

Non thermal emission from active galaxies

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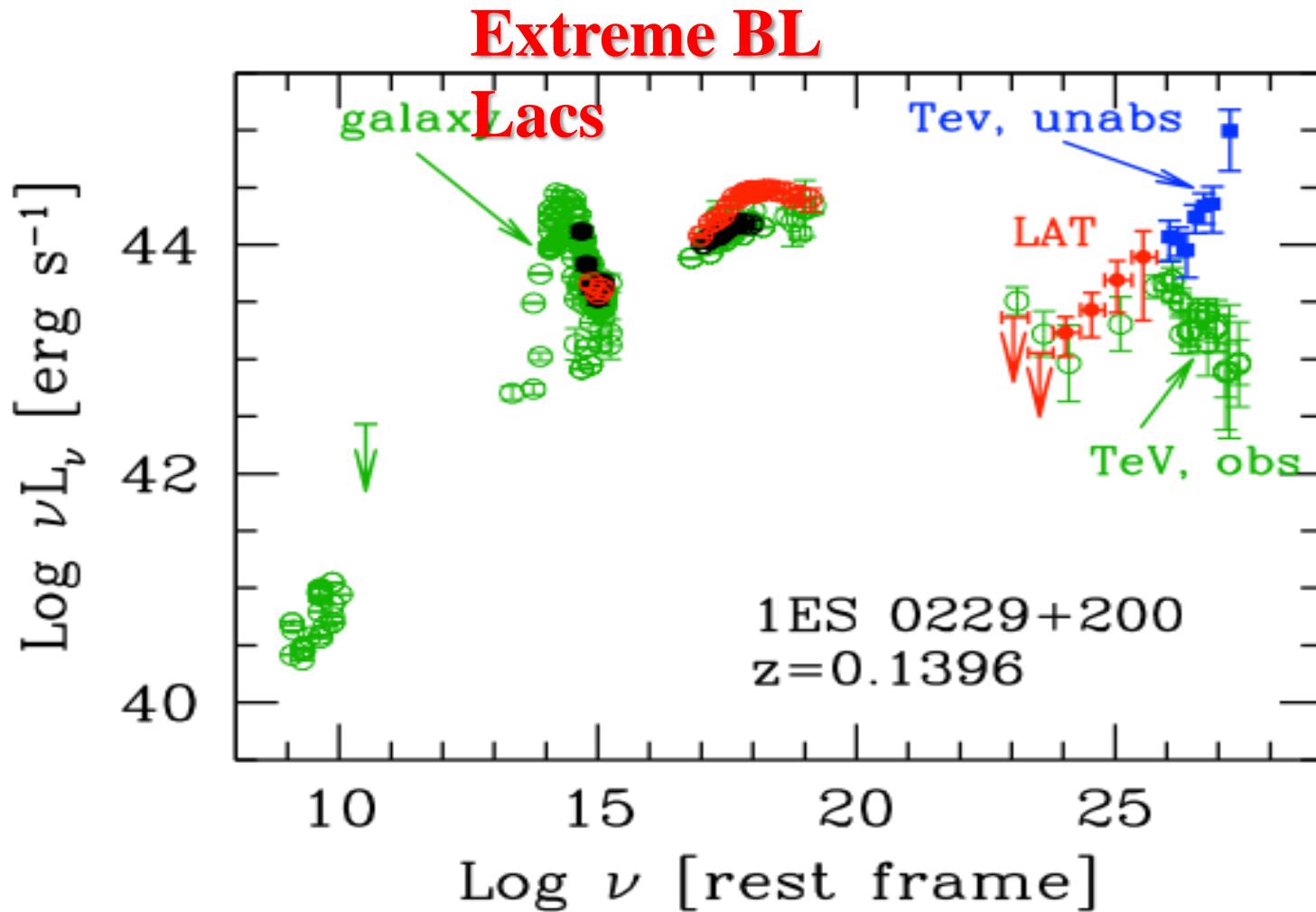
Jets in AGNs

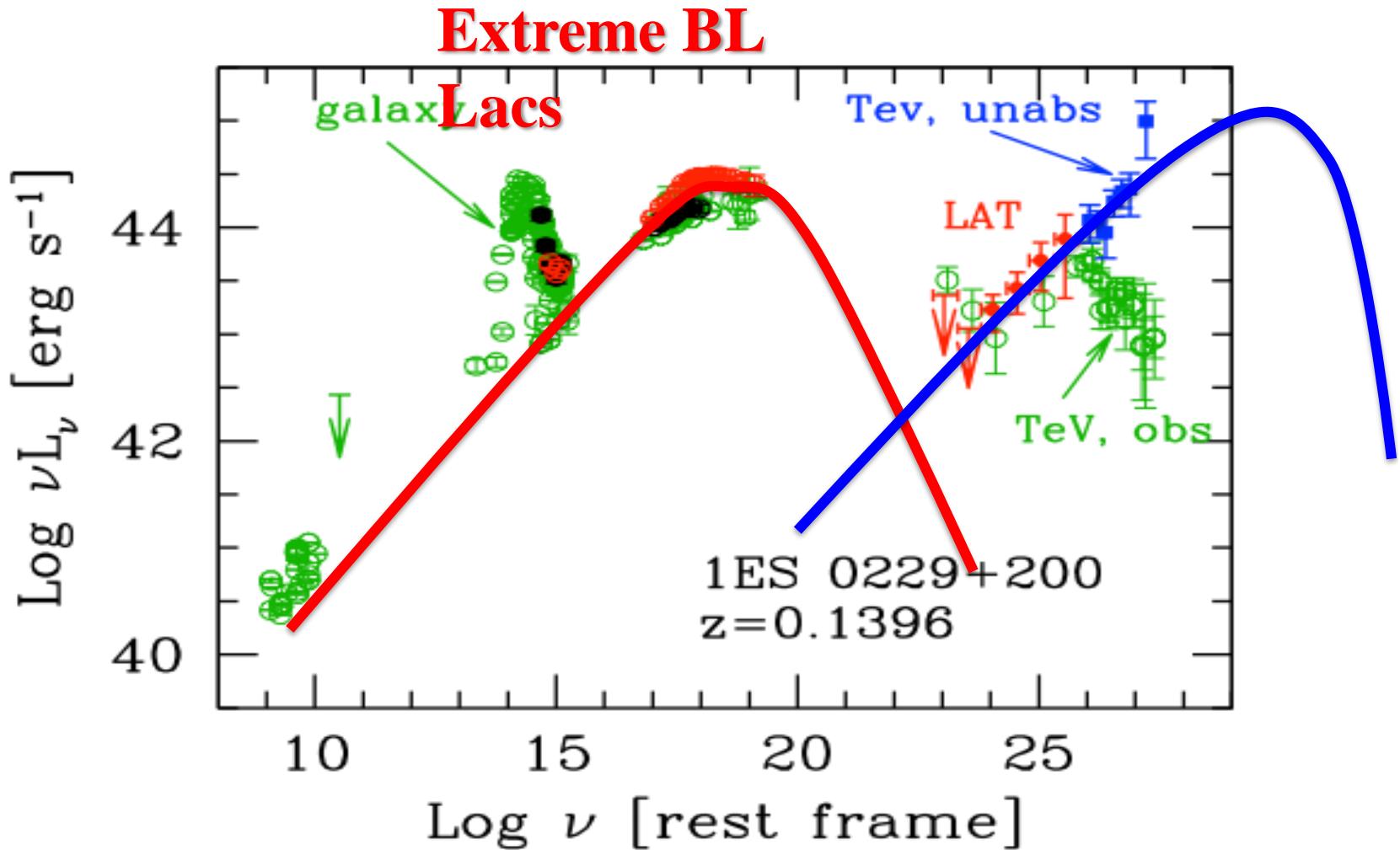
10% of AGNs have jets, those “pointing at us” are blazars

$$\Theta_{\text{view}} < 1/\Gamma$$

For blazars, $\sim \Gamma \sim 10-15 \rightarrow$ emission is strongly beamed

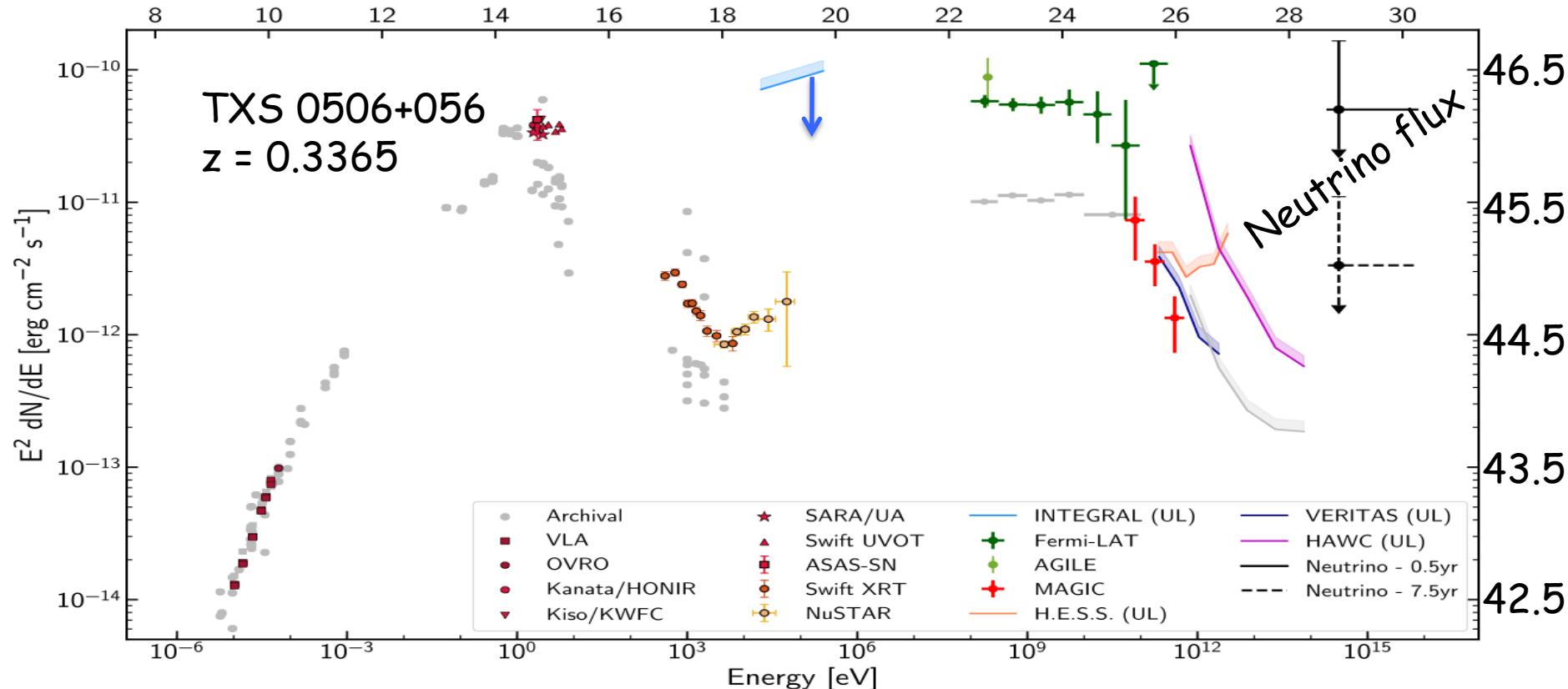
Jets are independent from the accretion regime





