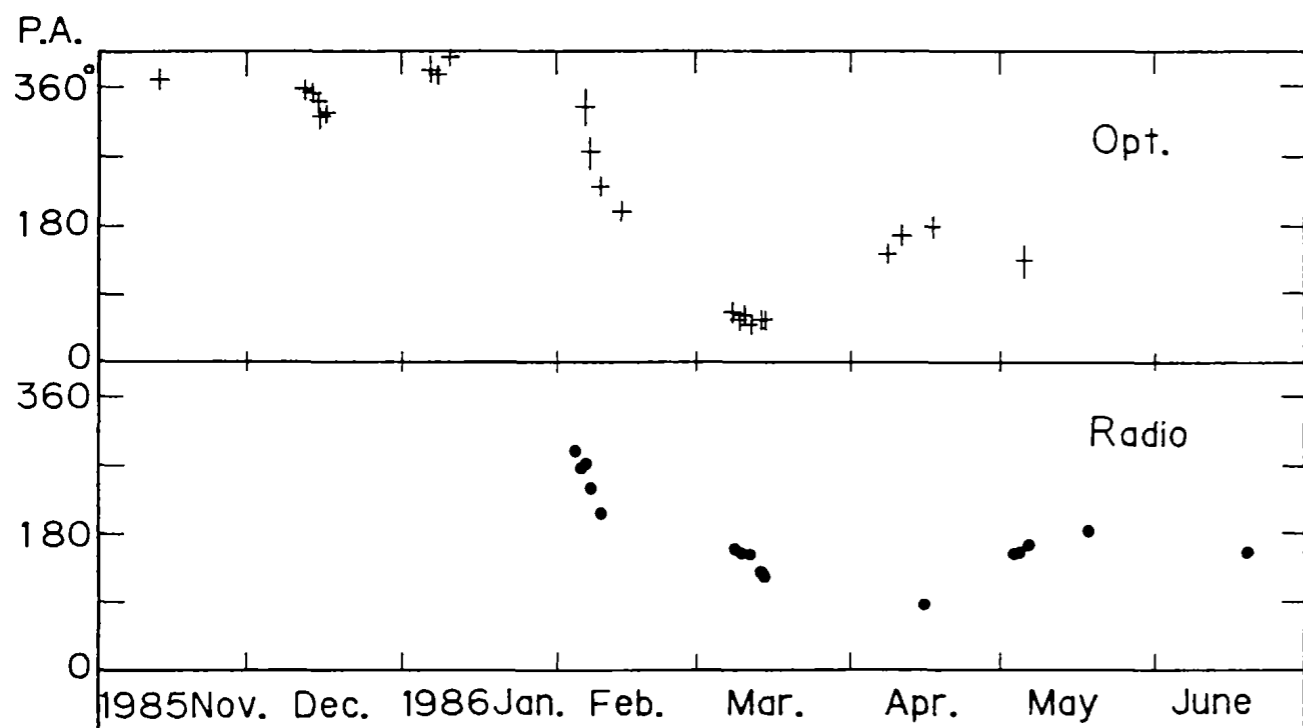
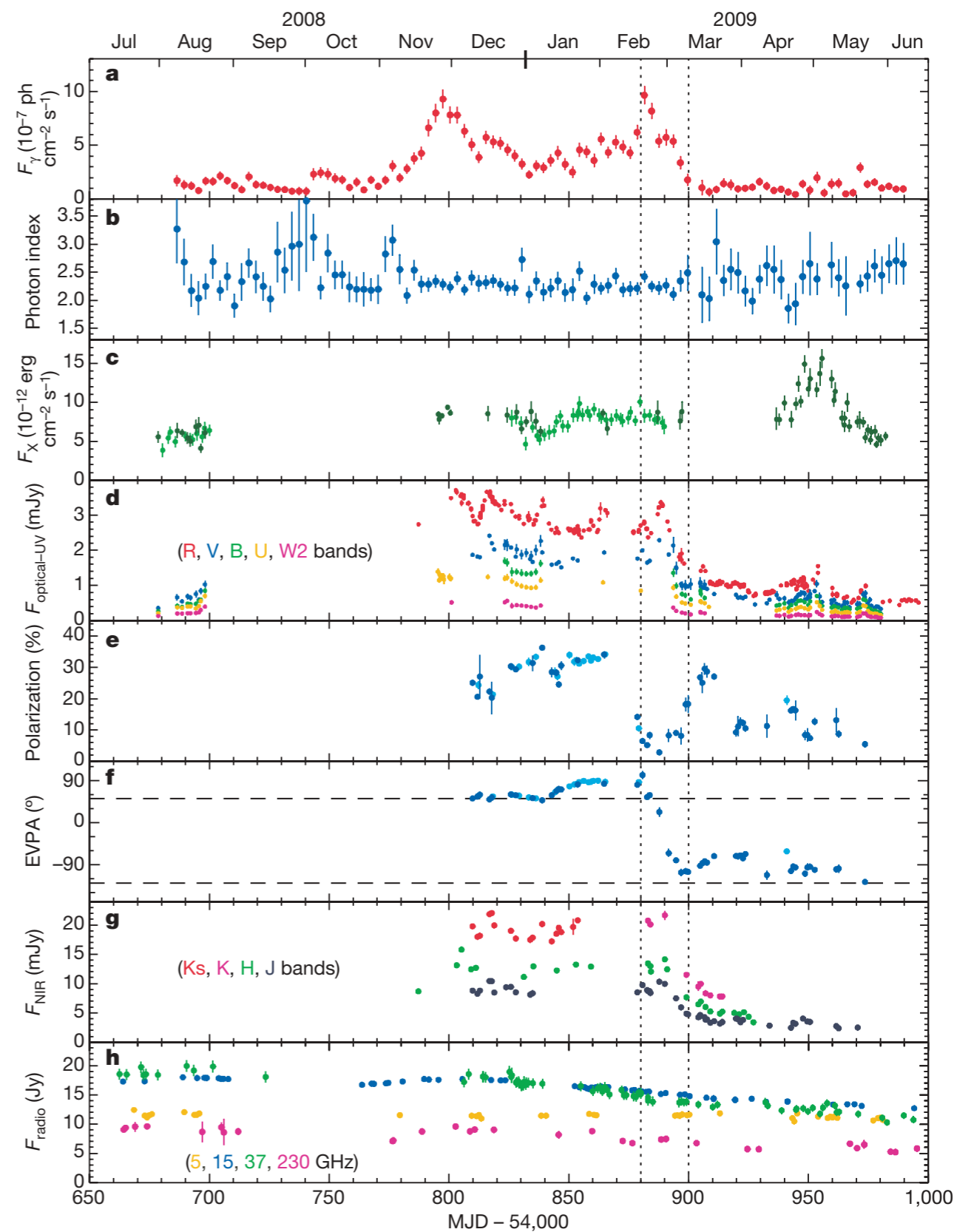


Marscher et al. 2008, Nature 452, 966



Kikuchi et al., 1980, A&A, 190, L8



Abdo et al. 2010, Nature 463, 919

RoboPol: the optical polarisation of a γ -ray flux limited sample of AGN

Emmanouil Angelakis¹

D. Blinov^{2,3}, V. Pavlidou^{2,3}, T. Hovatta⁴, I. Myserlis & the RoboPol collaboration

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²Foundation for Research and Technology - Hellas, IESL, Voutes, 7110 Heraklion, Greece

³Department of Physics and Institute for Plasma Physics, University of Crete, 71003, Heraklion, Greece

⁴Aalto University Metsahovi Radio Observatory, Metsahovintie 114, 02540 Kylmala, Finland



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the RoboPol program

Pavlidou, EA et al. 2014, MNRAS, 442, 1693

- unbiased samples:
 - ▶ 65 GL sources: from 2FGL
 - ▶ 15 GQ sources: variable in radio
- adaptive cadence: 3 - 0.3 nights
- 4-channel RoboPol polarimeter

King et al. 2014, MNRAS, 442, 1706

Ramaprakesh et al., in prep.



