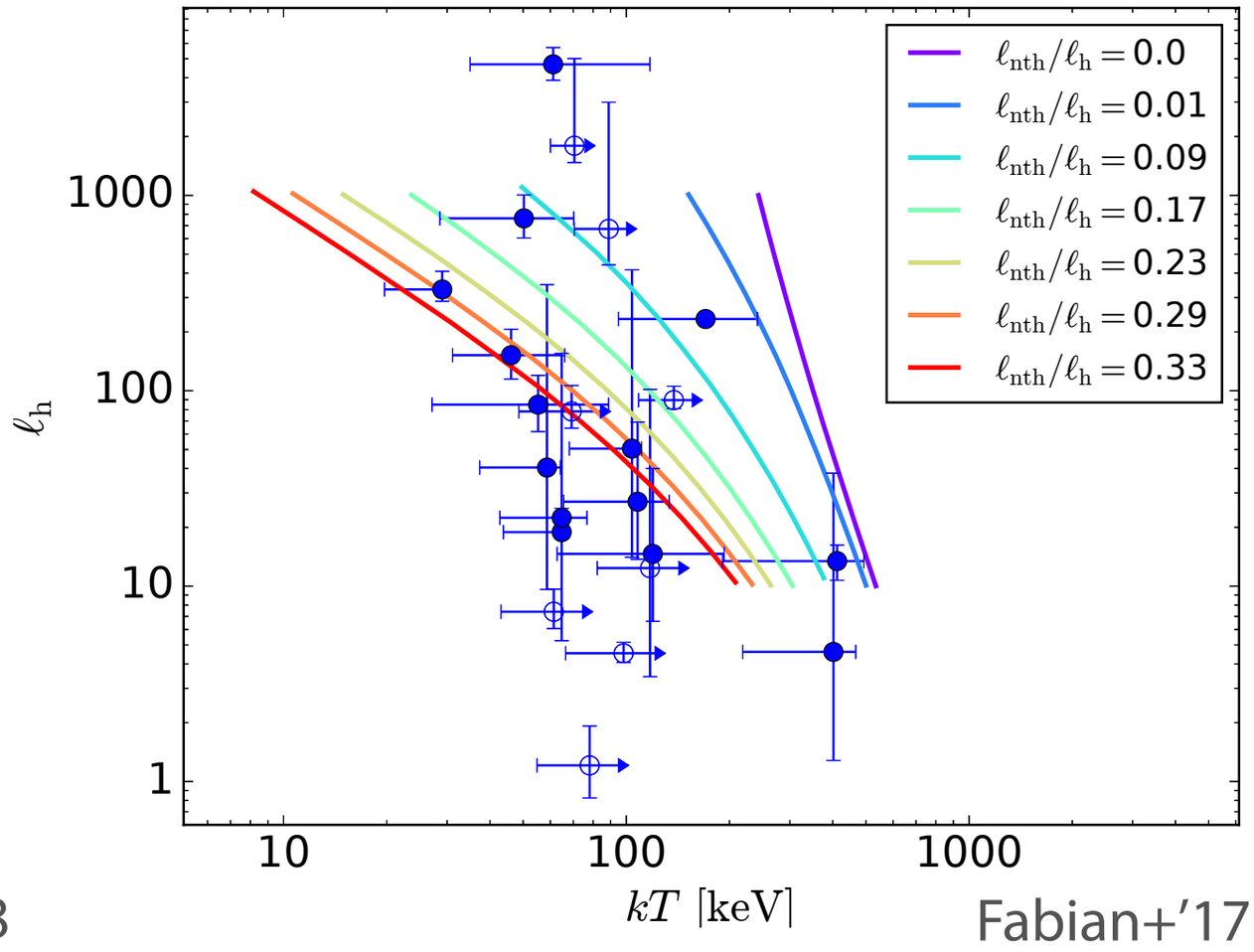


Sahakyan+'13

- a nearby radio galaxy
  - detected by COMPTEL
- Spectral break in GeV
- Smooth spectra from X-ray to MeV
  - Disk corona? or Jet?
  - Polarization? (10^{-9} erg/cm^2/s)
- Need to prepare hybrid corona model.

