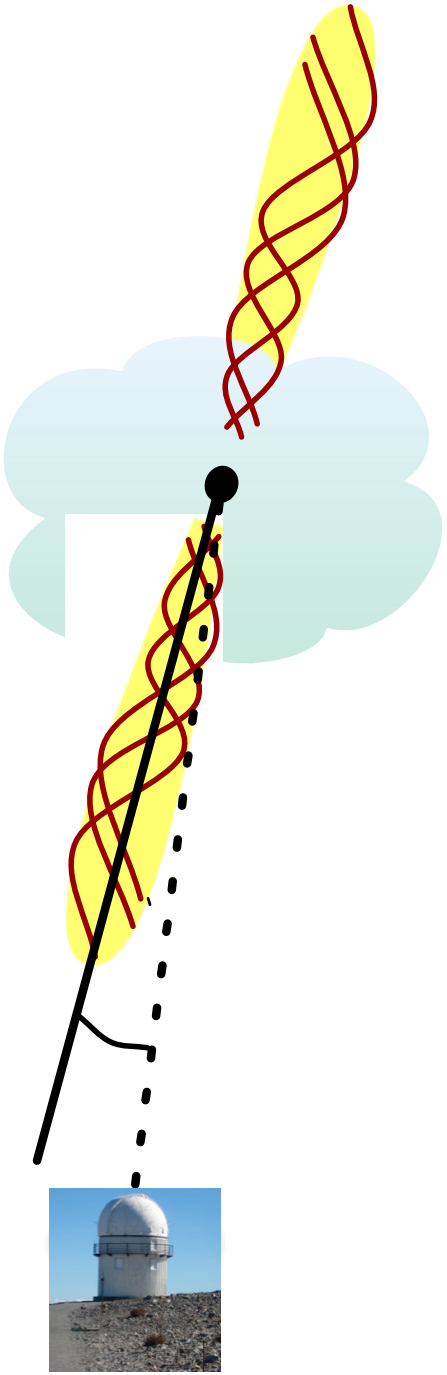

Optical Polarization of Blazars

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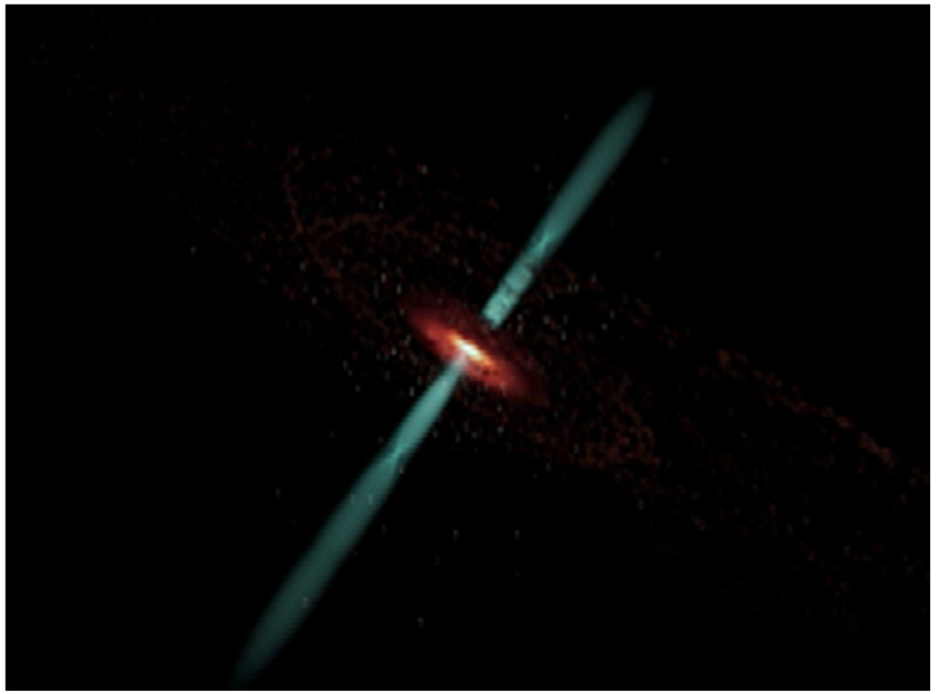
2 STSM visits to University of Crete

