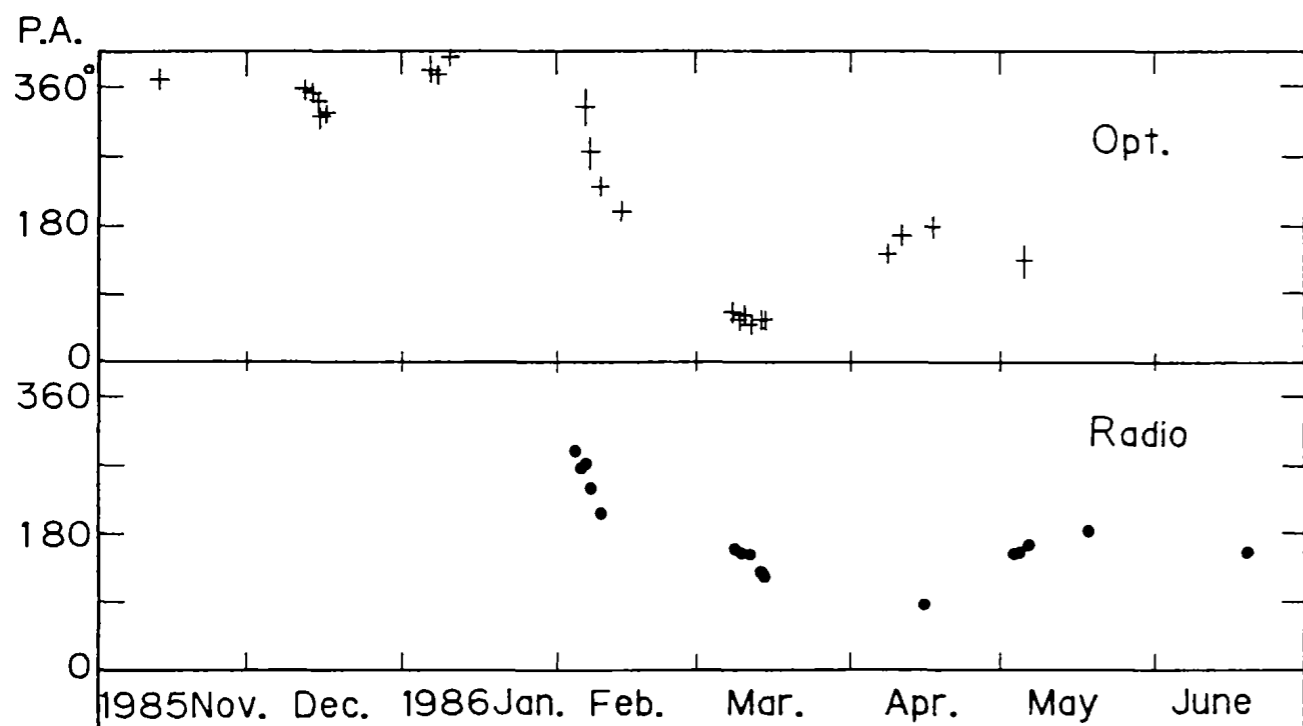
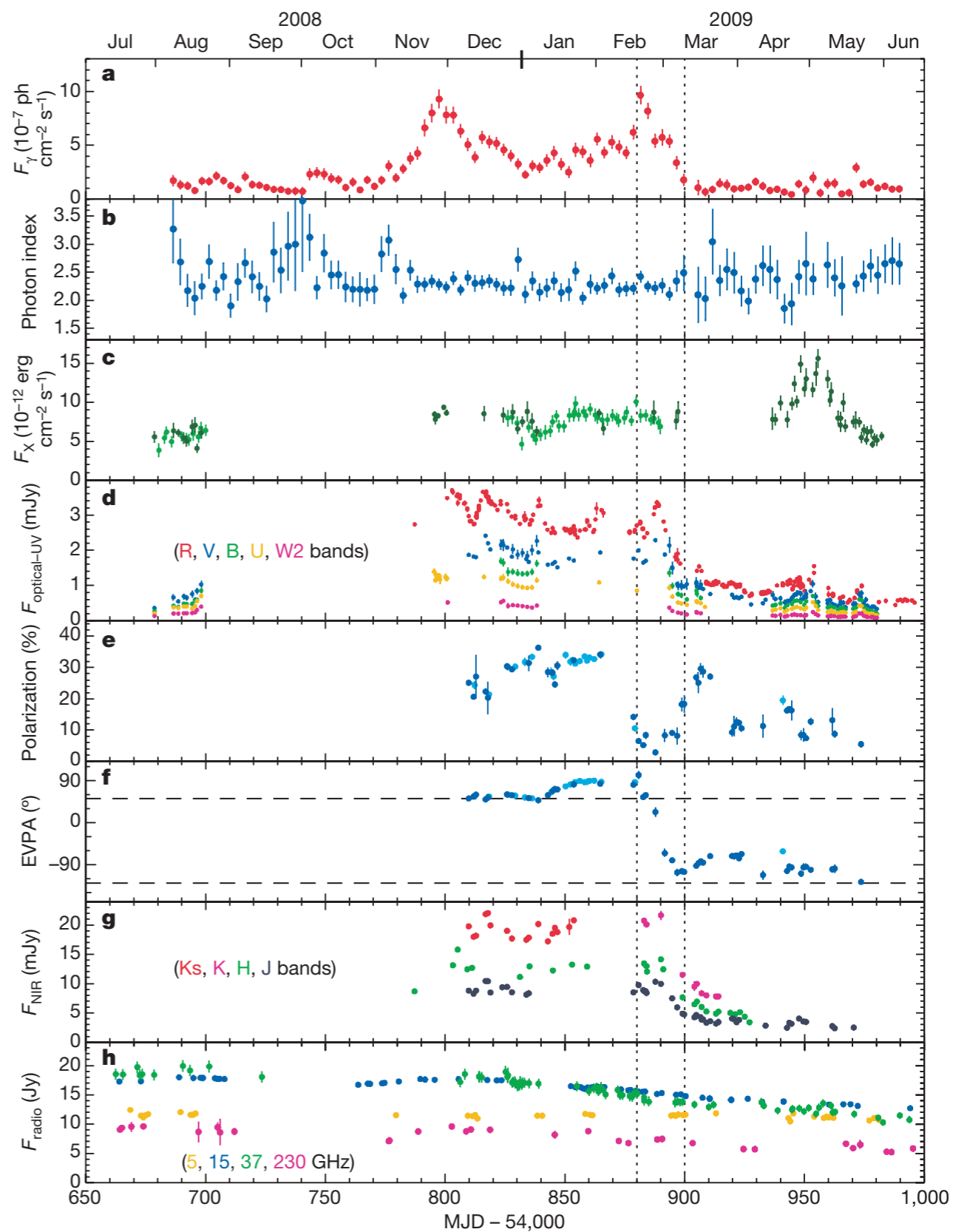