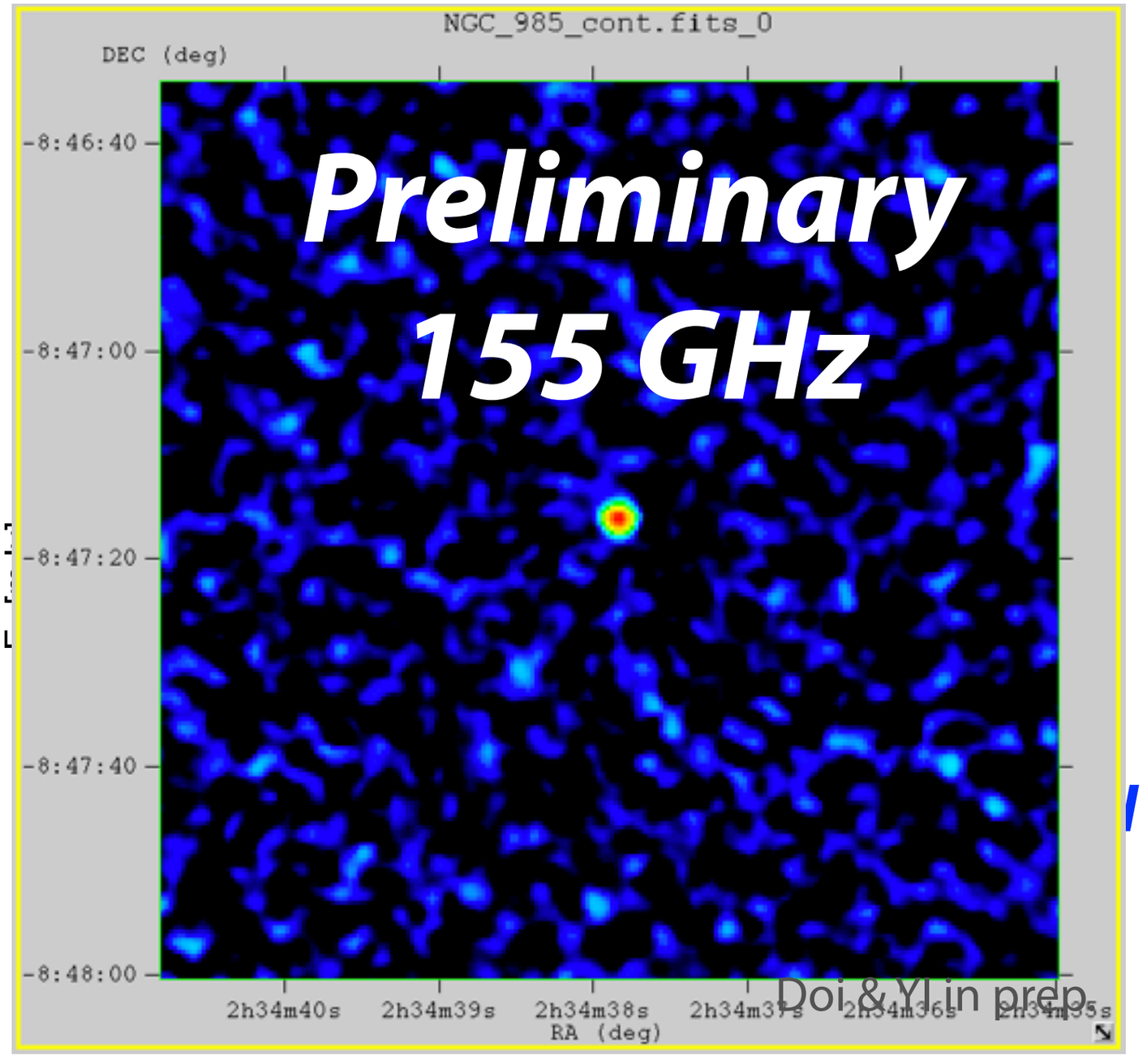
Seyferts





- Comptonization in a hot corona above the disk.
- If non-thermal electrons exist in a corona, non-thermal tail is expected (e.g. YI, Totani, & Ueda '08).
- A small fraction of non-thermal population is required (Fabian+'17)
  - See Mineshige-san's talk for MeV emission from accretion flows.

