The blazar CTA 102 behaviour during two giant outbursts

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- **The importance of monitoring projects in blazar studies was clear from the very discovery due to their violent variability on all time scales, from hours and even minutes to years.**

- **The outbursts that may occur unexpectedly for any given source act like a magnifying glass that allow to penetrate deeper in most conspicous regions of inner jet.**

- **Numerous successful campaigns were carried out that lead to systematic accumulation of observational data, either inside one observatory or as large international collaborations.**

Exceptional outburst of the blazar CTA 102 in 2012: The GASP-WEBT campaign and its extension. *

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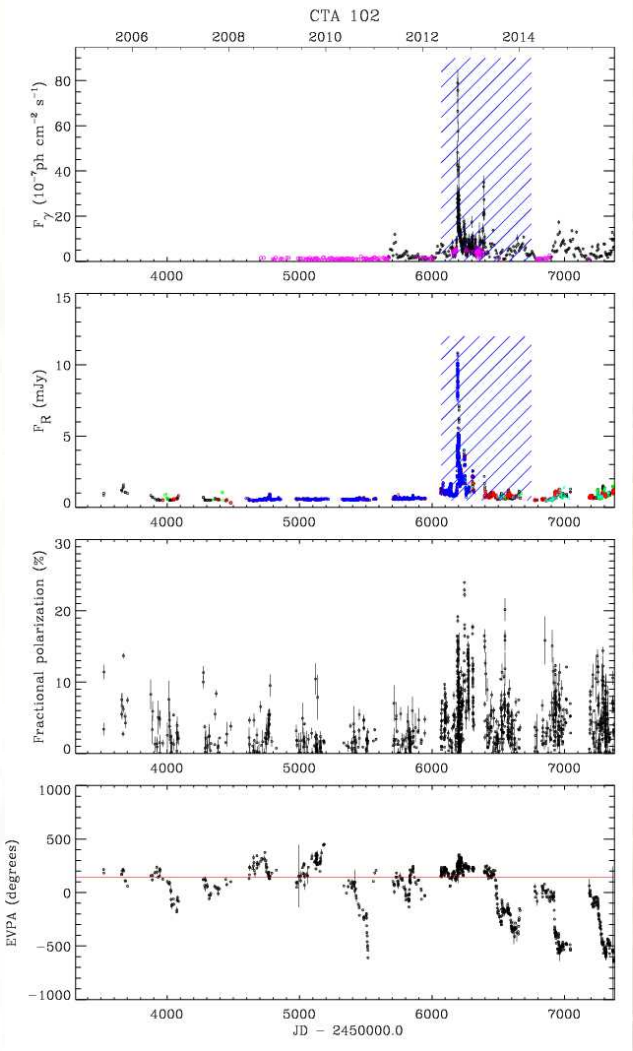
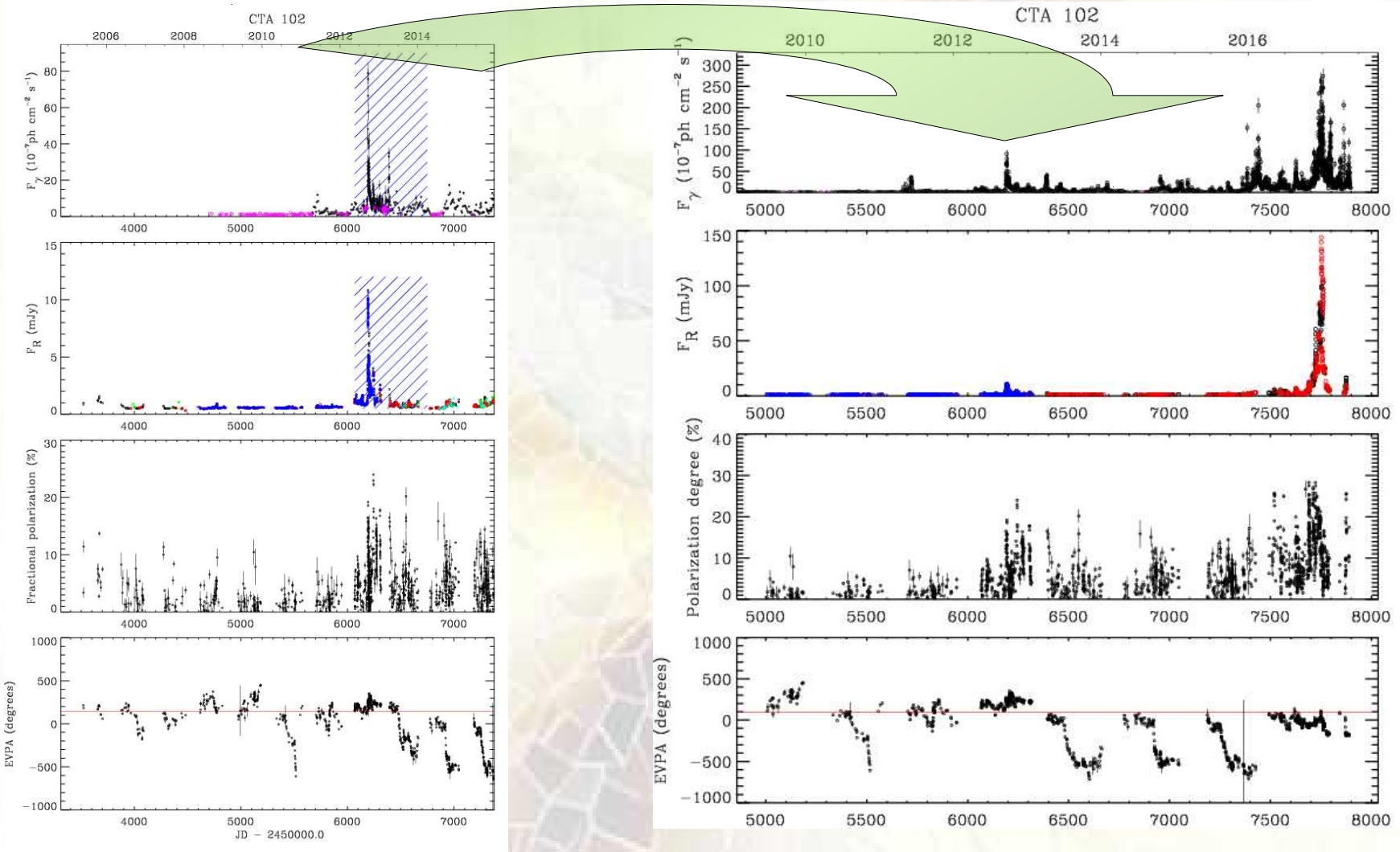
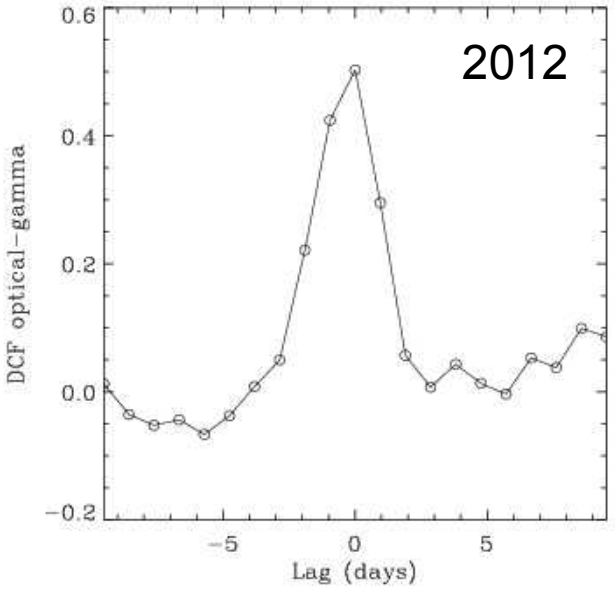
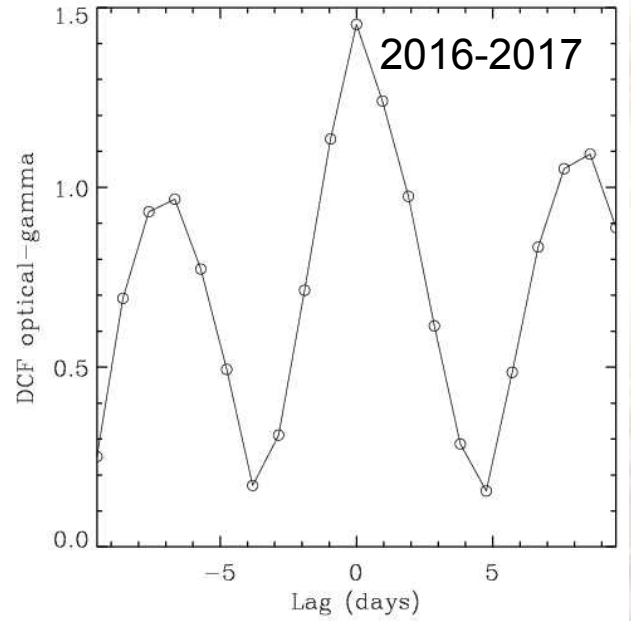
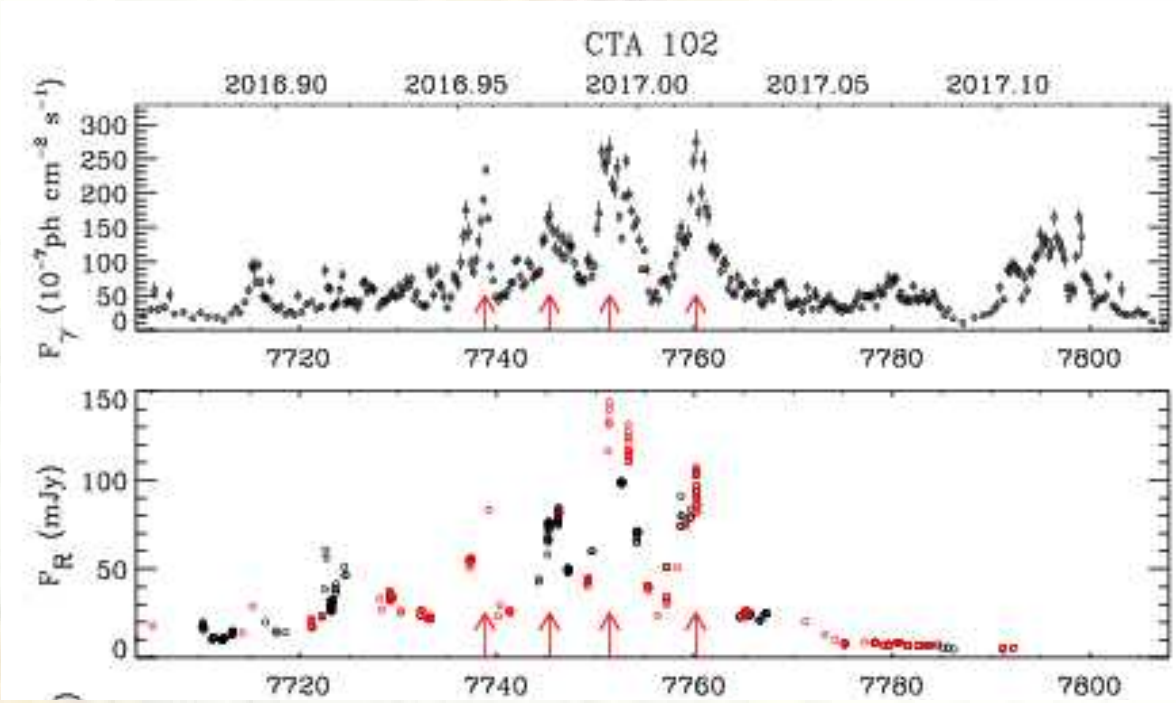