Intermediate BL Lacs

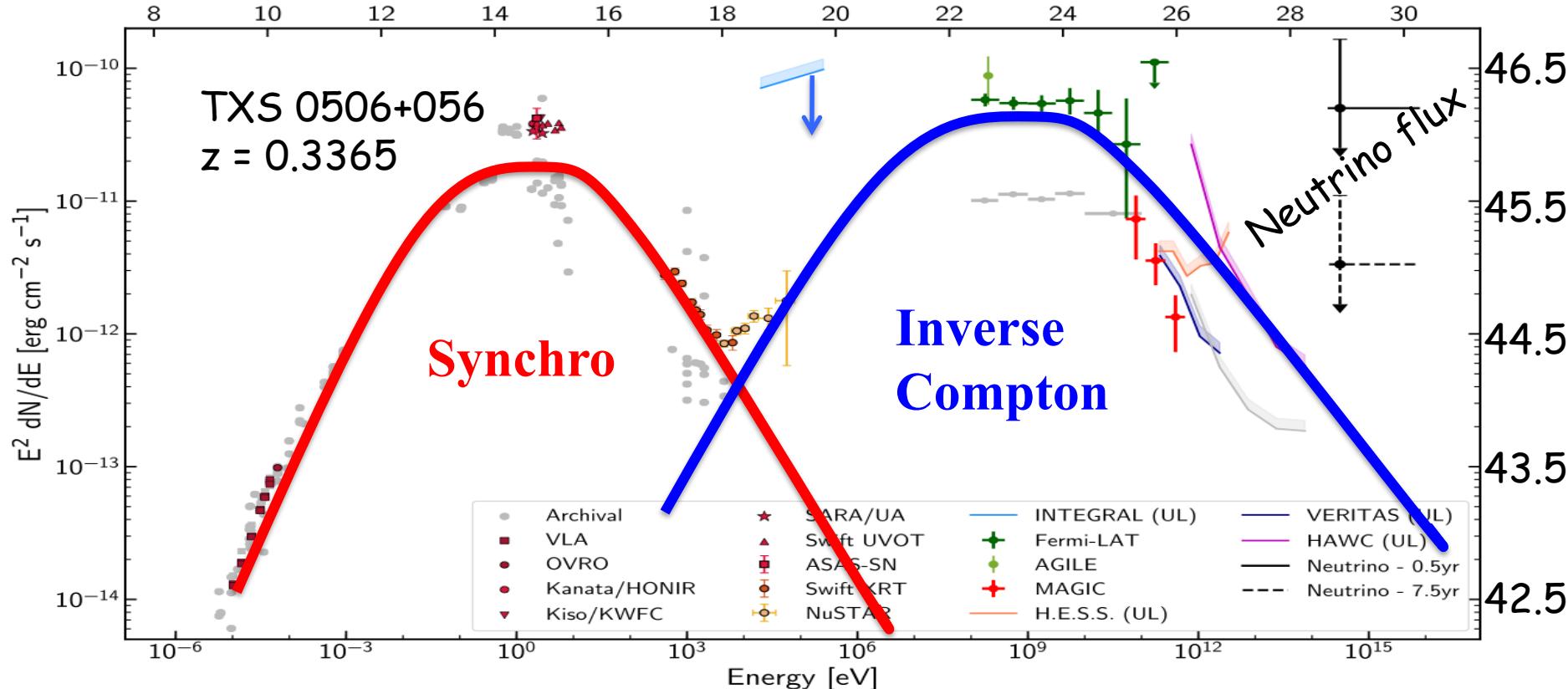
log(Frequency [Hz])



IceCube, Fermi-LAT, MAGIC, AGILE, ASAS-SN, HAWC, H.E.S.S., INTEGRAL, Kanata, Kiso, Kapteyn, Liverpool telescope, Subaru, Swift/NuSTAR, VERITAS, and VLA/17B-403 teams. arXiv:1807.08816

Intermediate BL Lacs

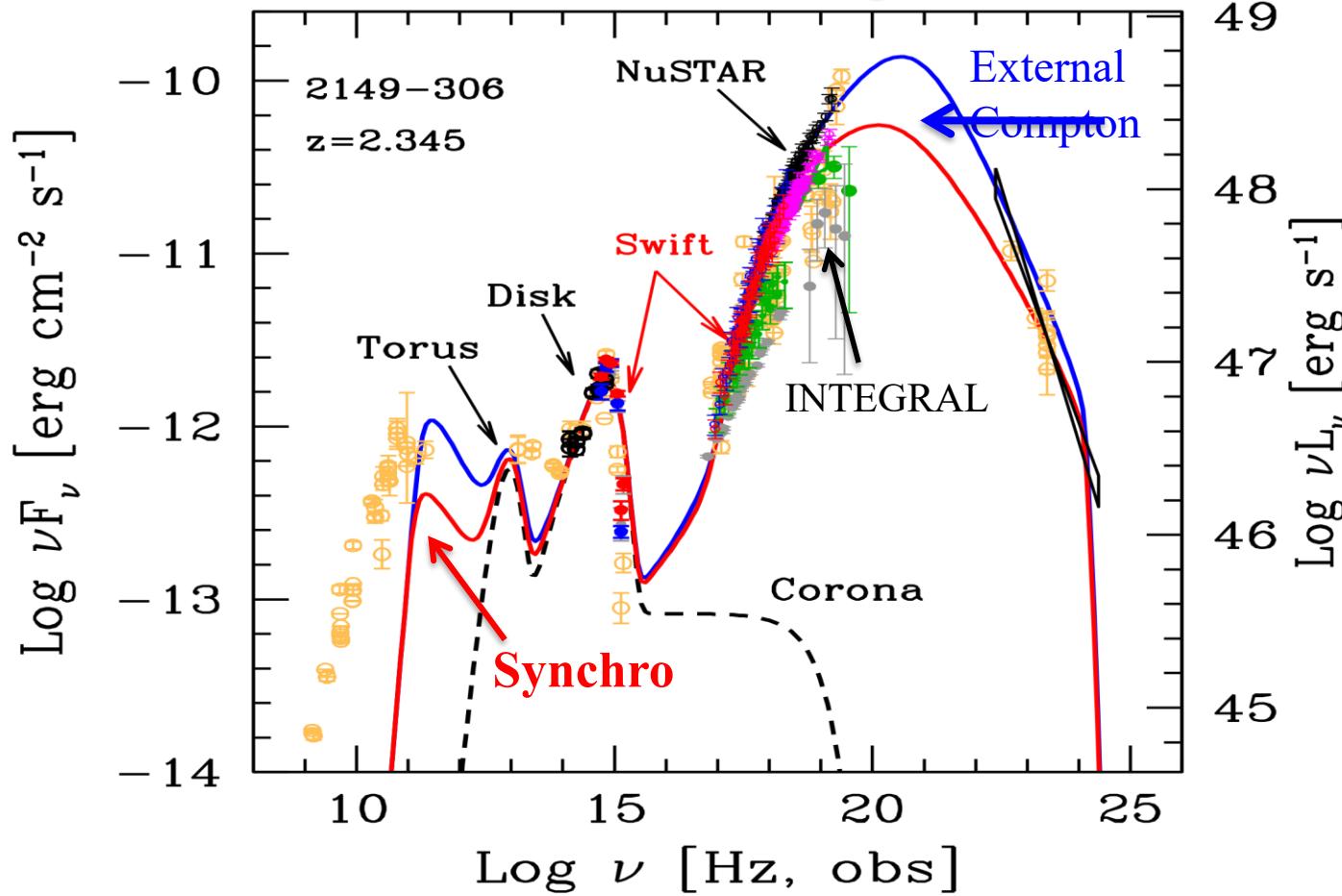
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IceCube, Fermi-LAT, MAGIC, AGILE, ASAS-SN, HAWC, H.E.S.S., INTEGRAL, Kanata, et al.,

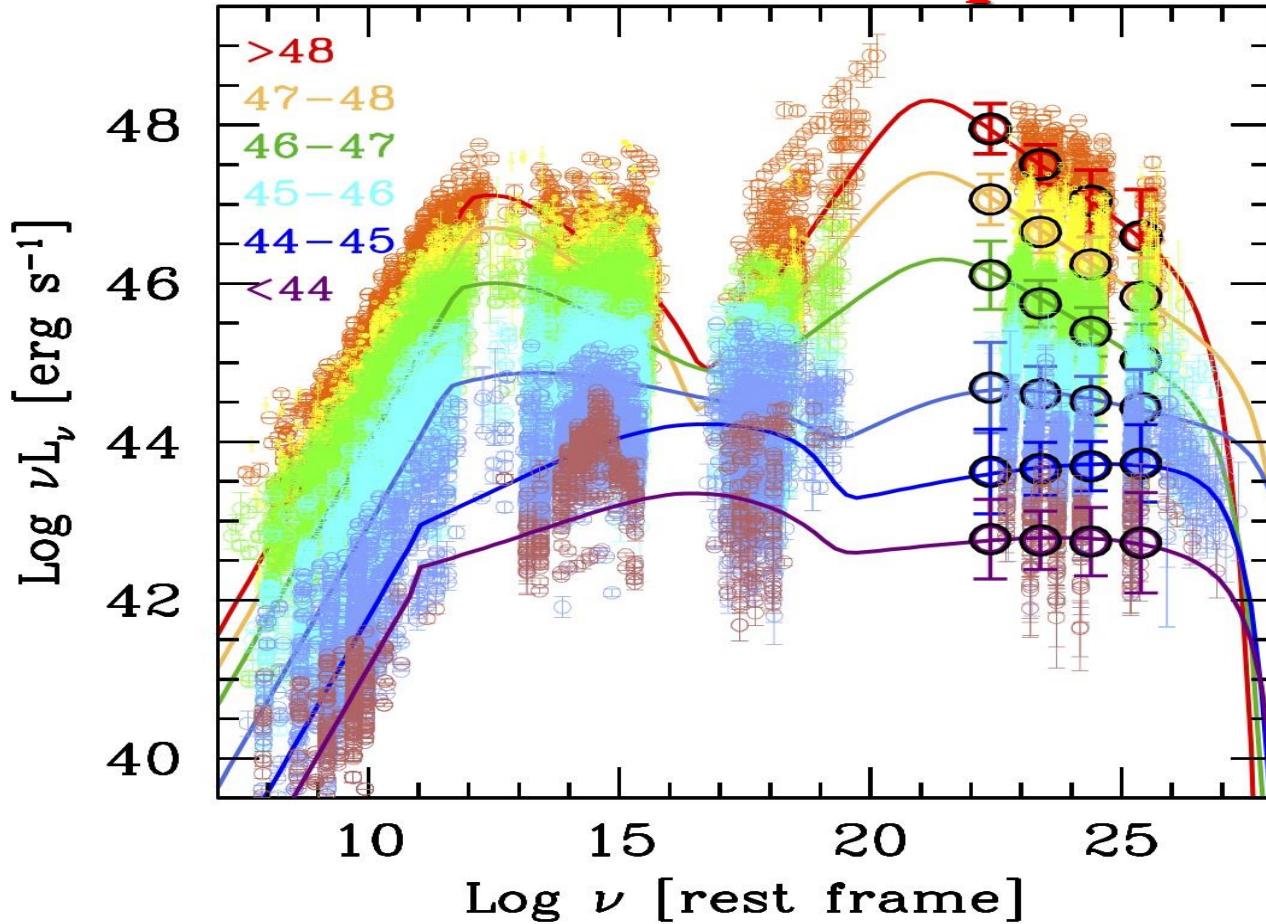
Liverpool telescope, Subaru, Swift/NuSTAR, VERITAS, and VLA/17B-403 teams. arXiv:1807.08816