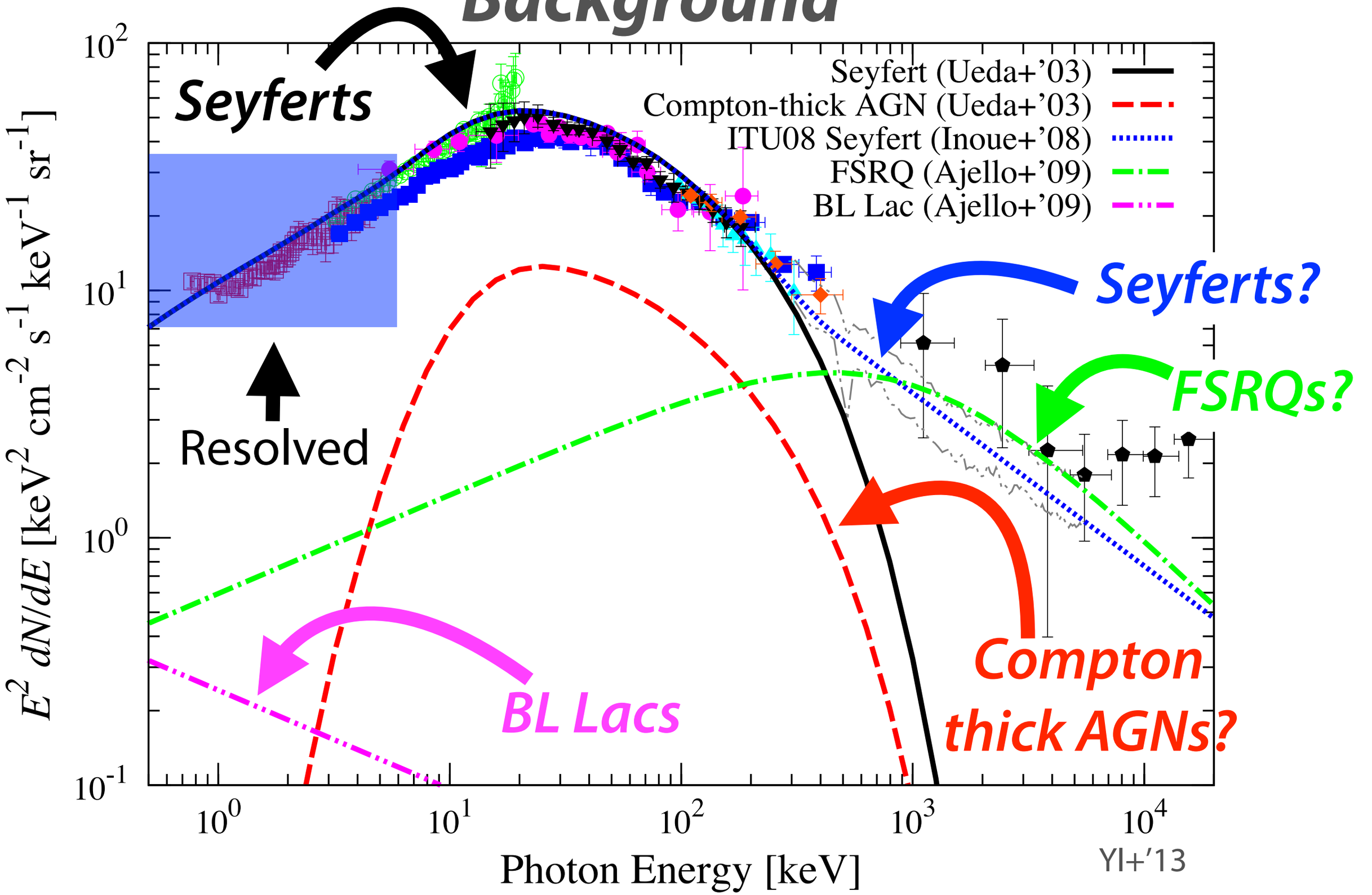
ALMA Observation toward NGC 985



- ALMA Cycle-3 Observation on this March.
- The excess is confirmed.
  - with the size of <0.02 arcsec (<16pc).
  - first discovery of the millimeter excess in Seyferts.
- Coronal Synchrotron emission is the most likely.
  - But, currently not clear whether it is thermal or hybrid.