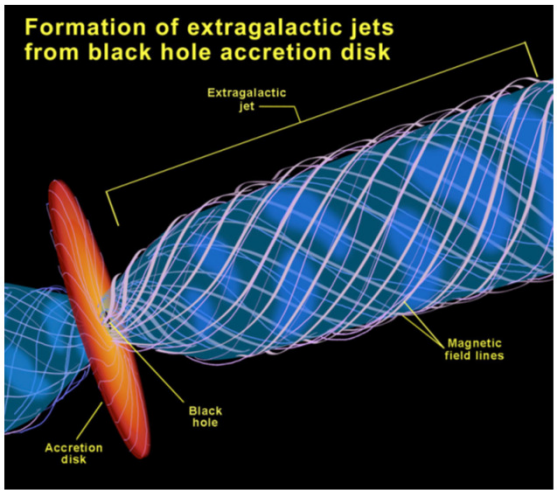
Aalto University

Blazars

- 10% of active galactic nuclei are radio loud with relativistic plasma jets
- Blazars when jet points to Earth
- Jets form through interaction of magnetic field and the black hole / accretion disk

Movie credit: Cosmovision

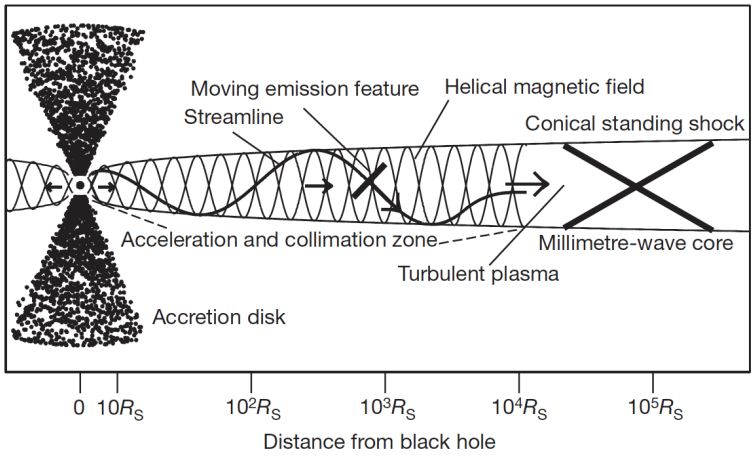




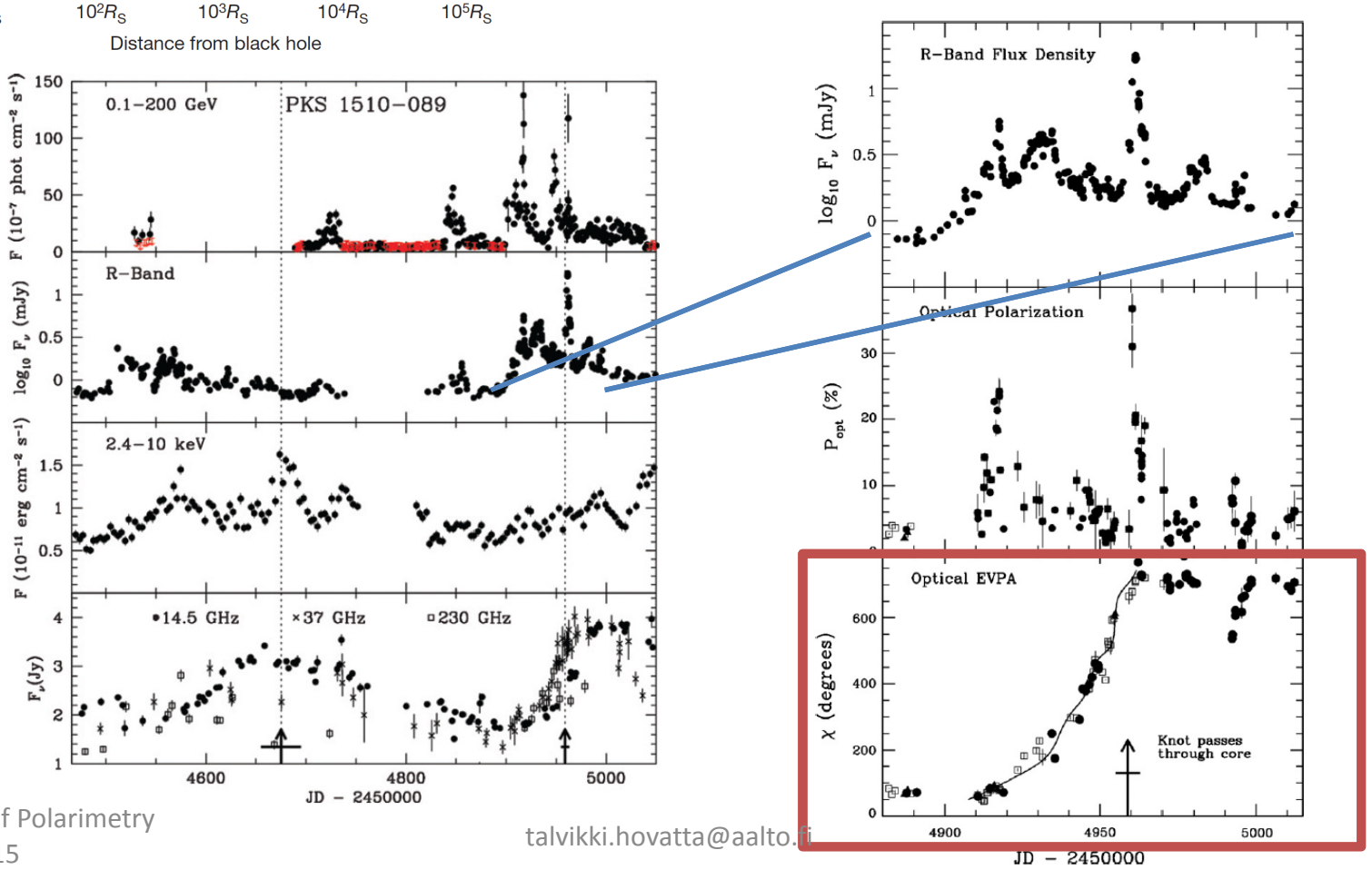
Credit: NASA and Ann Field (Space Telescope Science Institute)