Powerful FSRQs

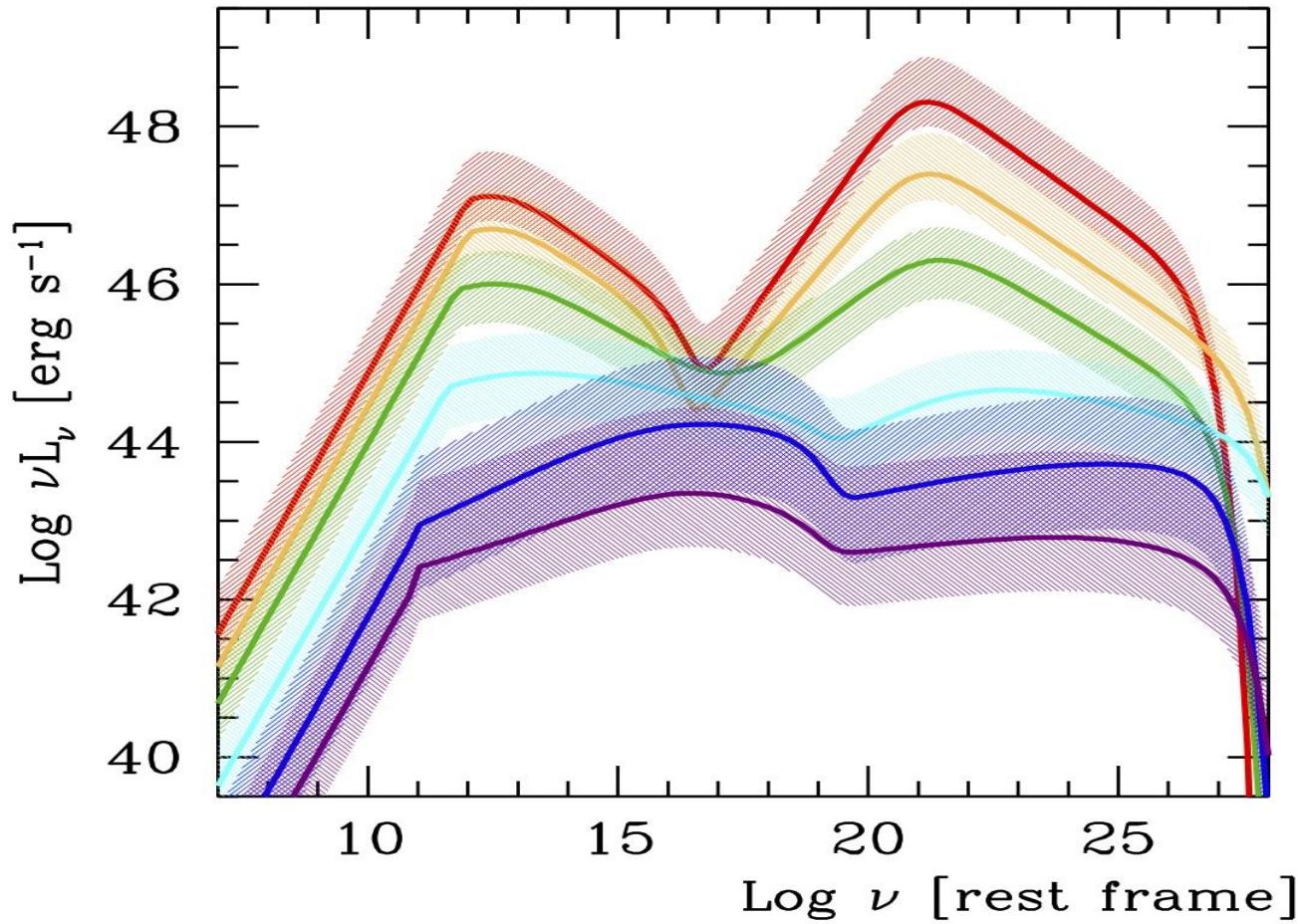


Tagliaferri+ 2015

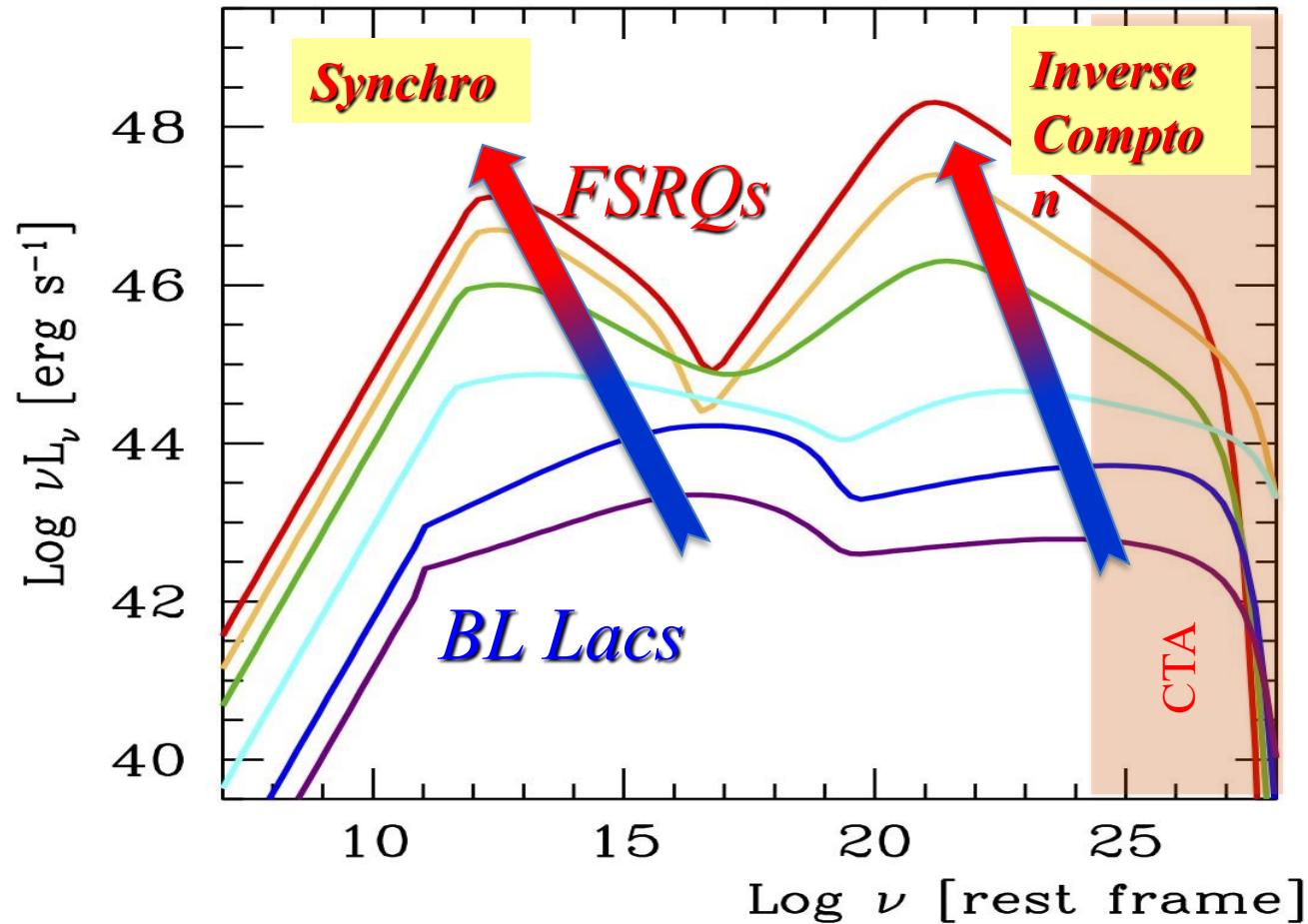
The new blazar sequence

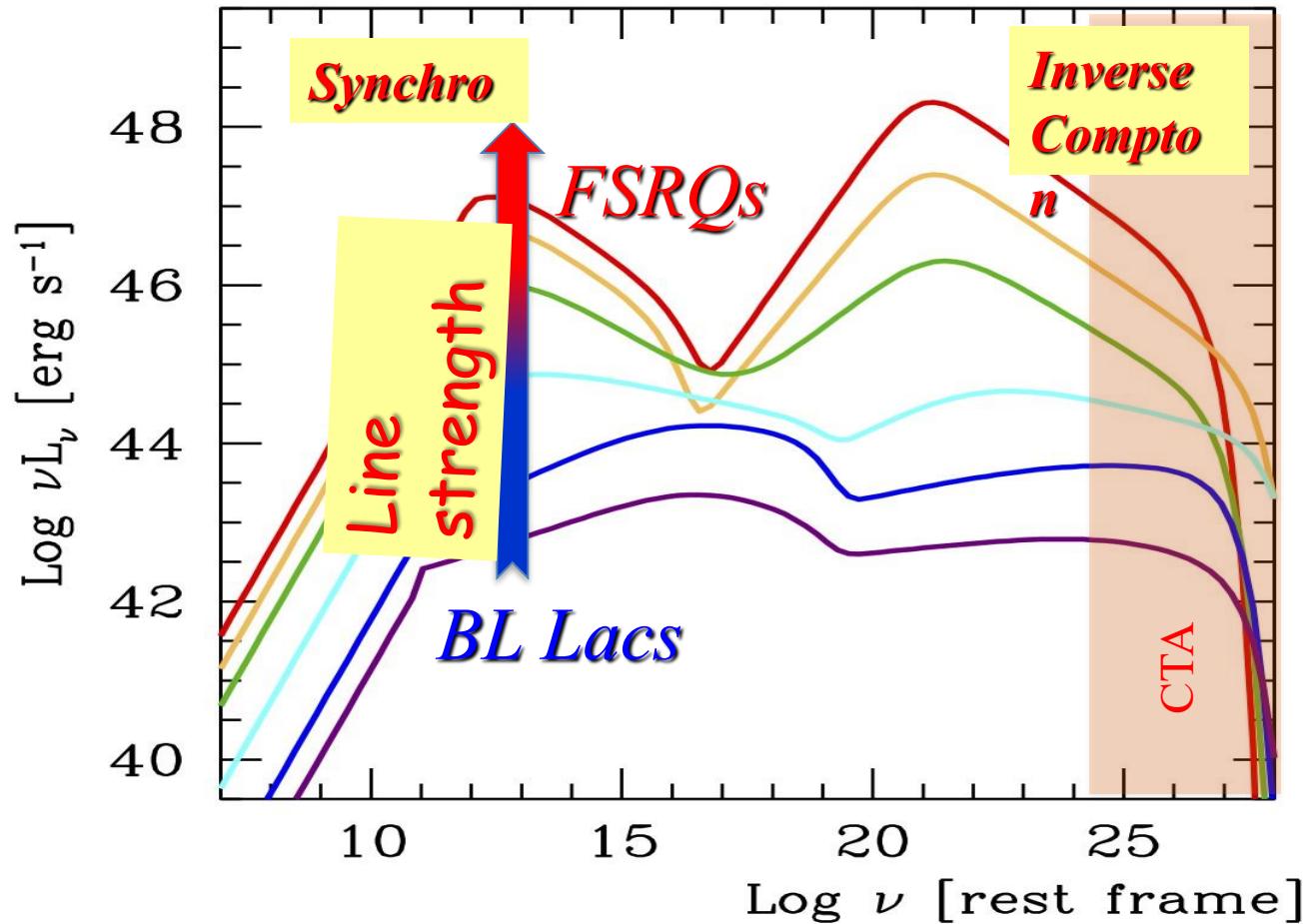


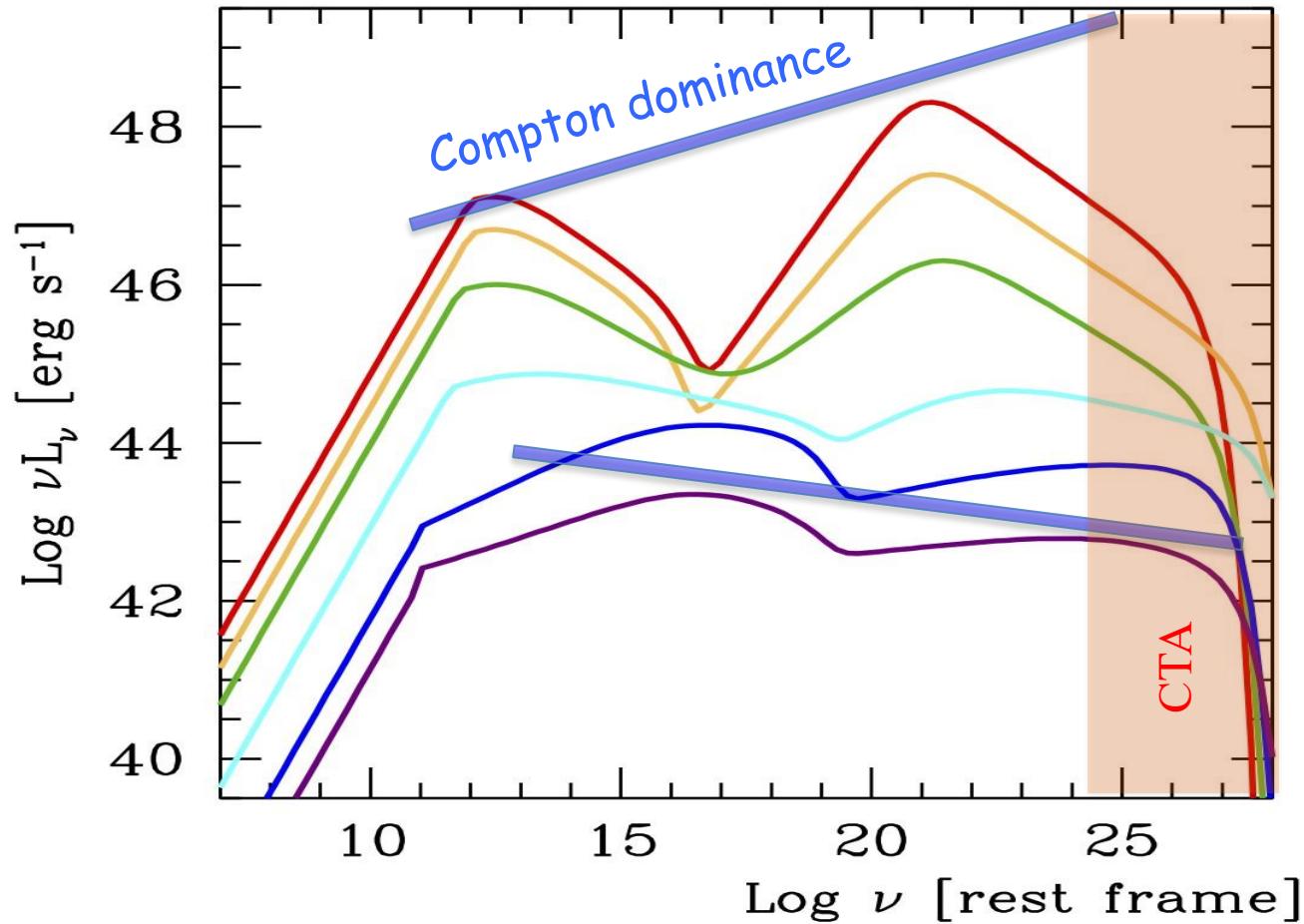
GG, Right+, 2017