- Our ALMA Cycle-4 proposal is accepted for higher frequency observations and another object.

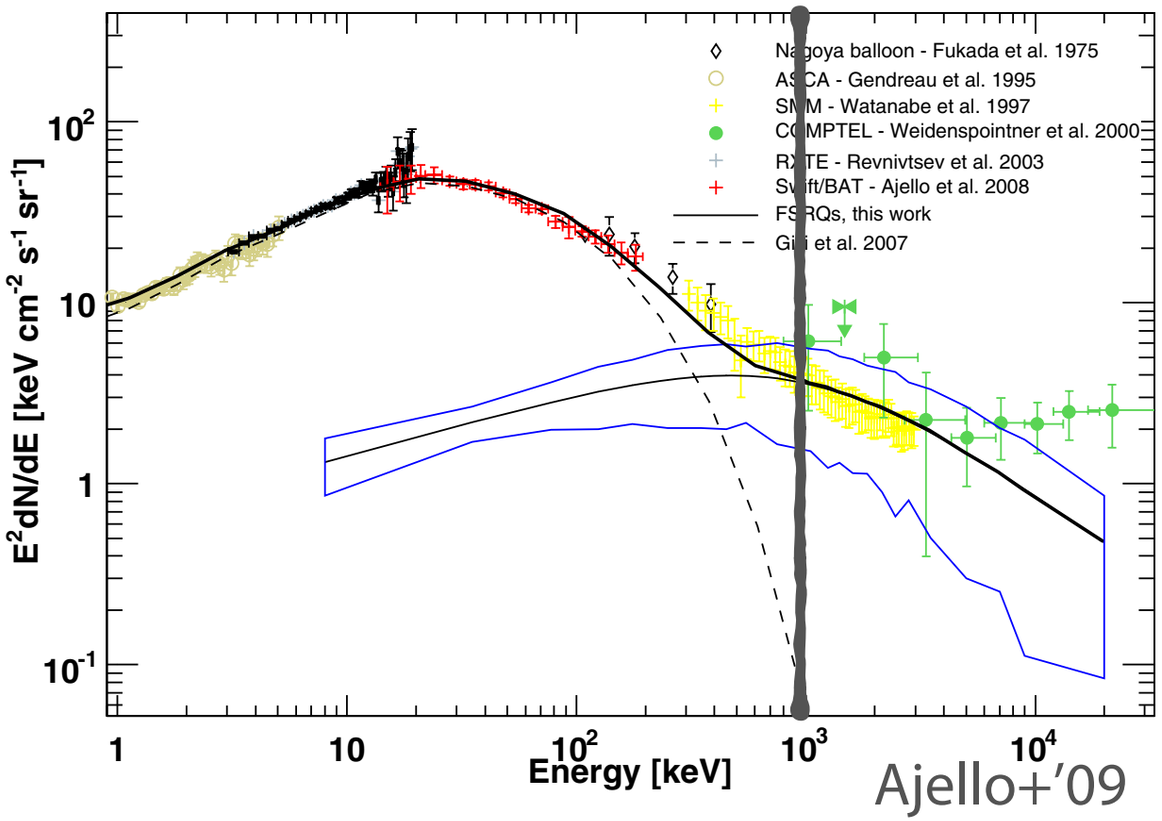