«We can expect that flaring activity in this blazar will be more pronounced than in previous years as long as the jet remains closely aligned with our line of sight.»
(Larionov+ 2016)

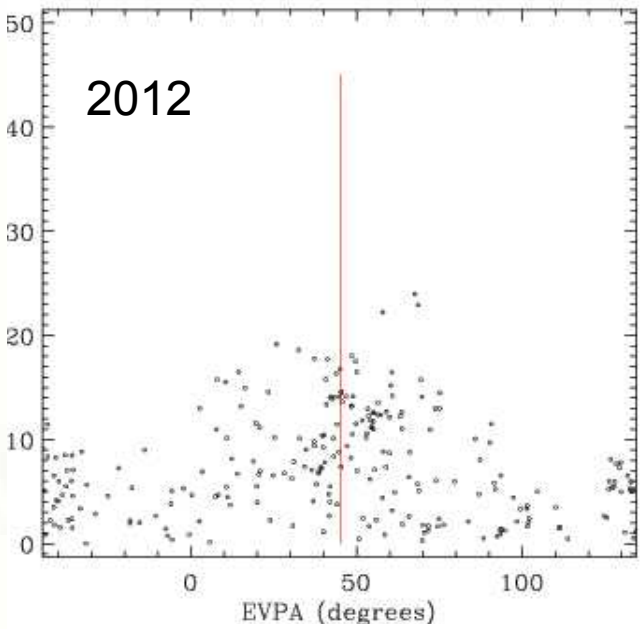

CTA 102
2006
2008
2010
2012
2014
F_γ (10^{-7}ph cm^{-2} s^{-1})
F_R (mJy)
Fractional polarization (%)
EVPA (degrees)
JD − 2450000.0
CTA 102
2010
2012
2014
2016
F_γ (10^{-7}ph cm^{-2} s^{-1})
F_R (mJy)
Polarization degree (%)
EVPA (degrees)

