Blazar高能辐射观测研究：从Fermi/LAT到LHAASO

梁恩维（广西大学）

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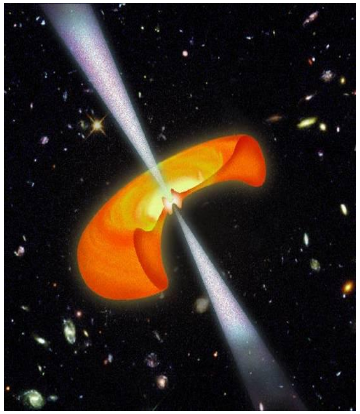
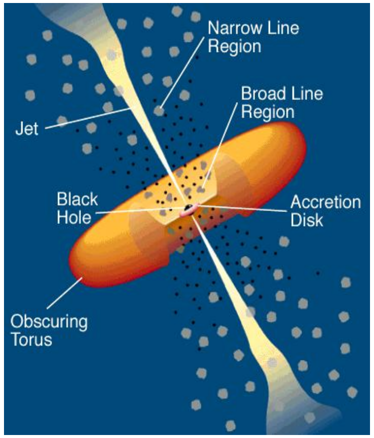
LHAASO合作组会议，2017.1.17-20 云南大学

Relativistic Jets in GRBs and AGNs



(woosley 1993)

GRB Jets: ultra-relativistic, powered by newly born stellar black holes or pulsars.



(Urry & Padovani 1995)

AGN Jets: Middle-relativistic, powered by super massive black holes.

Common issues:

- Radiation physics
- Particle acceleration
- Composition
- Jet formation
- Central engine
- Environment
- Host galaxies

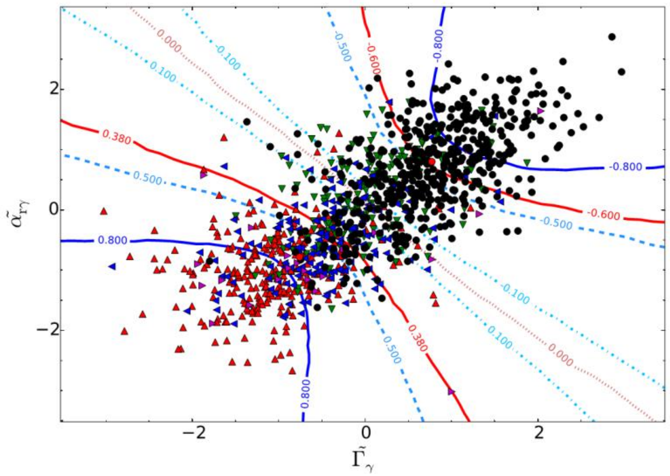
Outlines

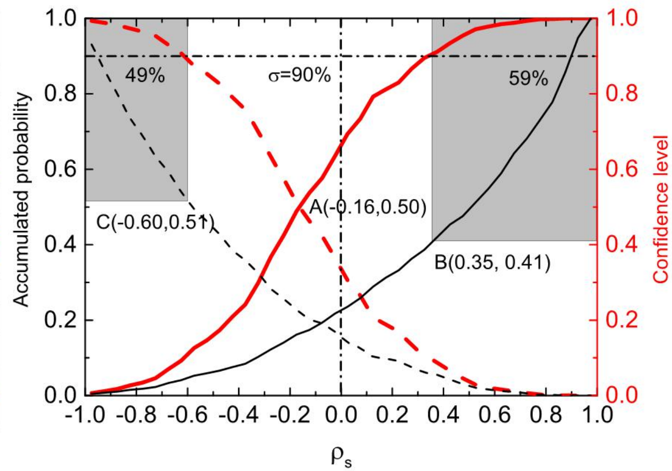
- **A statistical method for classification of Fermi/LAT blazar candidates and our observational campaign**
- **Spectral variation of 3C 454.3 at the GeV band**
- **Our Proposal of ToO Observations for GeV-TeV flares and Challenge to LHAASO observations for TeV flares of BL Lacs**

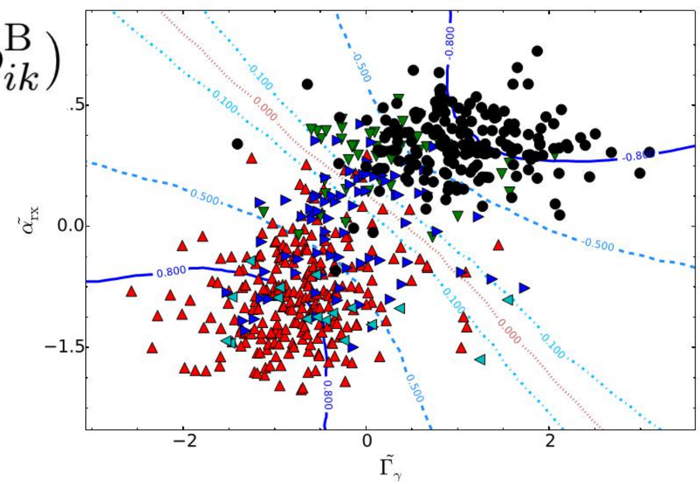
FSRQs and BL Lacs in the spectral Planes