Cosmic X-ray & MeV Gamma-ray Background



YI+'13

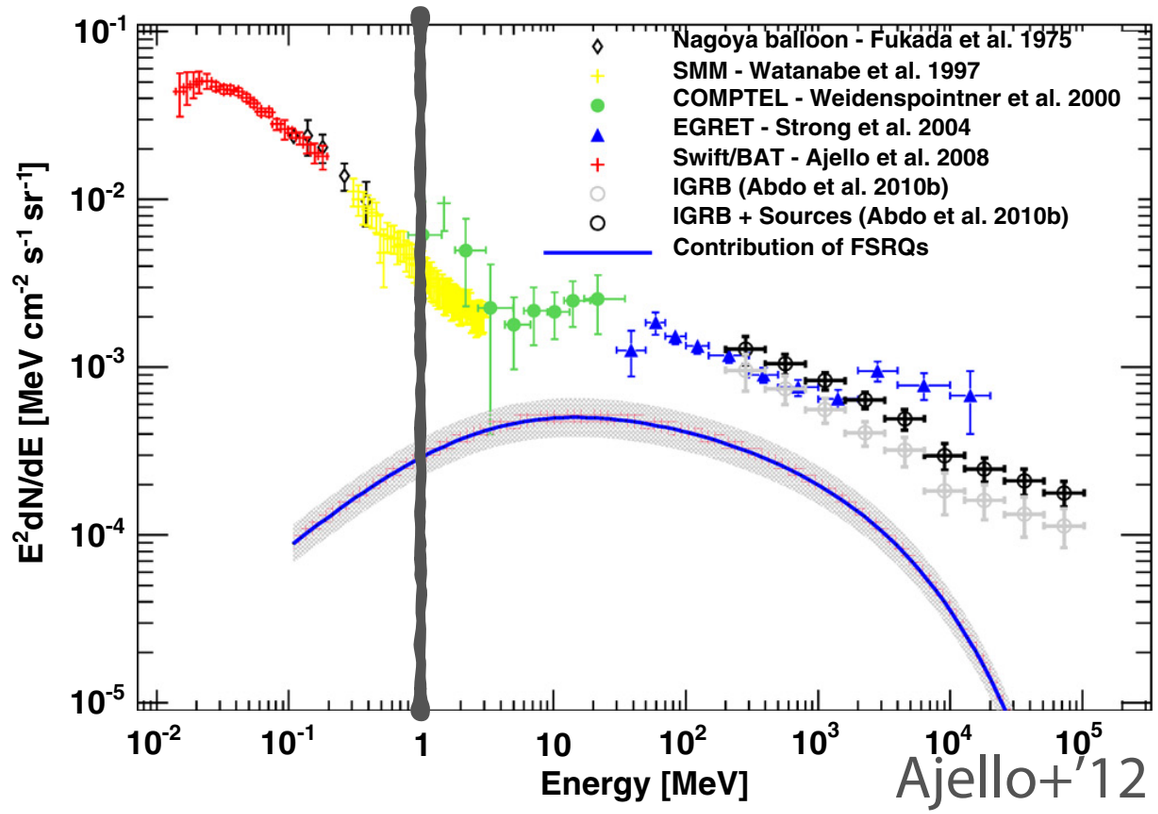
Blazars and Cosmic MeV Gamma-ray Background