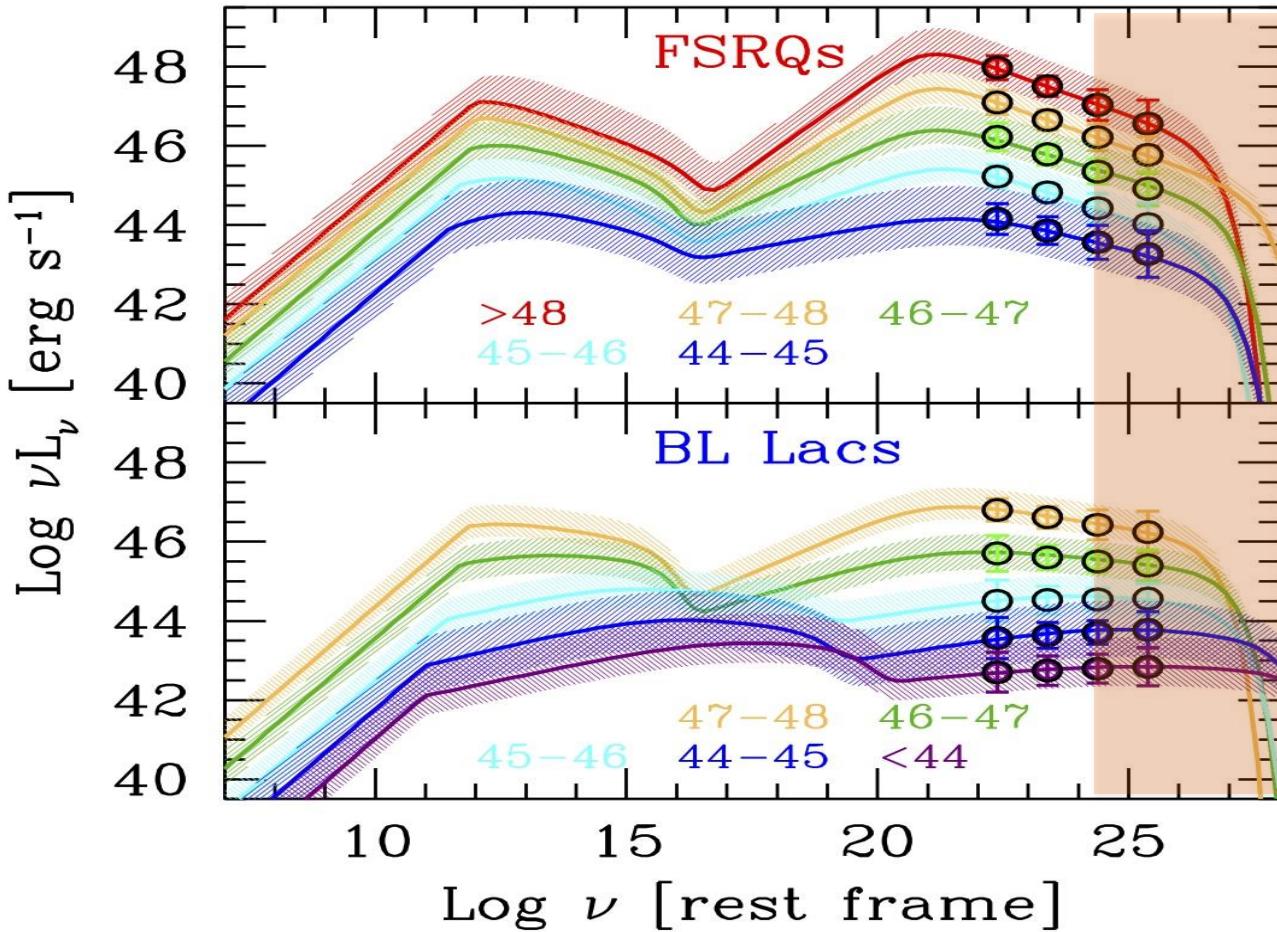
GG, Right+, 2017

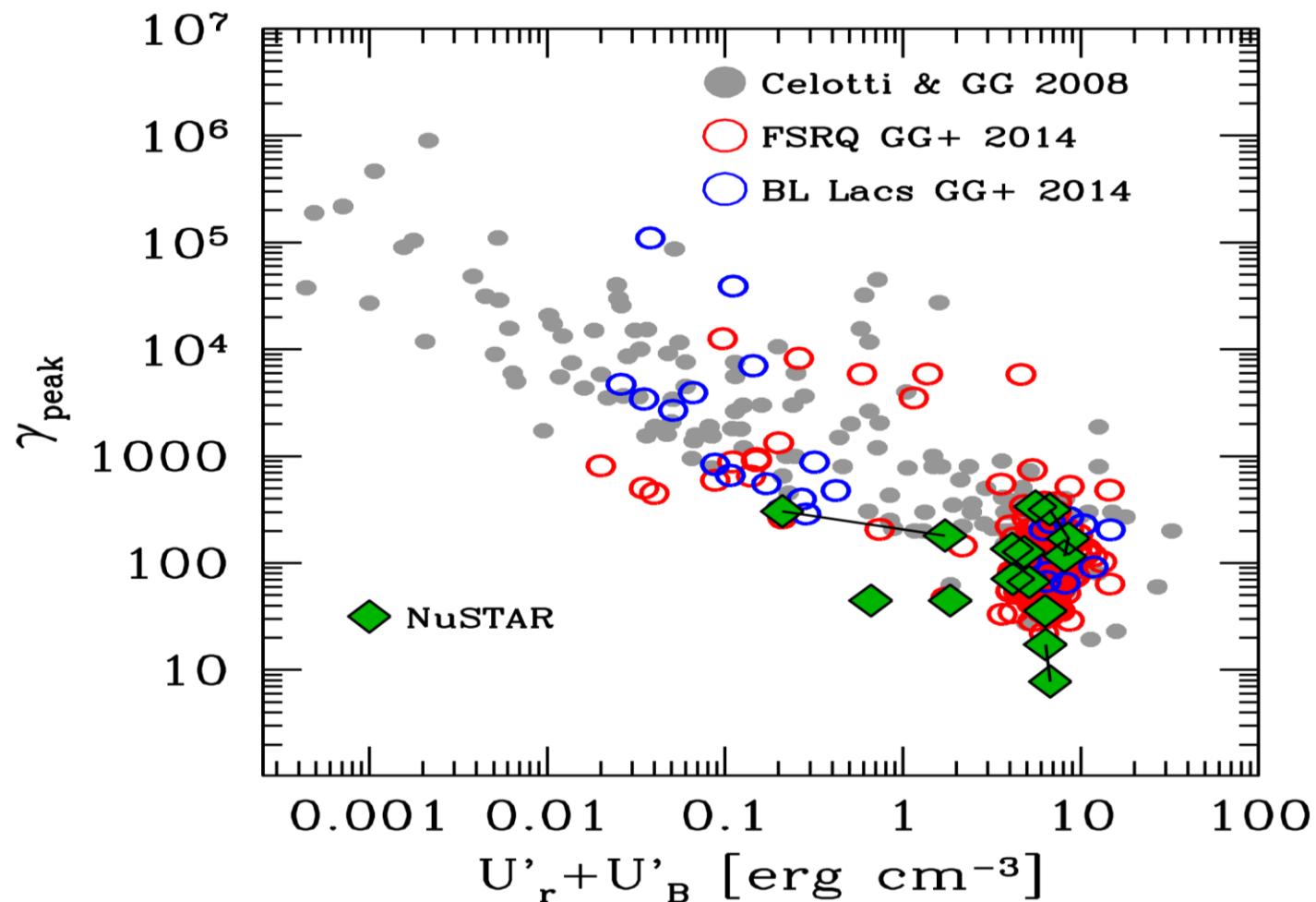


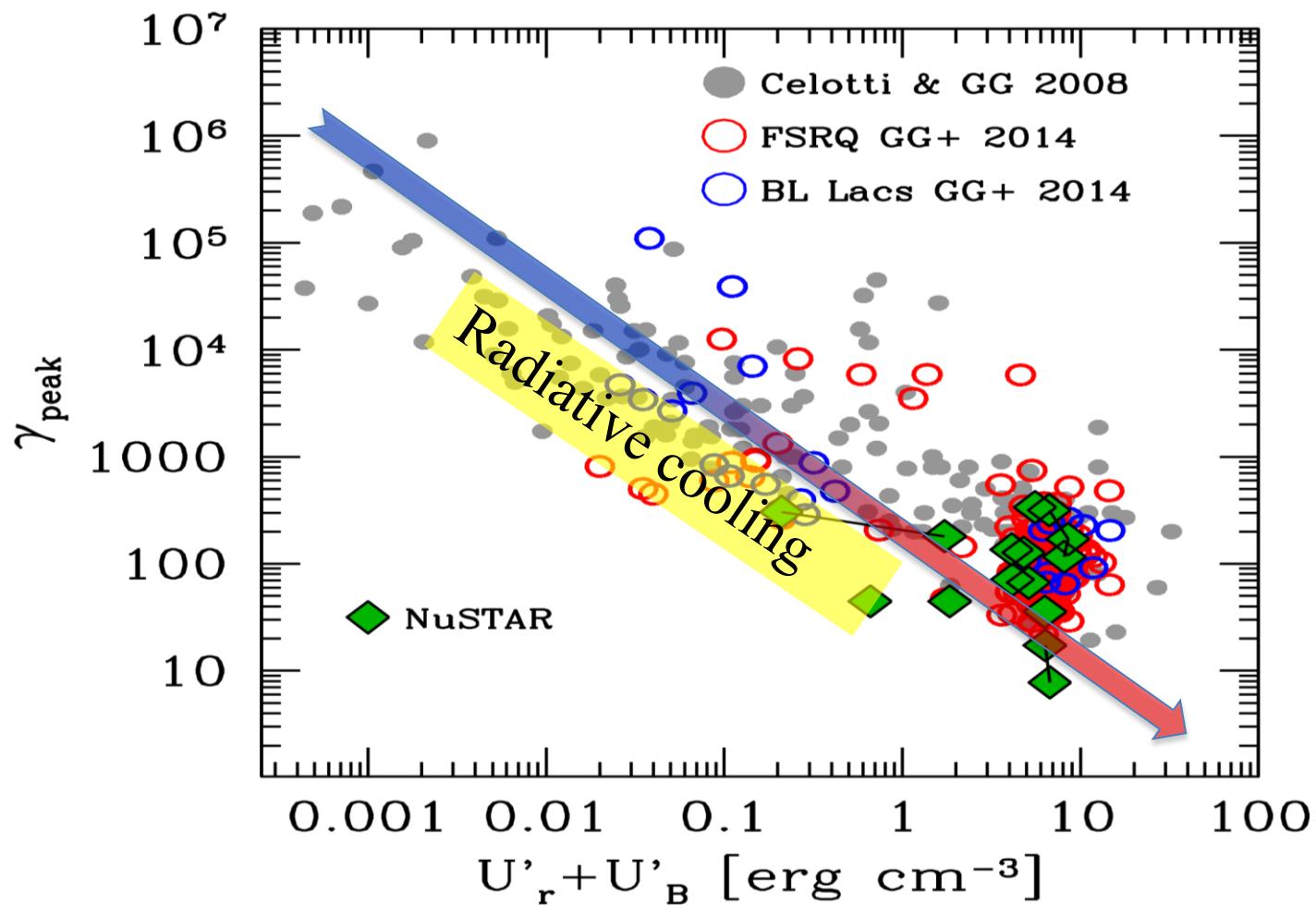




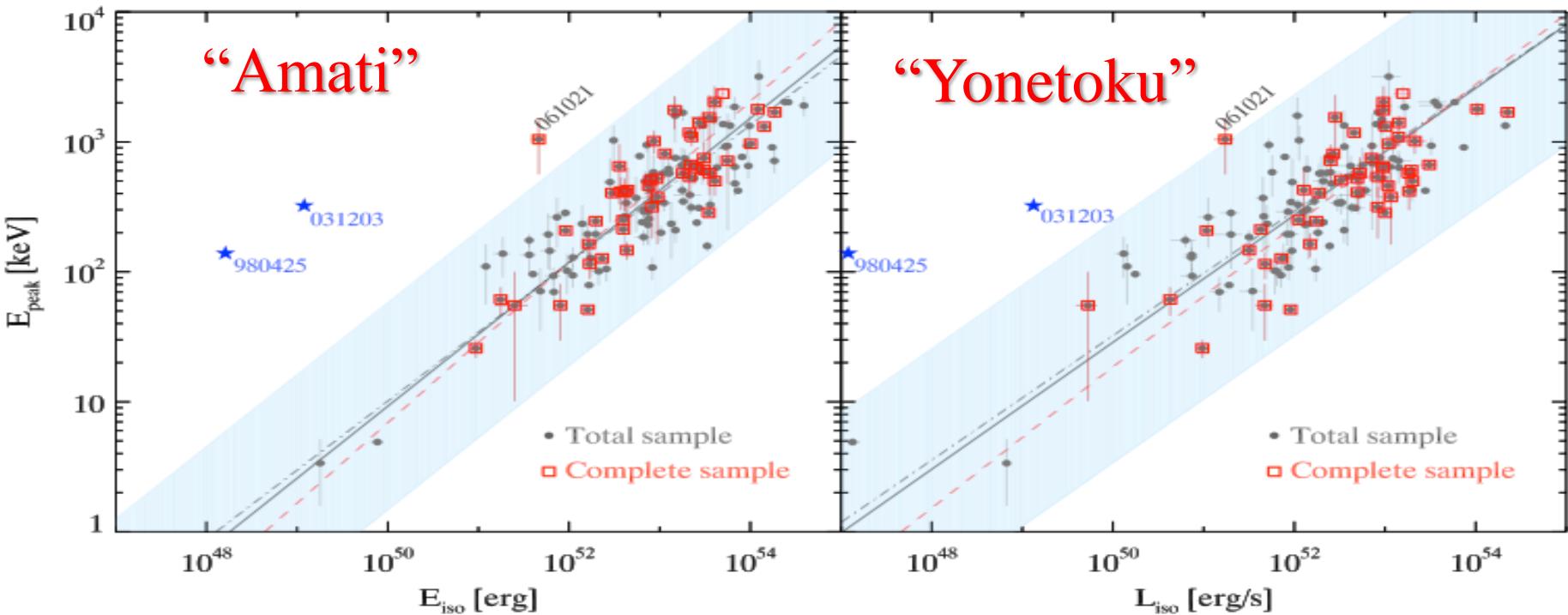
GG, Right+, 2017



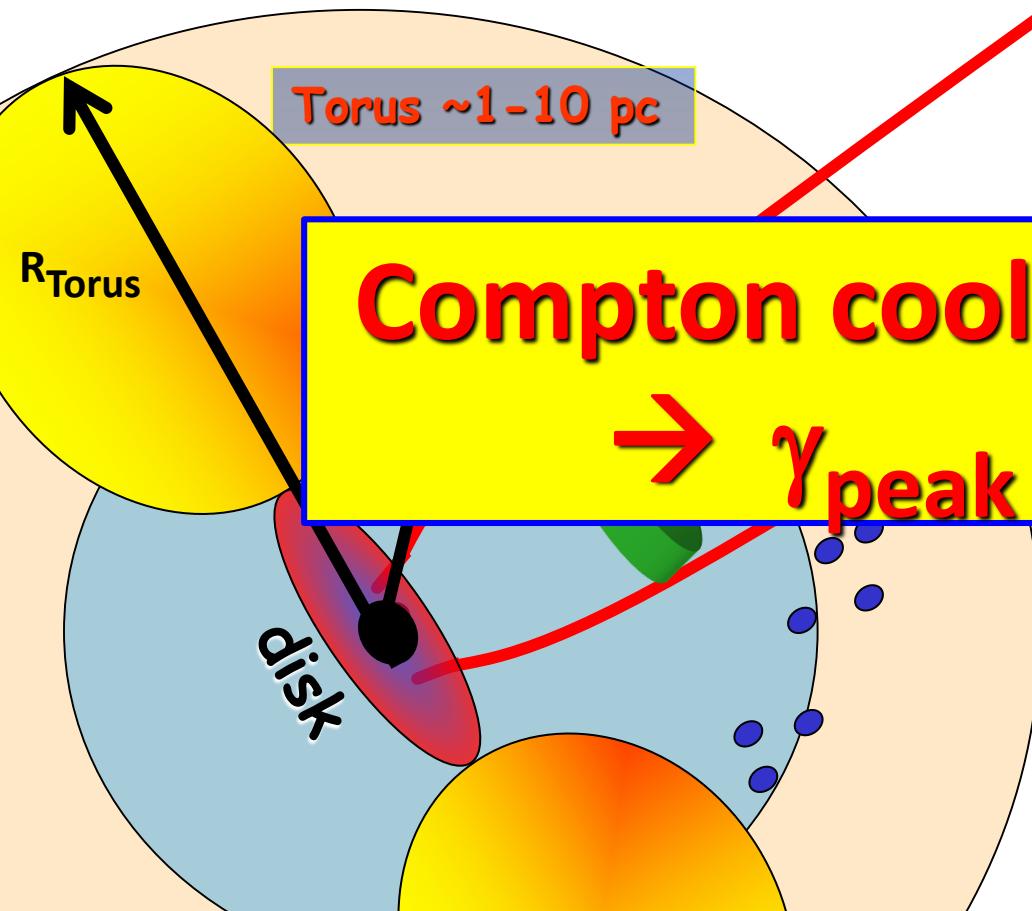




