

## Variability of the blazar 4C 38.41 (B3 1633+382) from GHz frequencies to GeV energies

Raiteri C., Villata M., Smith P., Larionov V., Acosta-Pulido J., Aller M., D'Ammando F., Gurwell M., Jorstad S., Joshi M., Kurtanidze O., Lähteenmäki A., Mirzaqulov D., Agudo I., Aller H., Arévalo M., Arkharov A., Bach U., Benítez E., Berdyugin A., Blinov D., Blumenthal K., Buemi C., Bueno A., Carleton T., Carnerero M., Carosati D., Casadio C., Chen W., Di Paola A., Dolci M., Efimova N., Ehgamberdiev S., Gómez J., González A., Hagen-Thorn V., Heidt J., Hiriart D., Holikov S., Konstantinova T., Kopatskaya E., Koptelova E., Kurtanidze S., Larionova E., Larionova L., León-Tavares J., Leto P., Lin H., Lindfors E., Marscher A., McHardy I., Molina S., Morozova D., Mujica R., Nikolashvili M., Nilsson K., Ovcharov E., Panwar N., Pasanen M., Puerto-Gimenez I., Reinthal R., Richter G., Ros J., Sakamoto T., Schwartz R., Sillanpää A., Smith N., Takalo L., Tammi J., Taylor B., Thum C., Tornikoski M., Tringali C., Troitsky I., Umama G., Valcheva A., Wehrle A.

*Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia*

---

### Abstract

**Context.** After years of modest optical activity, the quasar-type blazar 4C 38.41 (B3 1633+382) experienced a large outburst in 2011, which was detected throughout the entire electromagnetic spectrum, renewing interest in this source. **Aims.** We present the results of low-energy multifrequency monitoring by the GLAST-AGILE Support Program (GASP) of the Whole Earth Blazar Telescope (WEBT) consortium and collaborators, as well as those of spectropolarimetric/ spectrophotometric monitoring at the Steward Observatory. We also analyse high-energy observations of the Swift and Fermi satellites. This combined study aims to provide insights into the source broad-band emission and variability properties. **Methods.** We assemble optical, near-infrared, millimetre, and radio light curves and investigate their features and correlations. In the optical, we also analyse the spectroscopic and polarimetric properties of the source. We then compare the low-energy emission behaviour with that at high energies. **Results.** In the optical-UV band, several results indicate that there is a contribution from a quasi-stellar-object (QSO) like emission component, in addition to both variable and polarised jet emission. In the optical, the source is redder-when-brighter, at least for R  $\alpha$ ; 16. The optical spectra display broad emission lines, whose flux is constant in time. The observed degree of polarisation increases with flux and is higher in the red than the blue. The spectral energy distribution reveals a bump peaking around the U band. The unpolarised emission component is likely thermal radiation from the accretion disc that dilutes the jet polarisation. We estimate its brightness to be R QSO  $\sim$  17.85-18 and derive the intrinsic jet polarisation degree. We find no clear correlation between the optical and radio light curves, while the correlation between the optical and  $\gamma$ -ray flux apparently fades in time, likely because of an increasing optical to  $\gamma$ -ray flux ratio. **Conclusions.** As suggested for other blazars, the long-term variability of 4C 38.41 can be interpreted in terms of an inhomogeneous bent jet, where different emitting regions can change their alignment with respect to the line of sight, leading to variations in the Doppler factor  $\delta$ . Under the hypothesis that in the period 2008-2011 all the  $\gamma$ -ray and optical variability on a one-week timescale were due to changes in  $\delta$ , this would range between  $\sim$ 7 and  $\sim$ 21. If the variability were caused by changes in the viewing angle  $\theta$  only, then  $\theta$  would go from  $\sim$ 2.6°

to  $\sim 5^\circ$ . Variations in the viewing angle would also account for the dependence of the polarisation degree on the source brightness in the framework of a shock-in-jet model. © 2012 ESO.

<http://dx.doi.org/10.1051/0004-6361/201219492>

---

## **Keywords**

Galaxies: active, Galaxies: jets, Quasars: general, Quasars: individual: 4C 38.41