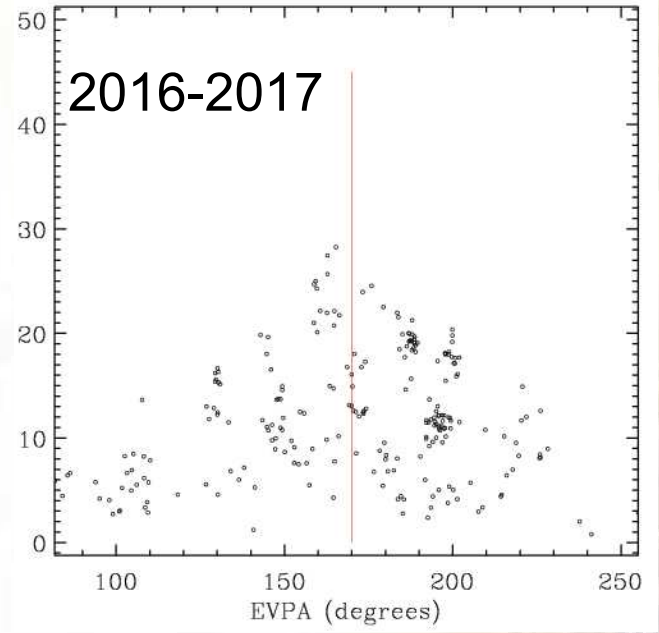


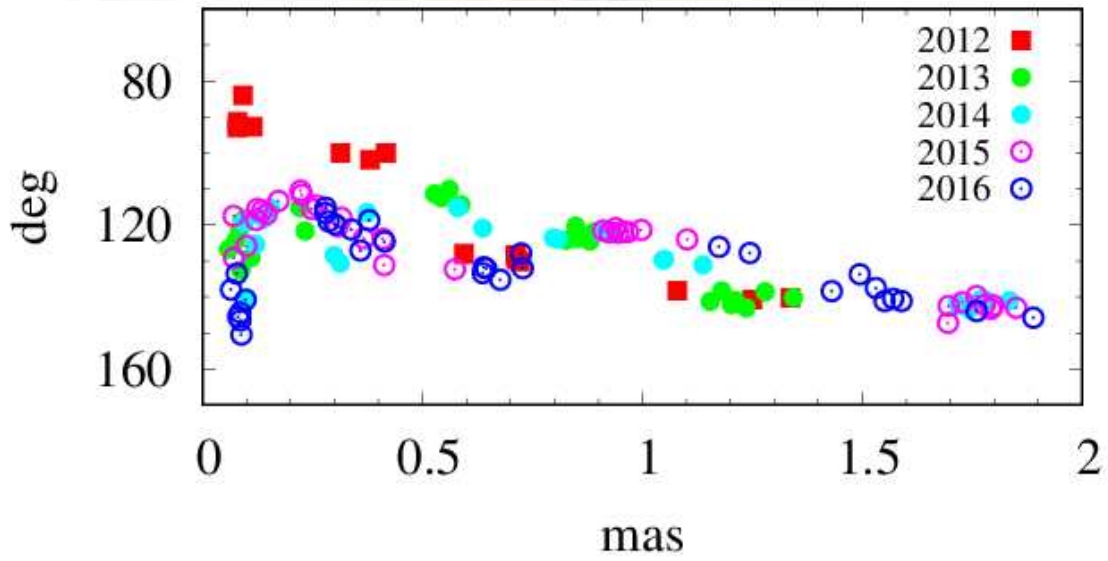


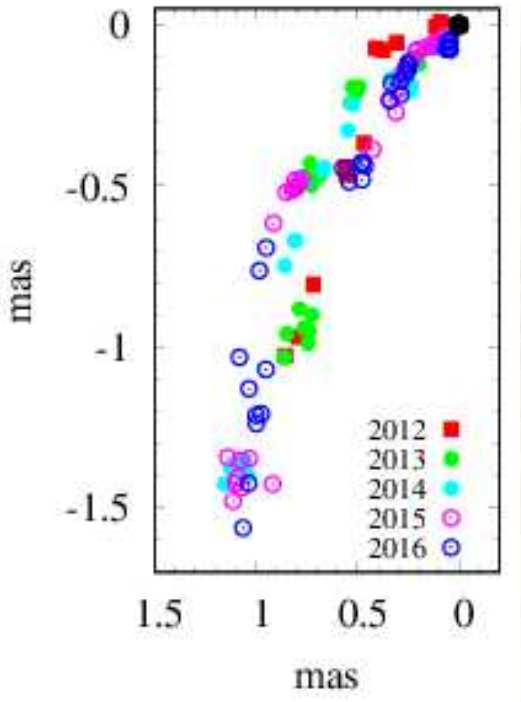


- During both outbursts there are no delays between γ-rays and optical => **the sites of synchrotron and IC radiation are co-spatial**.
- Triple DCF in 2016-2017 is a consequence of **~7 days recurrence** of optical and γ-ray outbursts.