Gamma Ray Bursts: just the opposite



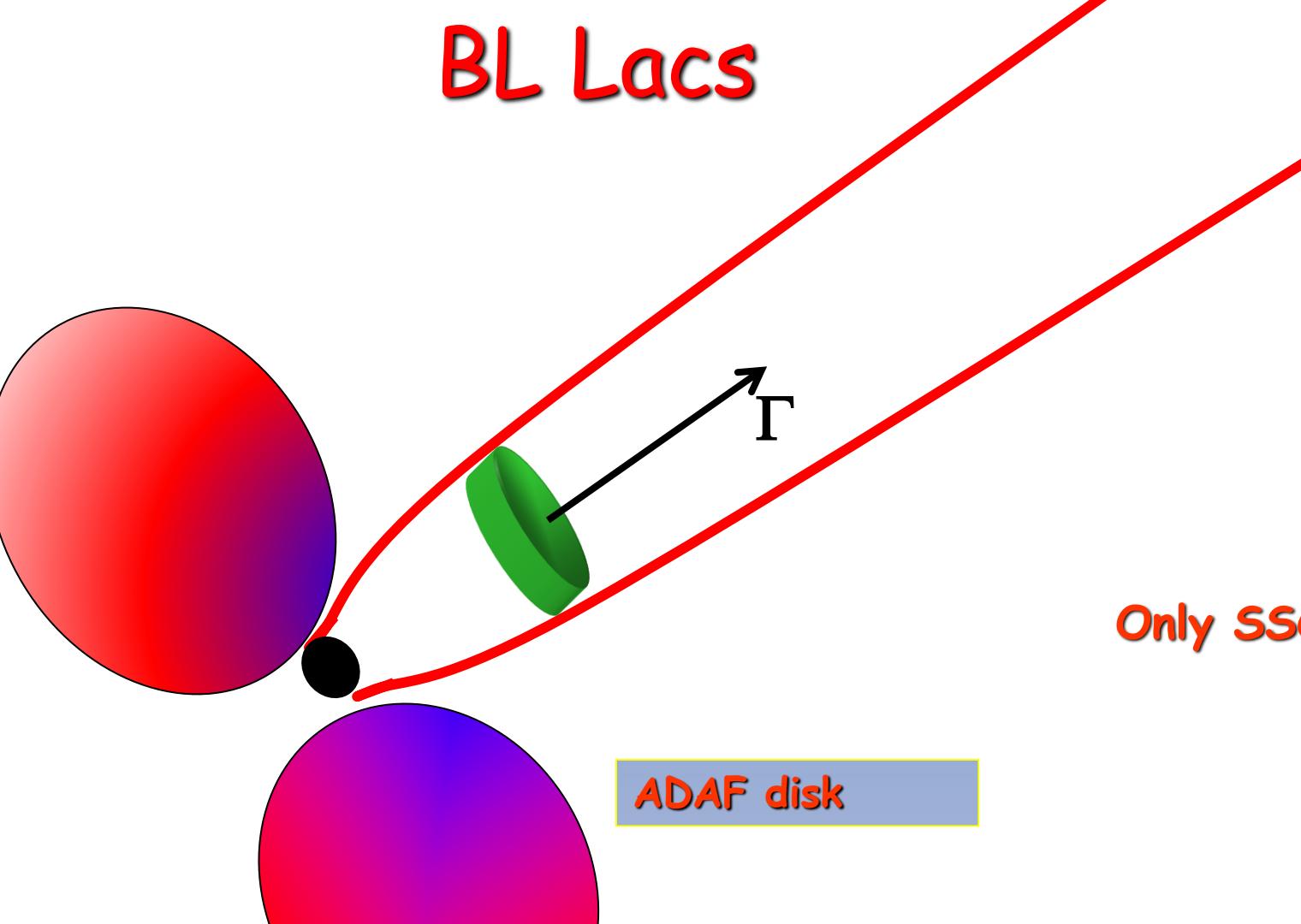
FSRQs



Compton cooling is constant
→ γ_{peak} is ~ Constant

$$R_{\text{BLR}} \propto L_d^{1/2}$$
$$R_{\text{torus}} \propto L_d^{1/2}$$
$$U_{\text{ext}} = L_d / R^2 c = \text{const}$$