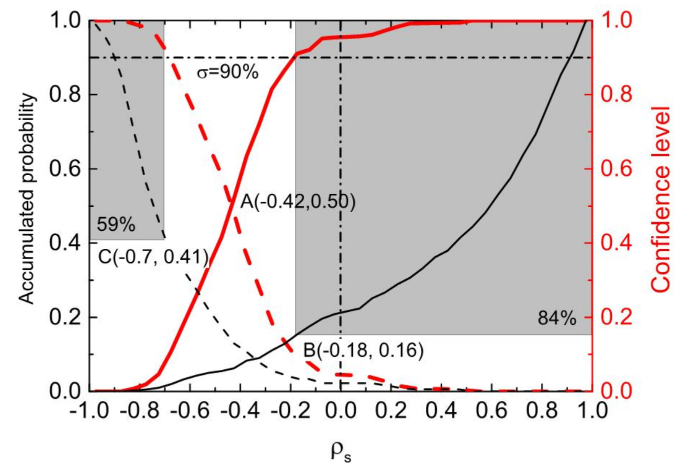
$$p_{ij} \propto e^{-r_{ij}/2}$$

$$\rho_{ijk} = -2\ln(p^{\mathrm{F}}_{ij}/p^{\mathrm{B}}_{ik})$$



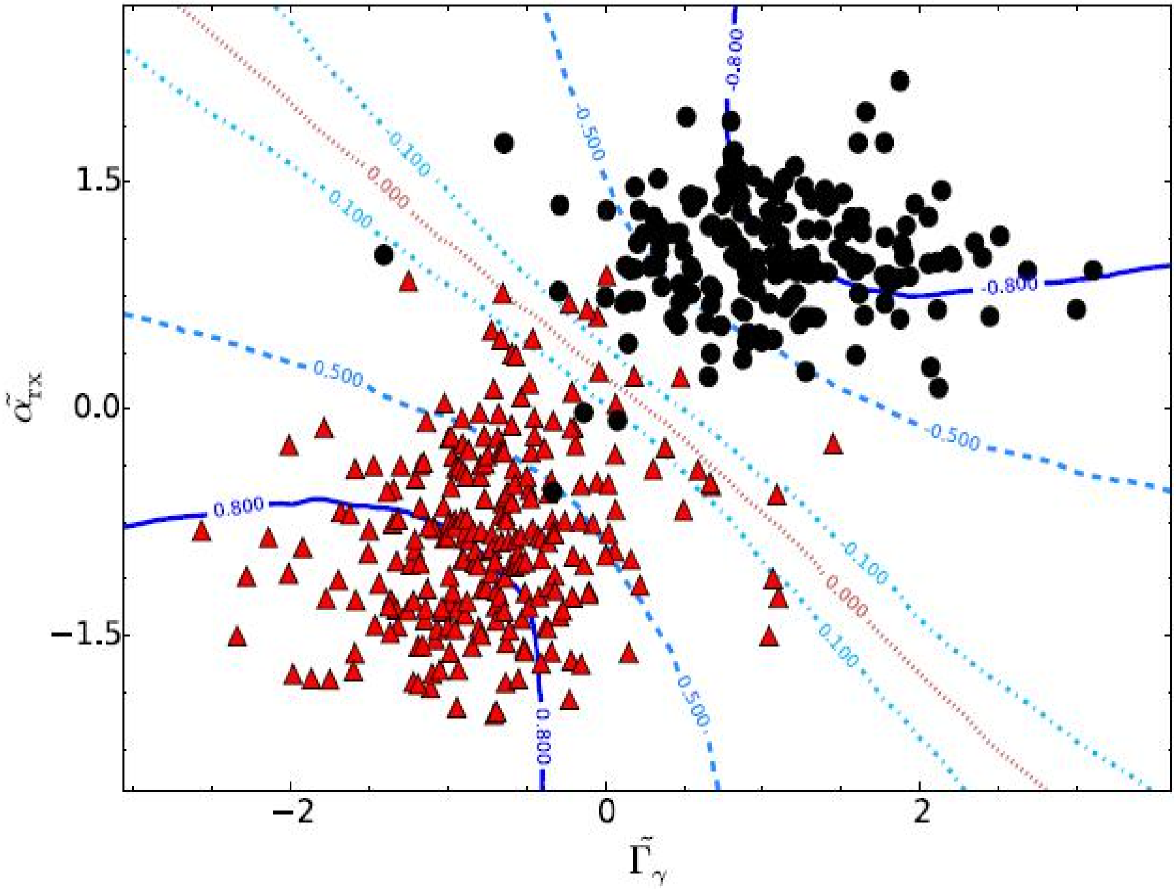






易庭丰，**张晋**，…梁恩维，2017, ApJ

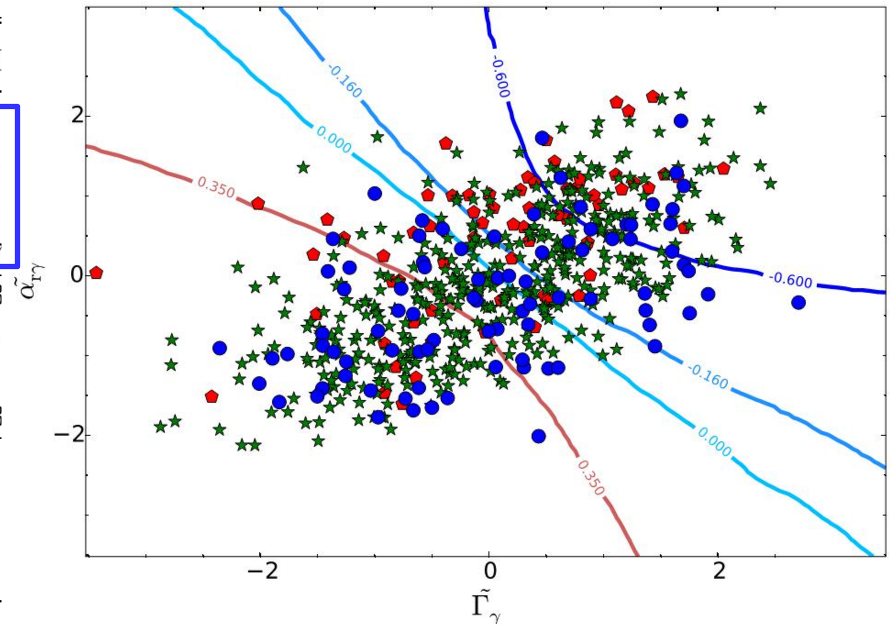
Classification for HBLs and FSRQs



易庭丰，**张晋**，…梁恩维，2017，ApJ

Classification for Blazar Candidates

Spectral Plane	Class	N	N_1	$\frac{N_1}{N} \times 100\%$	N_2	$\frac{N_2}{N} \times 1($
$\tilde{\Gamma}_\gamma - \tilde{\alpha}_{r\gamma}$	FSRQs	15	1	6.7	9	60
	BL Lacs	75	48	64	3	4.0
	BL $Lacs_1$	63	42	66.7	1	1.6
	BL $Lacs_2$	12	6	50	2	16.7
$\tilde{\Gamma}_\gamma - \tilde{\alpha}_{rx}$	FSRQs	3	0	0	1	33.3
	BL Lacs	38	33	86.8	1	2.6
	BL $Lacs_1$	31	29	93.5	0	0
	BL $Lacs_2$	7	4	57.1	1	14.3
$\tilde{\alpha}_{ox} - \tilde{\alpha}_{r\gamma}$	FSRQs	3	0	0	0	0
	BL Lacs	32	23	71.9	0	0
	BL $Lacs_1$	25	20	80	0	0
	BL $Lacs_2$	7	3	42.9	0	0



Massaro et al. (2016) presents spectroscopic identification for 78 blazar candidates (**63 BL Lacs and 15 FSRQs**). With our method, **42 out of the 63 BL Lacs and 9 out of the 15 FSRQs** can be picked up with our method **in a confidence level of 90%.**

易庭丰，**张晋**，…梁恩维，2017, ApJ

Classification for Blazar Candidates

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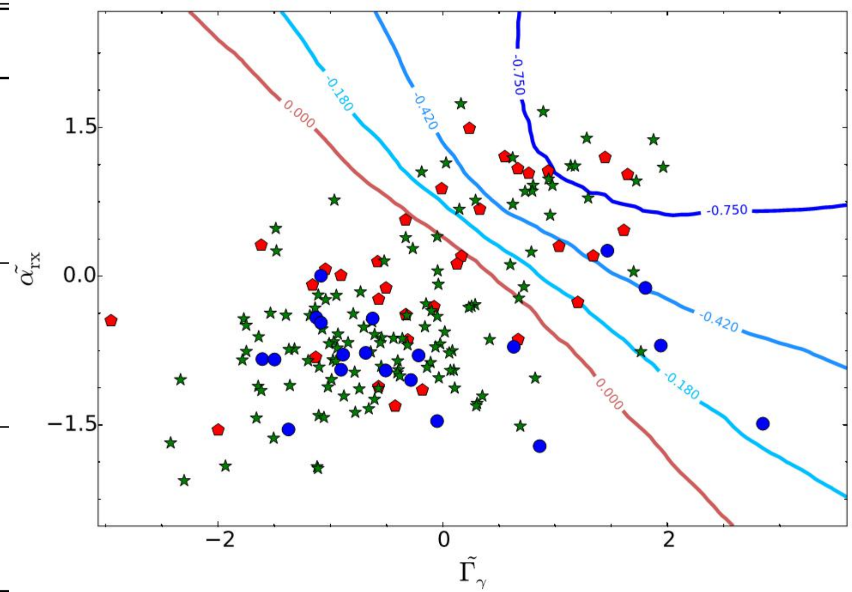
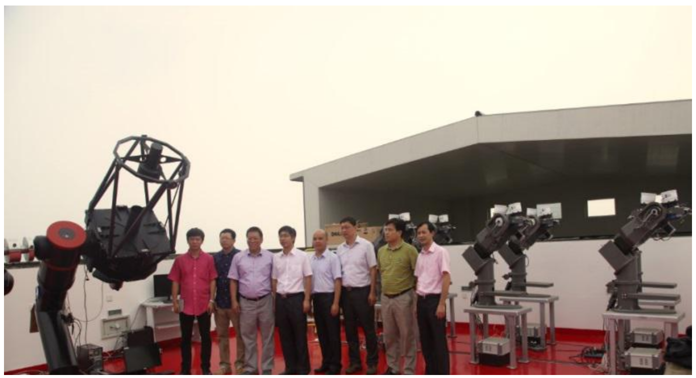


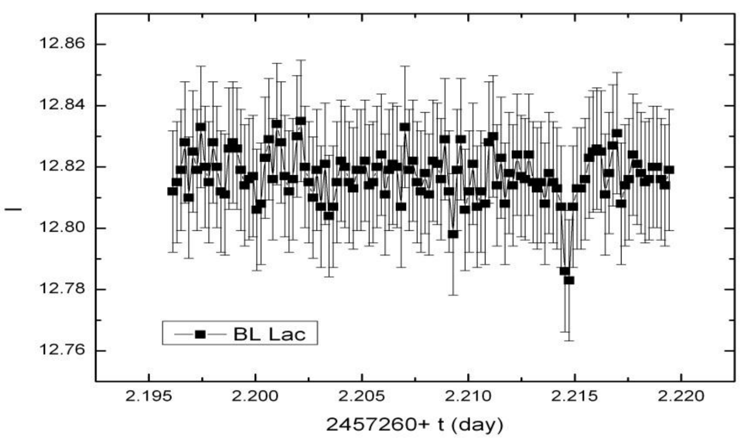
Massaro et al. (2016) presents spectroscopic identification for 34 blazar candidates **(31 BL Lacs and 3 FSRQs)**. With our method, **29 out of the 31 BL Lacs and 1 out of the 3 FSRQs** can be picked up with our method **in a confidence level of 90%.**