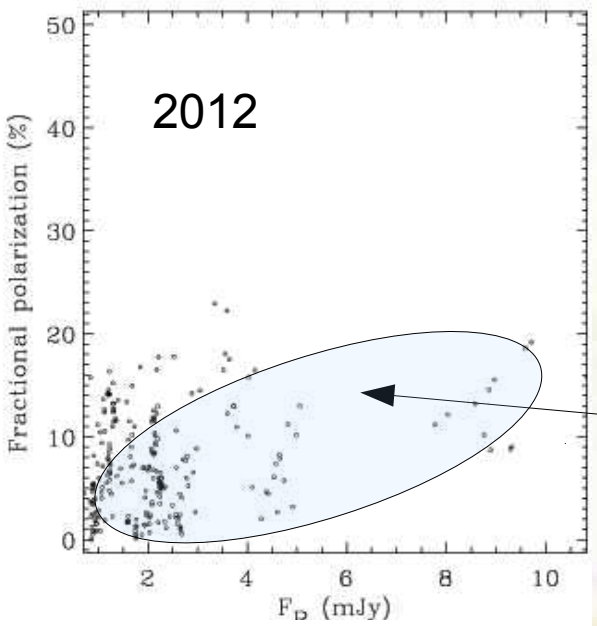


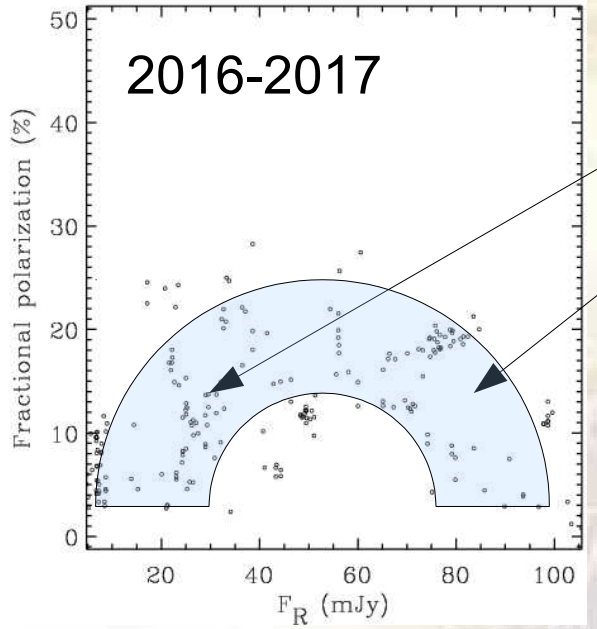




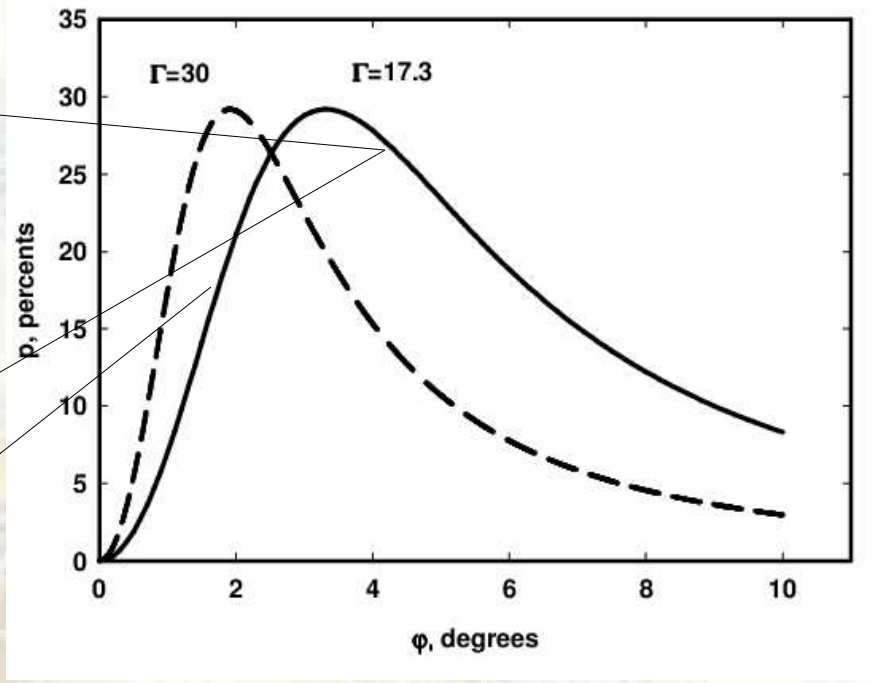


- 2012:
  $EVPA_{opt}$ - θ_{43GHz} ~ -45°
- 2016:
  $EVPA_{opt}$ - θ_{43GHz} ~ 30°