BL Lacs



jet power and accretion luminosity

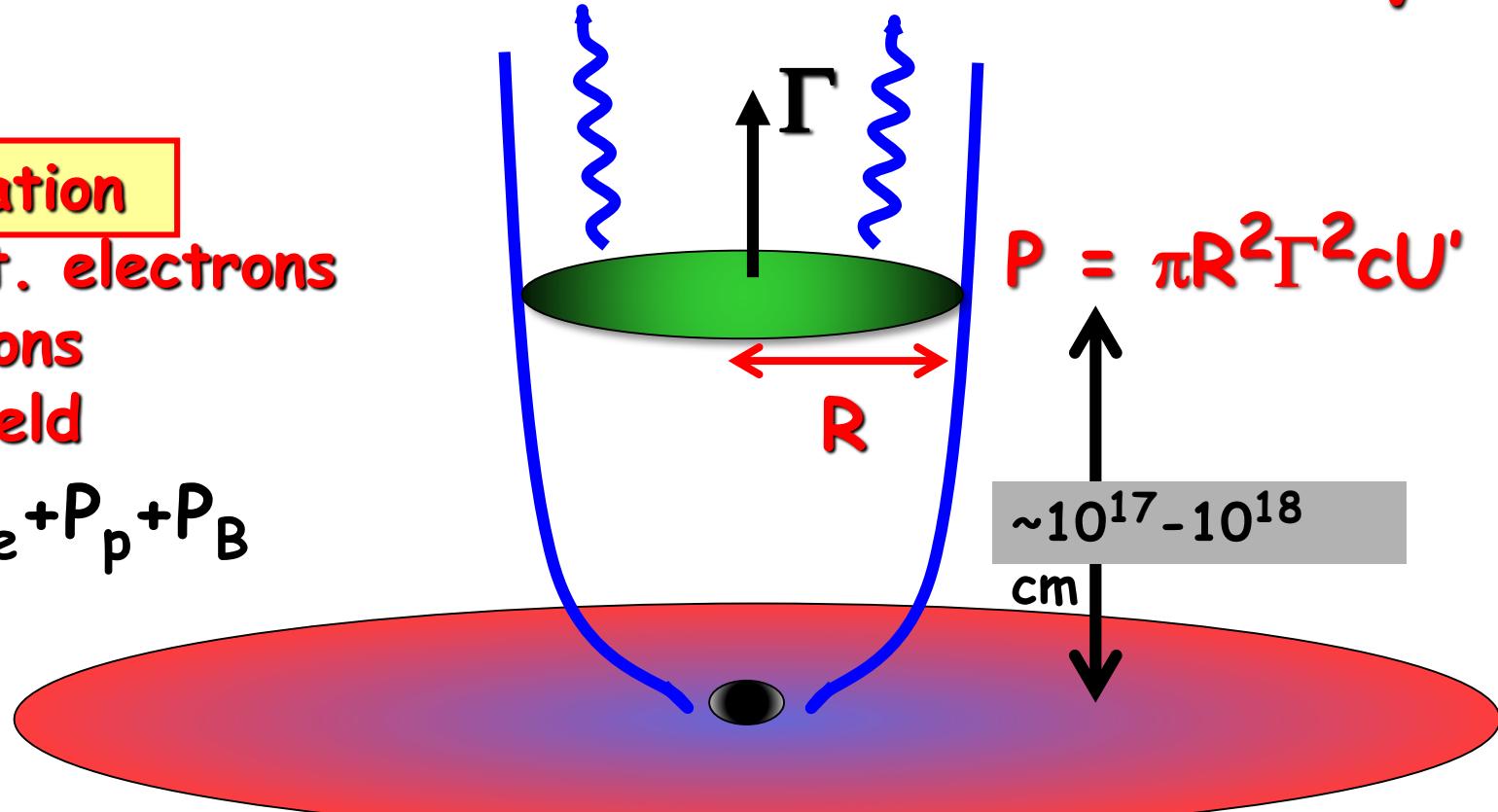
$P_r = \text{radiation}$

$P_e = \text{relat. electrons}$

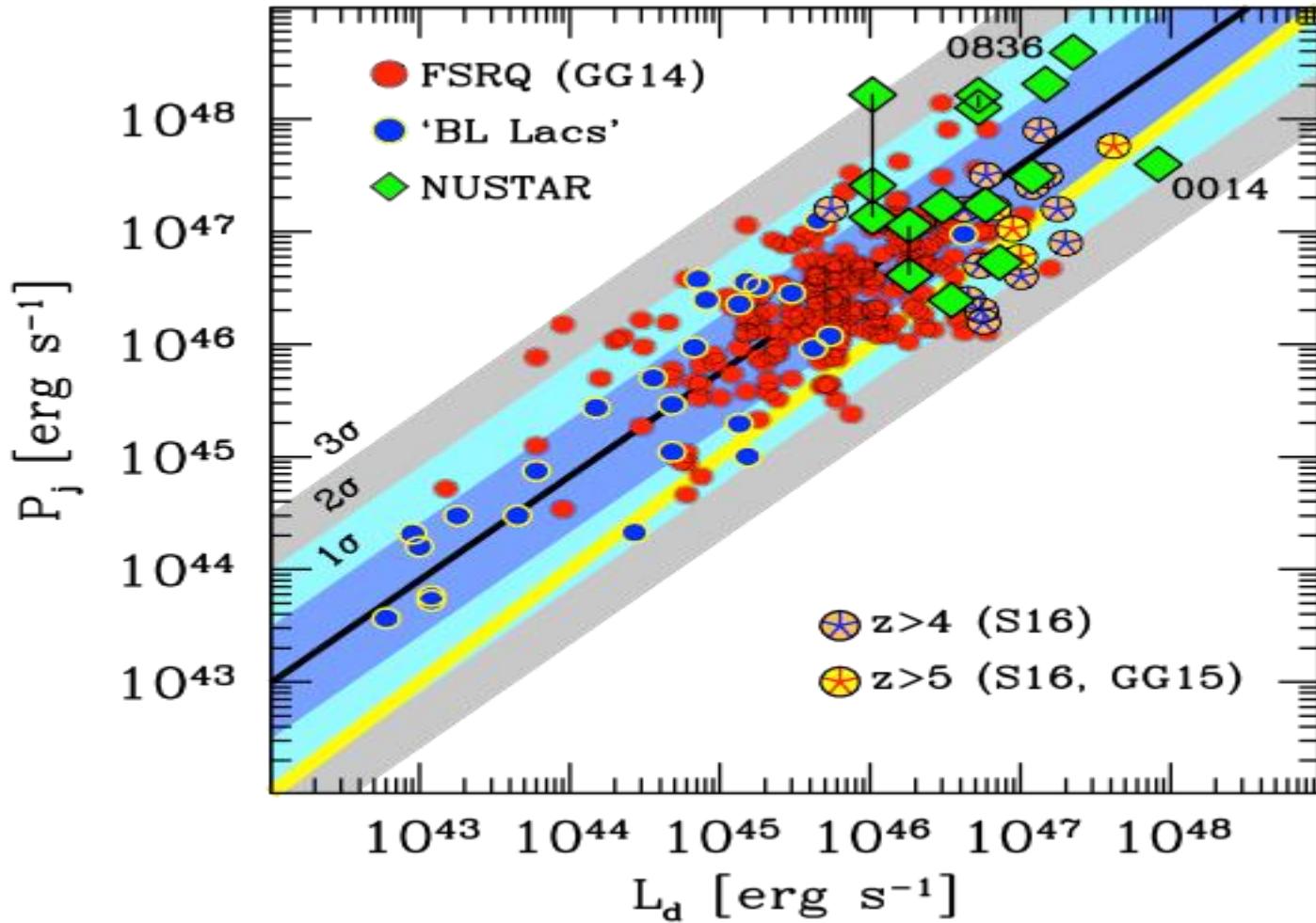
$P_p = \text{protons}$

$P_B = \text{B-field}$

$$P_{\text{jet}} = P_e + P_p + P_B$$

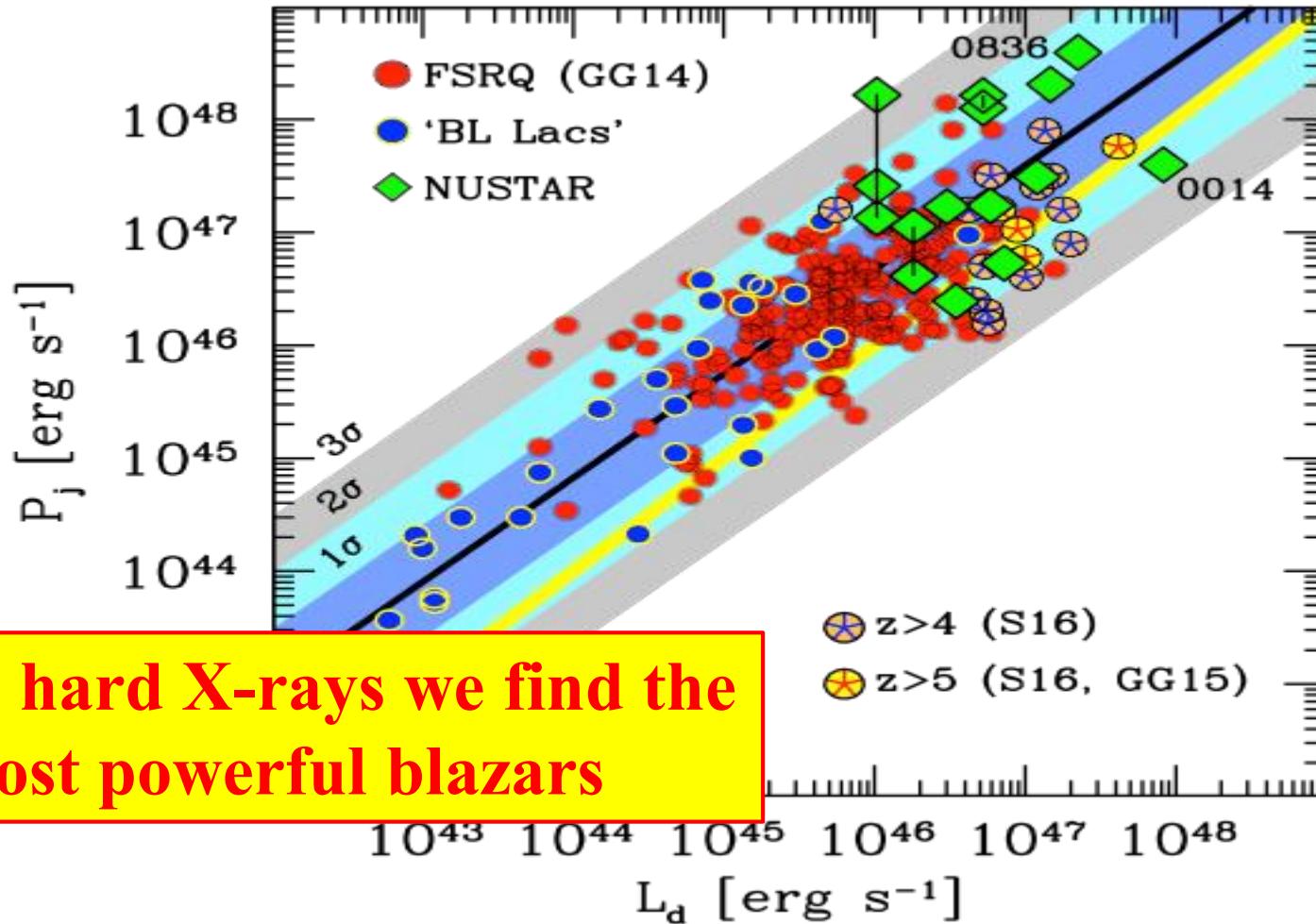


Shakura-Sunyaev disk: L_d

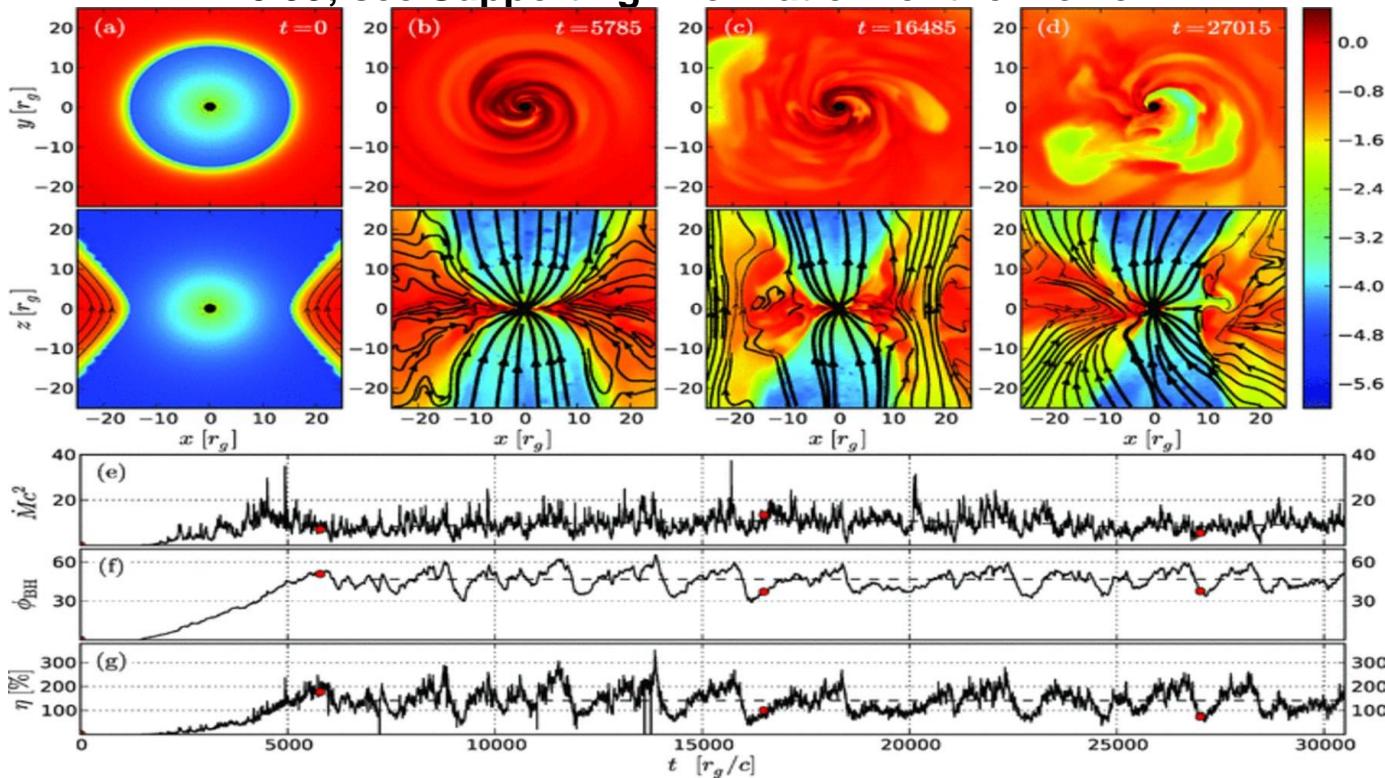


GG+
2019

GG+
2019