- Variability in total intensity and polarization when emission regions move down the jet

Optical polarization signatures

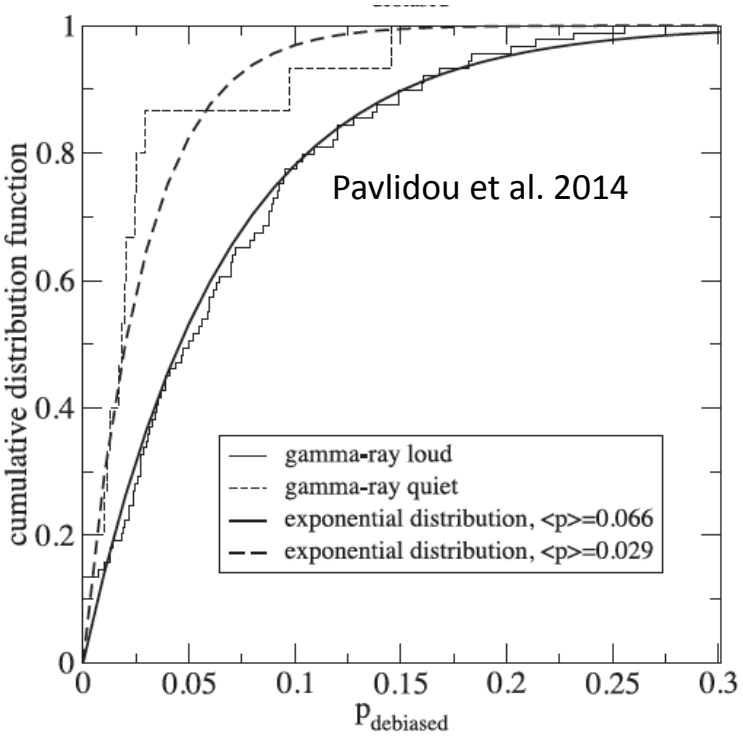


Marscher et al. 2008, 2010



RoboPol Blazar monitoring

- Are all rotations connected to γ-ray flares?
- Statistical sample
  - 62 γ-ray loud blazars (2FGL) with R-band magnitude > 17.5^{m}
  - Control sample of 15 γ-ray quiet sources (CGRaBS)
  - 24 additional interesting objects
- 4 nights / week observing time at Skinakas (3 years in total)