Caltech: M. Balokovic, A. Mahabal, T. J. Pearson, A. Readhead

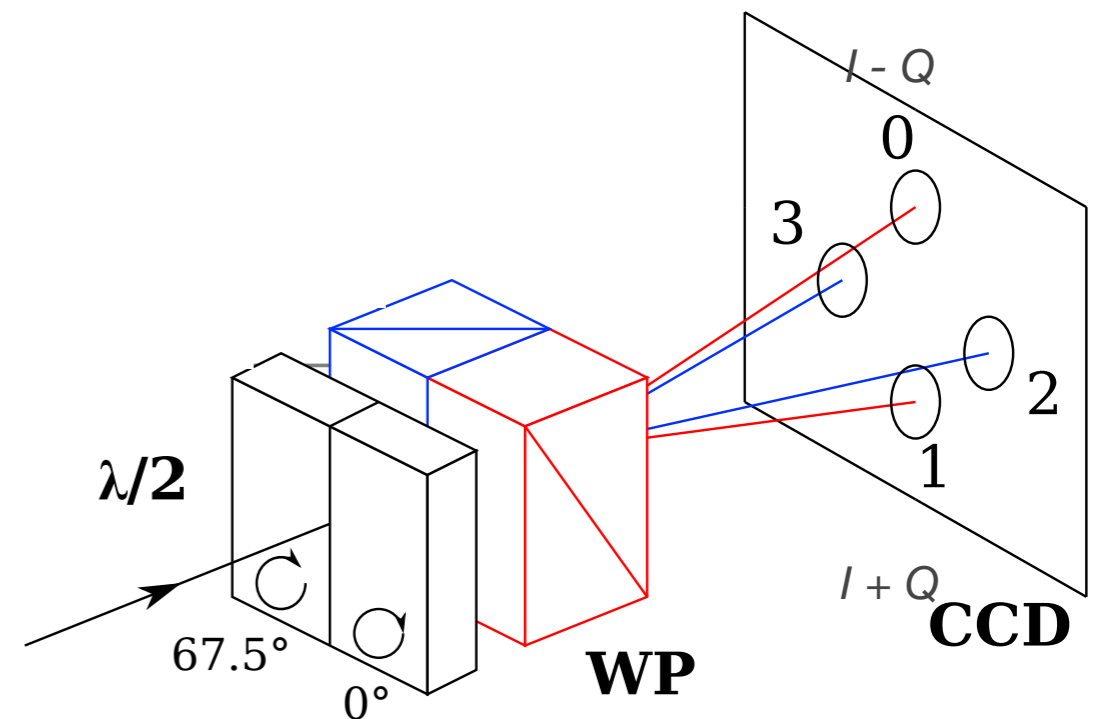
Uni of Crete: D. Blinov, N. Kylafis, G. Panopoulou, I. Papadakis, I. Papamastorakis, V. Pavlidou, P. Reig, K. Tassis

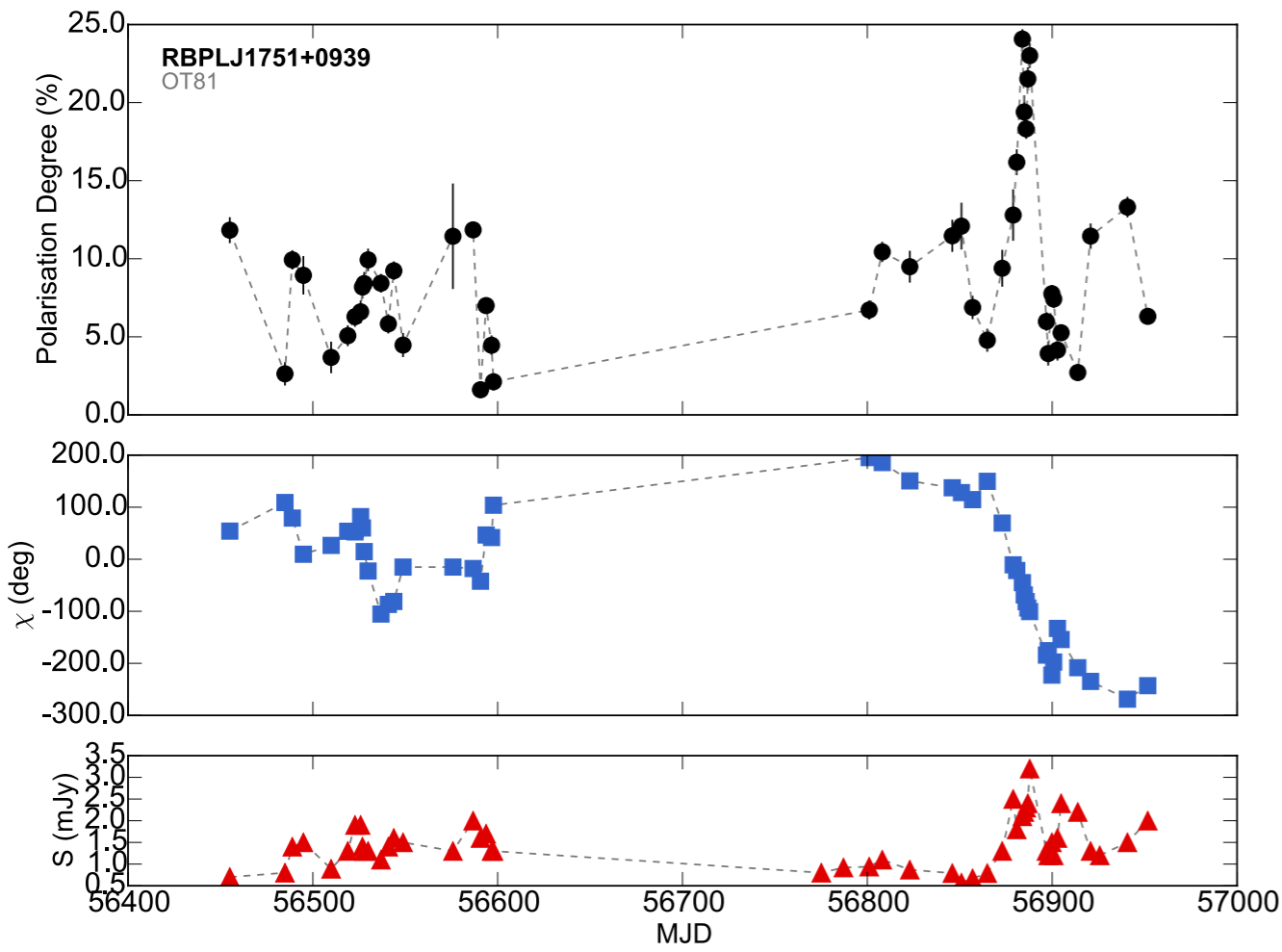
MPIfR: E. Angelakis, I. Myserlis, J. A. Zensus