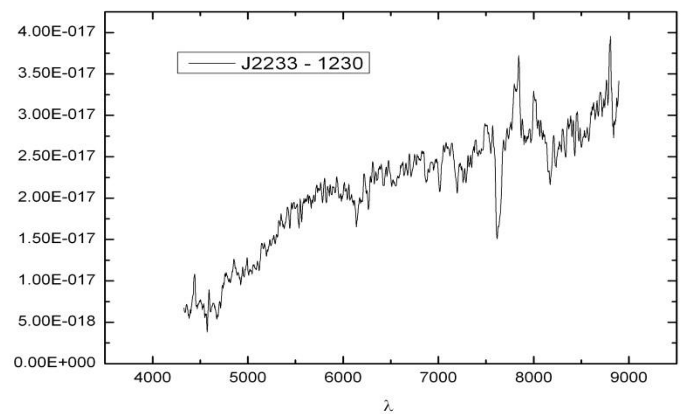
易庭丰，**张晋**，…梁恩维，2017, ApJ

Our observational campaign for spectroscopic identification of Blazar Candidates

60/80 cm Telescopes → 2 m telescopes

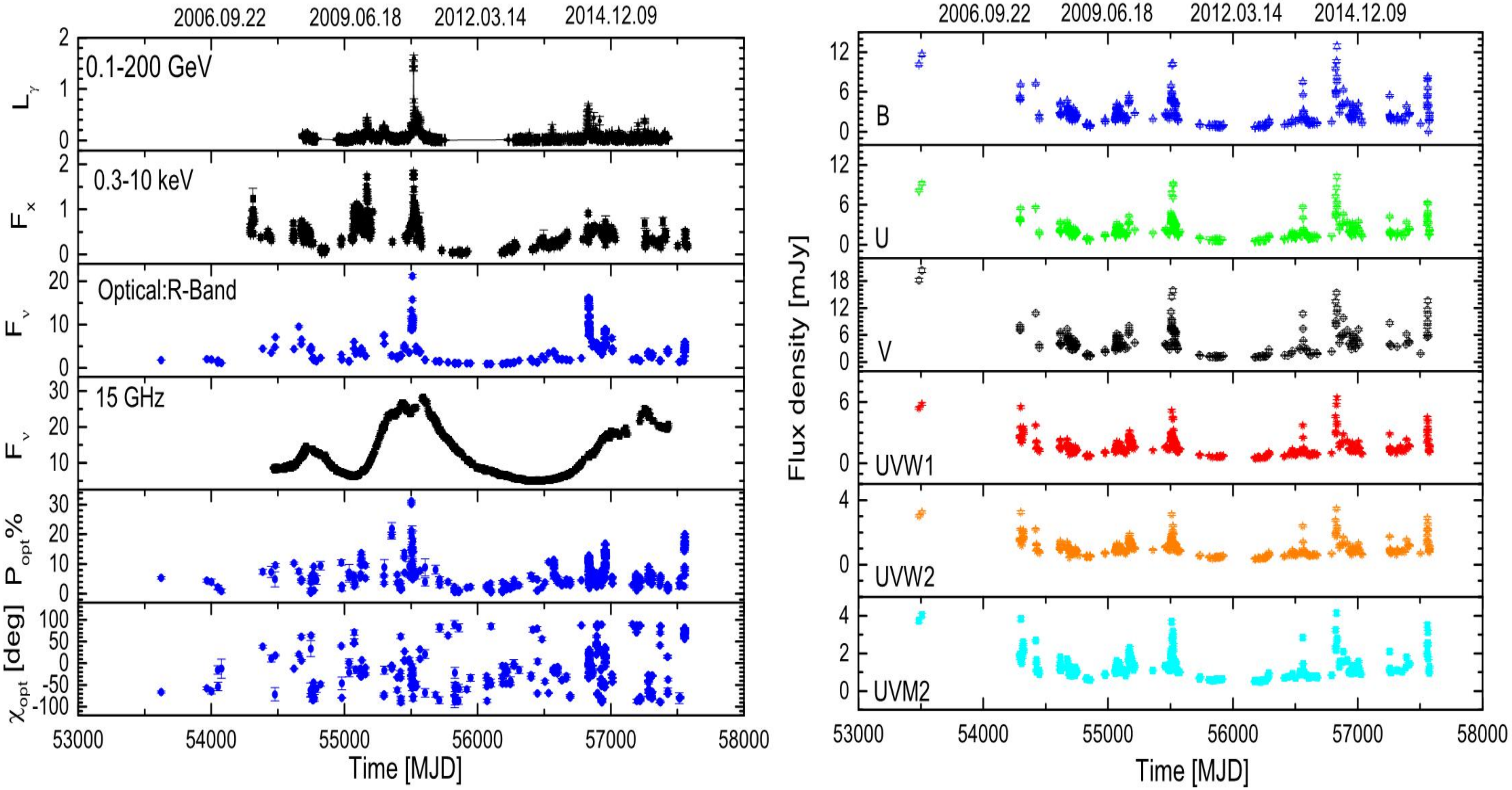






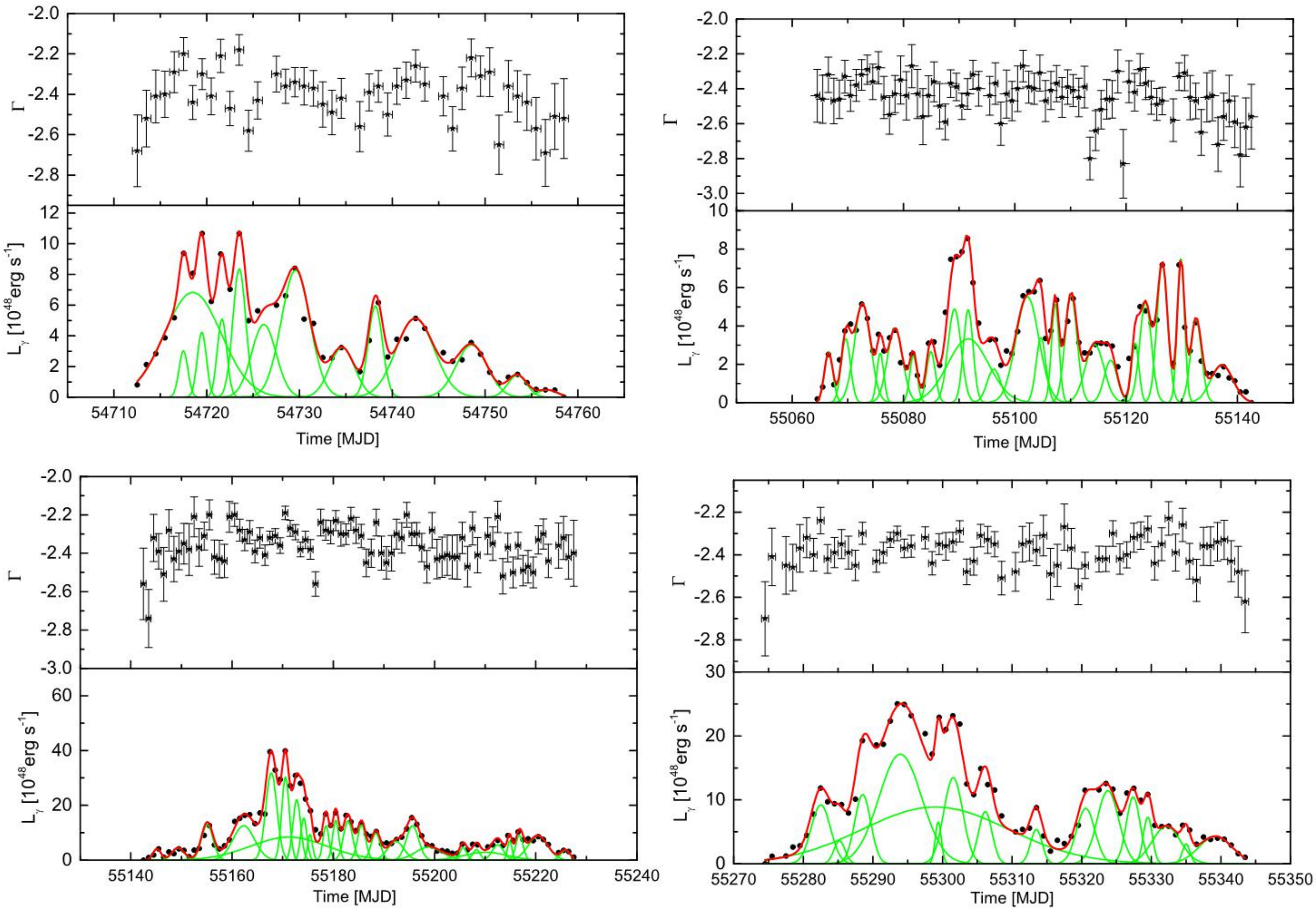
PI：易庭丰，主要合作者：**张晋**，梁恩维

Spectral Variation in GeV Flares of 3C 454.3



张海明，**张晋**，梁恩维等，2017

Photon index and flare duration



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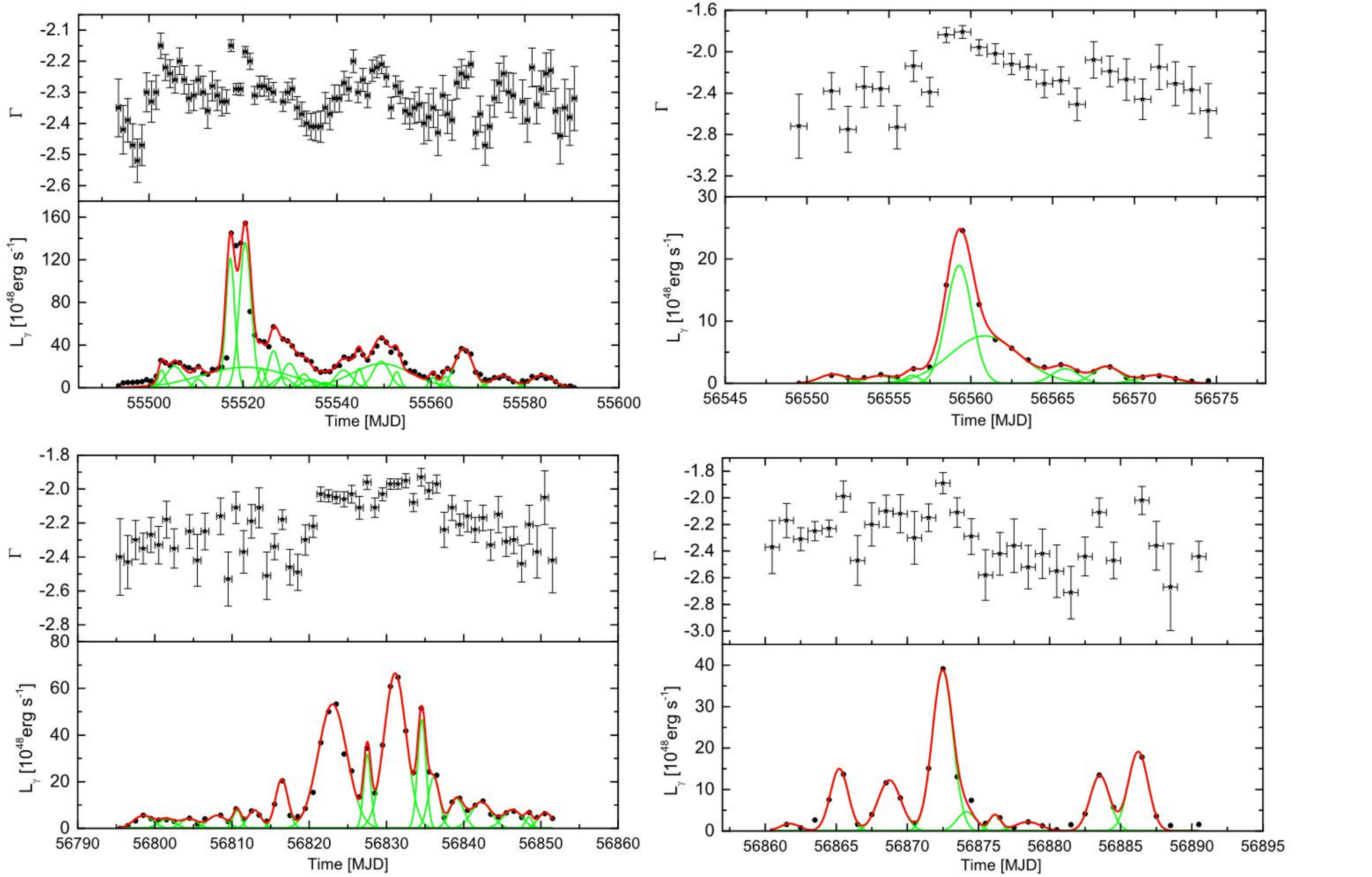
Photon index and flare duration