Marscher et al. 2008, Nature 452, 966



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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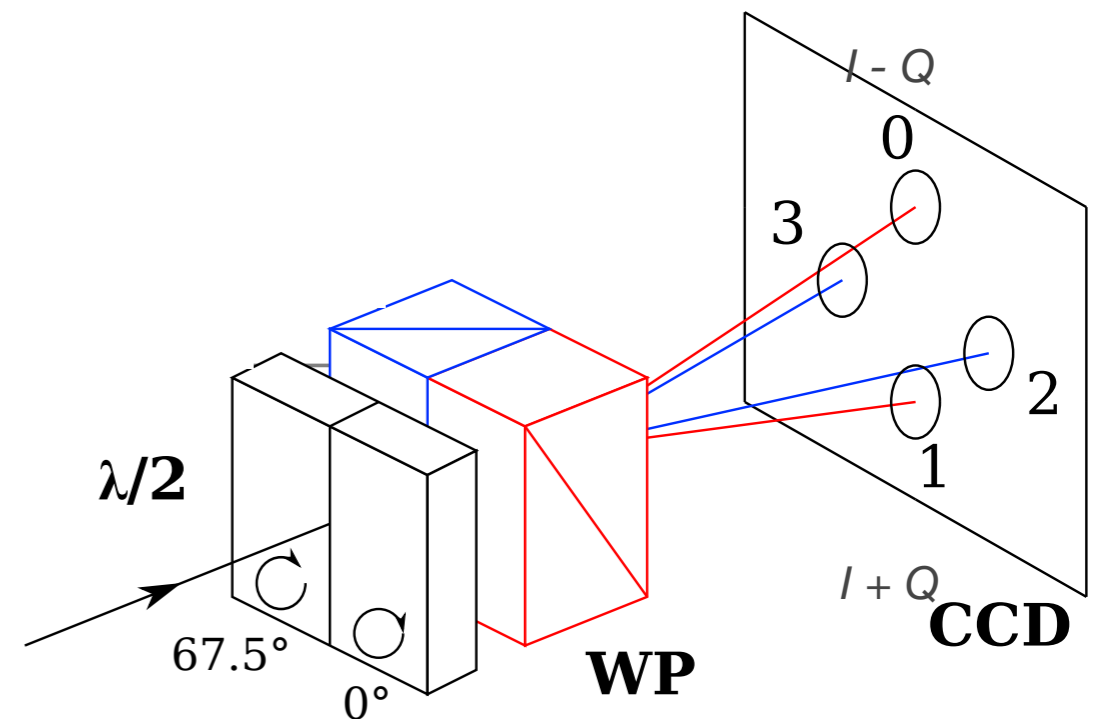
the RoboPol program

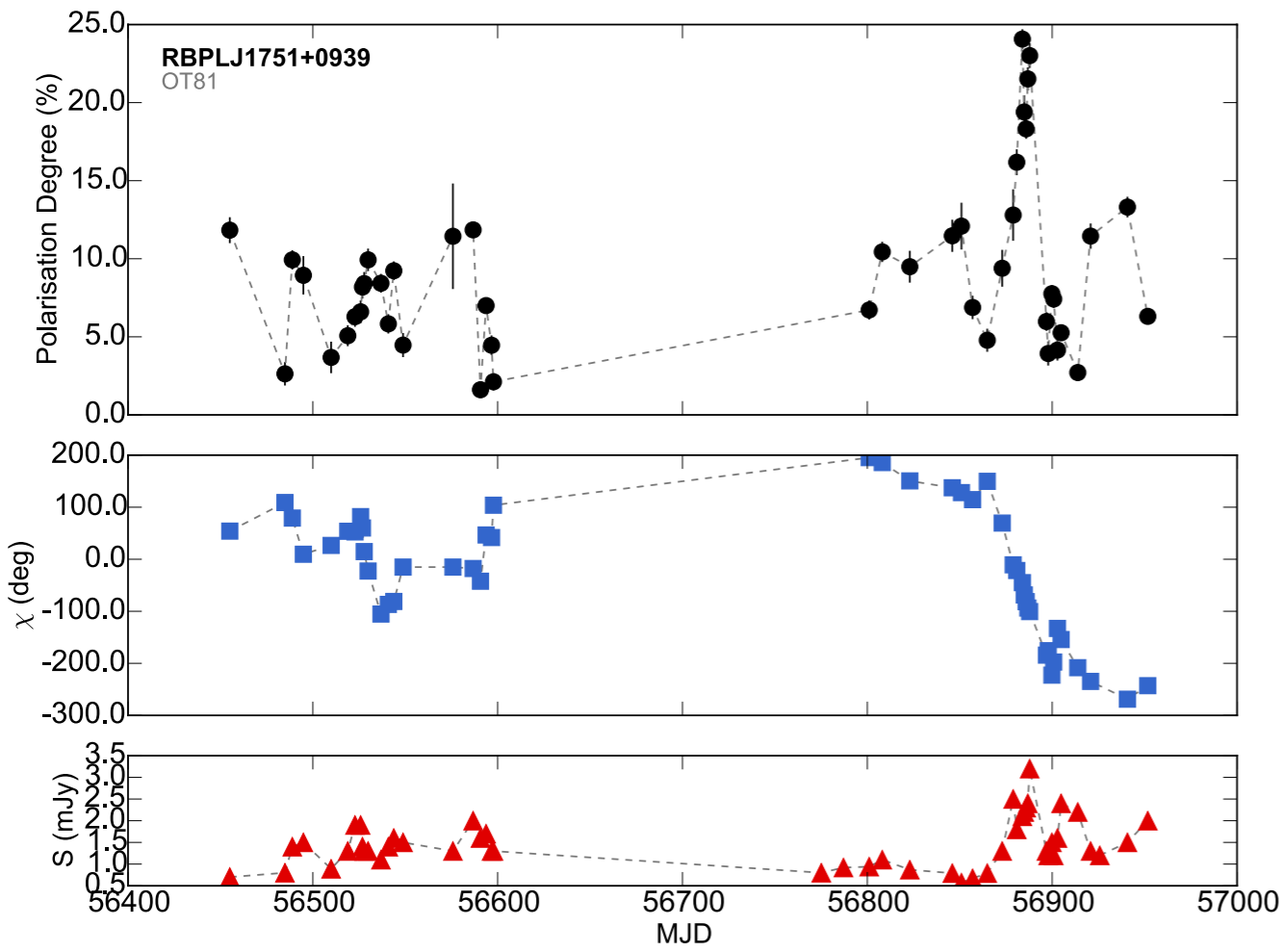
Pavlidou, EA et al. 2014, MNRAS, 442, 1693

- ➔ 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.



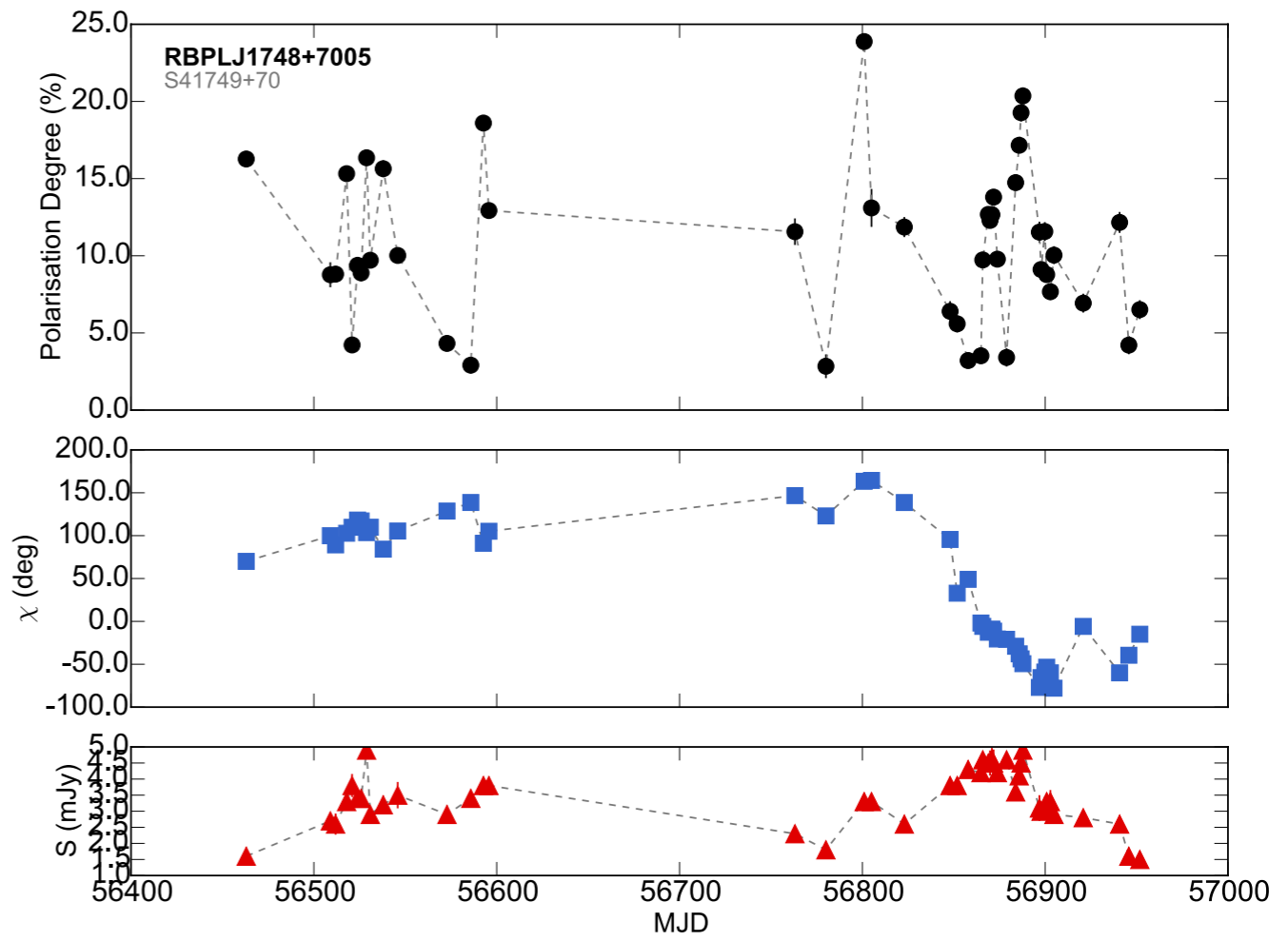
Caltech: M. Balokovic, A. Mahabal, T. J. Pearson, A. Readhead
Uni of Crete: D. Blinov, N. Kylafis, G. Panopoulou, I. Papadakis, I. Papamastorakis, V. Pavlidou, P. Reig, K. Tassis
MPIfR: E. Angelakis, I. Myserlis, J. A. Zensus
IUCAA: V. Joshi, S. Prabhudesai, A. Ramaprakash
Nicolaus Copernicus University: A. Kus - A. Marecki, E. Pazderski
Other: T. Hovatta, S. Kiehlmann, O. King