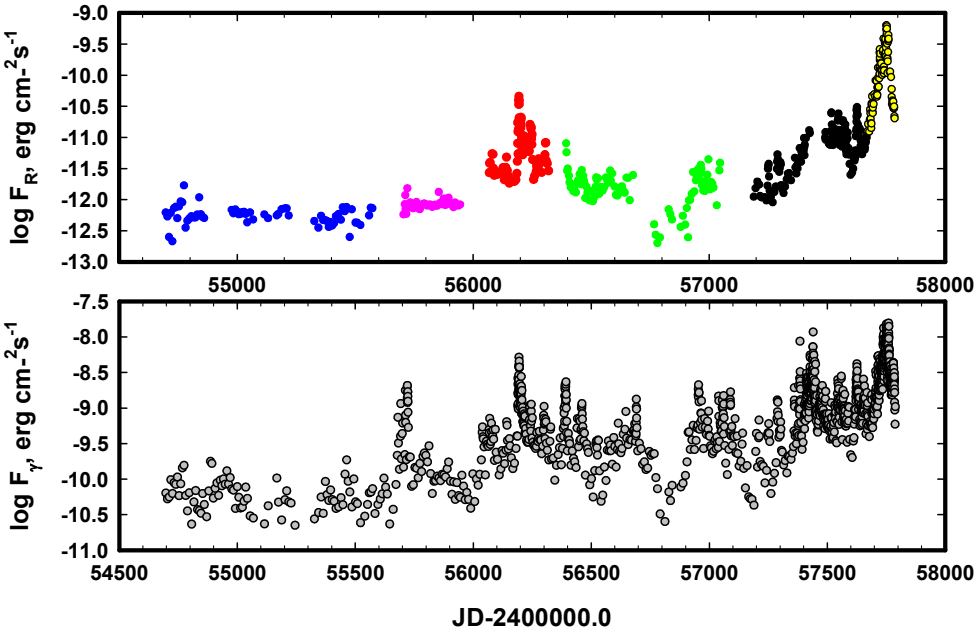




Behaviour of fractional polarization vs. viewing angle for plasma compression ratio η = 1.5, Lorentz-factor Γ = 17.3 (solid line), and Γ = 30 (dashed line), in the moving shock model. *(Figure 12 in Larionov+2016)*.

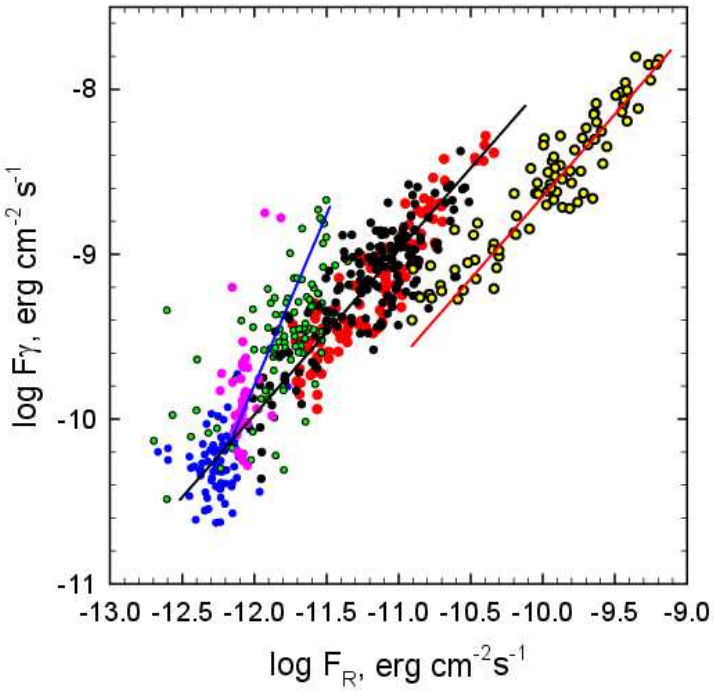


The dependence of PD vs. F_R during the 2016-2017 outburst reflects either smaller viewing angle or higher Lorentz-factor (or both)