张海明，**张晋**，梁恩维等，2017

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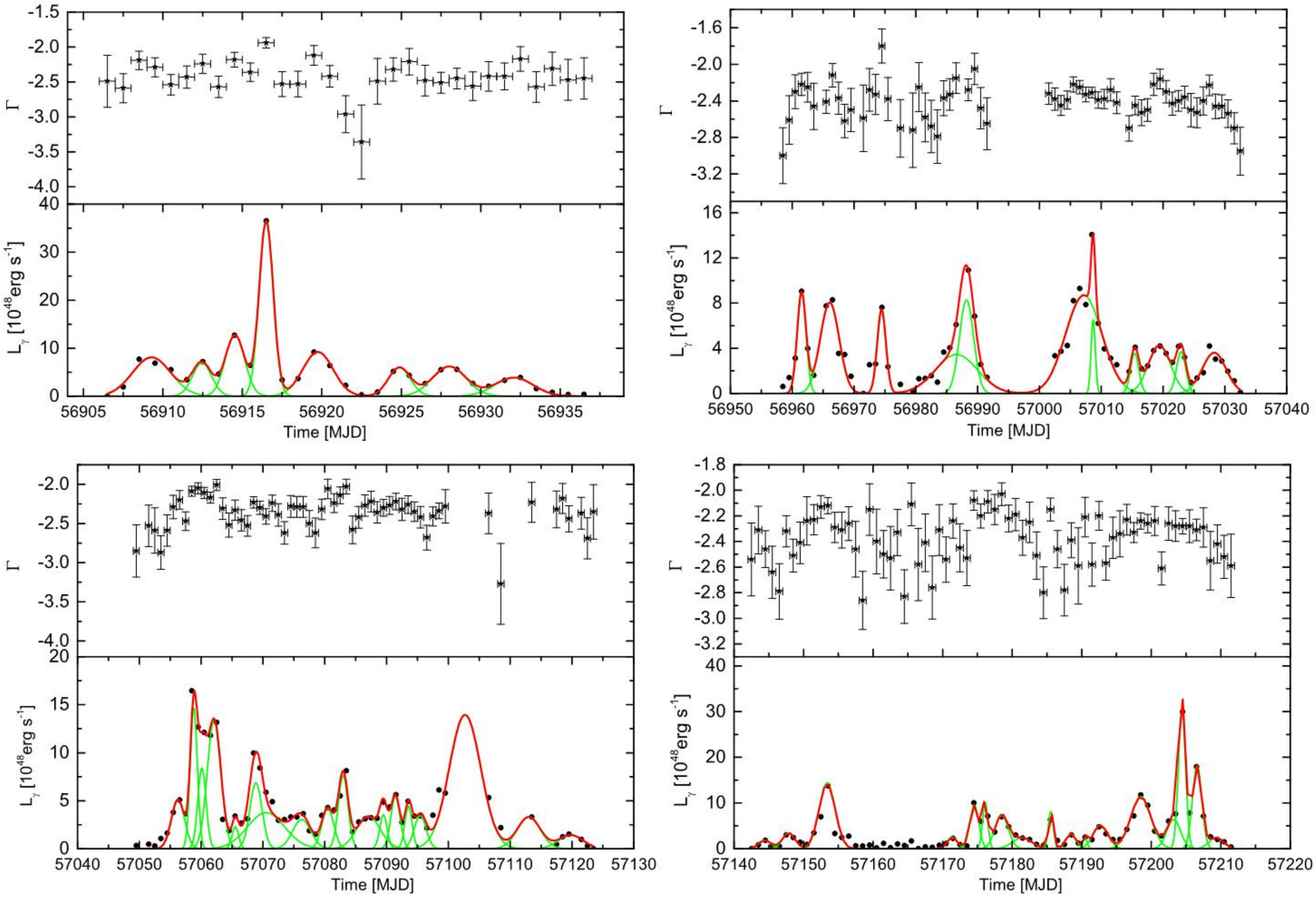

张海明，**张晋**，梁恩维等，2017

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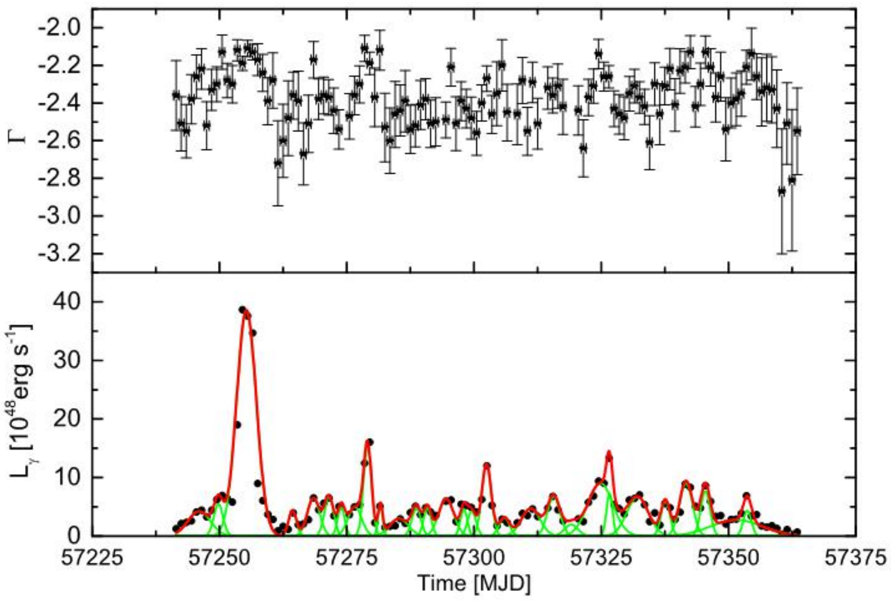
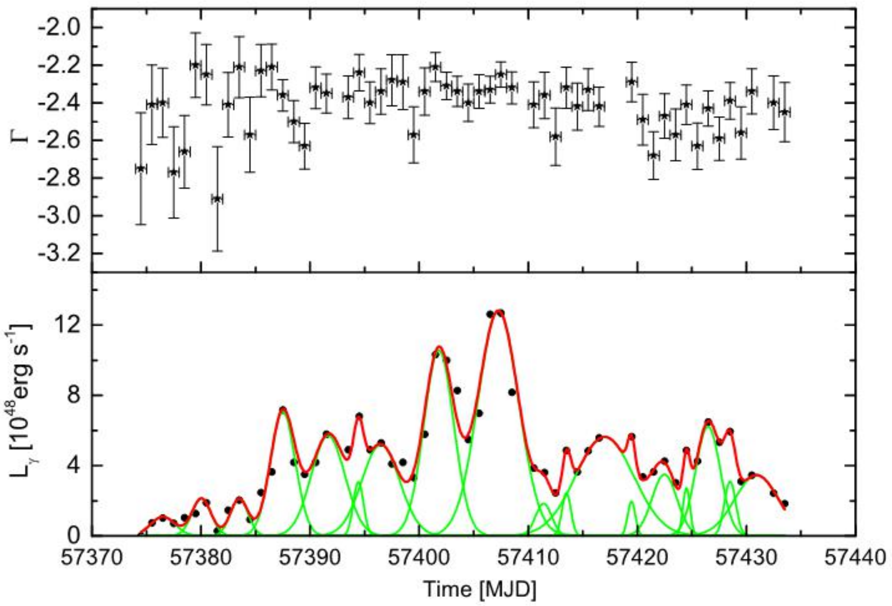
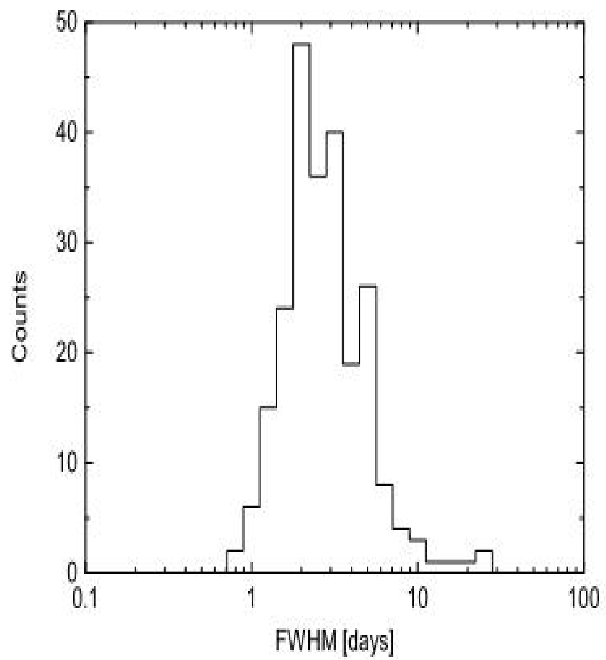
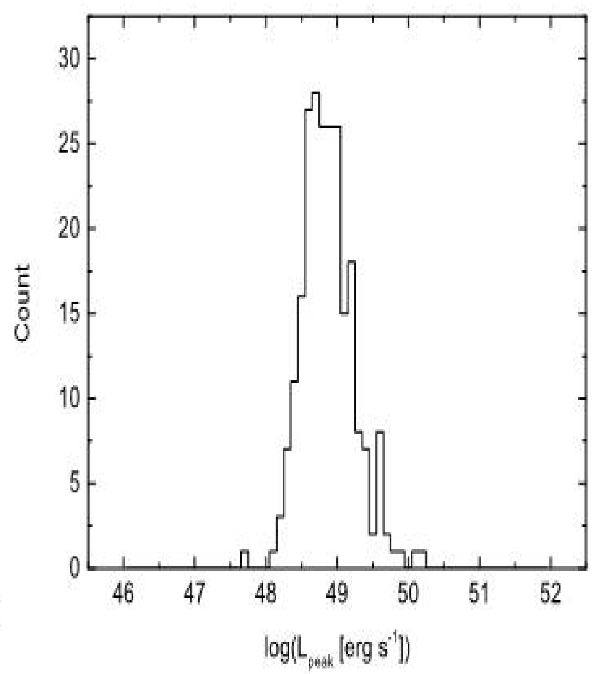