← season 2013 →

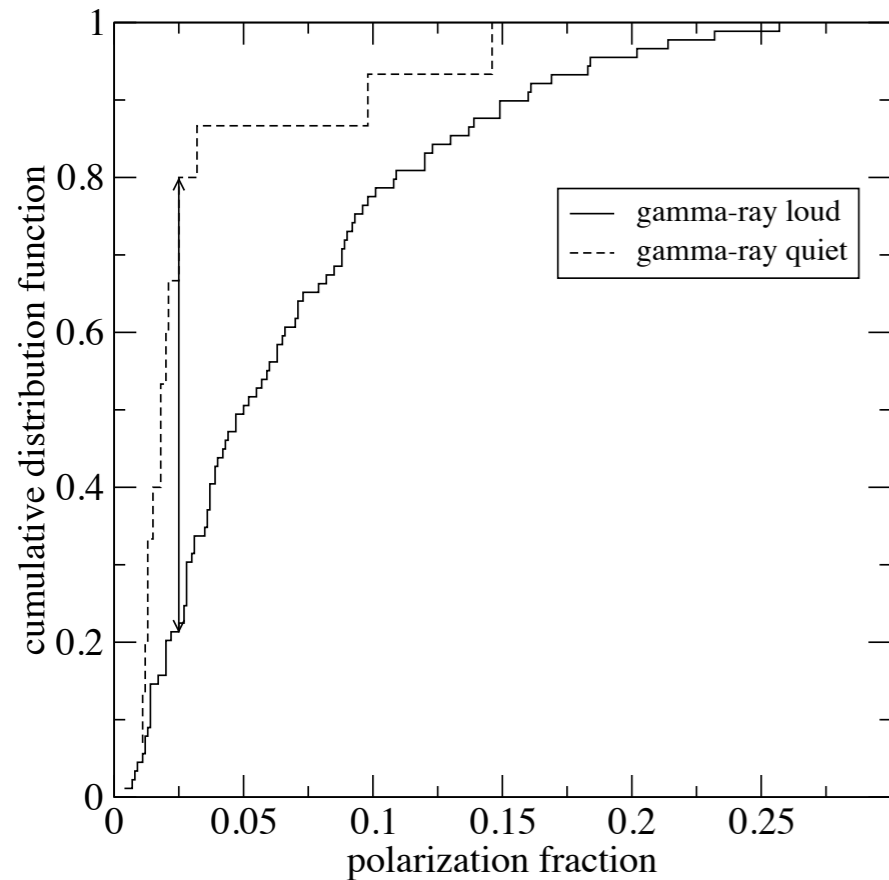
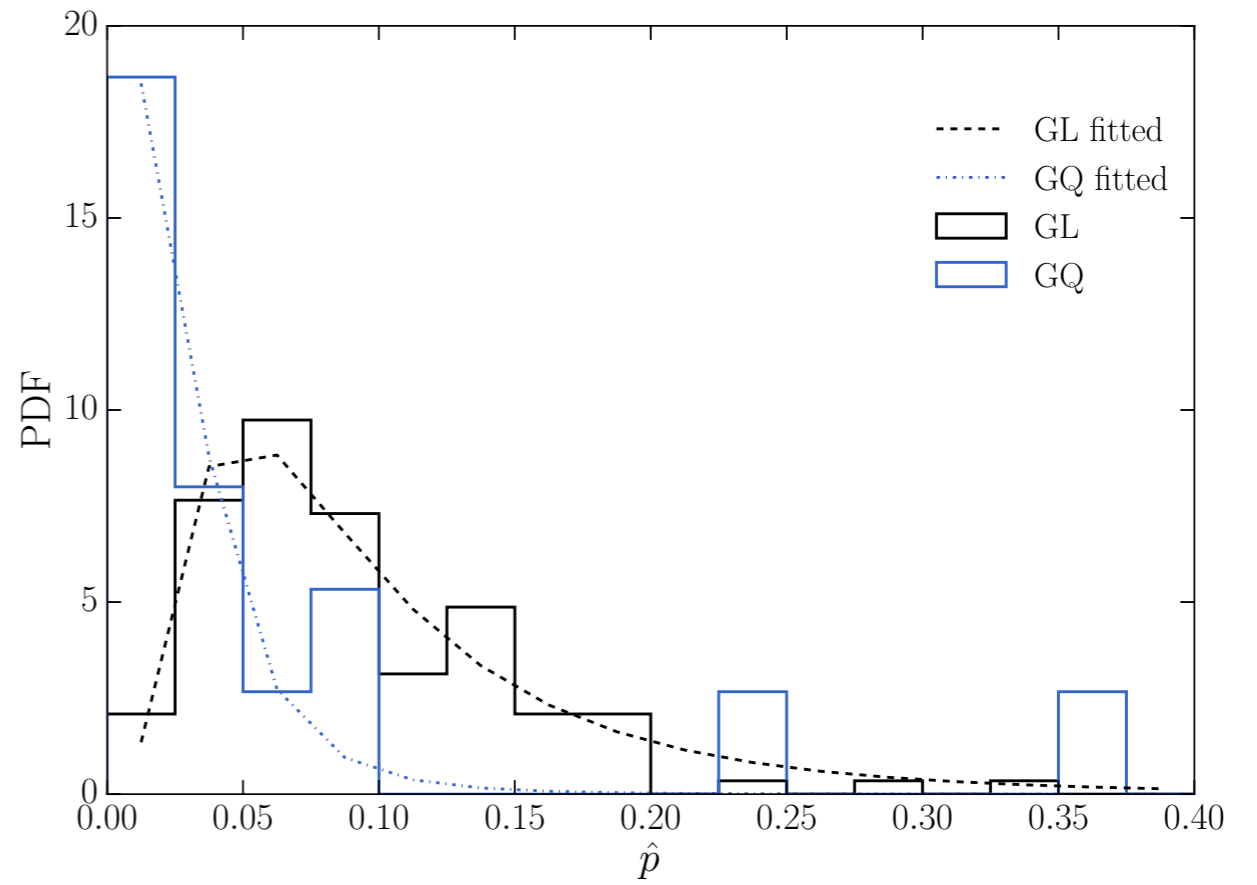
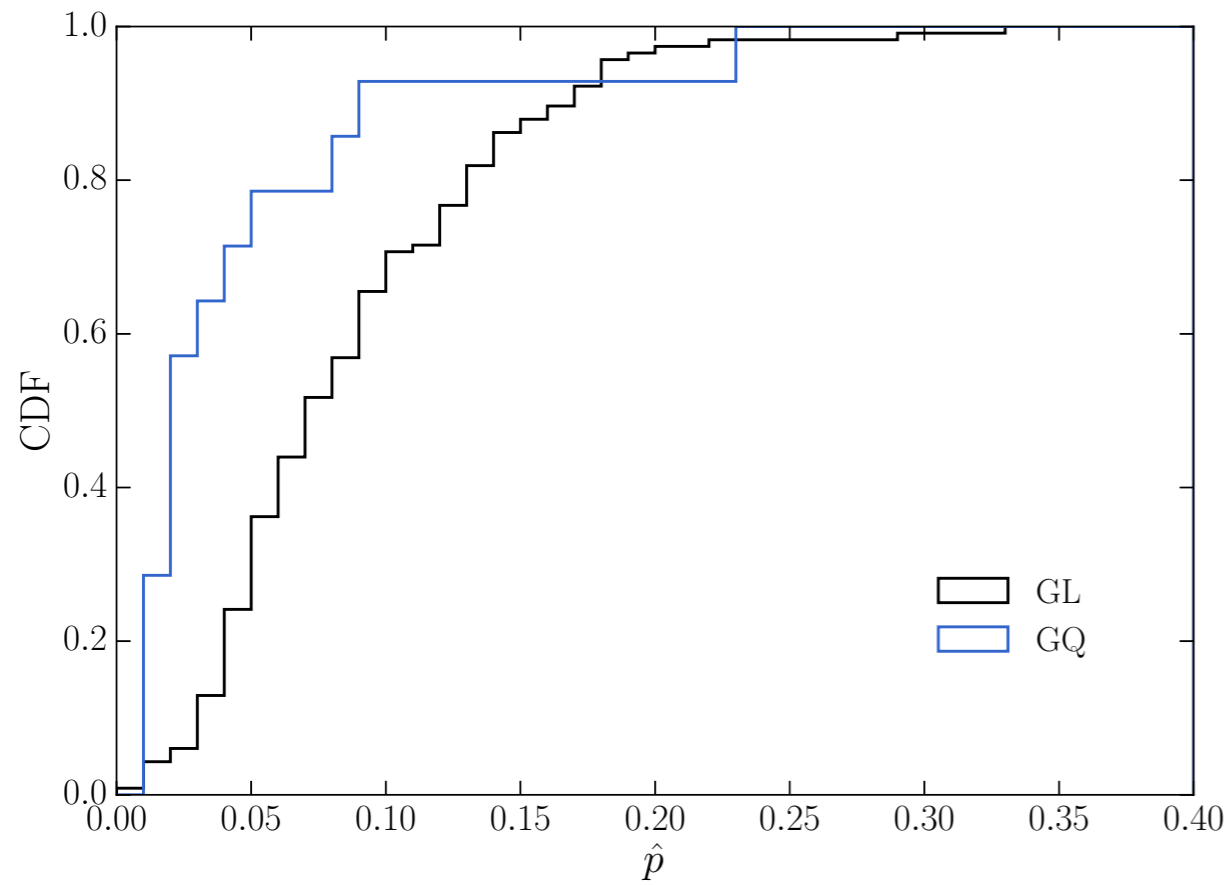
← season 2014 →



