Contribution ID: **323** Type: **oral**

High-energy variability of the gravitationally lensed blazar PKS 1830–211

Thursday, 26 September 2024 14:34 (17 minutes)

The production site and process responsible for the highly variable high-energy emission observed from blazar jets are still debated. Gravitational lenses can be used as microscopes to investigate the nature of such sources. We study the broad-band spectral properties and the high-energy variability of the gravitationally-lensed blazar PKS 1830-211, for which radio observations have revealed two images, to put constraints on the jet physics and the existence of a gravitationally-induced time delay and magnification ratio between the images. We utilize Swift/XRT, NuSTAR, and Fermi-LAT observations from 2016 and 2019 to compare periods of low activity and high activity in PKS 1830-211. Short-timescale variability is elucidated with an unbinned power spectrum analysis of time-tagged NuSTAR photon data. To study the gravitationally-induced time delay in the gamma-ray light curve observed with Fermi-LAT, we elaborate on existing methods and introduce new approaches. We develop a metric optimization method yielding a delay of 22.4 ± 5.7 days consistent with the value obtained by our auto-correlation approach, 21.96 ± 0.30 days, both of which being constant over time; the image magnification ratio is more difficult to estimate, and is subject to a two-fold ambiguity. When comparing the 2016 and 2019 datasets, the X-ray part of the SED, especially as seen by NuSTAR, is remarkably constant in comparison to the dramatic change in the gamma-rays. The X-ray and gamma-ray parts of the SED can be fitted with a single component resulting from Comptonisation of infrared emission from the dusty torus, with different gamma-ray states arising solely due to a shift of the break in the electron energy distribution.
The detection of a consistent lag throughout the whole light curve suggests that the the gamma-rays originate from a persistent location in the jet.

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Session Classification: Searches for Extragalactic astrophysical sources 2