An unexpected behaviour of dependence of F_γ *vs* $F_{optical}$

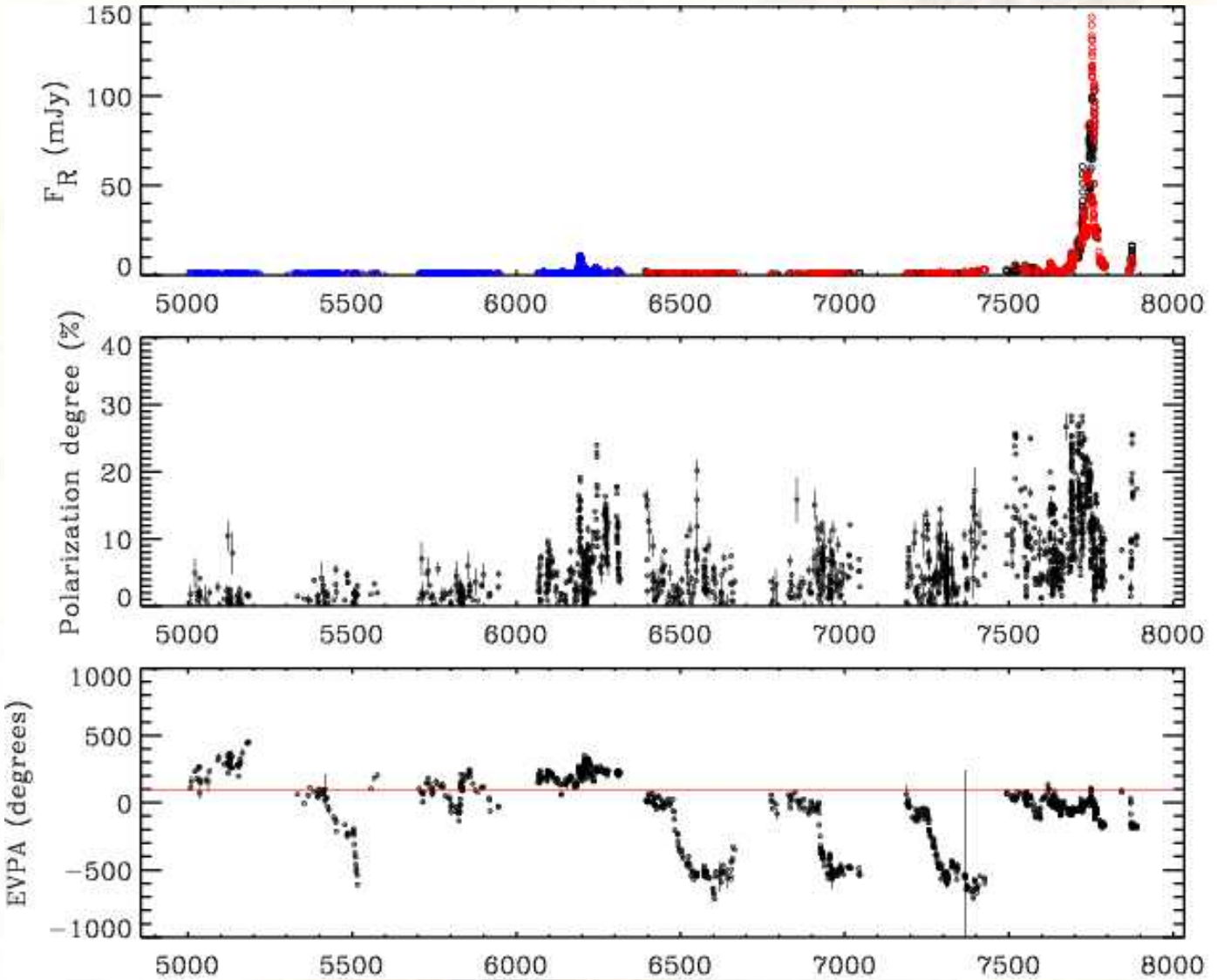
The 2016 outburst points location is distinctly different from 2012.



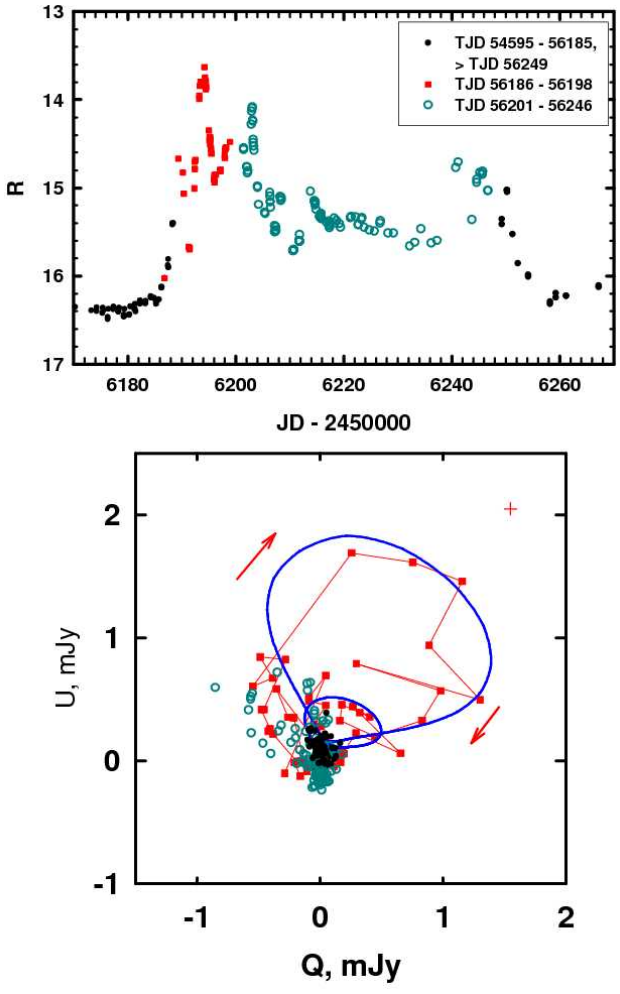
Does it mean that 2016 outburst is located downstream the jet, ~2 times farther then 2012 (supposing that

$F(IC) \sim n_e * F_{synchr}$ and $n_e \sim r^{-2}$)?