← 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

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

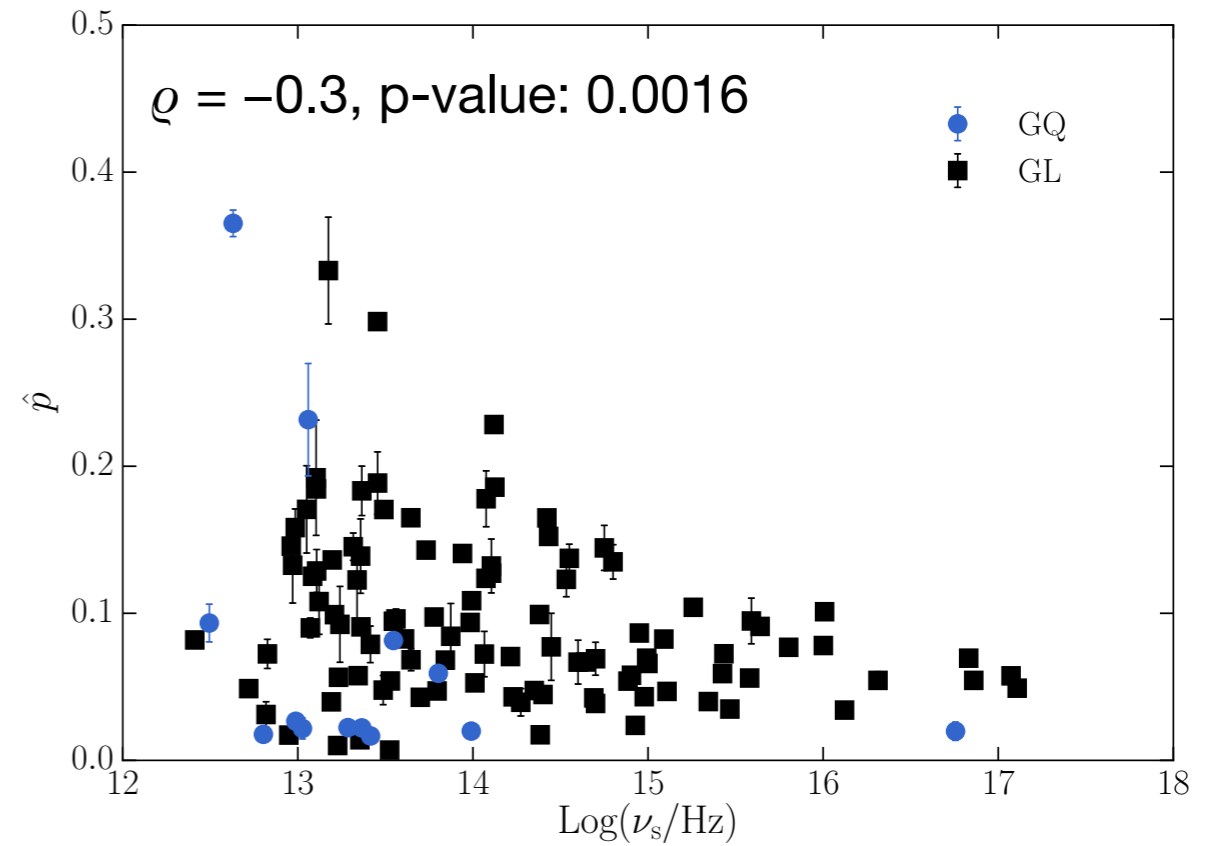
➔ GL: 0.105 (var: 0.0068)

➔ GQ: 0.035 (var: 0.0011)

the polarization of GL and GQ:

Angelakis et al. in prep.