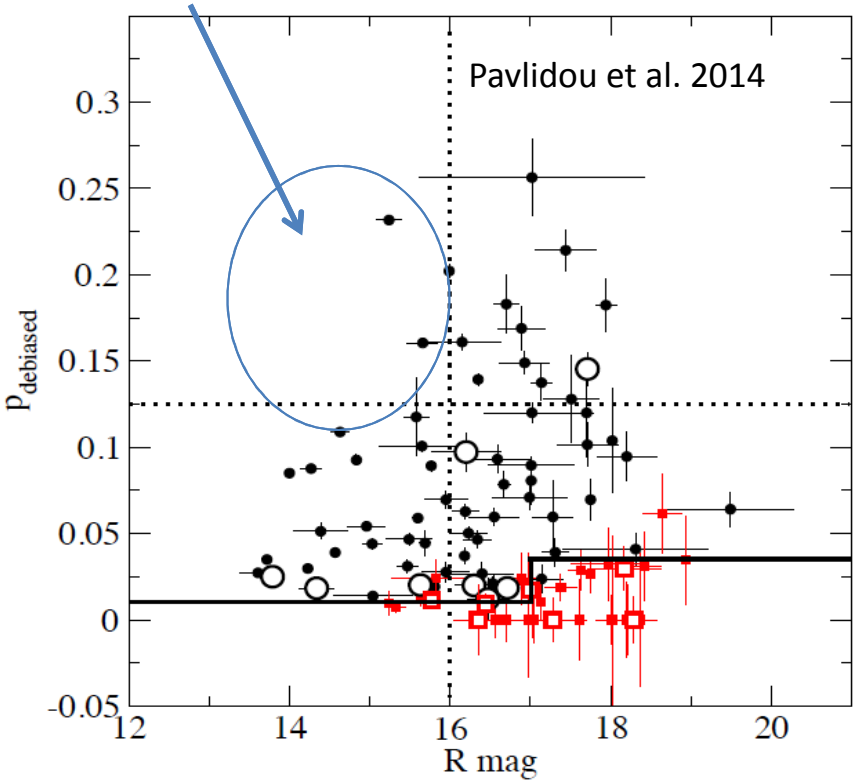


γ-ray loud mean p = 6.4%
γ-ray quiet mean p = 3.2%

Host galaxy contribution?

COST STSM: Optical polarization of blazars and the effect of host galaxy dilution

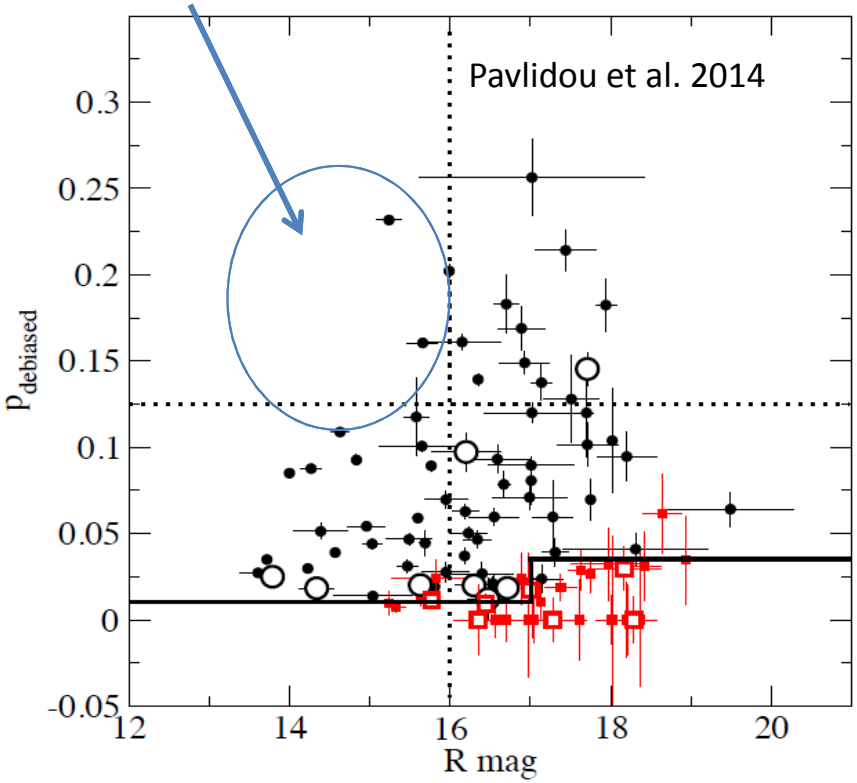
Deficit of sources?



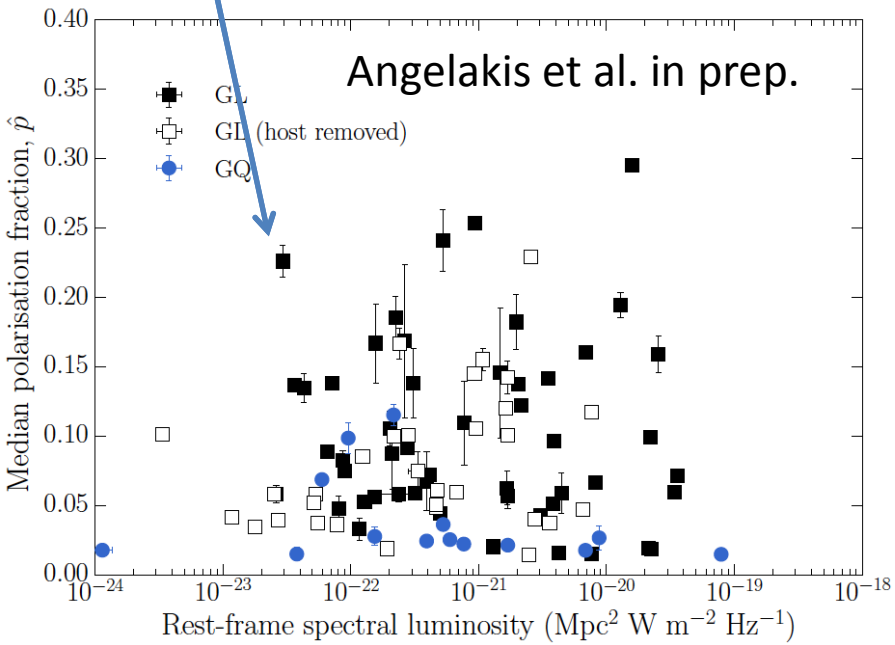
Host galaxy contribution?