Shows results from the fiducial GRMHD simulation A0.99fc for a BH with spin parameter $a = 0.99$; see Supporting Information for the movie.

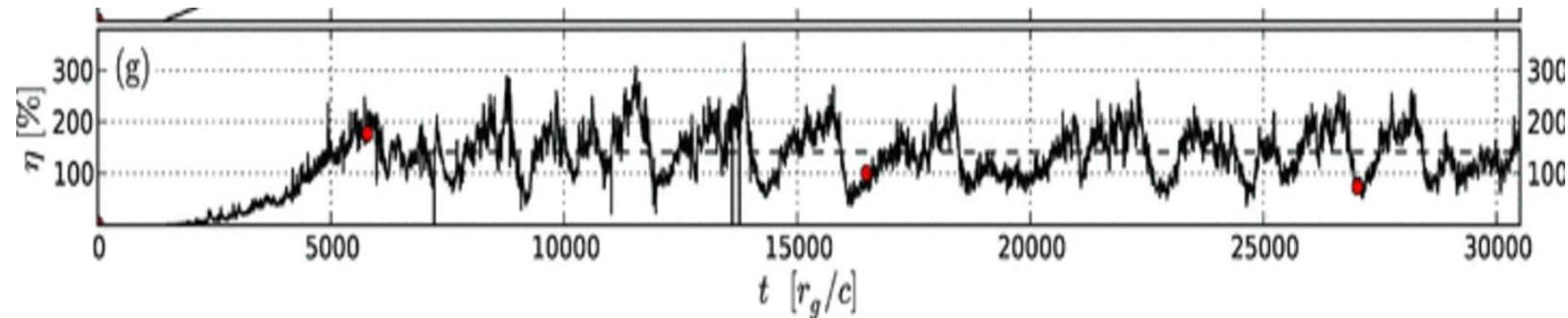


P_{jet}
Mc²

Tchekhovskoy A et al. MNRAS 2011;418:L79-L83

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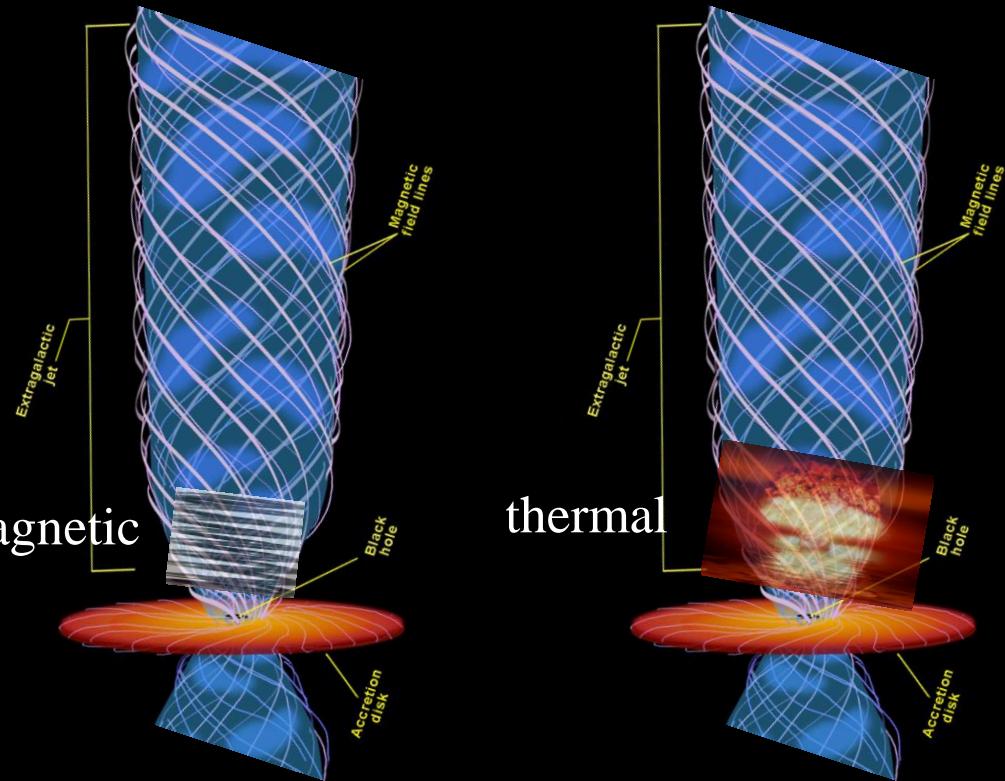
$\frac{P_{\text{jet}}}{Mc^2}$



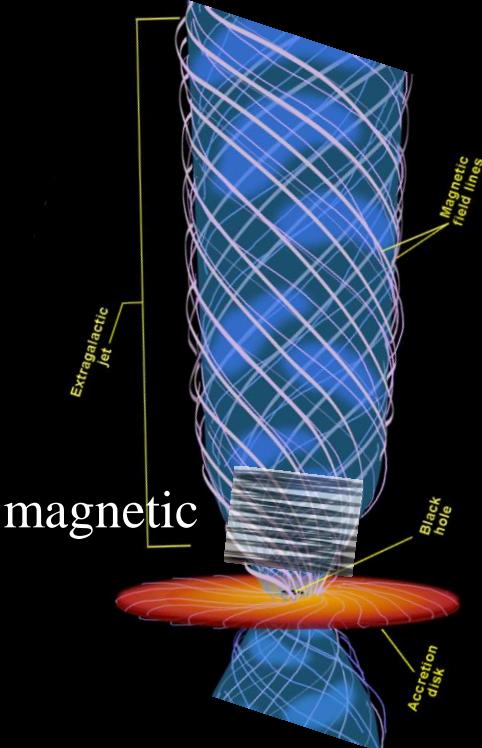
On average: $1 \text{ g in} \rightarrow 1.5 c^2 \text{ erg out}$