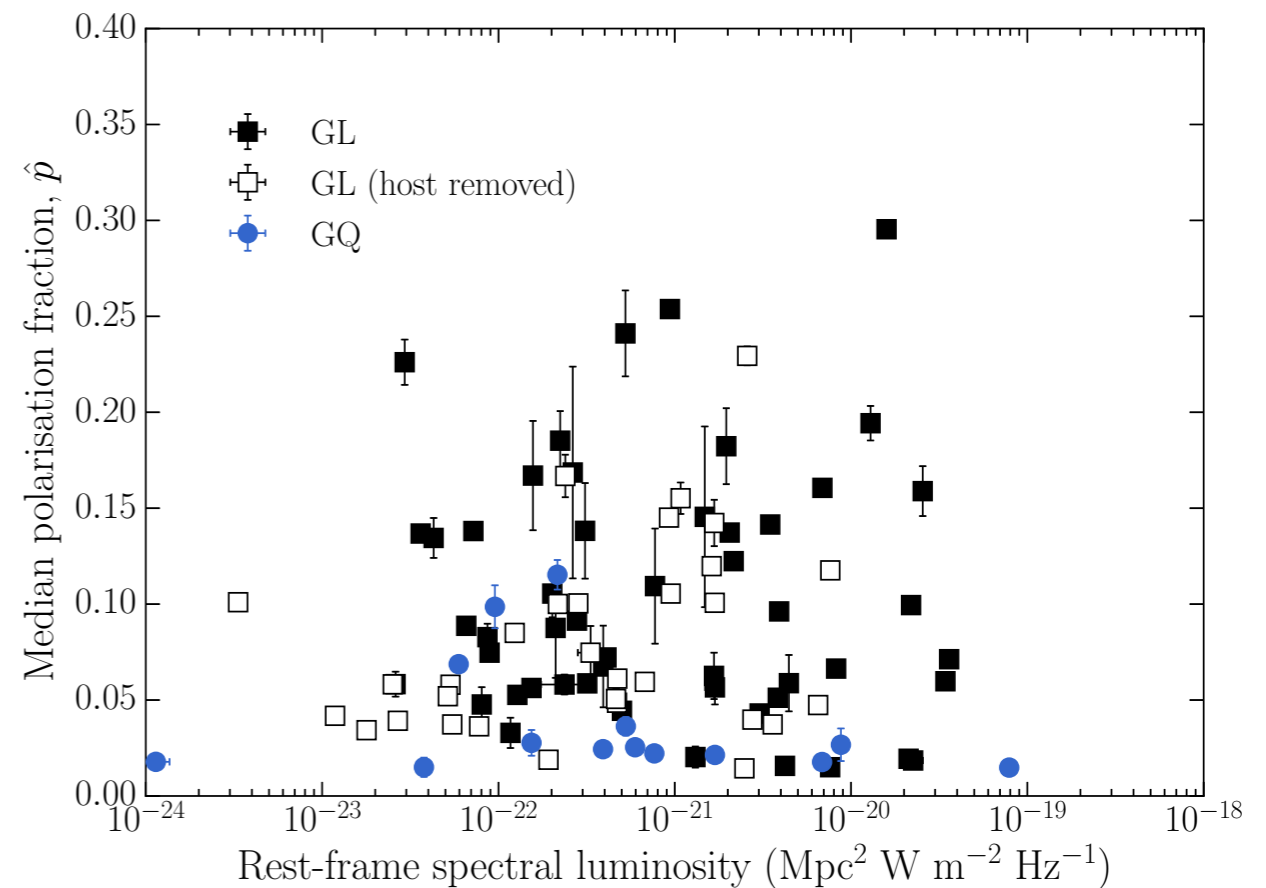
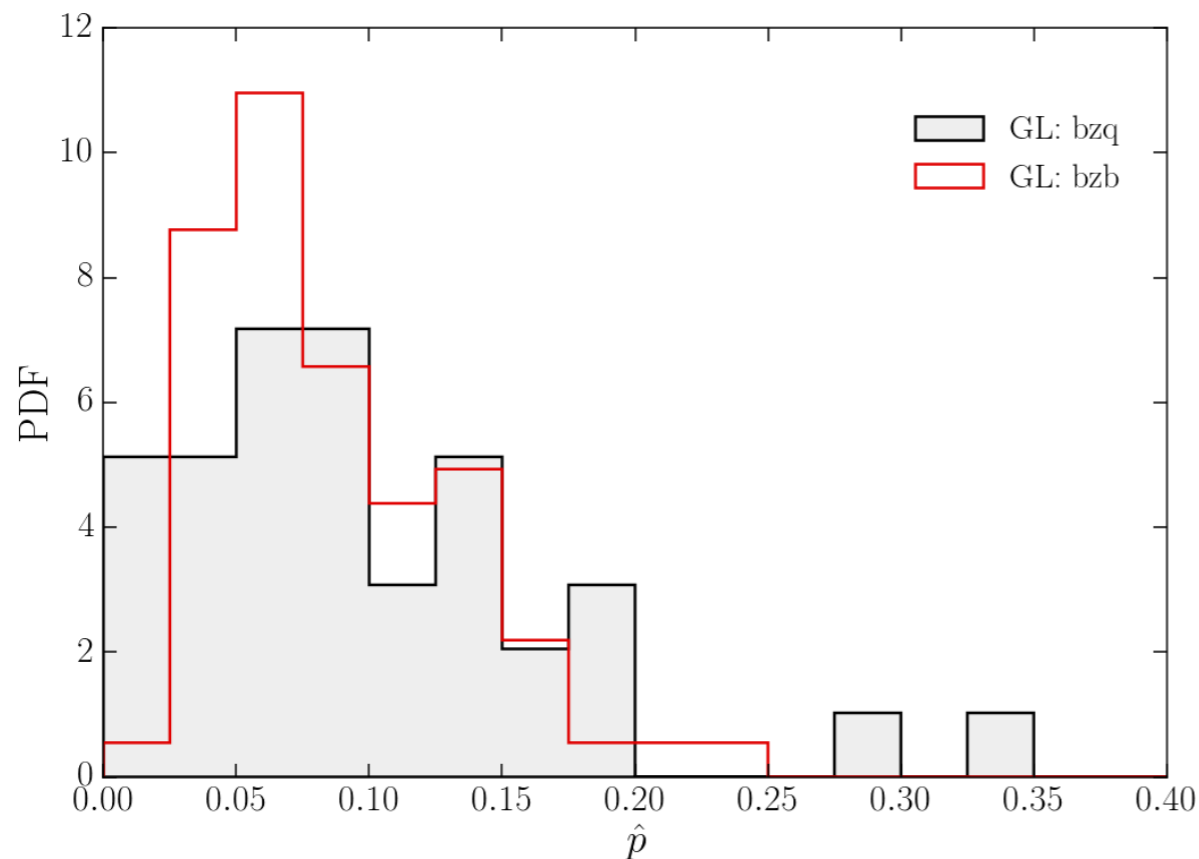
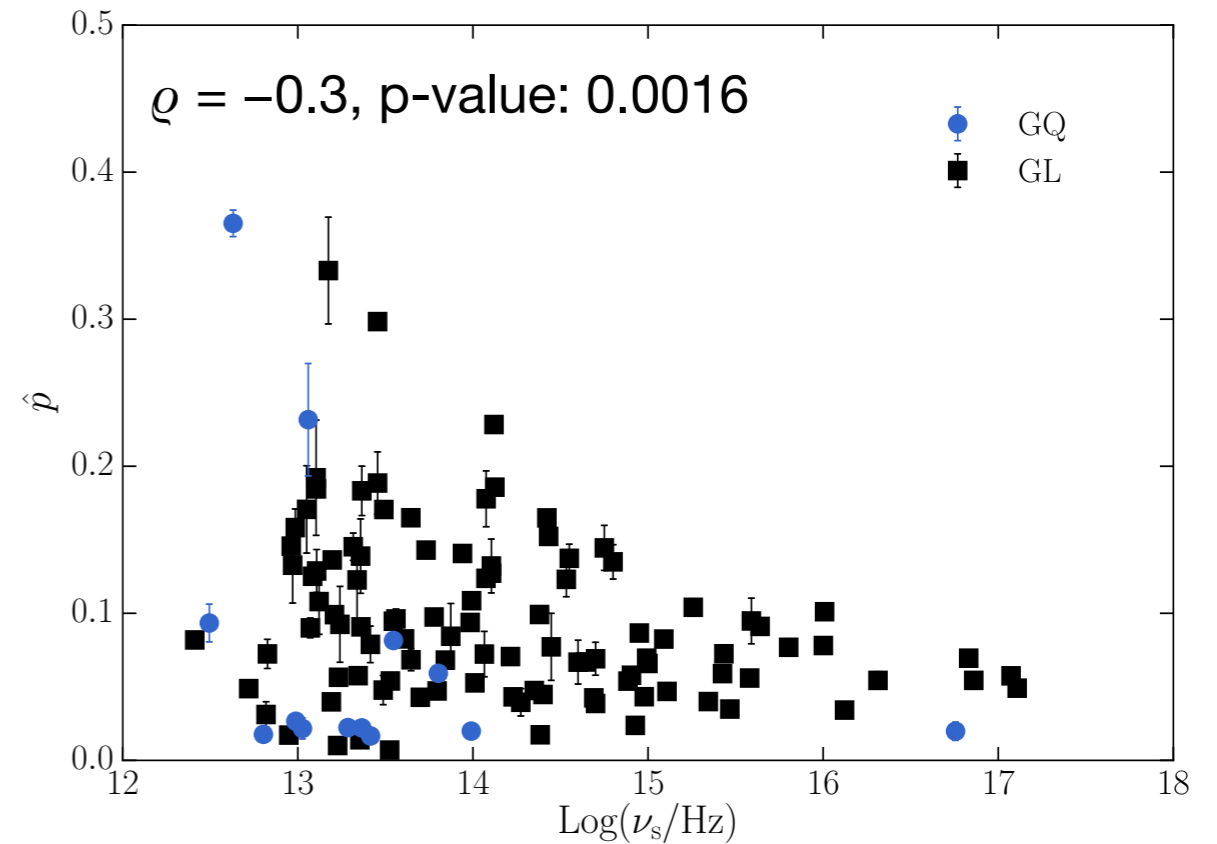
- GL more polarized than GQ:
 - ▶ uniformity of the field?
- function of the synchrotron peak



