Optical Polarization monitoring of W Comae

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ABSTRACT

In this poster we present the results of the R-band polarimetric variability study performed to the TeV Blazar W Comae (ON 231, z=0.102). Data obtained from 2008 February to 2013 May (~5.2 years) are analyzed. We find that the source presented a maximum flux variability of 2.8 mJy in Δt ~36 d. The minimum variability time scale displayed by the source during the monitored period is Δt~3.3 d. A maximum linear polarization degree value of P=(33.8±1.6)% was observed in 2013 May 12. We find a rotation of the position angle from 78° (2008 March 10) to 229° (2008 July 11), i.e. Δθ~151° in a period of 123 d, that corresponds to a rotation of ~1.2° per day. After the high activity state observed in 2008, the position angle shows a preferential value of ~66°, with small variations of ~15°-25°. From the Stoke's parameters we infere the existence of two optically-thin synchrotron components that contribute to the optical polarized flux. One of them is stable, with P~11%. Our data allowed us to estimate a doppler factor δ_D~27, a visual angle Φ~2° and a magnetic field intensity B=0.12G.

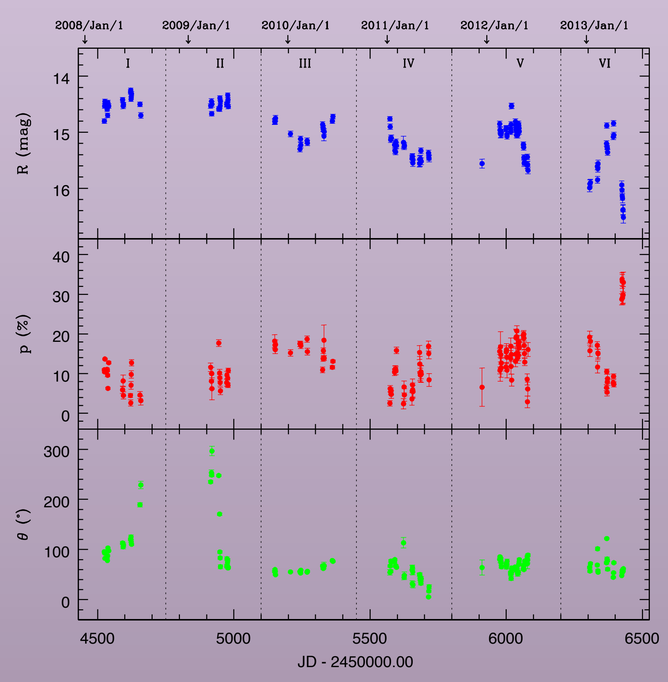

Fig 1. Light curve of W Coma obtained in ~5.2 years. Upper panel shows the R-band flux variations, middle panel the polarization degree P(%) variations, and lower panel the position angle variations. During the outburst of 2008 we find in **Cycle I (2008 Feb 29 to Jul 11)** that the position angle θ varied towards larger values. Then, in **Cycle II (2009 March 24 to May 28)** the value of θ declines more rapidly by a factor of ~4. From Cycles III to VI the source presented a preferential postion angle of optical polarization of ~66 °. In **Cycle VI (2013 Jan 13 to May 17)** we find the minimum flux value (~0.76 mJy) and also the maximum value P~34%.

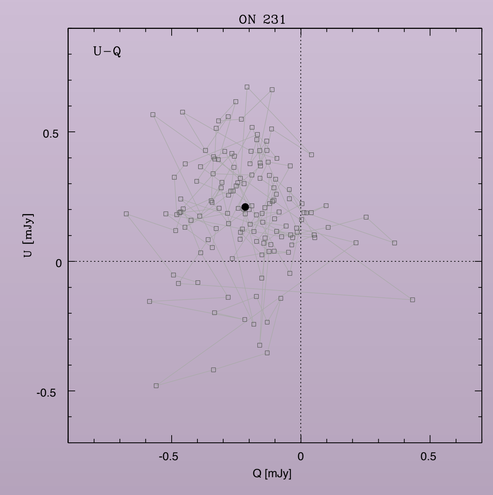

Fig 2. The Q-U plane for the stable polarized component. The obtained values of the absolute Stoke's parameters are <Q>=-0.22±0.02 mJy and <U>=0.21±0.03 mJy. This average values appear as the black filled point in the plane.