IUCAA: V. Joshi, S. Prabhudesai, A. Ramaprakash

Nicolaus Copernicus University: A. Kus - A. Marecki, E. Pazderski

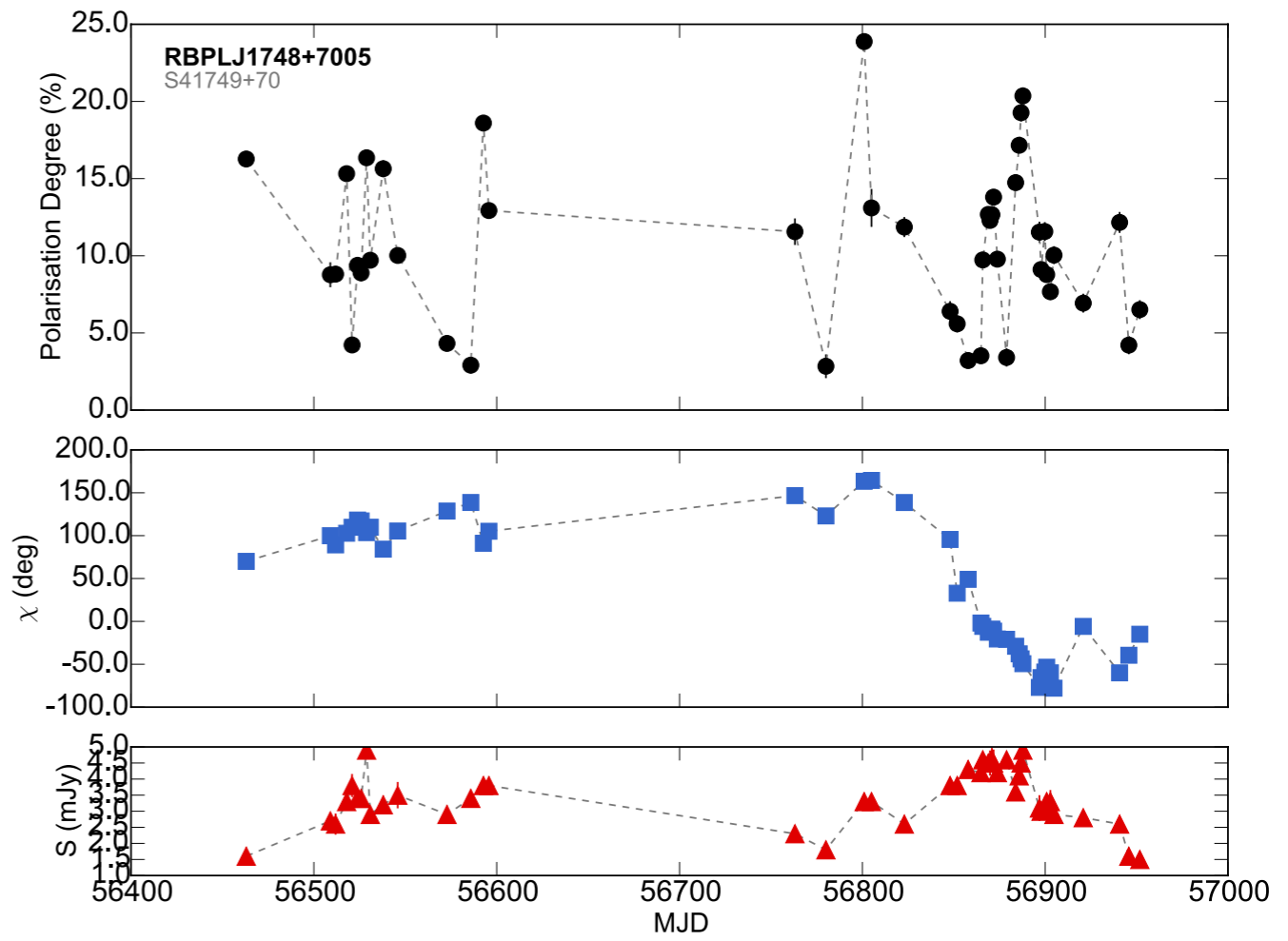
Other: T. Hovatta, S. Kiehlmann, O. King





← season 2013

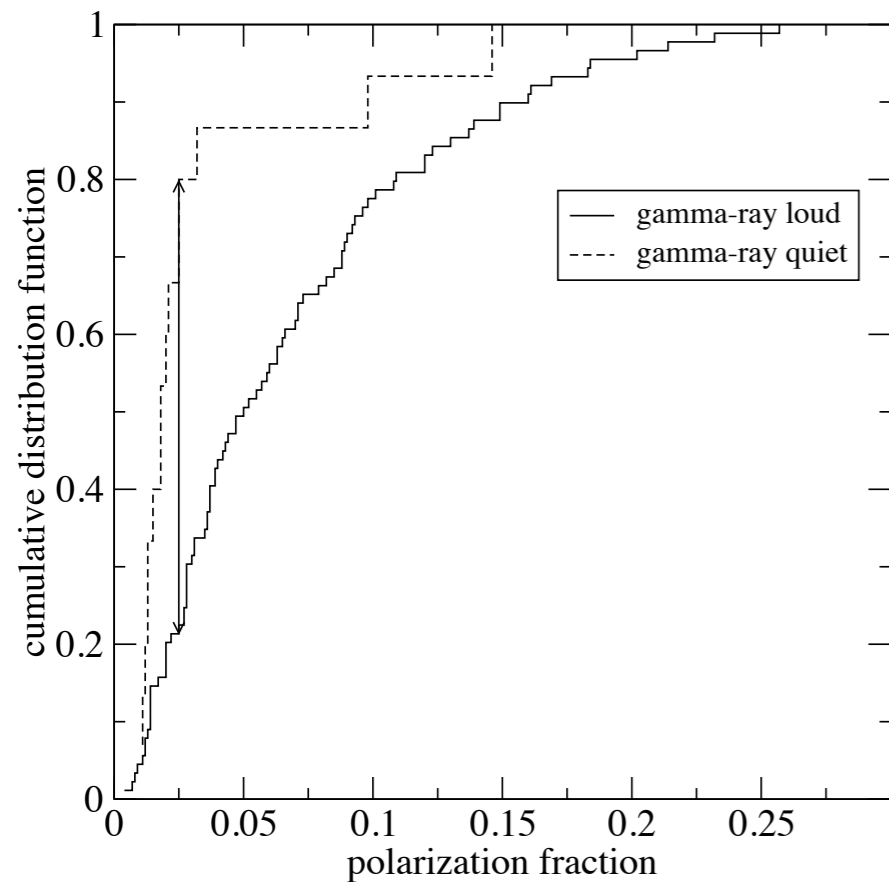
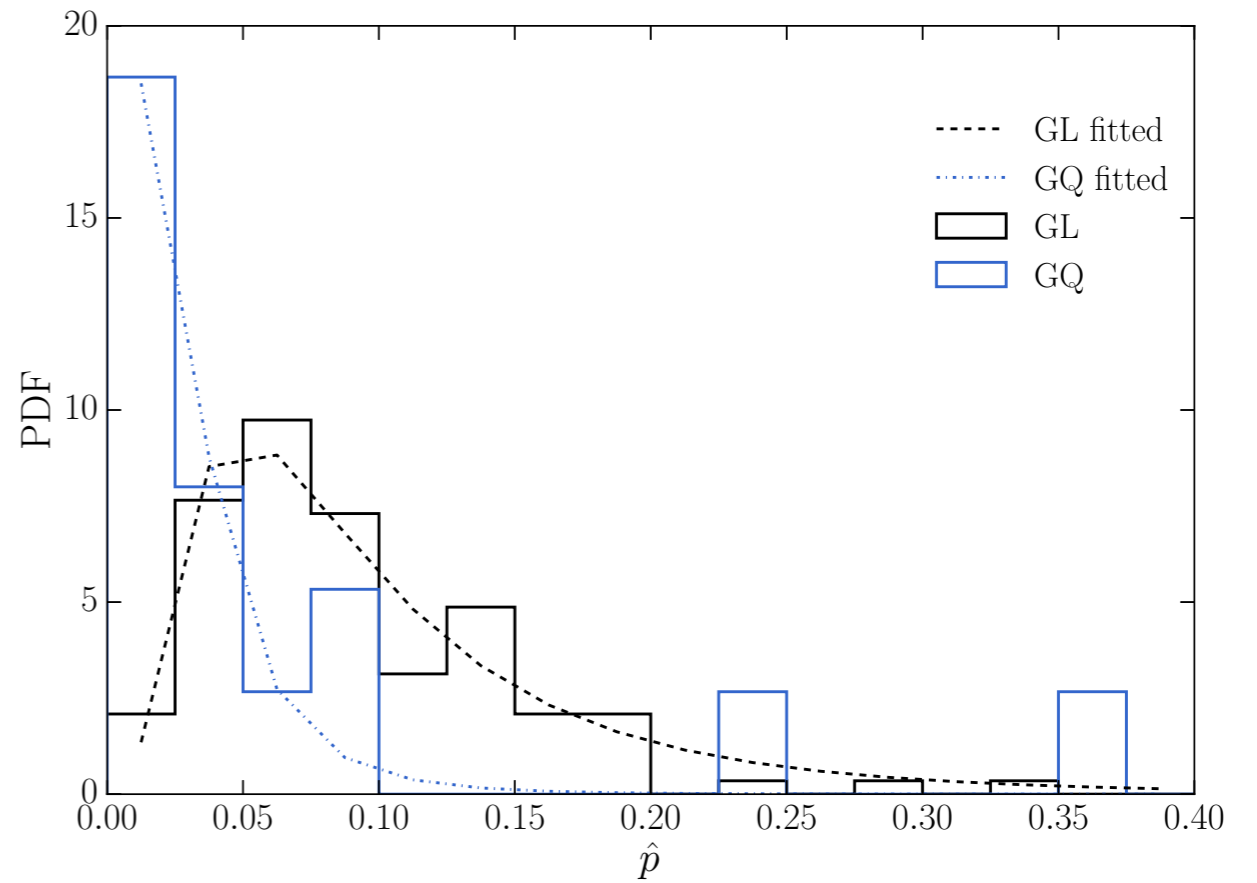
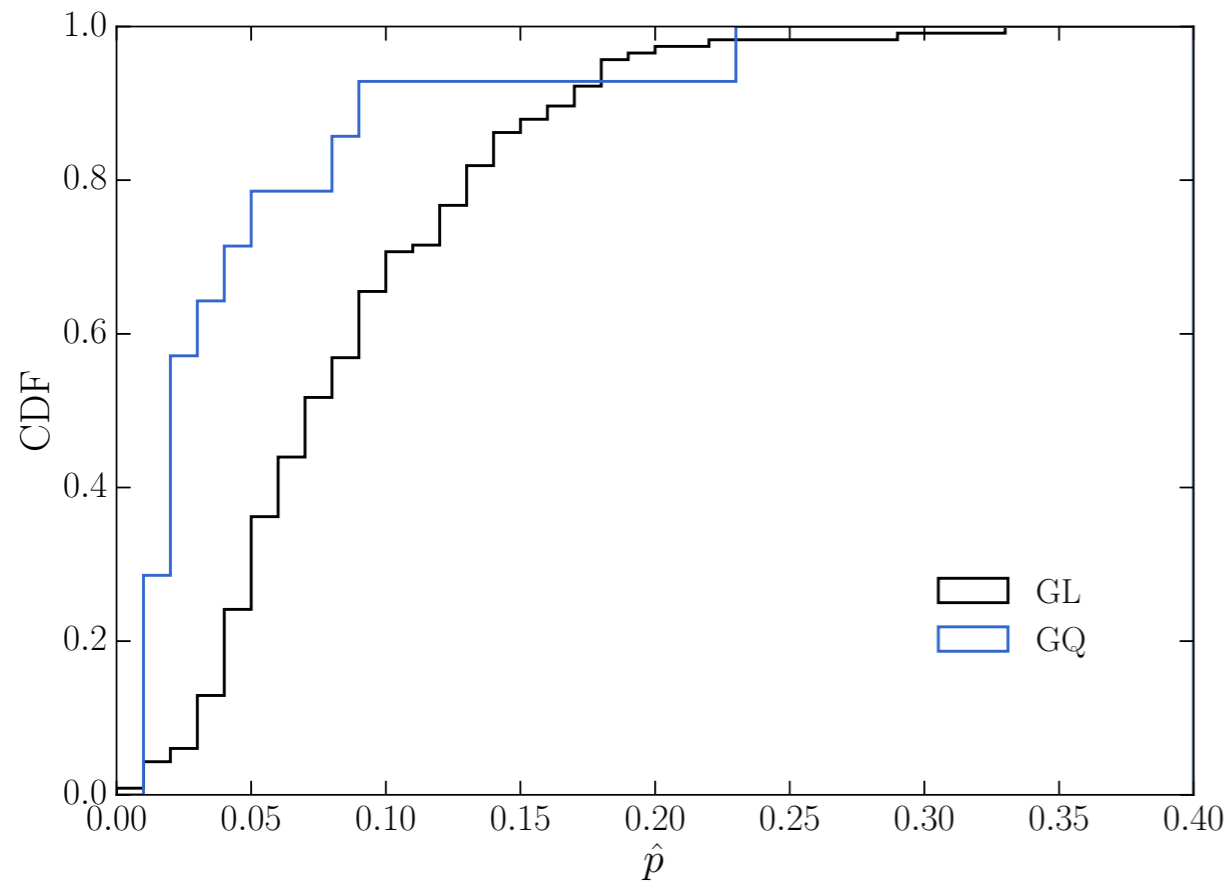
← season 2014