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

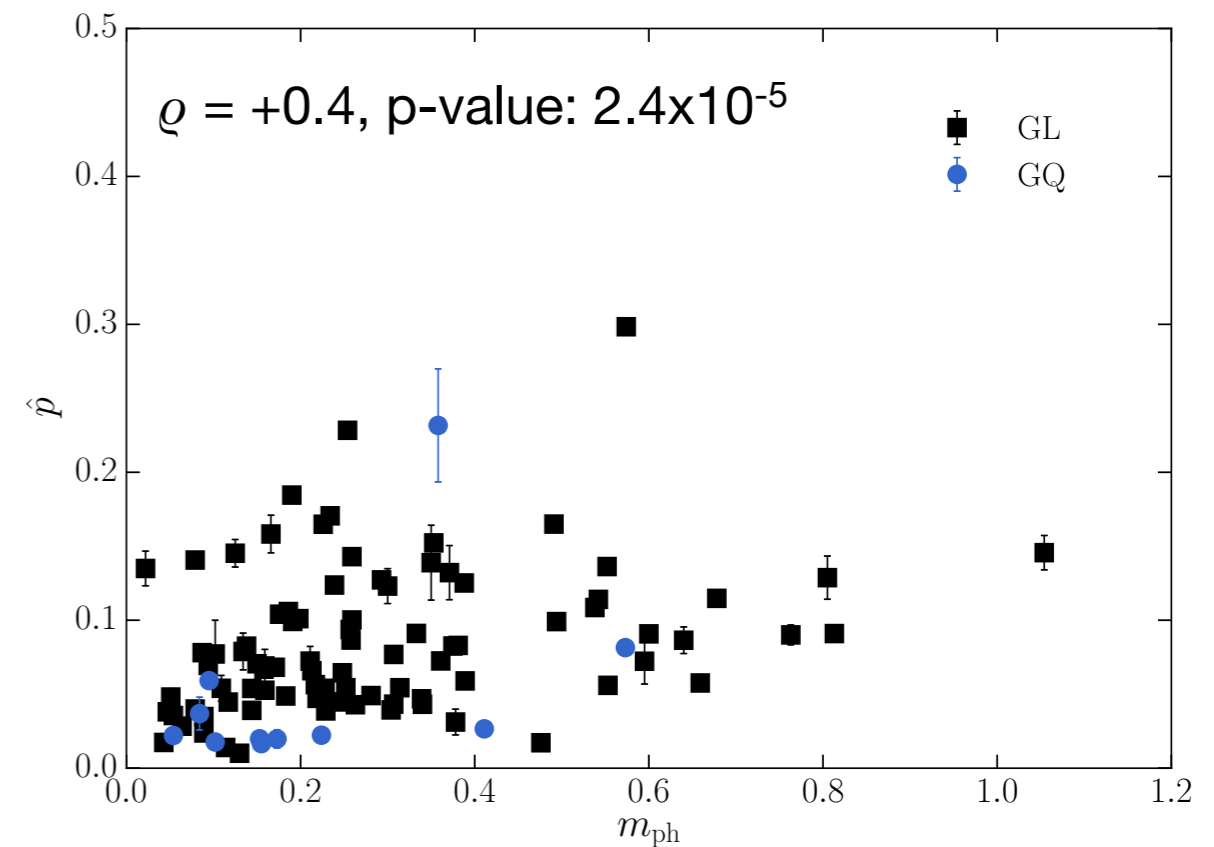
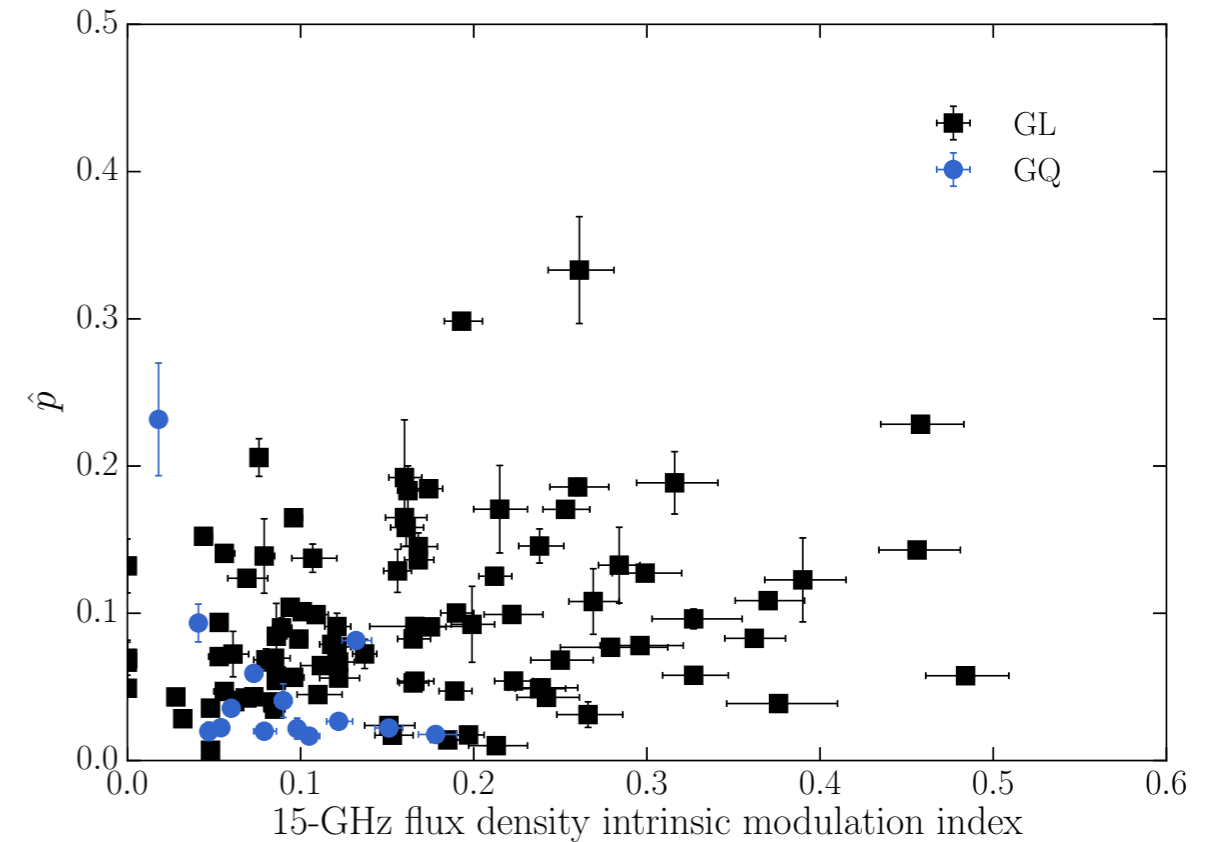


Angelakis et al. in prep.