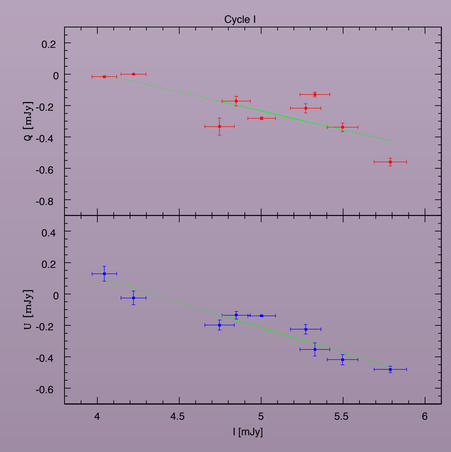

Fig 3. Correlations between the Stoke's parameters Q and U vs I. From these correlations we estimated the polarimetric parameters of the variable polarized component, and find that its maximum value is p_{var}=(40.1± 5.1)%

OBSERVATIONS

R-band photopolarimetric observations of W Comae were done using the 84cm telescope at the San Pedro Mártir observatory, in Baja California Mexico. Photometric data on this source obtained in 2008 were published in Acciari et al. 2009. In this work we show all photometric and polarimetric data collected up to now. All data were corrected for the host-galaxy contribution (m_{Rhost} =16.60). W Comae was observed between 2008 February to 2013 May 17 in 32 runs of 7 nights per run. Figure 1 shows the R-band light curve (LC), the polarization degree and the PA obtained from the analysis of all data points. For clarity the LC has been divided in six Cycles marked as vertical dotted lines.

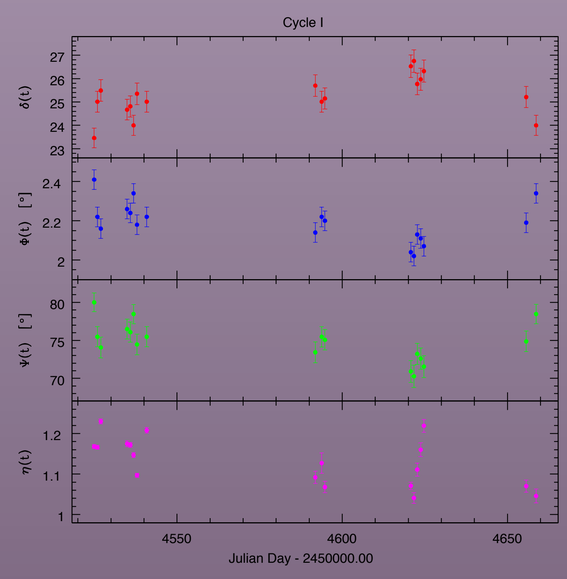

Fig 4. The minimum value of the visual angle of the jet (Φ ~2°) was estimated using data of this cycle, see blue points. The density ratio reached its maximum value also in this cycle.

RESULTS

Following the methodolgy presented in Sorcia et al. 2013, the statistical analysis done to our data shows that there is a correlation between the R-band flux and the polarization degree in Cycles III, IV and VI, with Pearson´s correlation coefficients of r_{pol} = -0.87±0.04, -0.75±0.05 and -0.89±0.02, respectiveley. Also we find a strong correlation between the R-band flux and θ: $r_{f\text{-}\theta}$ = 0.99±0.02, and between the polarization degree and θ: $r_{P\text{-}\theta}$ = -0.90±0.06. The polarimetric analysis led us to infere the superposition of two optically-thin synchrotron components (see Fig 2, 3 and 6). Assuming that the R-band flux variations are due to a shock, and also applying a one-zone homogeneous SSC model, we estimated some physical parameters associated with the relativistic jet (see Fig 4 and 5). These parameters are the doppler factor δ, the viewing angle of the jet Φ, the viewing angle of the shock Ψ and the plasma compression factor η as a function of time. When the source showed its maximum brightness (R=14.25 mag), the doppler factor δ~27, and during the minimum (R=16.52 mag) δ~16. We found also that the viewing angle of the jet is anticorrelated with the R-band flux, and has a minimum value of Φ=2.02˚ during the maximum brightness, and a maximum value of Φ=2.41˚. We find a maximum value for η=1.01 when the polarization degree has the minimum value of P=0.6%. Small changes in the compression factor can produce large changes in the polarization degree. The variability minimum time scale of ~3.3d obtained with our data allowed us to estimate the intensity of the magnetic field B=0.12 G.