← season 2013

← season 2014

- ➔ p uncertainty: less than 0.01
- ➔ χ uncertainty: 1-2 deg
- ➔ R -mag uncertainty: ~ 0.02 - 0.04 mag



median (KS test p: 6.5×10^{-4})

➔ GL: 0.078

➔ GQ: 0.031

$$\text{PDF} = \frac{1}{x\sigma\sqrt{2\pi}} e^{-\frac{(\ln x - \mu)^2}{2\sigma^2}}$$

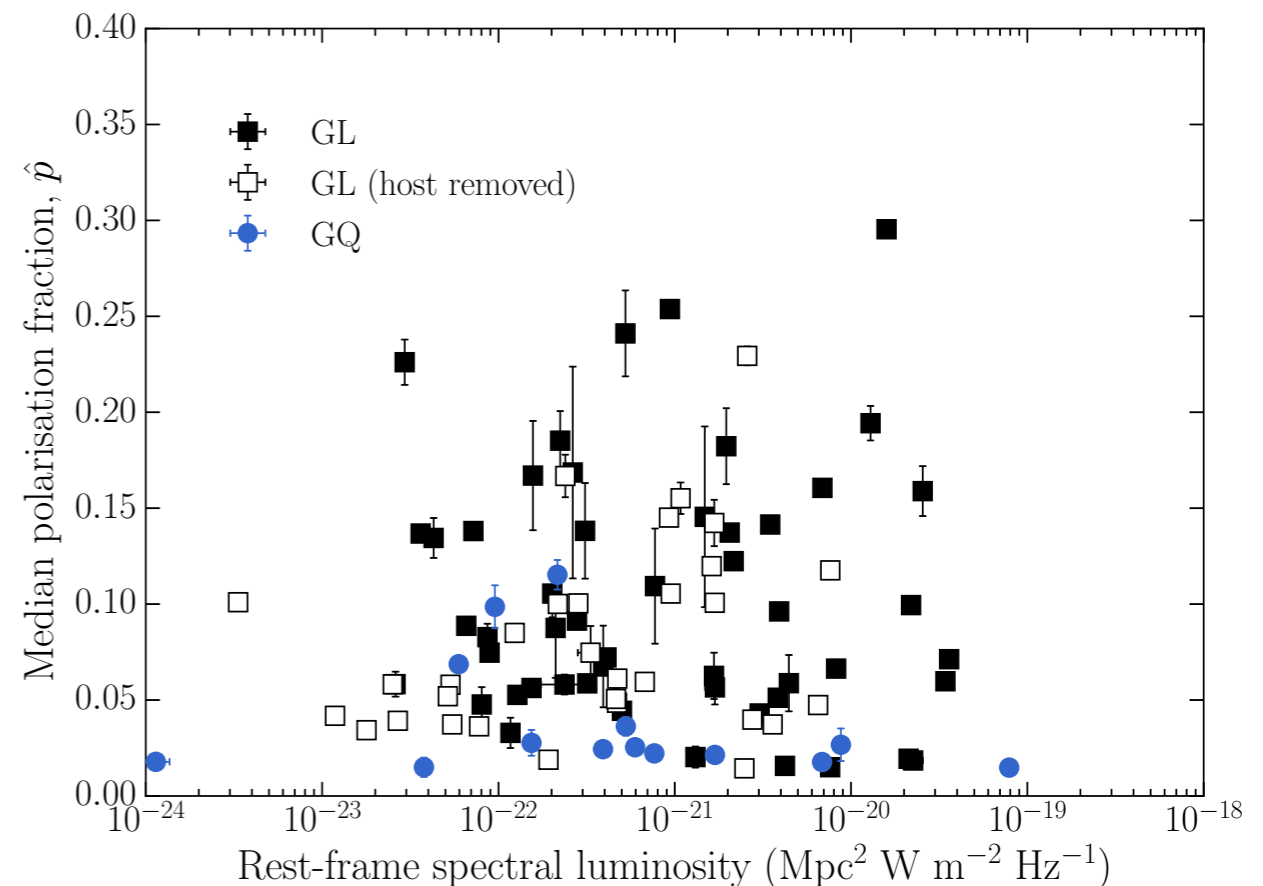
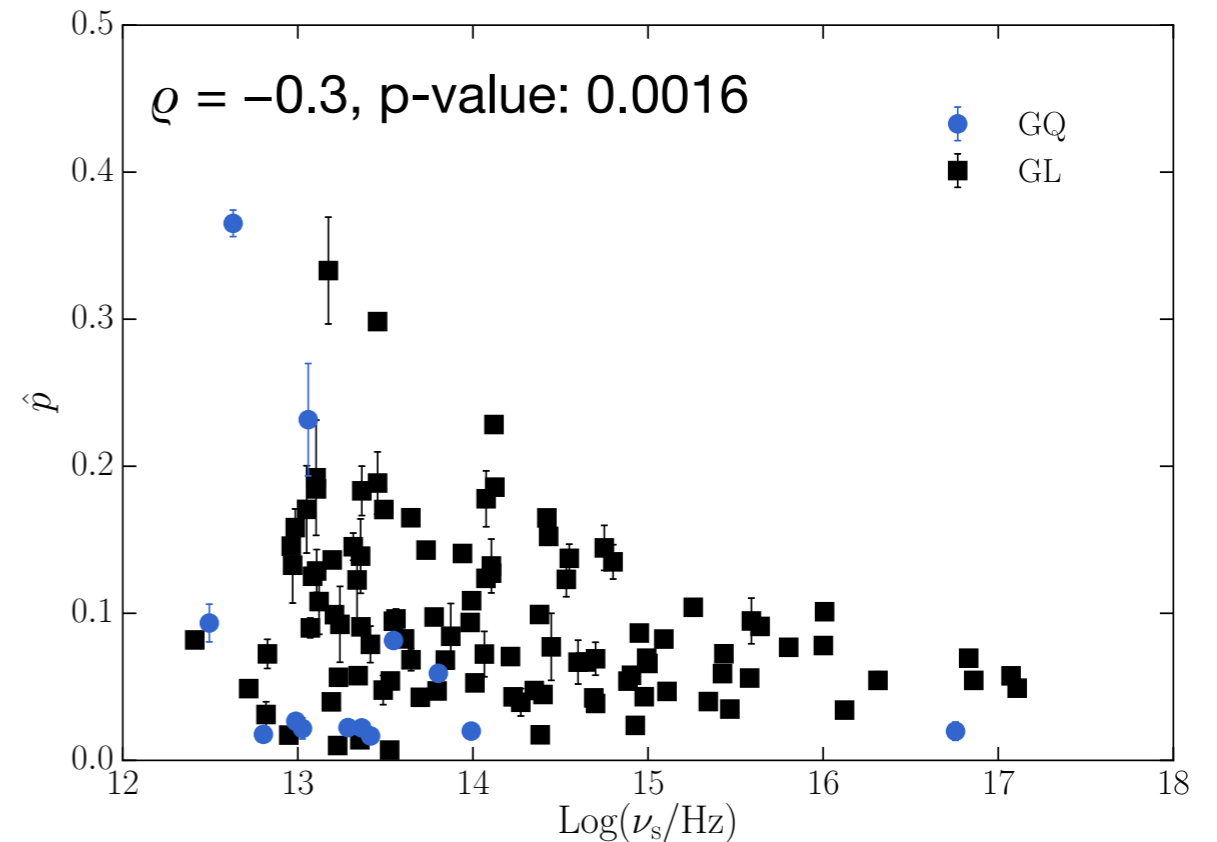
➔ GL: 0.105 (var: 0.0068)