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
- ➔ independent of the radio variability amplitude
- ➔ correlated with the optical variability amplitude

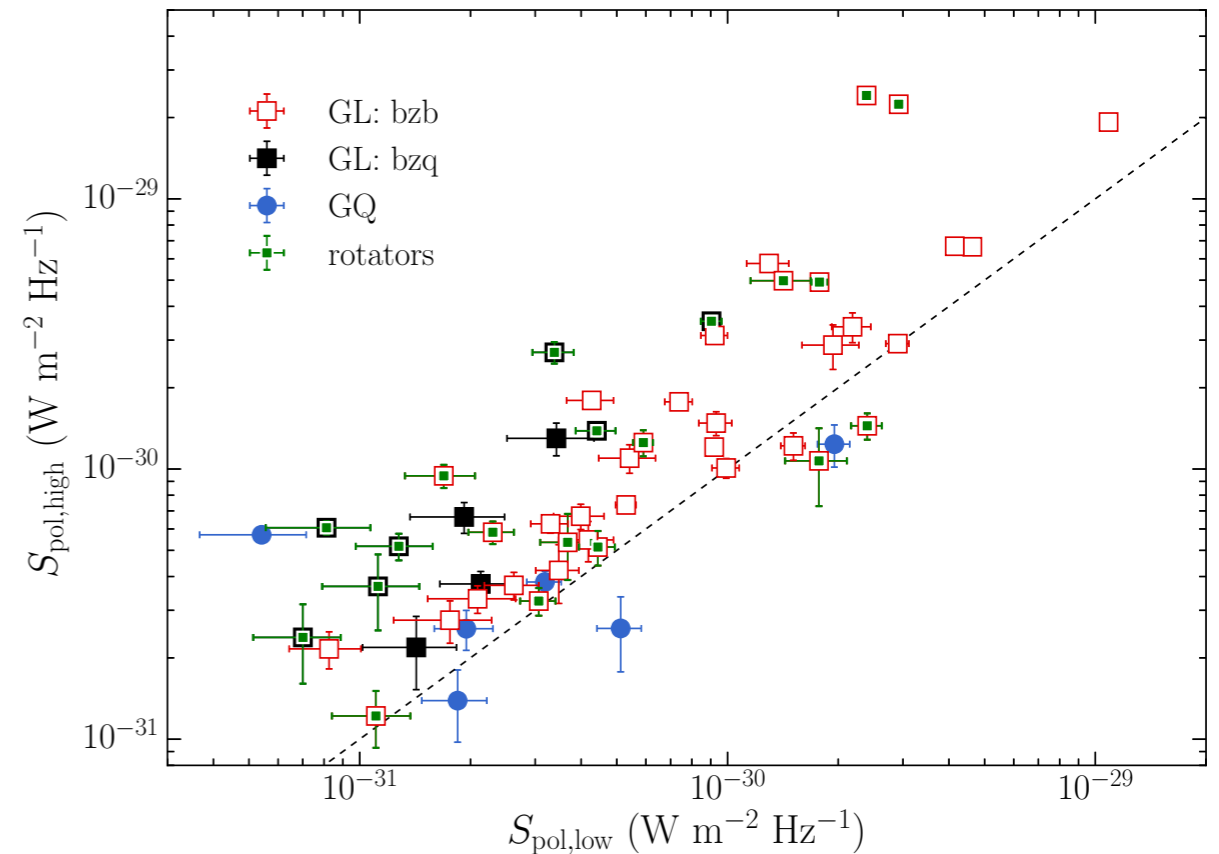


Angelakis et al. in prep.

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
- ➔ independent of the radio variability amplitude
- ➔ correlated with the optical variability amplitude
- ➔ **non-thermal events?**
- ➔ a mechanism that:
 - ▶ **moves the SED horizontally**
 - ▶ **increases the polarisation**



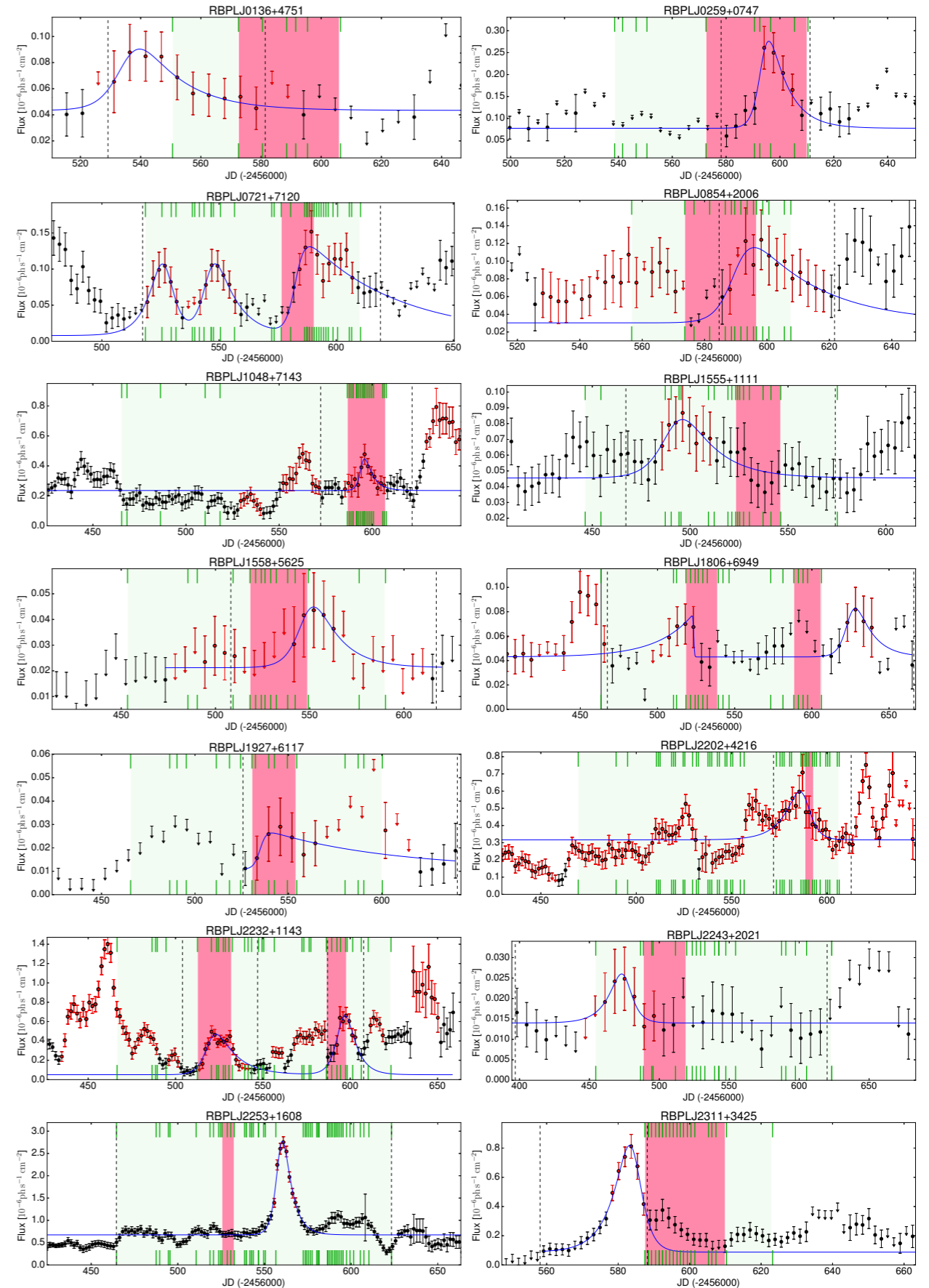
Angelakis et al. in prep.