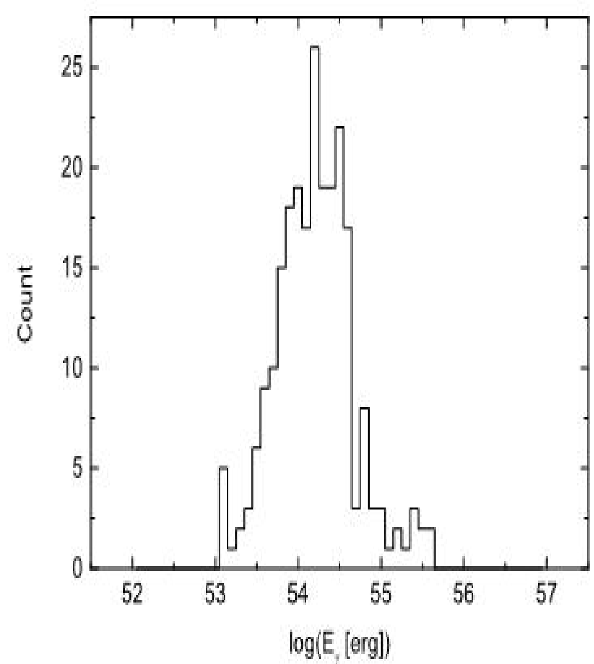


张海明，**张晋，**梁恩维等，2017

Distributions of duration, peak luminosity and flare energy







Median~ 2.3 d

Median~ 6.1E48 erg/s

Median~ 1.4E54 erg

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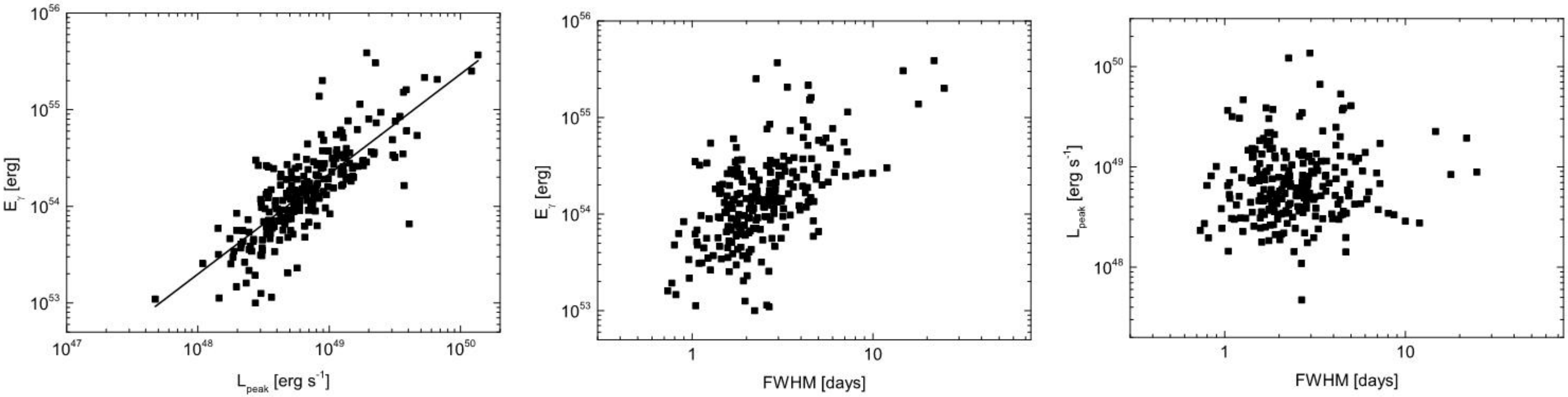
Correlations of duration, peak luminosity and flare energy



The released energy during a flare strongly depends on the peak luminosity of the flare, does not mainly depend on the duration of the flare.

The violent flare with short timescale may release the same energy as the weak flare with long timescale.

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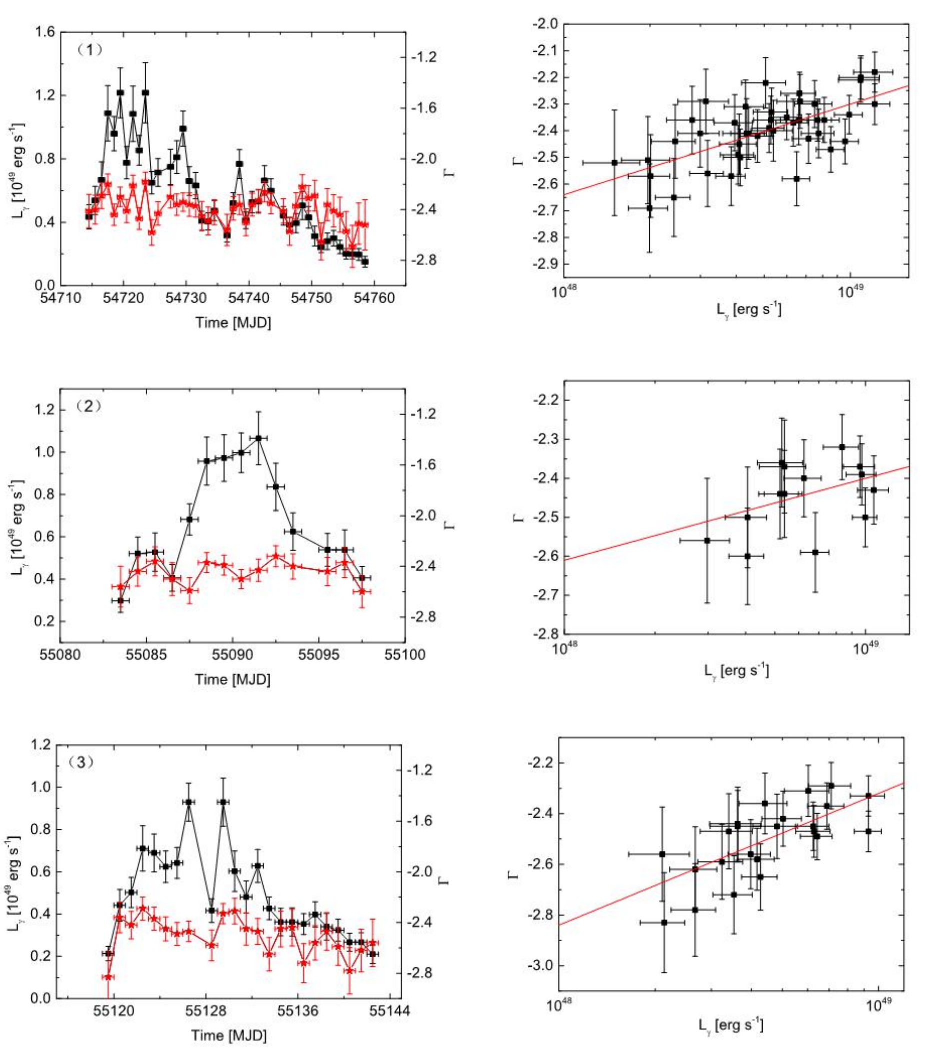
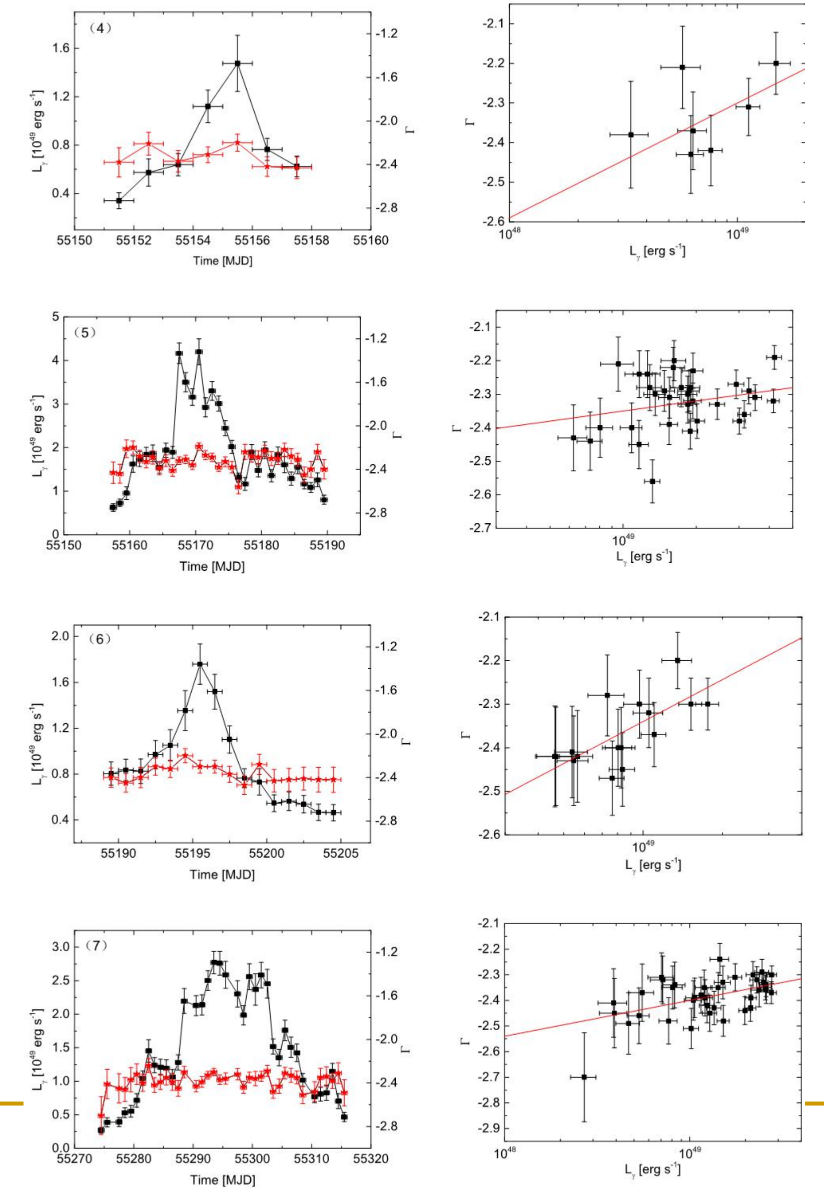
Luminosity vs. Photon Index





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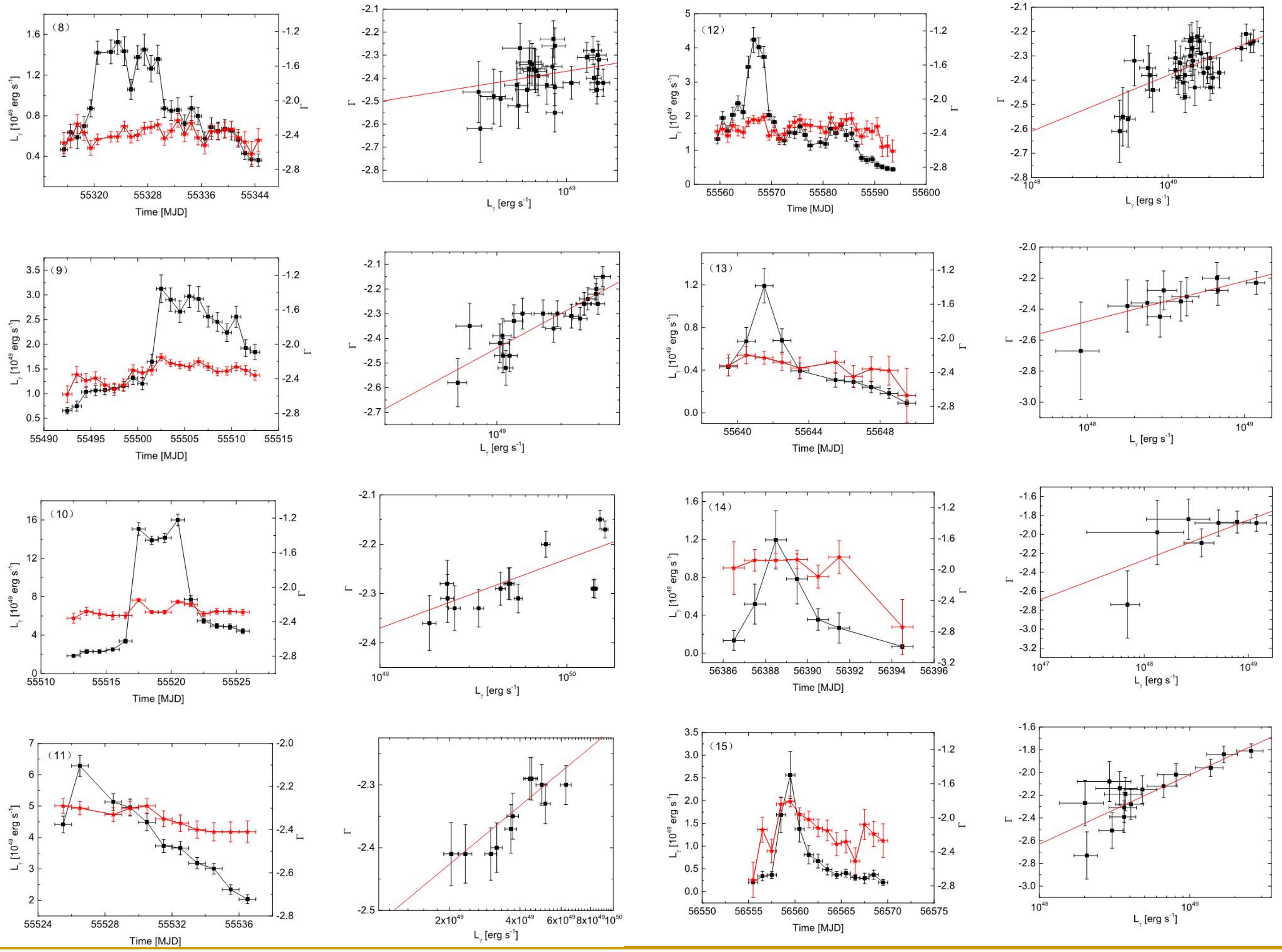
Luminosity vs. Photon Index