Based on Swift-BAT



Ajello+'09

Based on Fermi-LAT

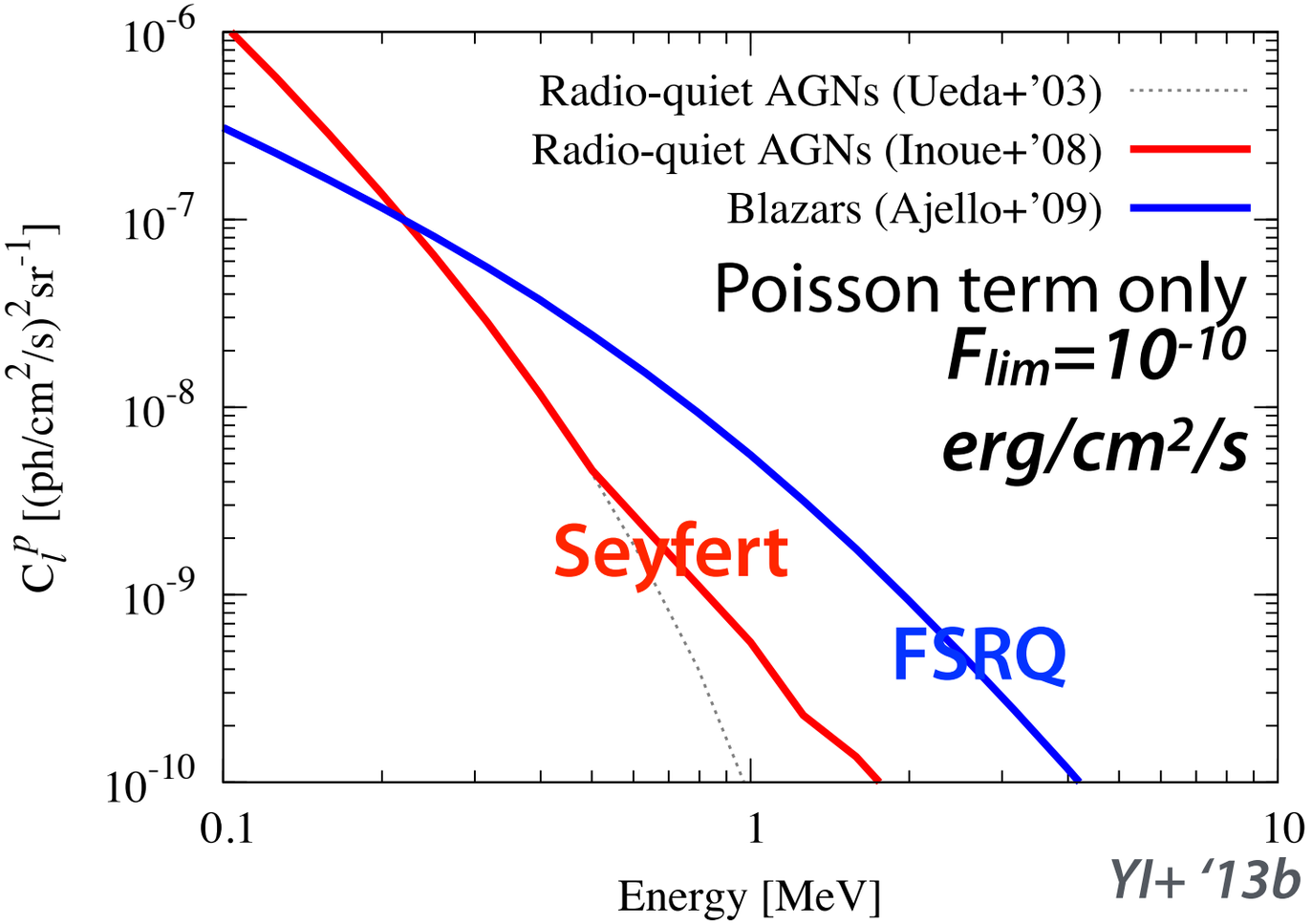


Ajello+'12

- FSRQs contribute to the GeV gamma-ray background with a peak at ~100 MeV (e.g. YI & Totani '09, Ajello +'12)