COST STSM: Optical polarization of blazars and the effect of host galaxy dilution

Deficit of sources?



No deficit



Variability plays a larger role!

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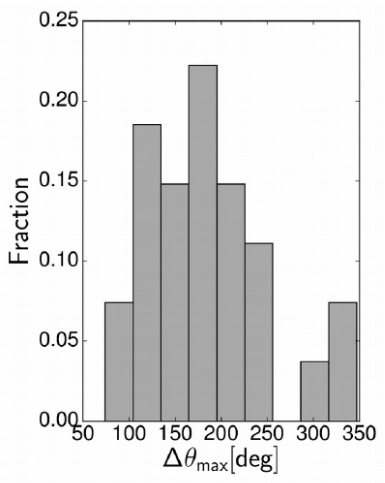
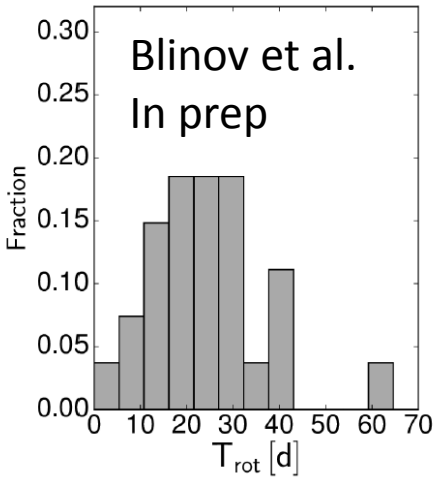
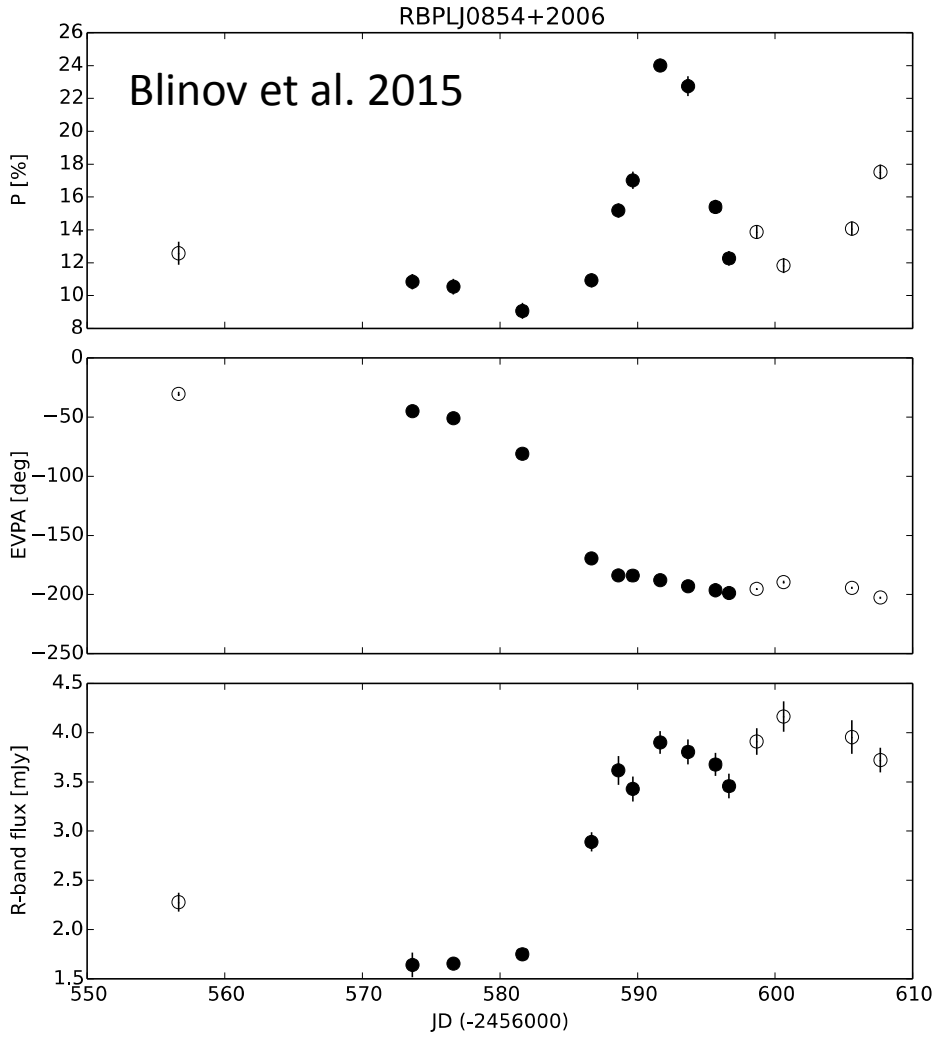
EVPA rotations