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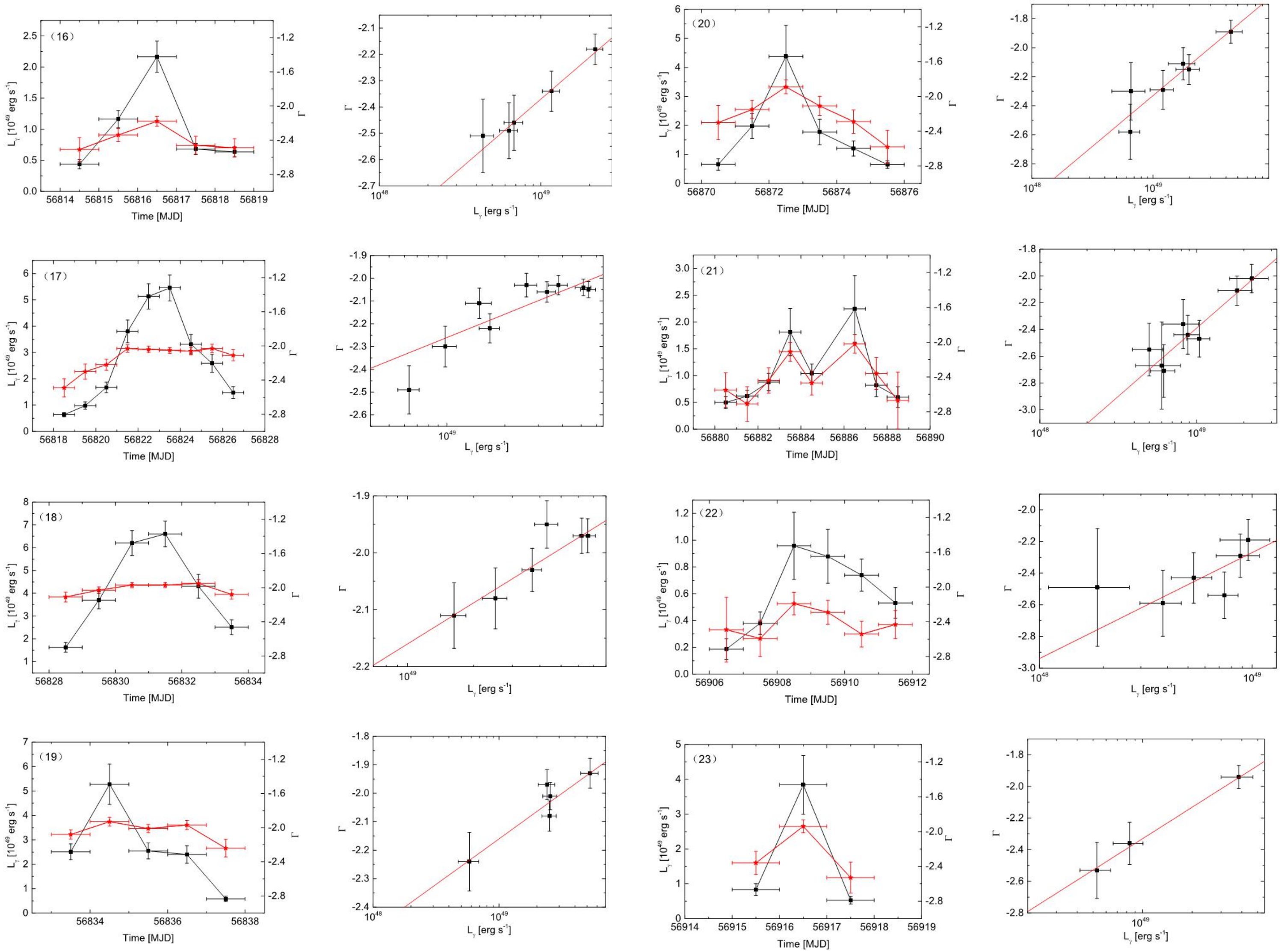

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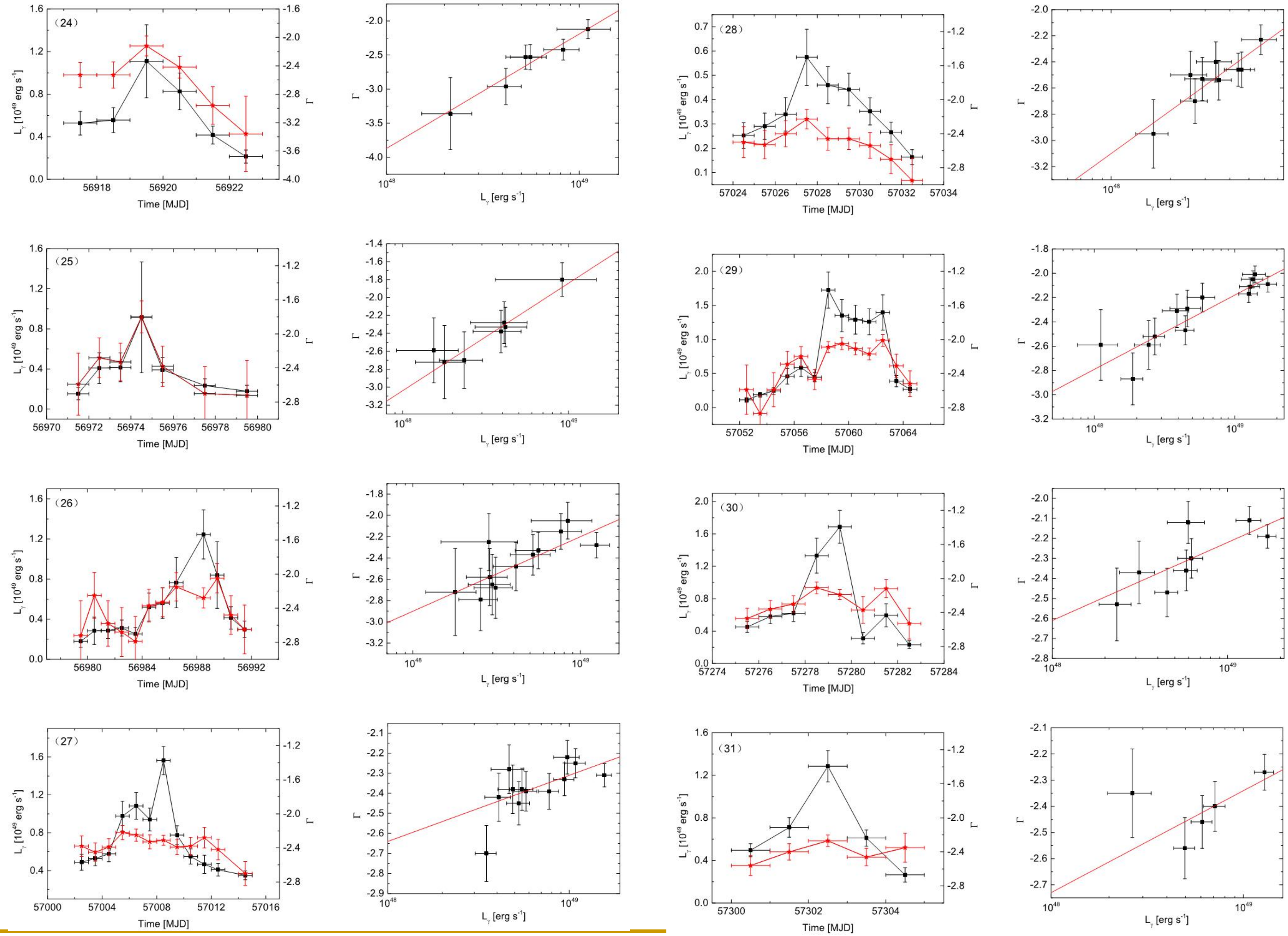