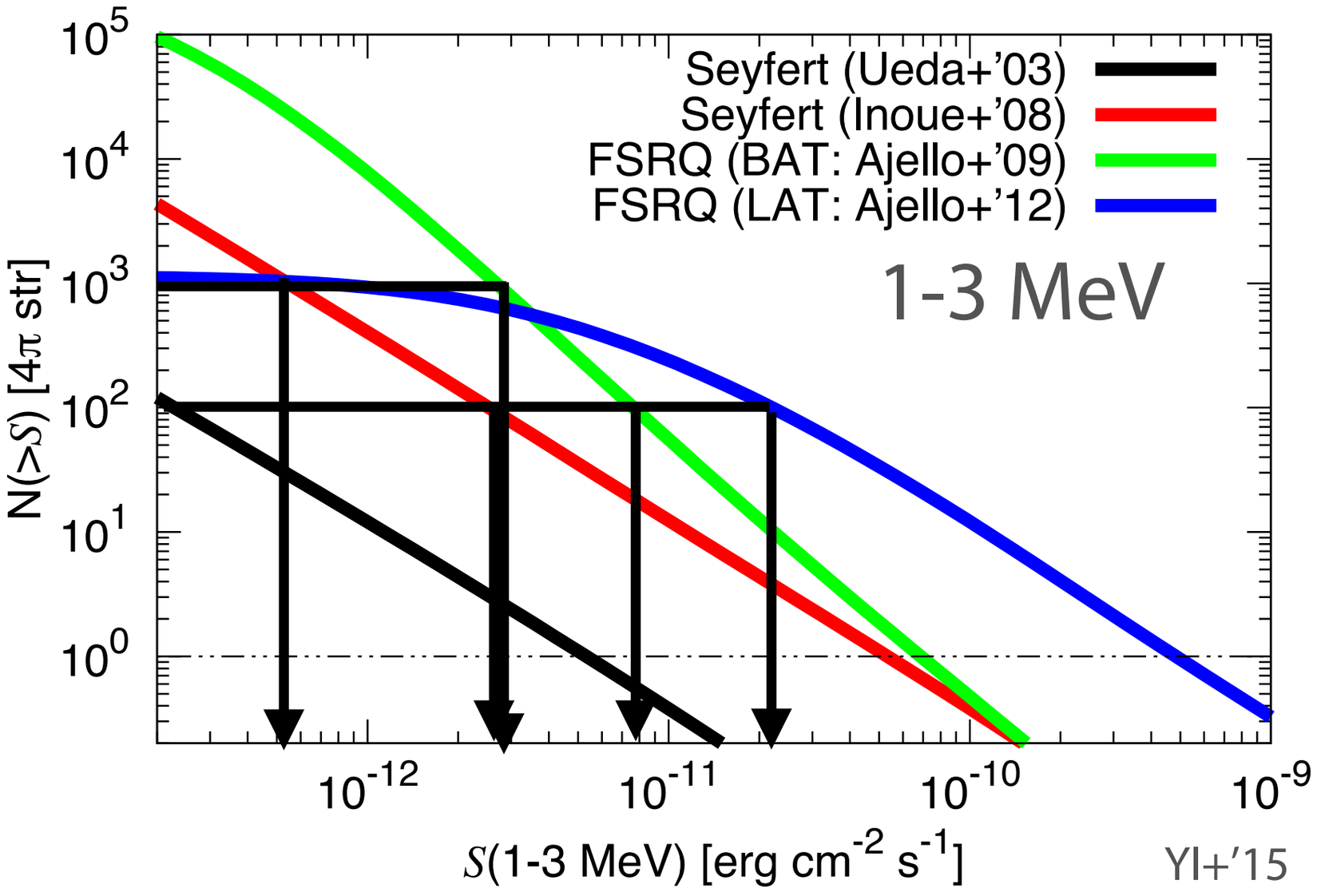
  ➡See Toda san's talk.

Angular Power Spectra of the MeV background



- Even achieving the sensitivity of 10^{-11} erg/cm^2/s, it is hard to resolve the MeV sky (***YI+'15***).
- Answers are in "***Anisotropy***".
  - Cosmic background radiation is not isotropic.
- future MeV satellites will distinguish Seyfert & blazar scenarios through anisotropy in the sky.

Expected Source Counts



YI+'15

- To detect ~100 srcs., 10^{-11} erg/cm^2/s is required.
- To detect ~1000 srcs. (like Fermi), ~10^{-12} erg/cm^2/s is required.
  - Ultimate goal is to achieve 10^{-13} erg/cm^2/s to see a break in logN-logS.

Summary

- Blazars, Radio galaxies, and Seyferts are important targets for MeV astronomy.
  - 10^{-11} erg/cm^2/s will allow us to study various new thing (e.g. low energy electrons, high-z blazars,,,)
- MeV gamma-ray background would come from Seyferts or blazars.
  - Anisotropy will answer this. 10^{-10} erg/cm^2/s is sufficient.
- Sensitivity of 10^{-11} erg/cm^2/s will detect ~100 AGNs
- Sensitivity of 10^{-12} erg/cm^2/s will detect ~1000 AGNs like Fermi.