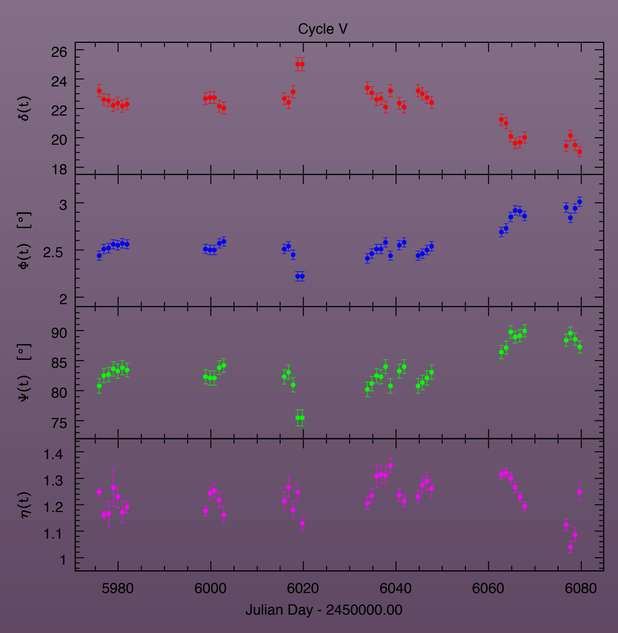

Fig 5. Time variations found between the different estimated parameters are shown for **cycle V (2012 Feb 18 to Jun 1)**. Runs are separated by 3 weeks, and each one shows time variations of Δt ~ 1d. This is our best sampled cycle. The object is in a quiescent variability state, however the doppler factor shows its maximum and a minimum values.

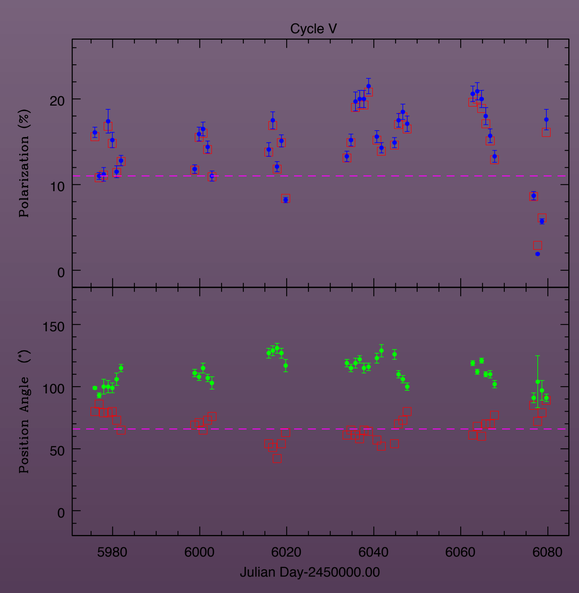

Fig 6. The two polarized components variations during **cycle V.** Red empty squares represent the observations. Dashed lines mark the values of the polarized degree (upper panel) and the postion angle θ (lower panel) of the constant polarized component. Blue and green dots represent the variations of the polarized variable component.

References

Acciari, V. A., Aliu, E., Aune, T. et al. 2009 ApJ, 707, 612
Sorcia, M., Benítez, E., Hiriart, D. et al. 2013 ApJS, 206, 1