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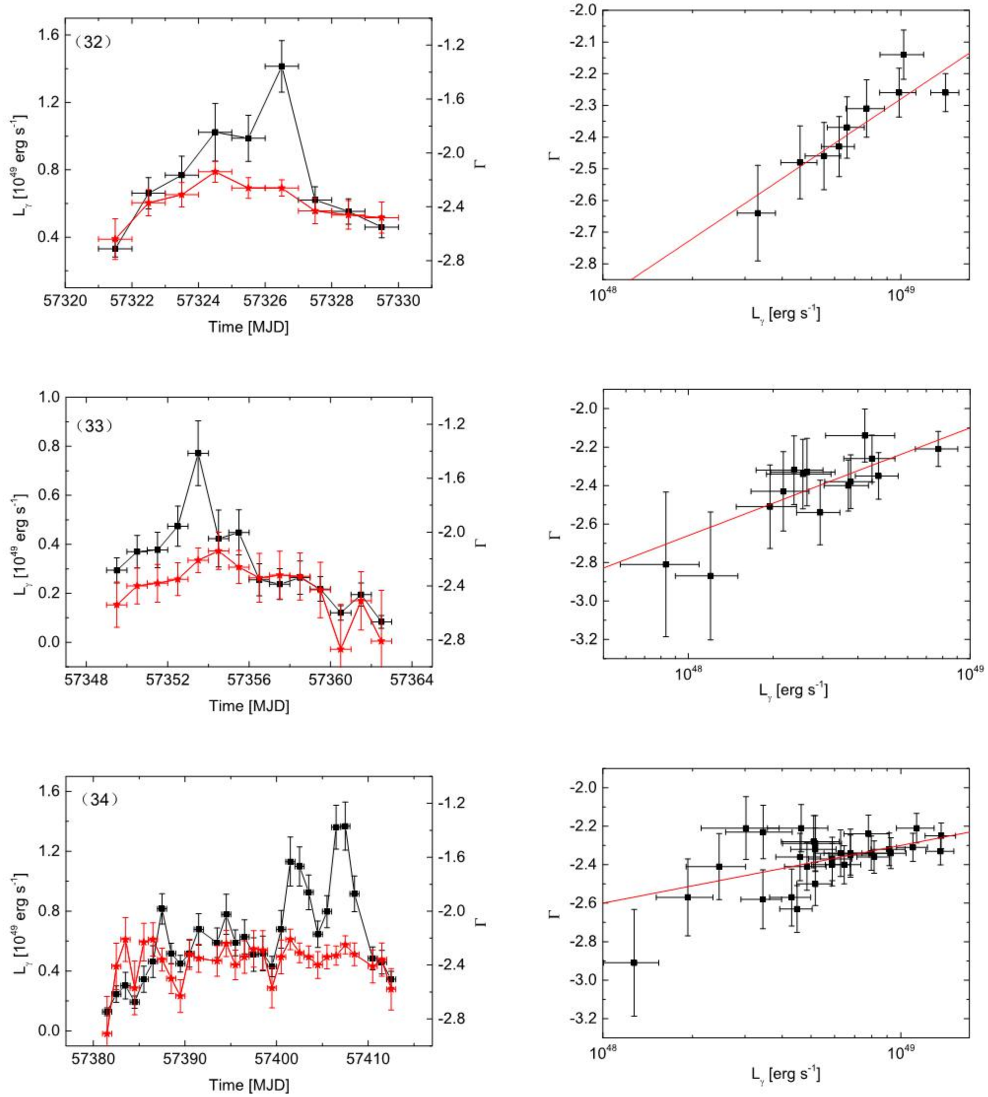

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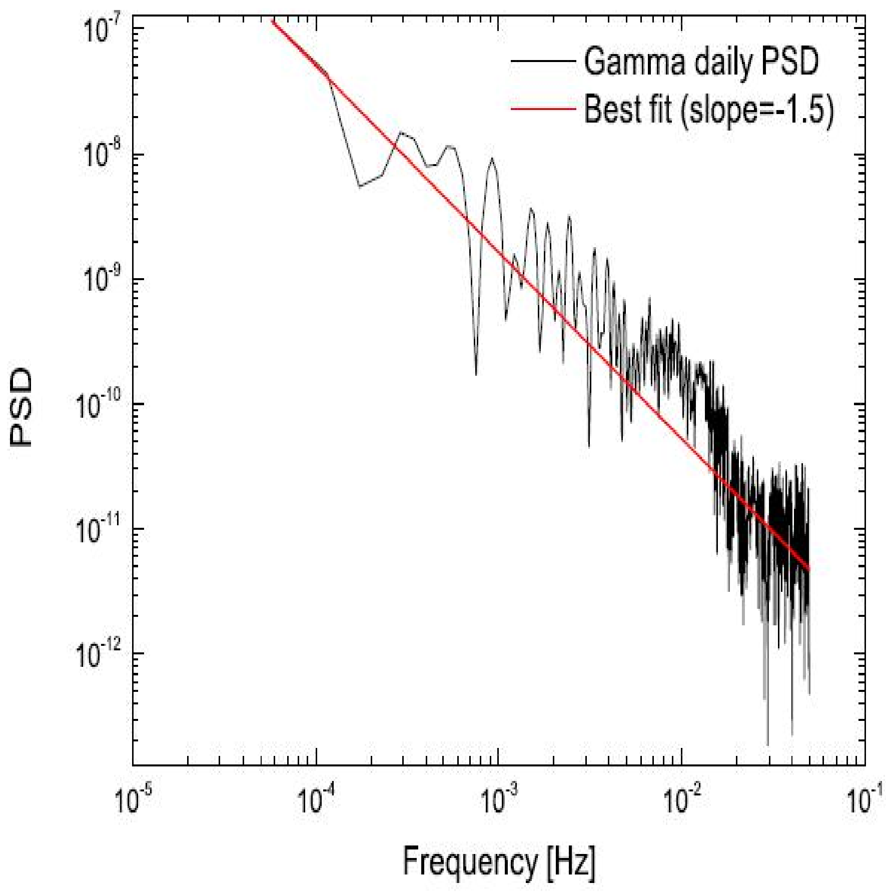
Power-density Spectrum

Generally being consistent with the red noise PDS→
from radiation regions of the jet or the central engine?



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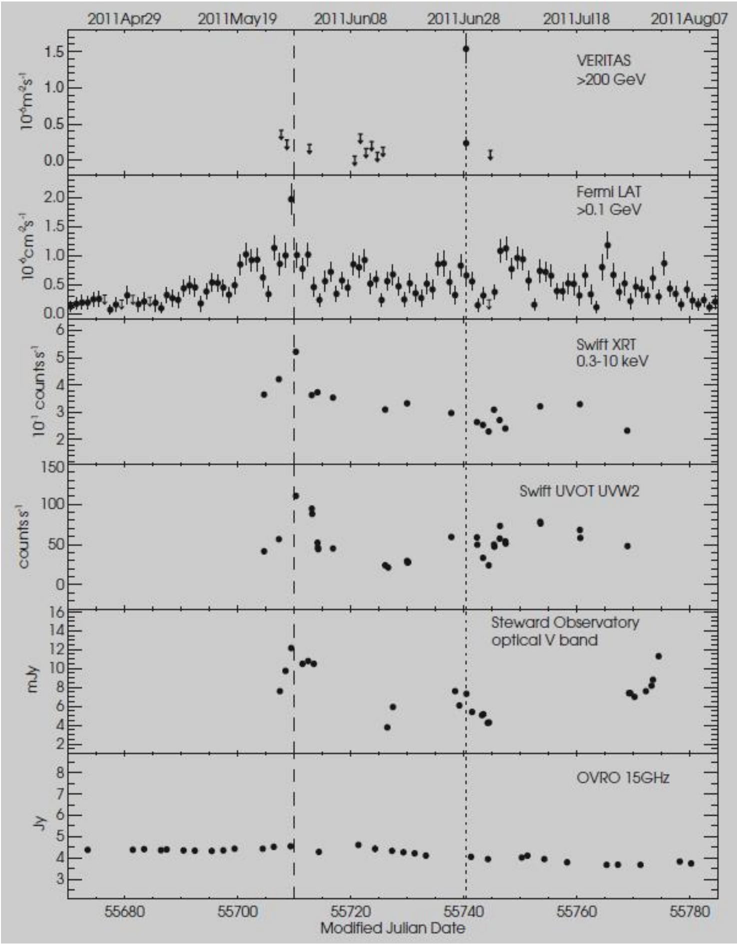
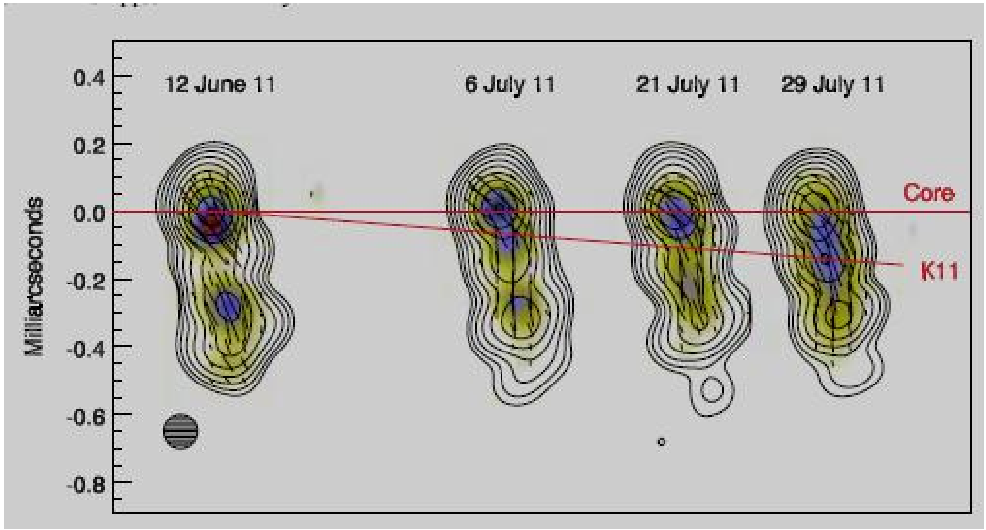
Observation campaign:

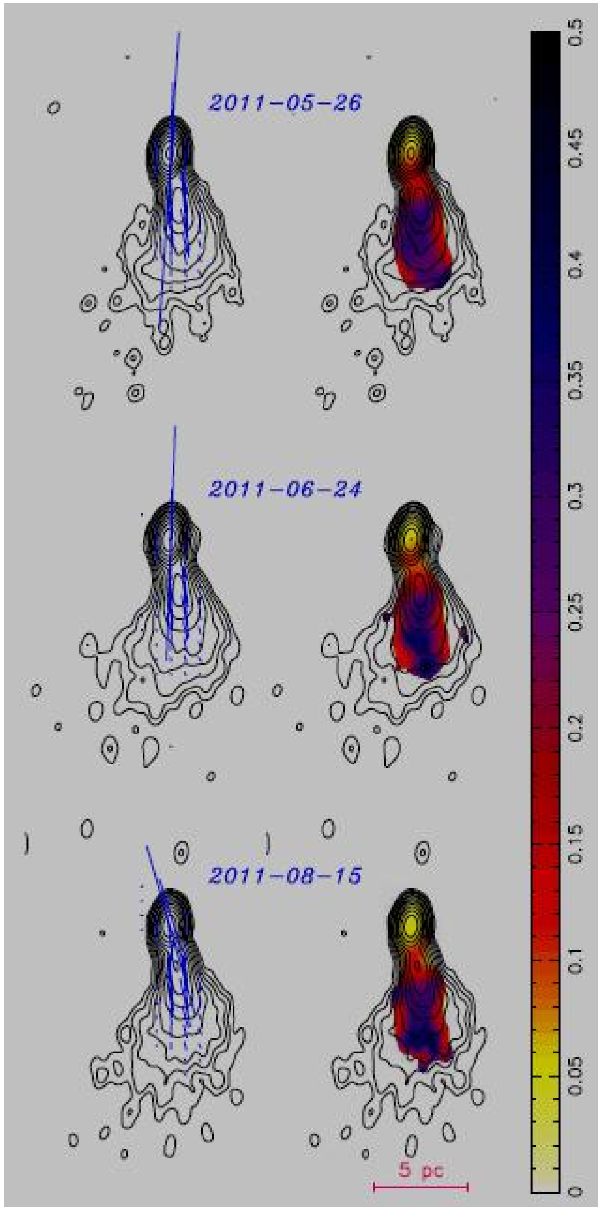
Rapid TeV gamma-ray Flaring of BL Lacertae



VLBA observations show that a new, superluminal knot emerges from the core around the time of the TeV gamma-ray flare.