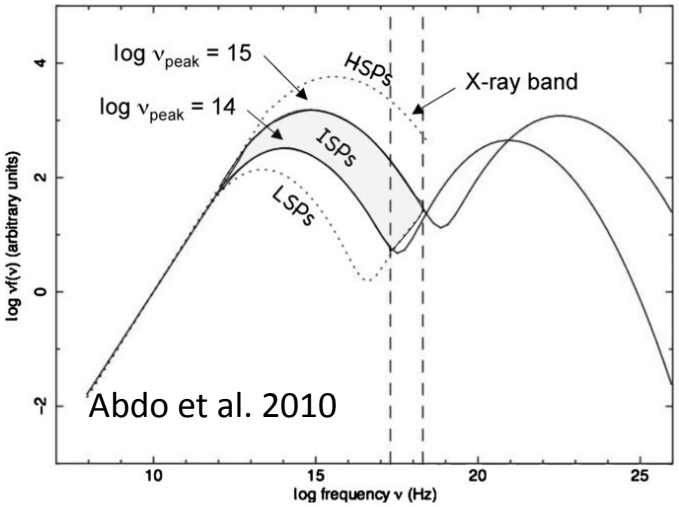
- Prior to RoboPol 16 EVPA rotations in 10 blazars were known
- RoboPol added 27 new rotations in 2 seasons
- All rotations in γ-ray loud sources



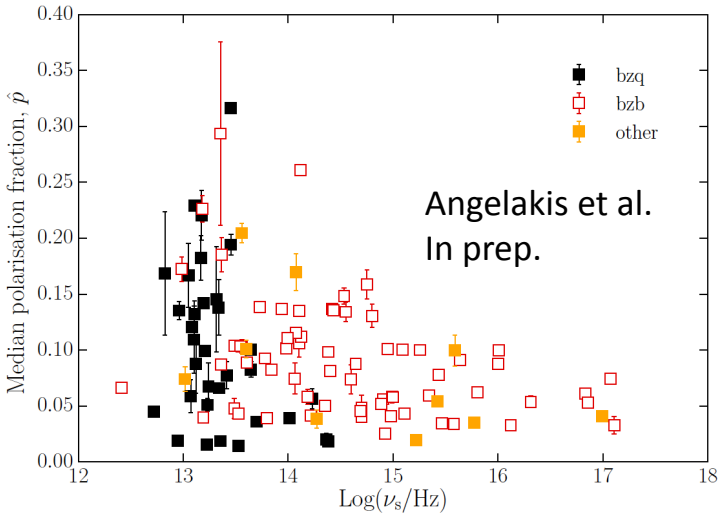


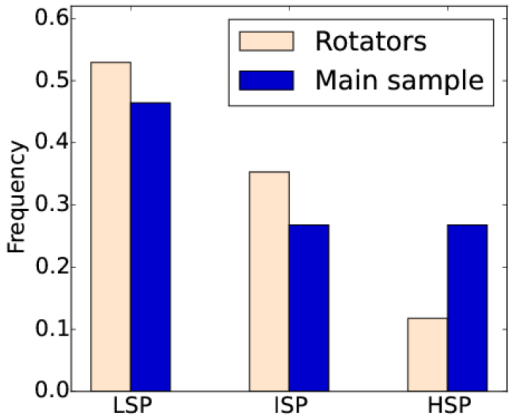


Blazar sub-populations



- Blazars can be classified based on their spectral energy distributions (SED)
  - Polarization higher in low synchrotron peak (LSP) sources
  - Rotations more common in LSP sources





Blinov et al.
In prep.

