Variability of blazar 3C 273 examined by astronomers

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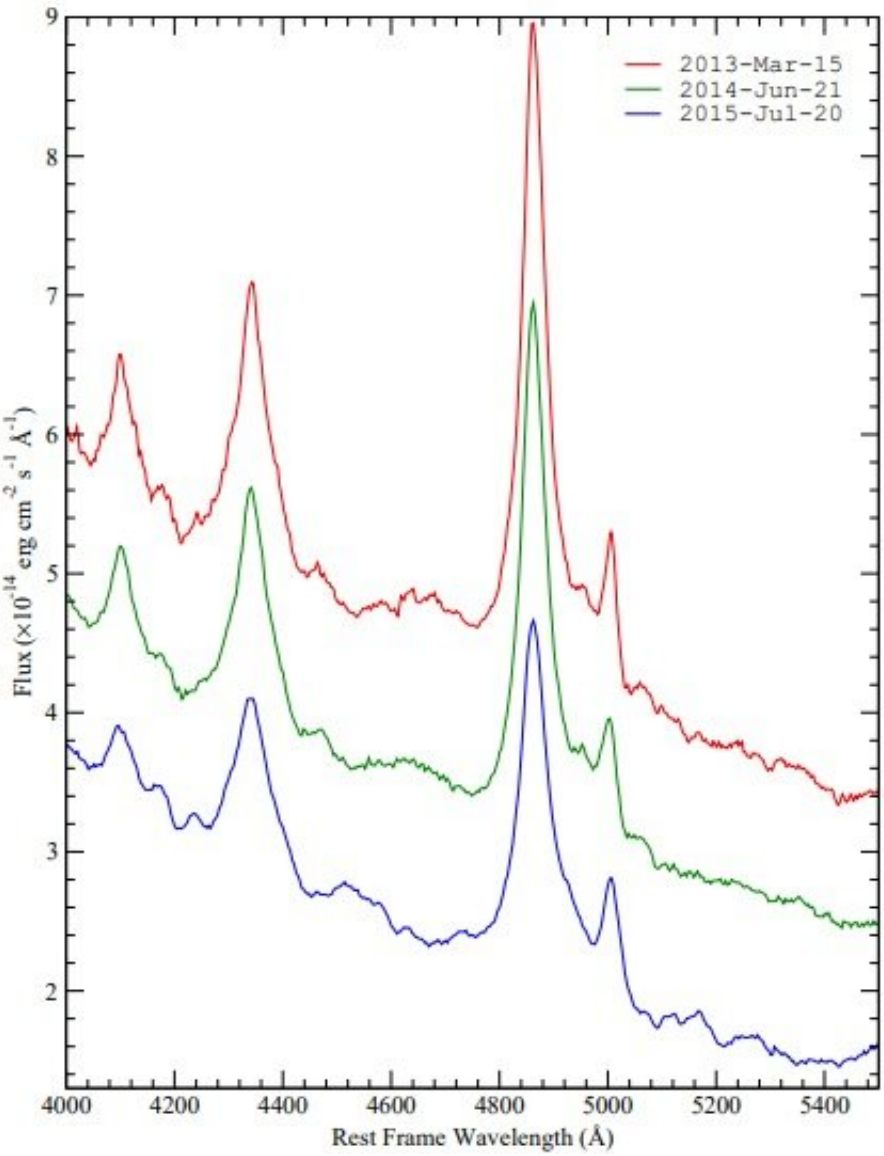

Spectra of 3C 273 at different activity states. The red spectrum corresponds to

the date of the highest continuum flux observed, the blue spectrum corresponds to the lowest continuum flux observed, and the green spectrum corresponds to a medium point in continuum flux between the red and blue spectra. Credit: Fernandes et al., 2020.

Using data from space observatories and ground-based telescopes, astronomers have investigated variability of a blazar known as 3C 273. The new study, presented in a paper published July 6 on the arXiv pre-print server, sheds more light on the emission from this source.

Blazars are very compact quasars associated with supermassive black holes at the centers of active, giant elliptical galaxies. Based on their optical emission properties, astronomers divide blazars into two classes: flat-spectrum radio quasars (FSRQs) that feature prominent and broad optical emission lines, and BL Lacertae objects (BL Lacs), which do not.

Located some 2.44 billion light years away, 3C 273 is one of the closest quasars to Earth, and is optically the brightest such object in the sky. Given that 3C 273 was the first discovered quasar, it has been comprehensively studied in different wavelengths. The observations show that it is a blazars of the FSRQ subclass, highly variable from radio to gamma-rays.

A team of astronomers led by Sunil Fernandes of the University of Texas at San Antonio took a closer look at the variable nature of 3C 273. They analyzed observational data of this blazar obtained between 2008 and 2015 with various instruments, including NASA's Fermi spacecraft and Steward Observatory.

"We present multiwavelength light curves and polarimetric data of the Flat Spectrum Radio Quasar 3C 273 over eight years. The wavelength

range of our data set extends from radio to gamma-rays," the astronomers wrote in the paper.

In general, the millimeter and radio emission in blazars are dominated by synchrotron emission from the blazar's jet. However, in the case of 3C 273, the dominant component of the optical emission does not share the synchrotron origin that the 1 mm and the 15 GHz emission have. This suggests that the optical emission is dominated by thermal emission from the accretion disk during the studied period.

According to the paper, no correlation was found between the gamma-ray luminosity and the gamma-ray spectral index. This finding may indicate that the energetics of the gamma-ray production processes causing the variability in 3C 273 are different from other blazars. However, the astronomers noted that the lack of this correlation might be also due to sampling problems, therefore further studies of the blazar are required in order to confirm this.

The study has also identified an anti-correlation between the 15 GHz and V-band light curves. The researchers assume that it could be due the fact that an ejection from the blazar's jet, and therefore an increment in radio synchrotron emission, is caused after the inner part of the accretion disk falls into the black hole. This causes a drop in the accretion disk emission.

"A scenario that fits the observed behavior, is the case where the inner part of the accretion disk falls into the black hole, which causes a drop in the X-ray emission; this event is normally followed by the ejection of a component from the jet base," the authors of the paper concluded.

More information: Fernandes et al., Multiwavelength Analysis of the Variability of the Blazar 3C 273, arXiv:2007.03105 [astro-ph.HE] arxiv.org/abs/2007.03105

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