Arlen et al. 2013



The polarization change of the core shown by MOJAVE images before and after the TeV γ-ray flare further supports the emergence of a new component associated with the gamma-ray flare.

We have submitted our observational proposal of radio-optical ToO observations for GeV-TeV flares of BL Lacs.

PI: 张晋（国台）

Challenge to LHAASO observations for TeV flares of BL Lacs: EBL absorption

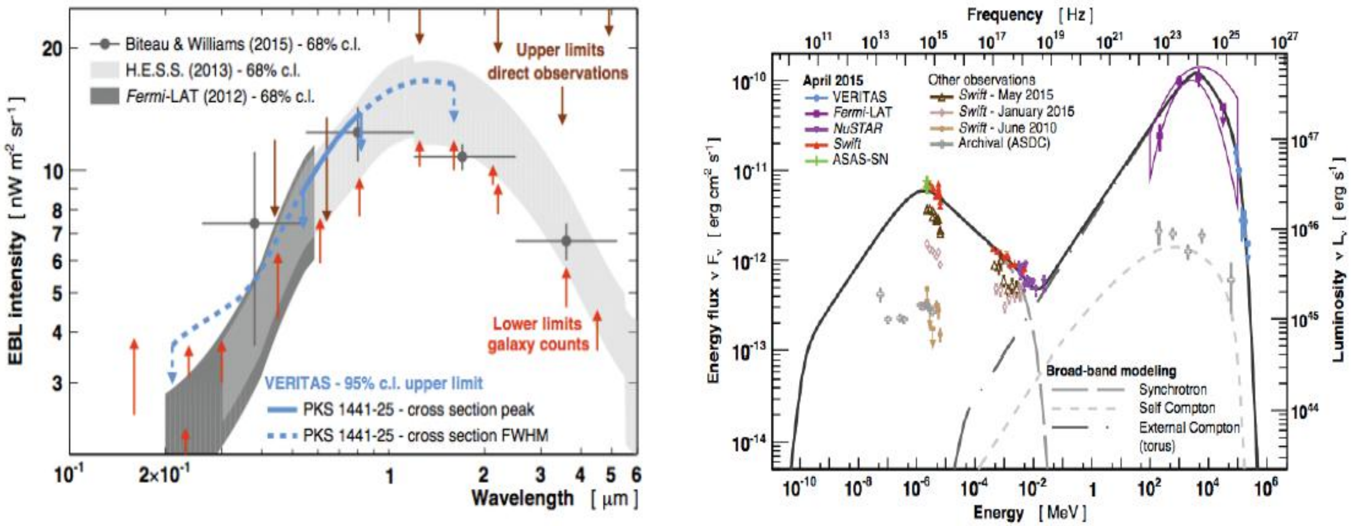


FIGURE 1. Left: VERITAS constraints on the EBL SED derived from PKS 1441+25. Right: SED of PKS 1441.

PKS 1441+25 is an FSRQ located at a redshift of $z = 0.939$. It was discovered as a VHE γ-ray emitter by MAGIC [6] in April 2015, following a flaring alert from *Fermi*-LAT. These flare detections triggered a week-long ToO observation campaign with VERITAS, resulting in the detection ($\sim 8\sigma$) of a very soft spectrum ($\Gamma = 5.3 \pm 0.5$) excess of ~400 events in 15 h of good-quality observations [7]. The observed flux was steady at ~5% Crab above 80 GeV during the ToO period, which also coincided with a period of enhanced MWL emission. No significant excess was observed from the source during a further ~4 h of data taken in May 2015, after the MeV-GeV (*Fermi*-LAT) flare had subsided, nor was any seen during snapshot monitoring in 2016. After correcting the observed *Fermi*-LAT and VERITAS spectra for EBL effects, the two data sets connect smoothly. This suggests that it is not unusual that VERITAS detected this object below 200 GeV, despite its redshift of ~1. Indeed, the VERITAS detection yields limits on the EBL that are comparable to the strongest known (see Figure 1), and are consistent with recent models. Of particular note in the VERITAS study

Abeysekara et al. 2016

Outlines

Thanks!

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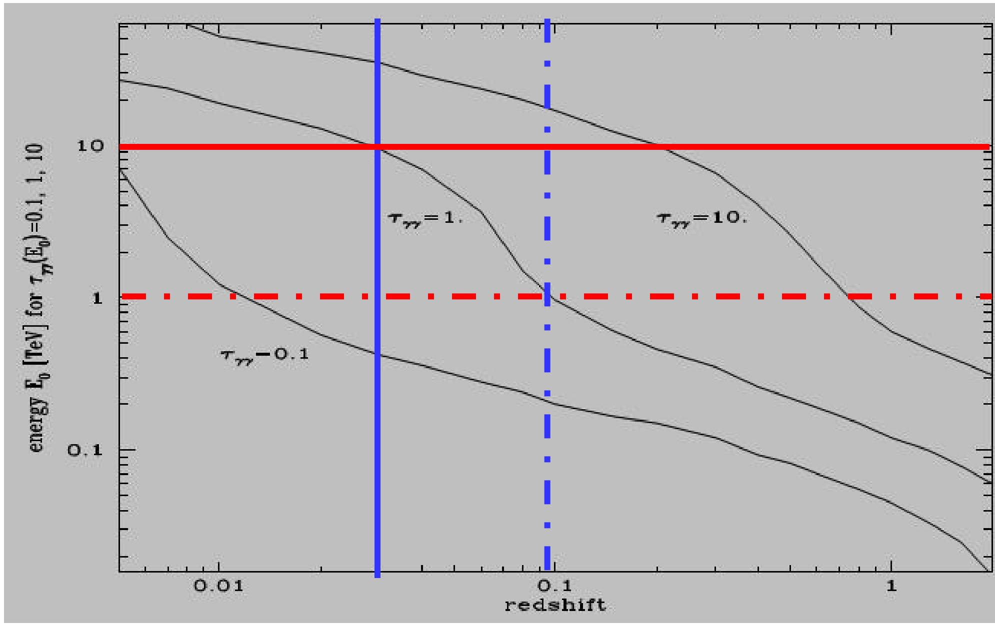
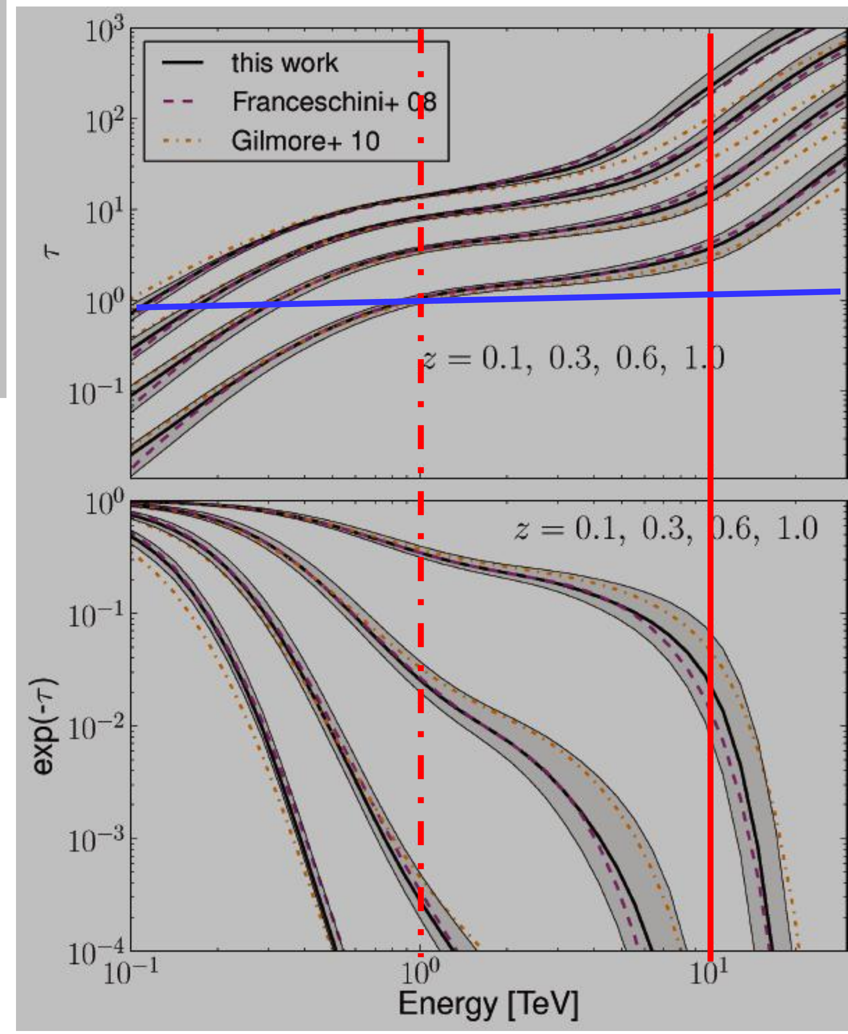
EBL 光深问题



Franceschini et al. 2008



Domınguez et al. 2011