➔ GQ: 0.035 (var: 0.0011)

the polarization of GL and GQ:

Angelakis et al. in prep.

- ➔ GL more polarized than GQ:
 - uniformity of the field?
- ➔ function of the synchrotron peak
- ➔ independent of luminosity:
 - no association with source class
- ➔ a mechanism that:
 - moves the SED horizontally
 - increases the polarisation

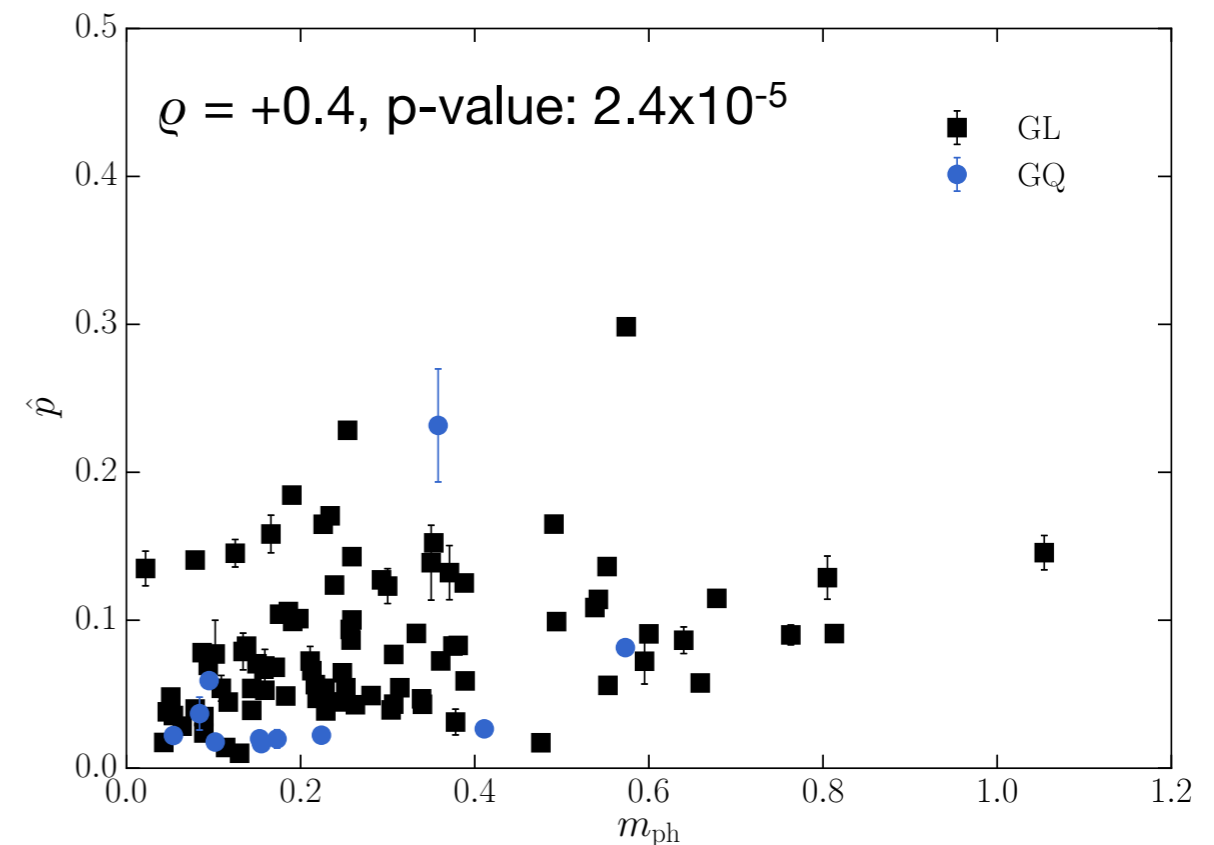
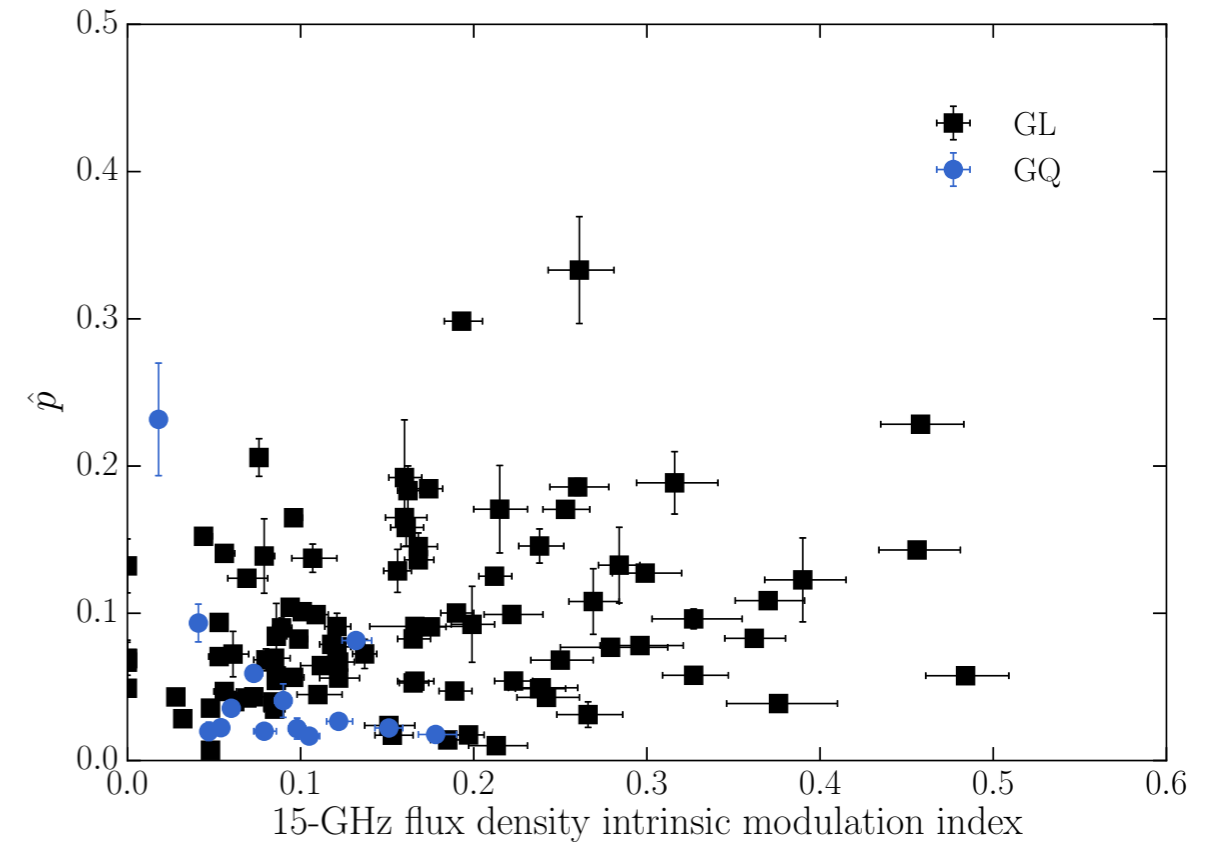