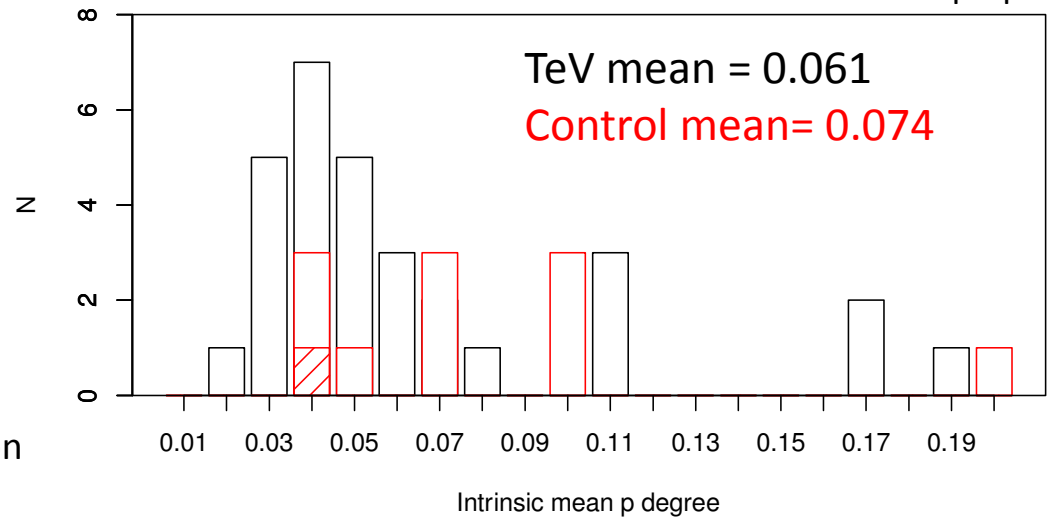
TeV Blazars

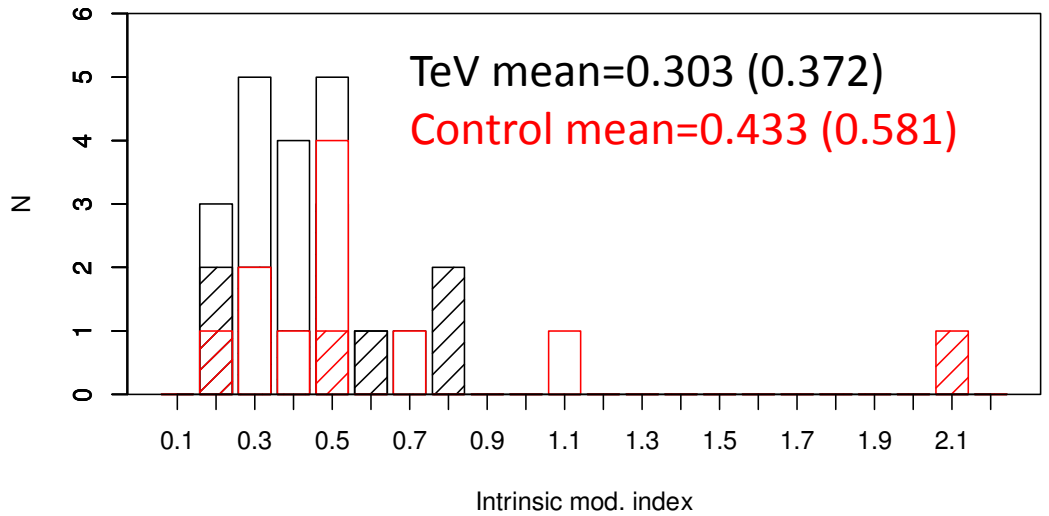
COST STSM: Polarization monitoring of TeV blazars

- In 2003 only 6 blazars had been detected at > 100 GeV energies
- Now the number has increased to > 50 http://tevcat.uchicago.edu/
  - Most of these are classified as high-spectral peaking (HSP) objects based on their SED
- For the first time it is possible to do population studies!
- Research question:

  Are there differences in the optical polarization properties of TeV-detected and non-detected (=control) sources?

Hovatta et al. in prep.