Rotations ?

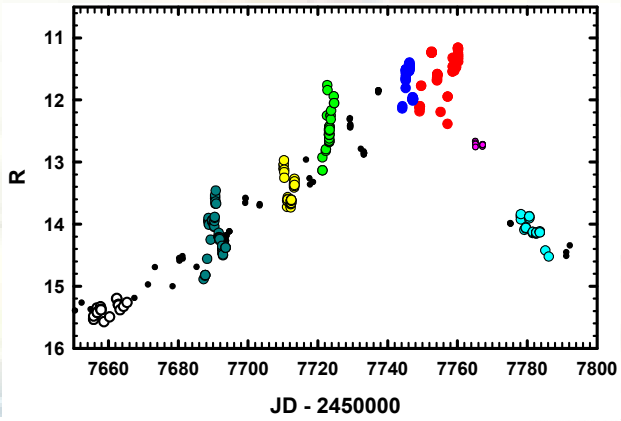

150
100
50
0
F_R (mJy)
5000
5500
6000
6500
7000
7500
8000
40
30
20
10
0
Polarization degree (%)
1000
500
0
−500
−1000
EVPA (degrees)

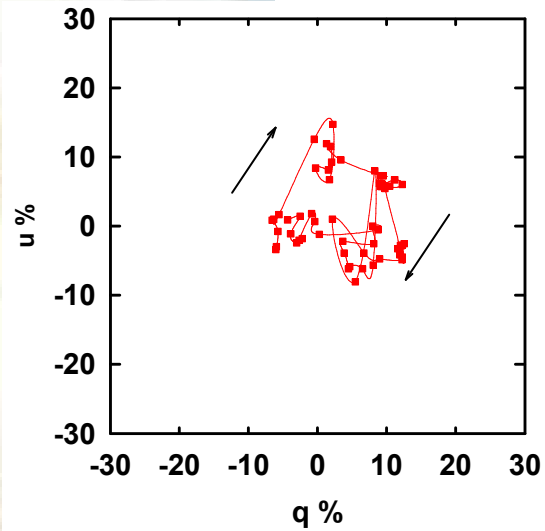
2012



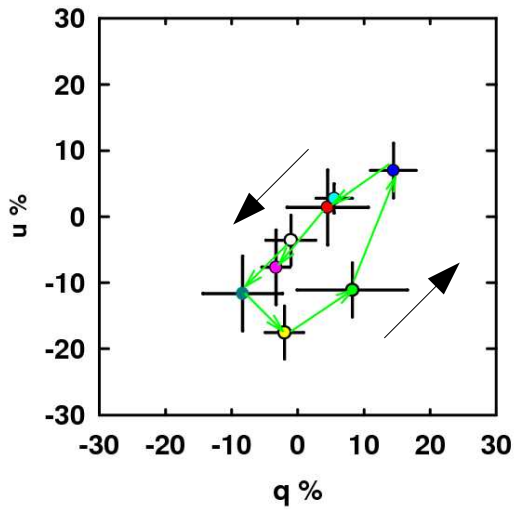
clockwise

2016-2017





clockwise



counterclockwise

Summary

- During both outbursts there are no delays between γ-rays and optical => **the sites of synchrotron and IC radiation are co-spatial**
- The dependence of PD vs. F_R during the 2016-2017 outburst reflects **either smaller viewing angle or higher Lorentz-factor (or both)**
- **EVPA behavior is substantially different between the 2012 & 2016-17 outbursts**
- **The shift of log F_{opt} – log F_γ dependence** may be caused by the location of the 2016-17 outburst being 2 times farther downstream from the BH than during 2012 event.=> Consistent with theoretical expectation that higher Lorentz factors are achieved farther from BH when ratio of magnetic to rest-mass energy at jet base increases
- As in the 2012 case, the 2016-17 outburst shows **clockwise rotation near the peak of the optical light curve on a time scale of several days**
- **On a time scale of months we notice counter-clockwise rotation** that might be a sign of two helices twisted in opposite directions

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Crimea


Ευχαριστώ!
Спасибо за внимание !
Thank you !