Angelakis et al. in prep.

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Angelakis et al. in prep.

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- ➔ does not depend on the radio variability amplitude
- ➔ correlated with the optical variability amplitude

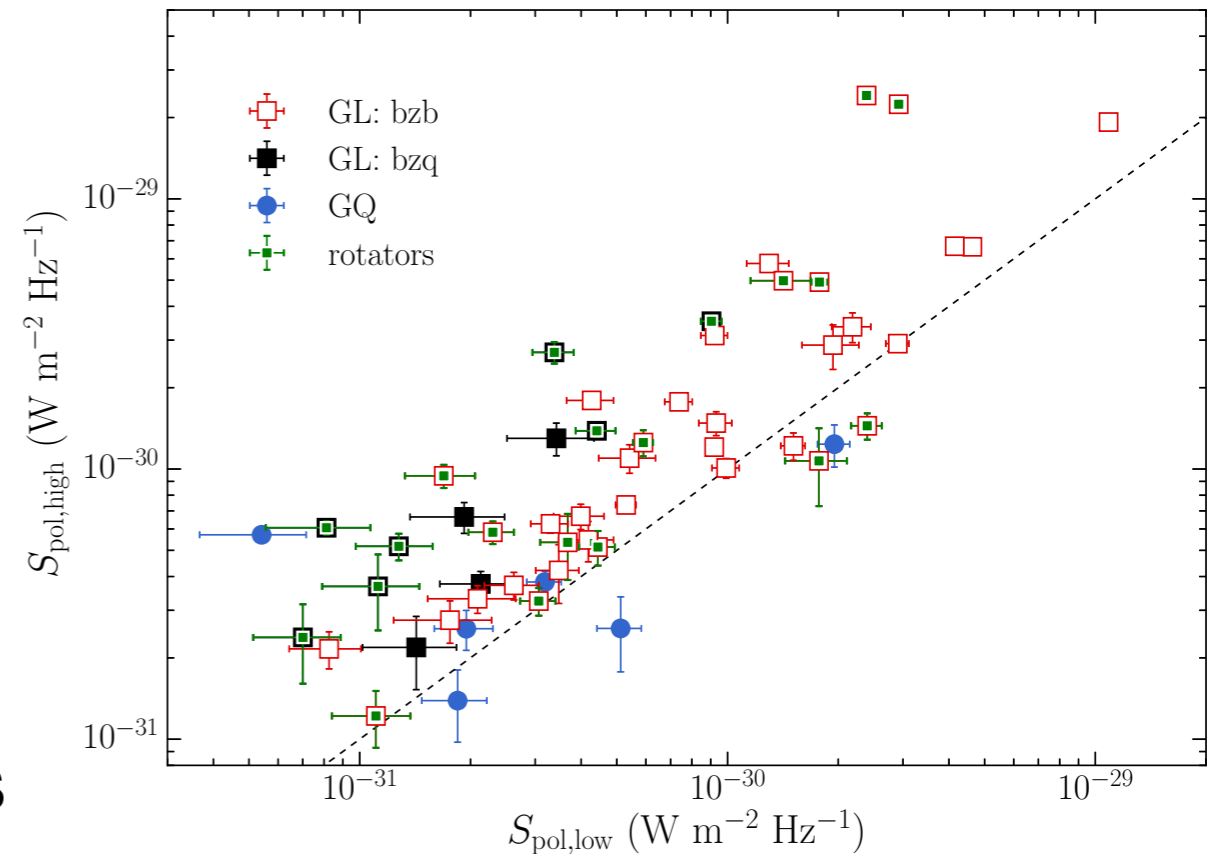


Angelakis et al. in prep.

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Angelakis et al. in prep.

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Angelakis et al. in prep.

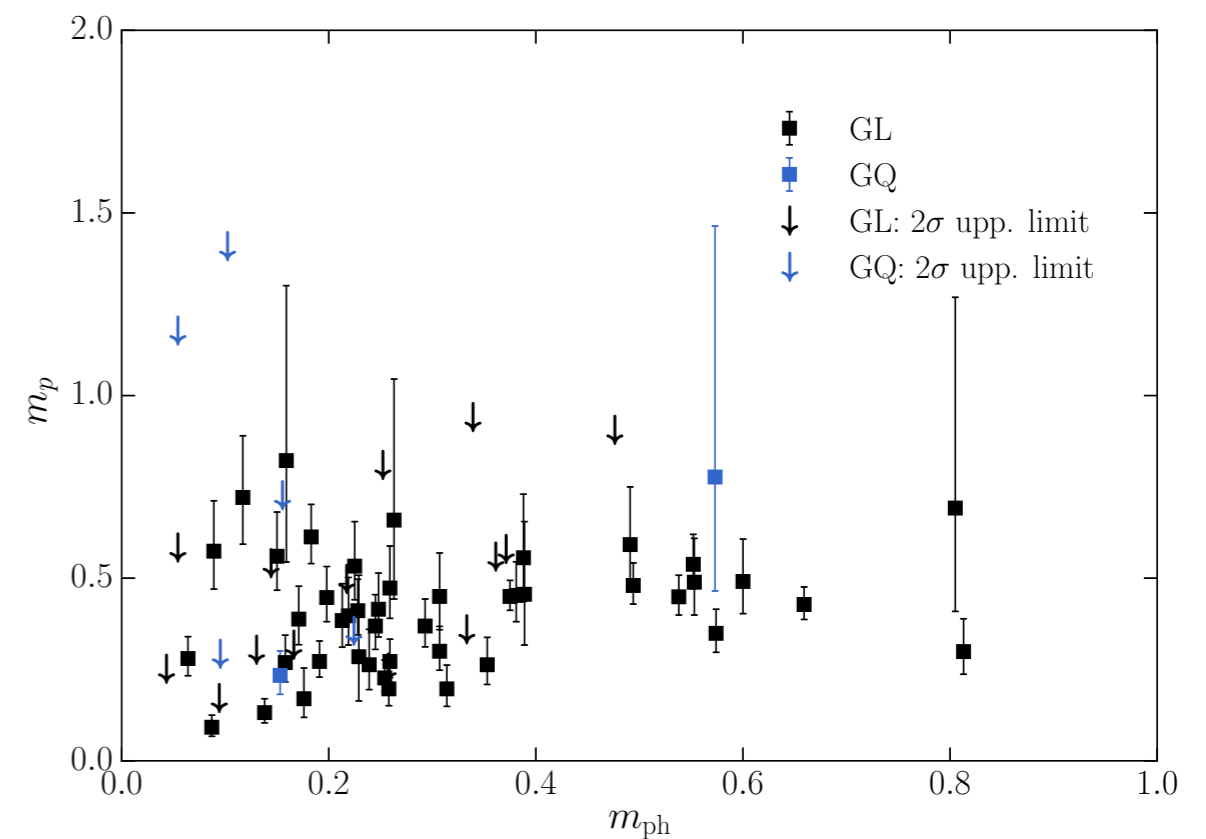
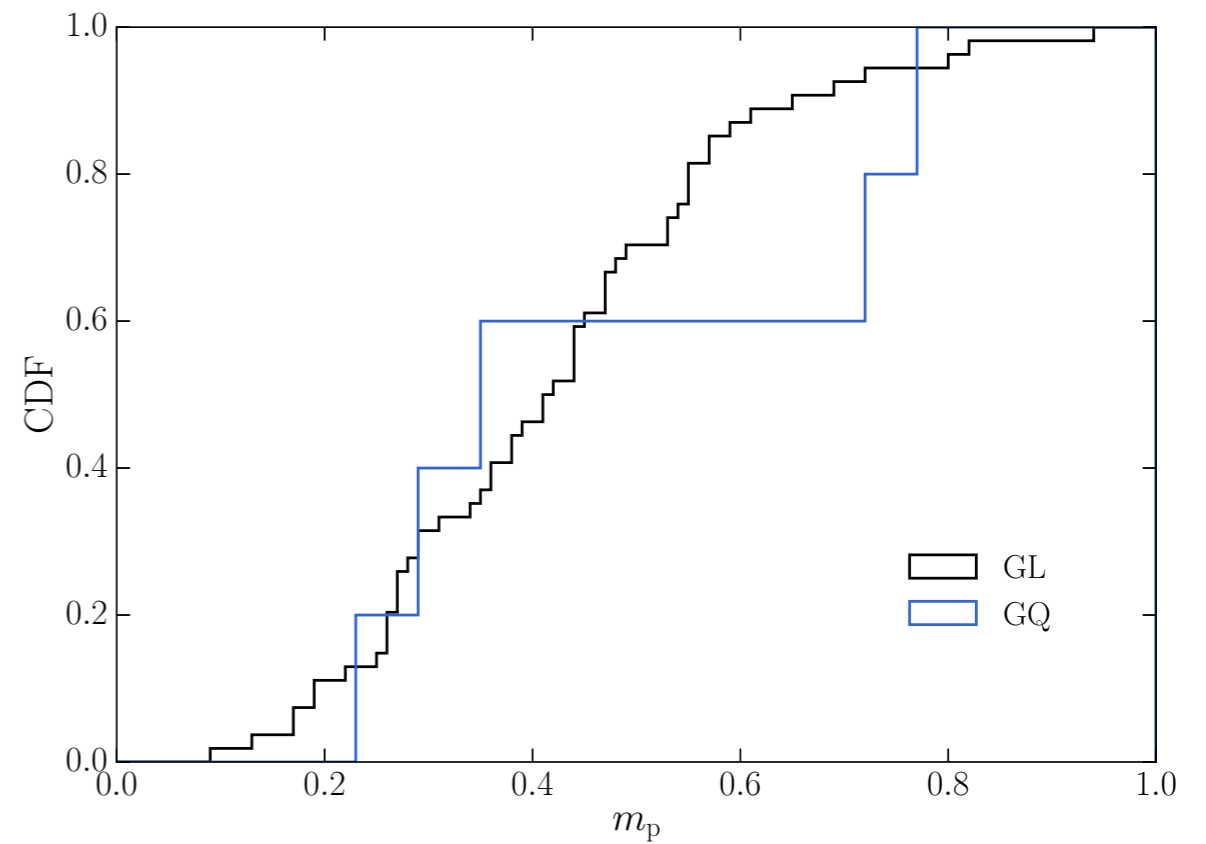
polarization variability of GL and GQ:

Angelakis et al. in prep.

$$pdf(p_i; \alpha, \beta) = \frac{p_i^{\alpha-1} (1-p_i)^{\beta-1}}{B(\alpha, \beta)}$$

$$p_0 = \frac{\alpha}{\alpha + \beta}$$

$$m_p = \frac{\sqrt{Var}}{\mu} = \frac{\sqrt{\frac{\alpha\beta}{(\alpha+\beta)^2(\alpha+\beta+1)}}}{\frac{\alpha}{\alpha+\beta}}$$



Angelakis et al. in prep.

EVPA rotations

Blinov et al. 2015, MNRAS.453.1669B; Blinov et al. in prep.

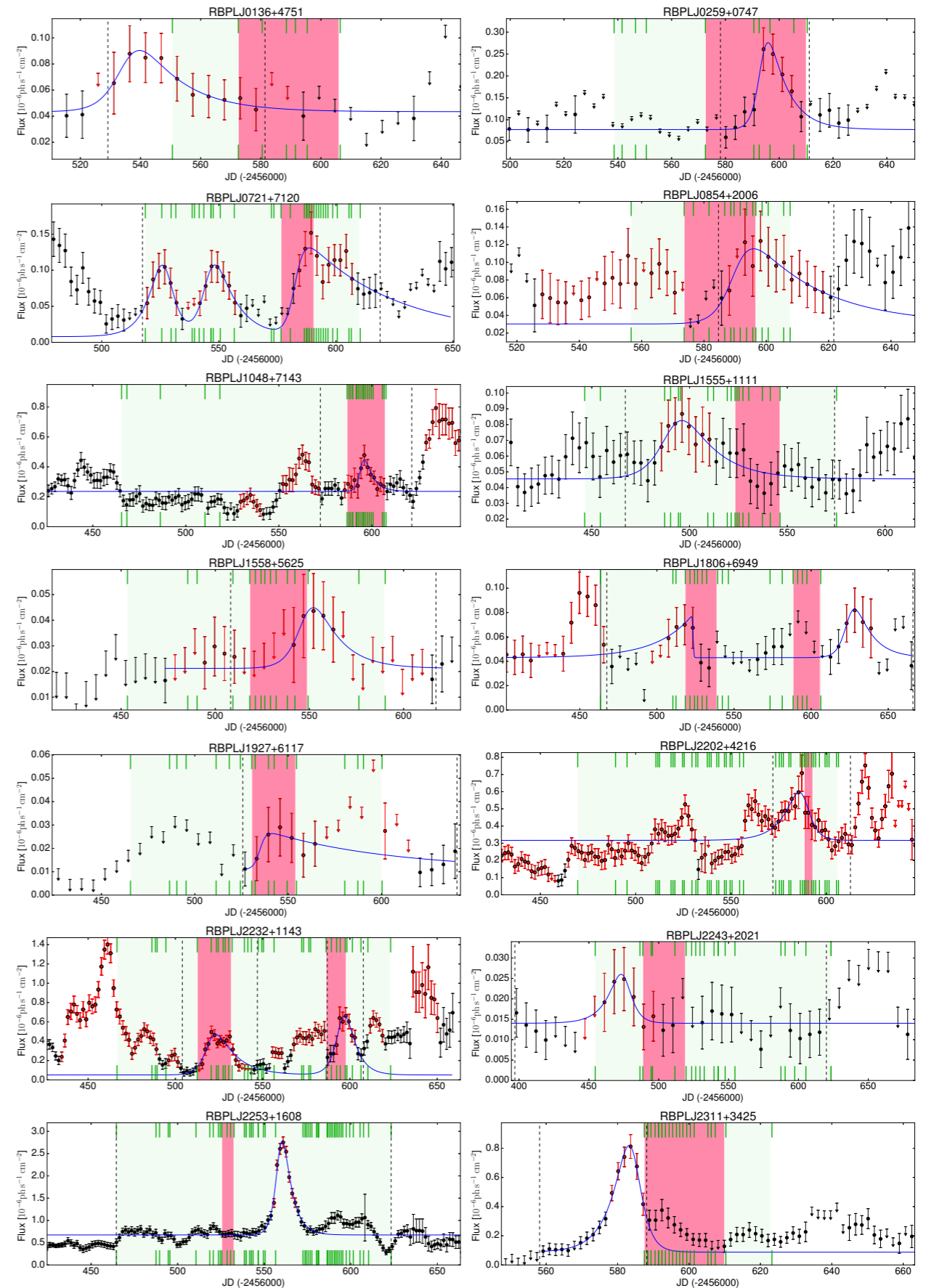
→ detected 27 rotations:

▶ 2013: 16 rotations in 13 blazars

Blinov et al. 2015, MNRAS.453.1669B

▶ 2014: 11 rotations in 10 blazars

Blinov et al. in prep.



EVPA rotations

Blinov et al. 2015, MNRAS.453.1669B; Blinov et al. in prep.