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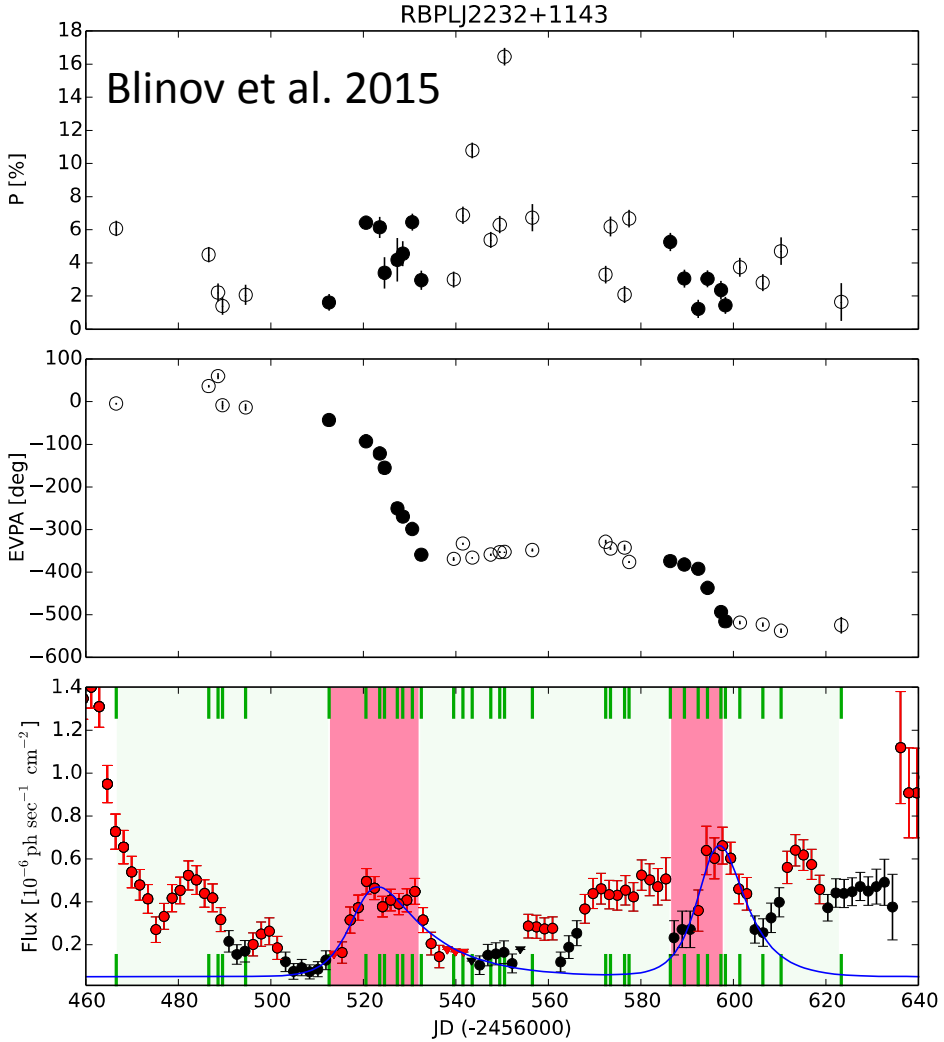
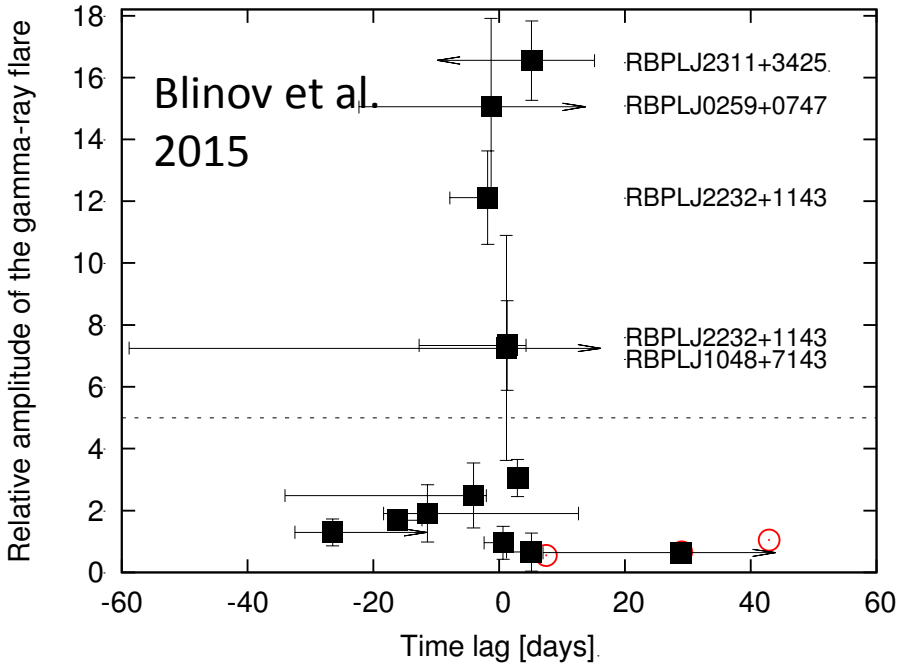
Summary

- RoboPol monitors a sample of about 100 blazars in high cadence
- There is a connection between optical polarization and γ-ray emission in blazars
  - γ- ray loud objects have higher polarization
- RoboPol has tripled the number of EVPA rotations
  - All EVPA rotations are seen in γ-ray loud objects
  - All types of blazars show rotations but low-synchrotron peak objects have higher tendency
- Optical polarization does not seem to be connected to TeV emission
  - Needs to be verified with simultaneous data

Gamma-ray connection





2 types of rotations?