Tchekhovskoy A et al. MNRAS 2011;418:L79-L83

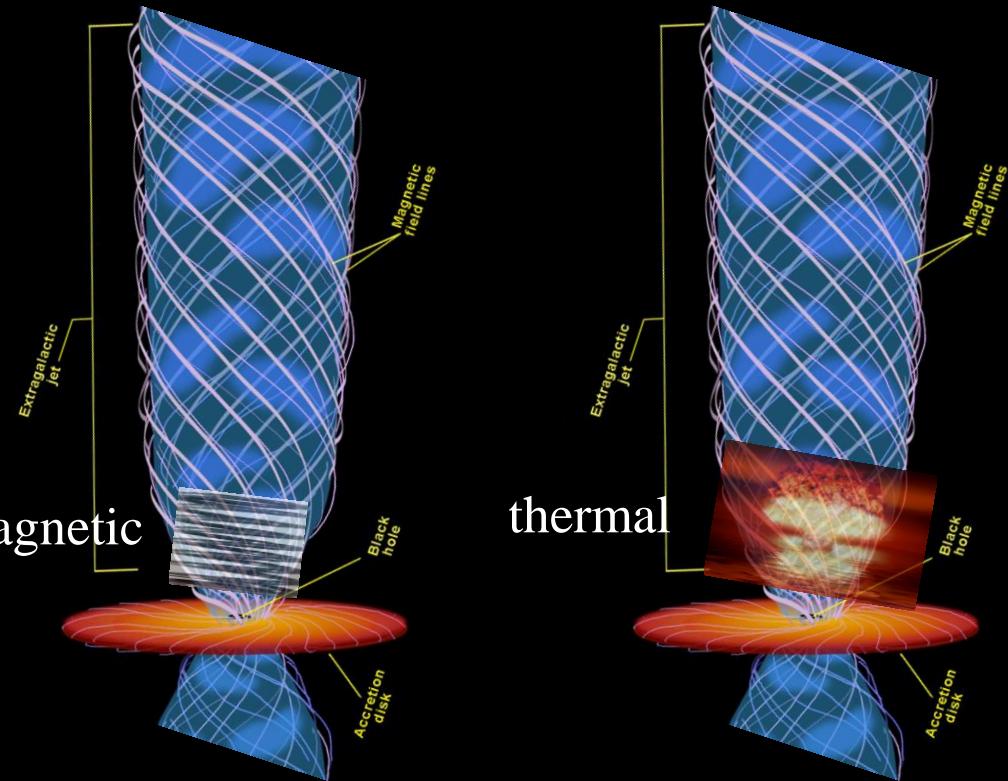
GRBs



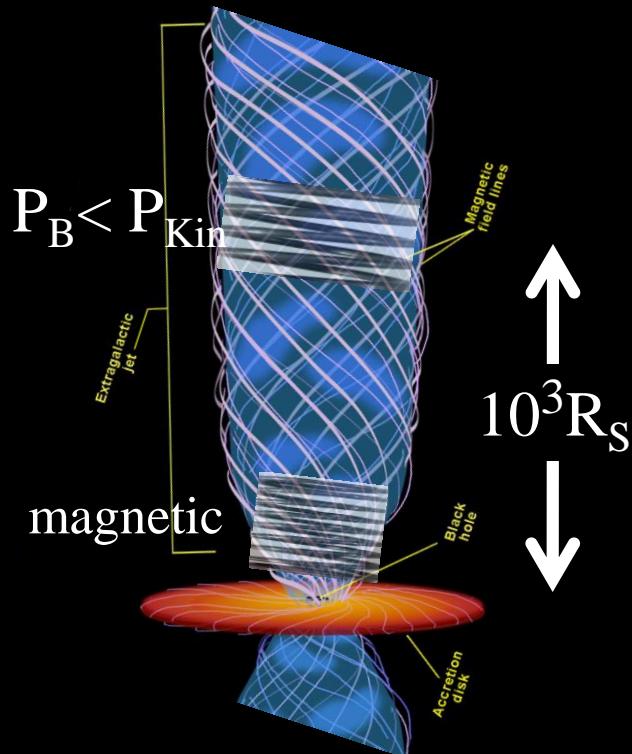
Blazars

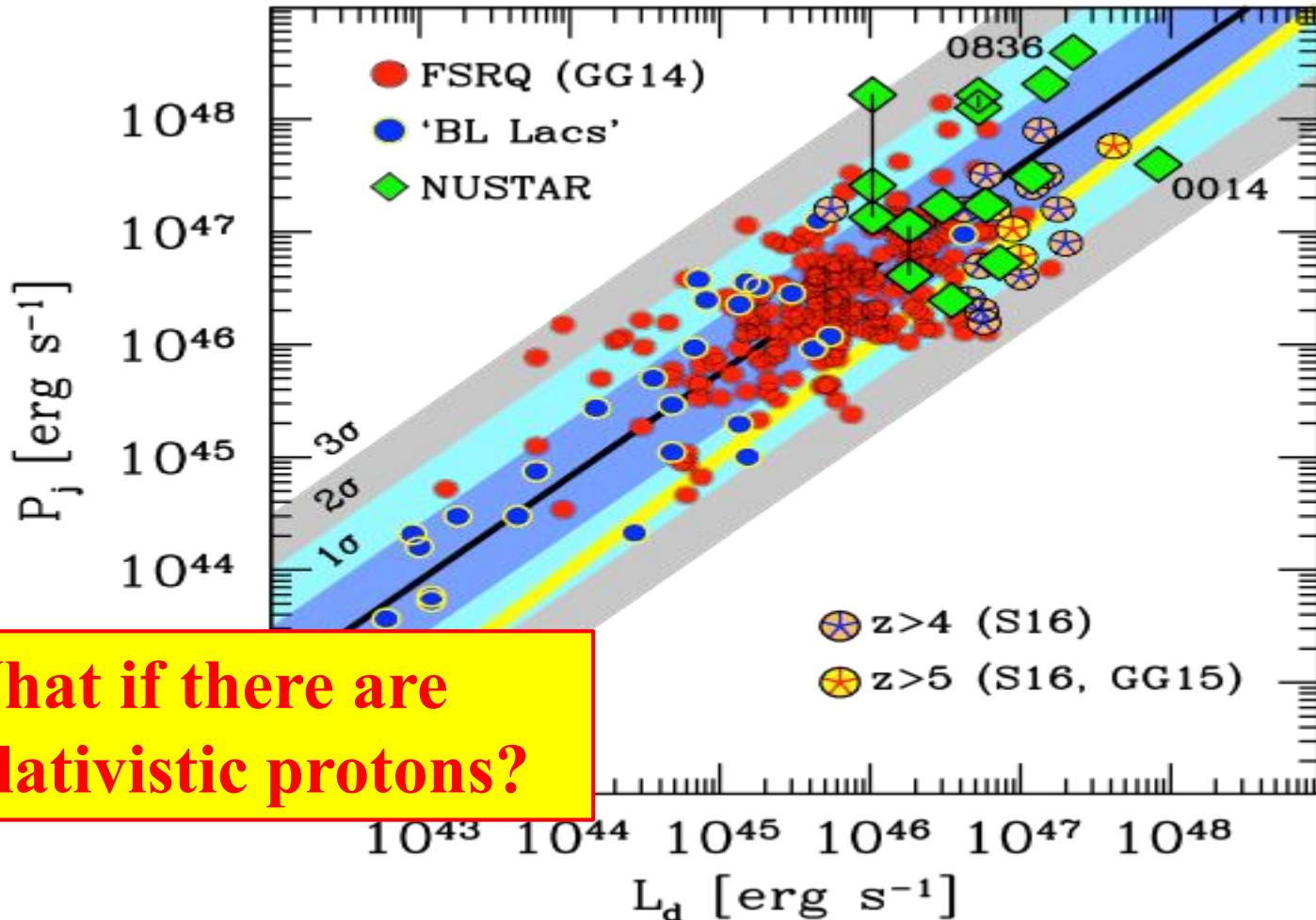


GRBs



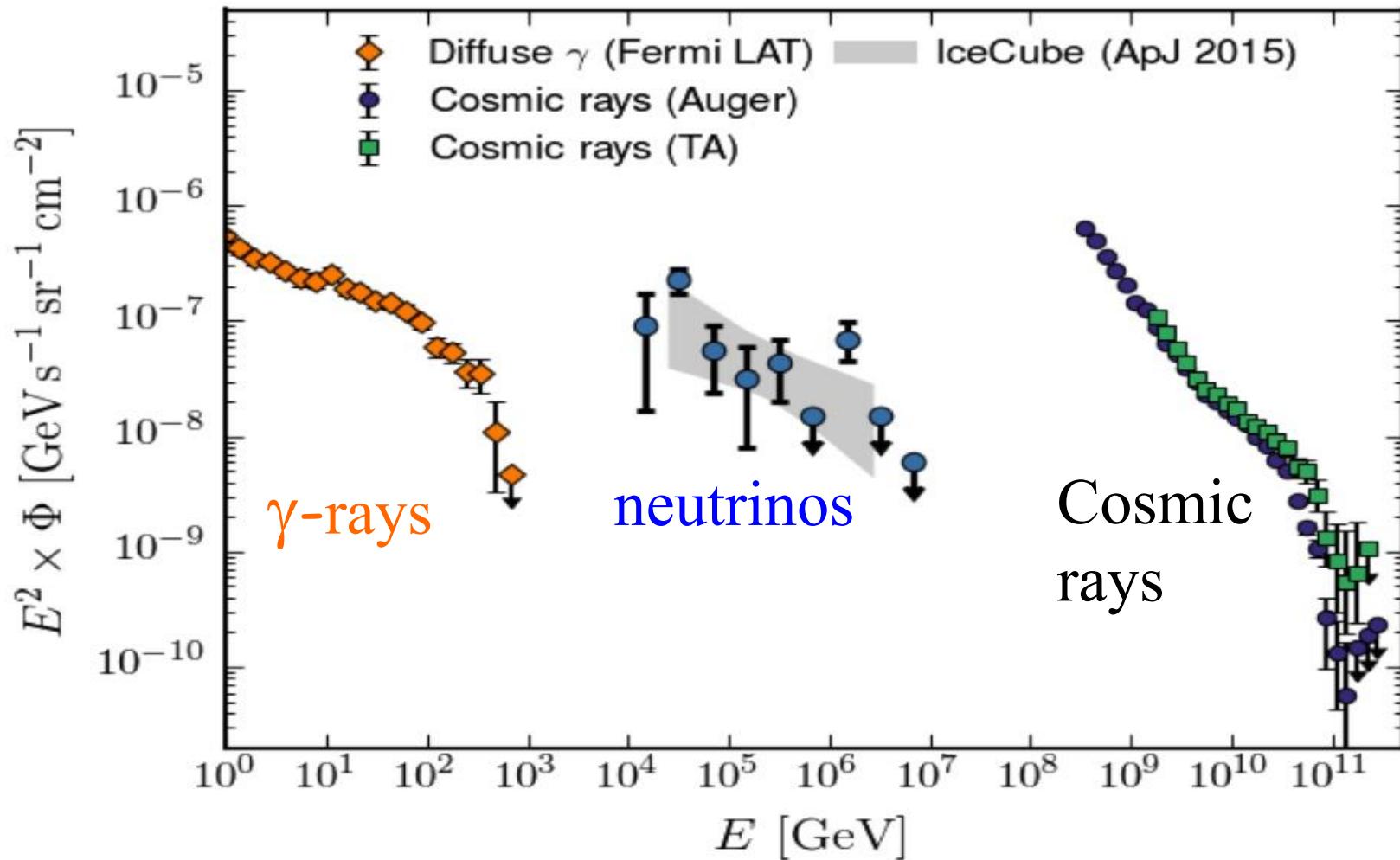
Blazars





What if there are
relativistic protons?

GG+
2019



Gaisser 1801.01551

Energy crisis?

If ultra-relativistic protons are required for neutrinos or to generate the non-thermal SED:

$$P_{\text{jet}} \gg M c^2$$

Energy crisis?

If ultra-relativistic protons are required for neutrinos or to generate the non-thermal SED:

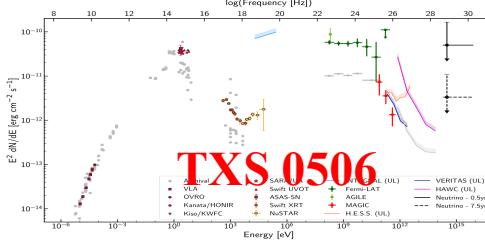
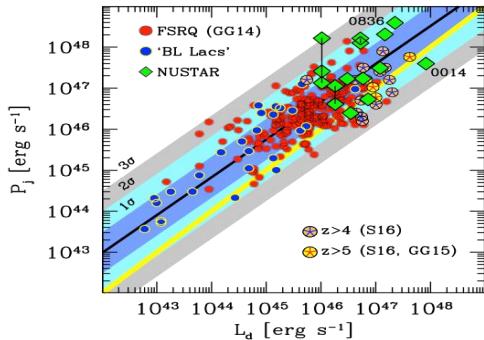
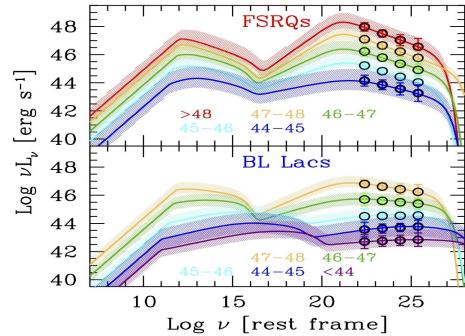
$$P_{\text{jet}} \gg \dot{M} c^2$$

Possible if: total efficiency $\eta = \eta_{\text{accr}} + \eta_{\text{jet}}$

$$\eta_{\text{accr}} \gg \eta_{\text{jet}}$$

Most of the gravitational energy DOES NOT heat the disk, but is used to amplify the magnetic field to power the jet

Conclusions



Blazar sequence revisited



$P_{\text{jet}} \sim M c^2$, larger than L_d



$\eta_{\text{accre}} \ll \eta_{\text{jet}}$??