→ detected 27 rotations:

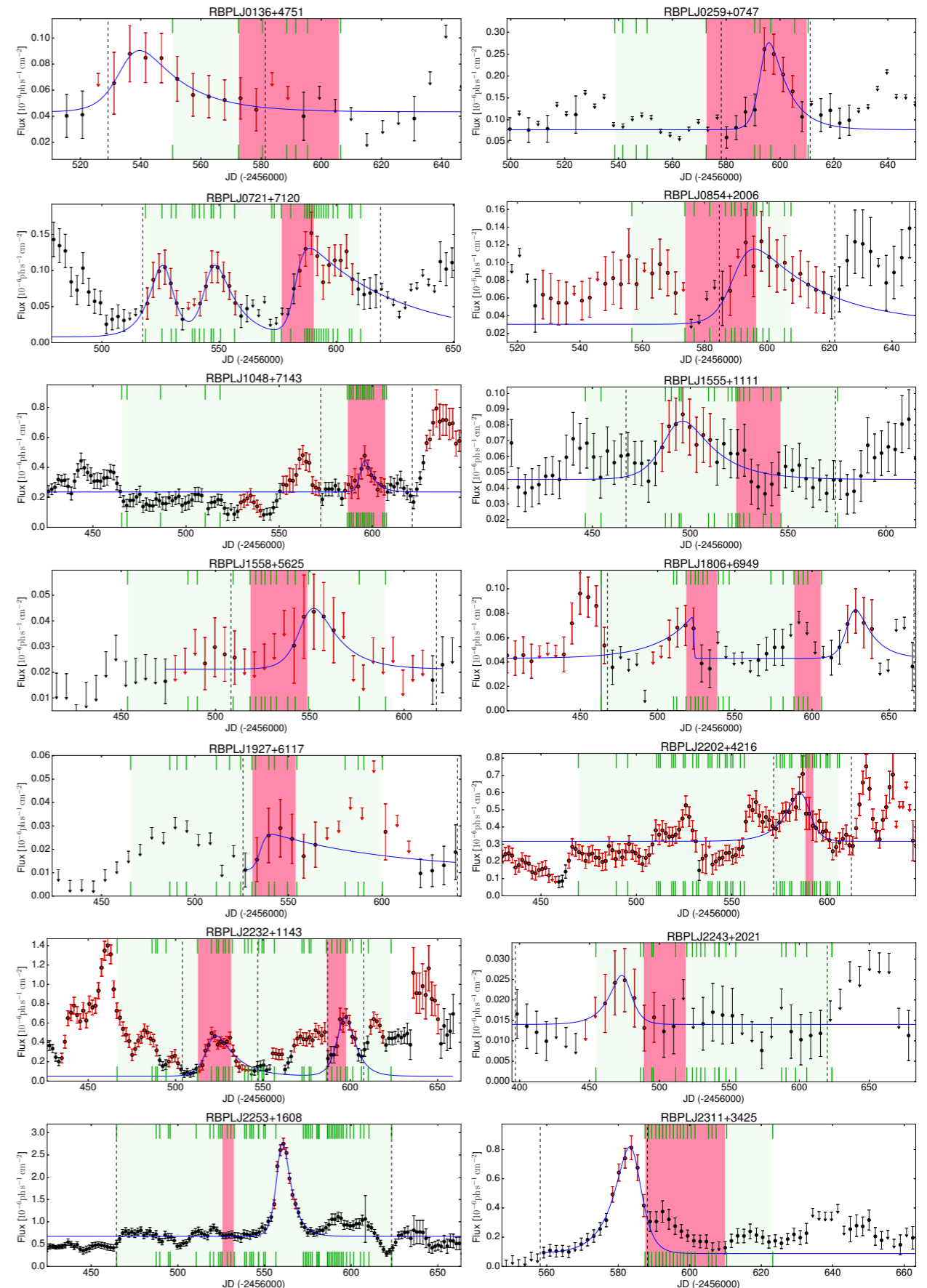
- ▶ 2013: 16 rotations in 13 blazars
Blinov et al. 2015, MNRAS.453.1669B
- ▶ 2014: 11 rotations in 10 blazars
Blinov et al. in prep.

→ all classes can “rotate” (HSP/LSP, FSRQs/BL Lacs, TeV and non-TeV)

- ▶ there is some dependence on the synchrotron peak with LSP rotations more often

→ both senses of rotation are allowed in the same source

- ▶ the rate can vary a lot for the same source



EVPA rotations

Blinov et al. 2015, MNRAS.453.1669B; Blinov et al. in prep.

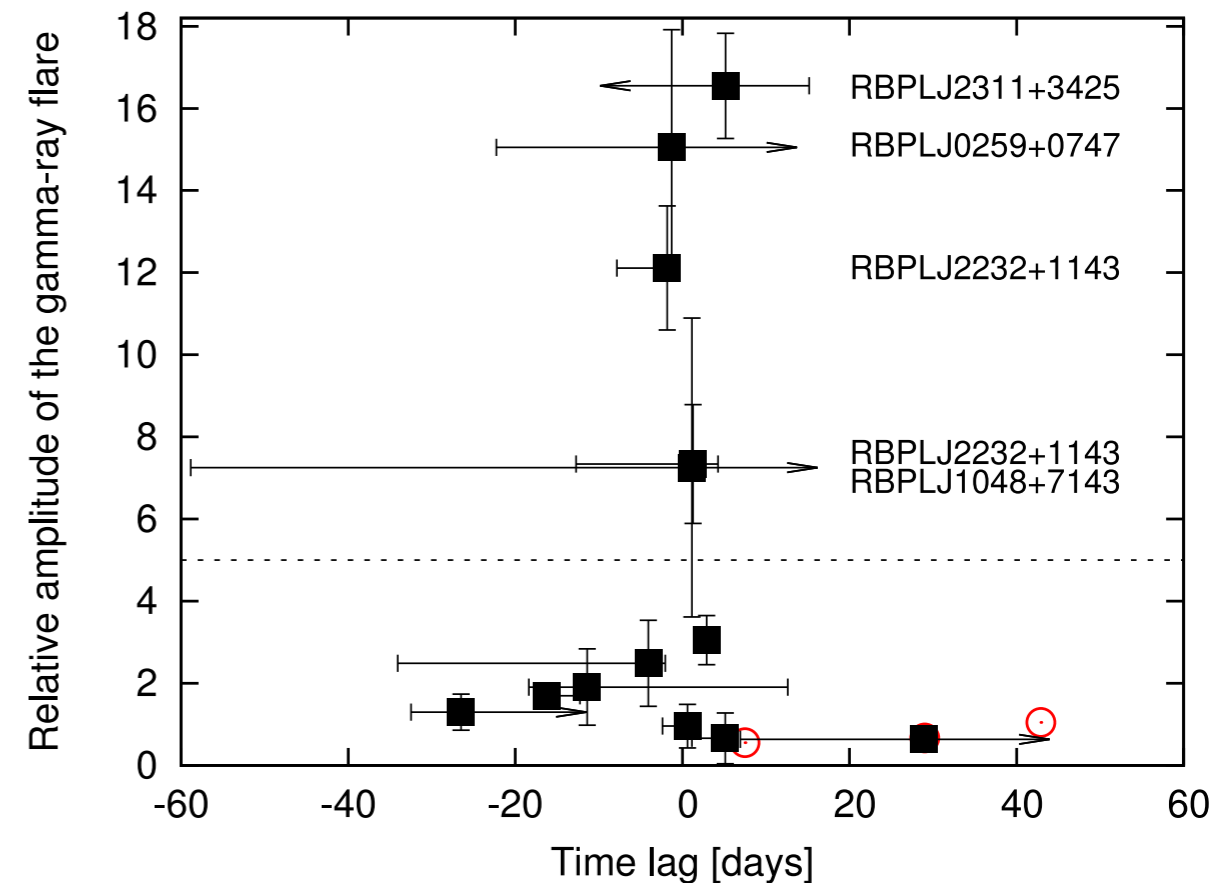
- ➔ all “rotators” are GL:
 - physical relation between γ -ray and optical polarization variability

- ➔ MC simulations: it is unlikely ($p \leq 1.5 \times 10^{-2}$), that all the rotations are due to a random walk process

EVPA rotations

Blinov et al. 2015, MNRAS.453.1669B; Blinov et al. in prep.

- data suggest:
 - ▶ the highest amplitude γ -ray flares are associated with smaller-than-average time lags
- two physical mechanisms:
 - ▶ one results higher amplitude flares and EVPA rotations
 - ▶ the other may be RW processes producing smaller amplitude flares, not related with rotations



thank you

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