EVPA rotations

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

→ detected 27 rotations:

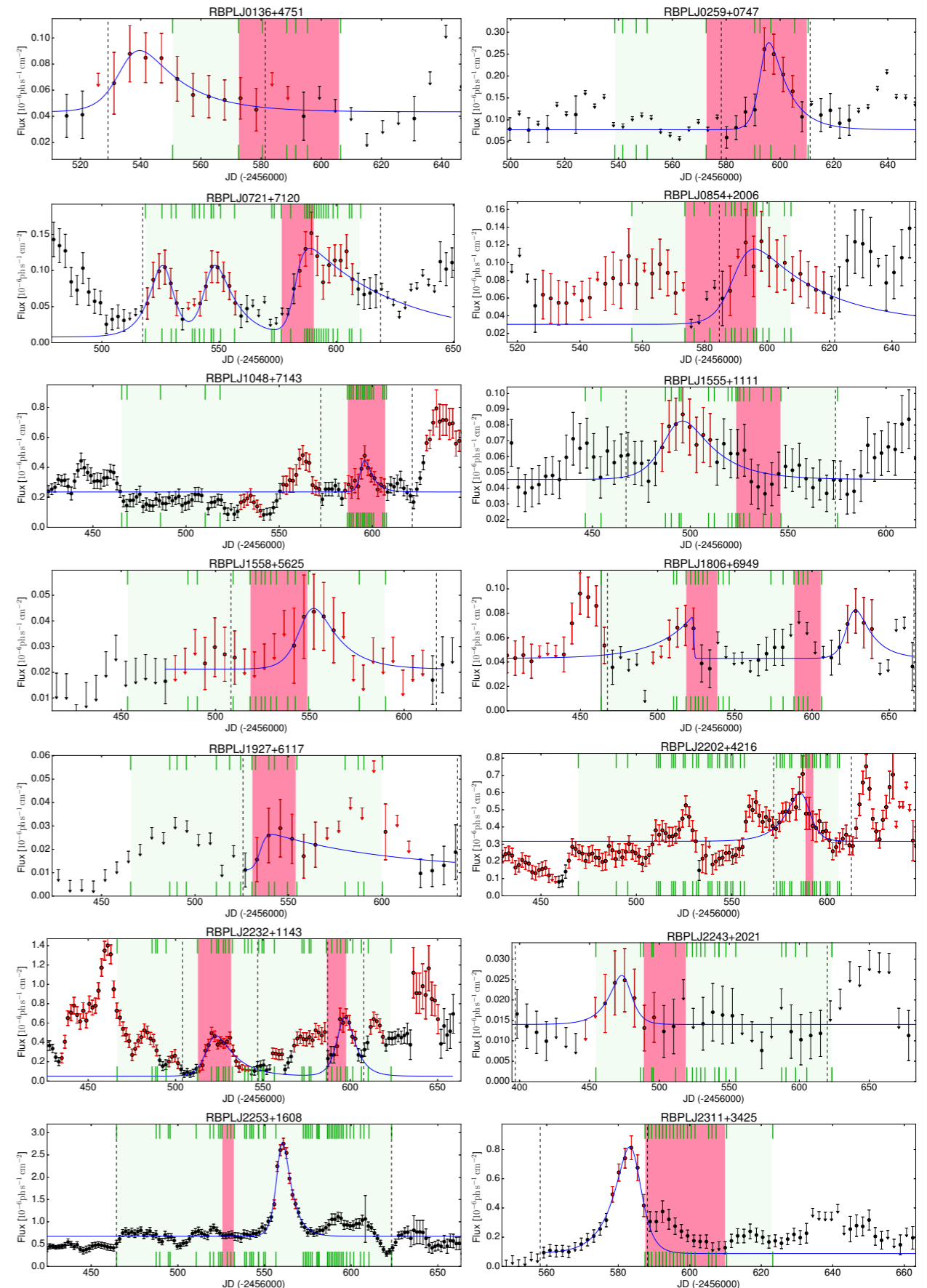
- ▶ 2013: 16 rotations in 13 blazars
Blinov et al. 2015, MNRAS.453.1669B
- ▶ 2014: 11 rotations in 10 blazars
Blinov et al. in prep.



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

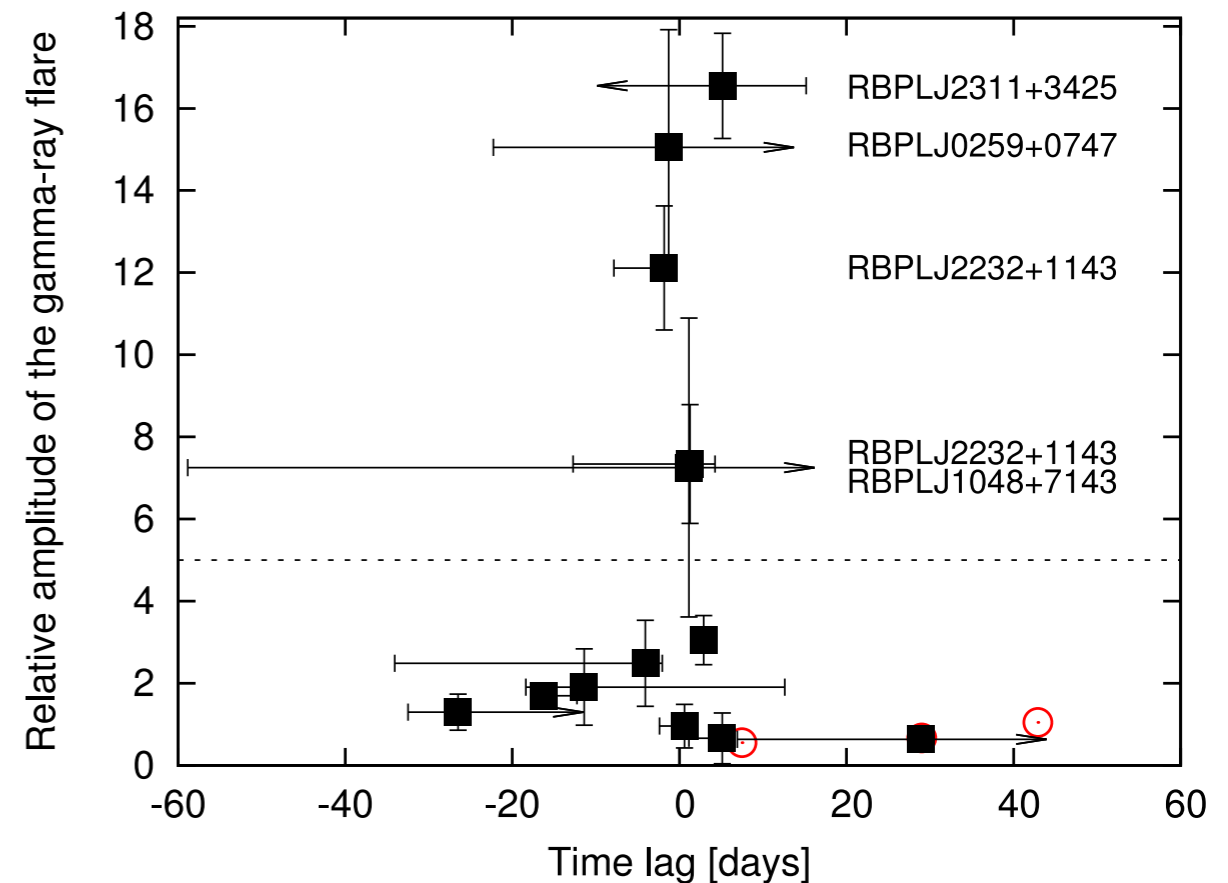
Blinov et al. 2015, MNRAS.453.1669B; Blinov et al. in prep.

- ➔ 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



summary:

- high cadence, high precision optical linear polarization monitoring
- GL sources significantly more polarised:
 - ▶ *B*-field uniformity
 - ▶ non-thermal variability dominance
- 27 rotations found in 2 seasons (16 before RoboPol)
 - ▶ not all rotations are associated with a HE outburst
 - ▶ all “rotators” are GL: physical connection with γ -ray activity
 - ▶ unlikely that all are due to a random walk
 - ▶ data suggest: the highest amplitude γ -ray flares are associated with smaller-than-average time lags

thank you

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