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X-ray intraday variability of the TeV blazar Mrk 421 with XMM-Newton

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Markarian 421 is a bright high synchrotron energy peaked blazar showing wide featureless non-thermal spectrum. We analyse the large set of its X-ray observations taken with the EPIC-PN instrument onboard XMM-Newton satellite to probe into the intraday variability properties observed in the source. The photon energy band of 0.3 - 10.0 keV, and its sub-bands, soft 0.3-2.0 keV and hard 2.0-10.0 keV, data are analysed over 17 years of observations. Fractional variability amplitude and the minimum variability timescale has been calculated. We also probed into the spectral variability by studying hardness ratio for each observation. The correlation between the variability in the two energy bands has been studied using the method of discrete correlation function and by inspecting the normalized light curves.

The fractional variability displays clear variability in 23 observations out of 25. The minimum flux variability time scale τ_{var} ranges from 1.03 ks to 10.59 ks. The fractional variability is higher in the higher energy band than the lower energy band. In the HR-I diagram the source typically shows the harder-when-brighter trend. An interesting trend was revealed for the time lags observed in DCFs, which has the tendency to change sign with the observed lower and higher fractional variabilities. The circular loop structures observed in HR-I plots are accompanied by different signs of the measured time lag. From our single frequency band analysis, we speculate on the constraints for possible particle acceleration and emission processes in the jet, supporting the processes involving a turbulent behavior except of shocks.

Primary author: Ms NOEL, Angel Priyana (Astronomical Observatory of Jagiellonian University, Krakow, Poland)

Co-authors: WIERZCHOLSKA, Alicja (Institute of Nuclear Physics, PAN, Krakow, Poland); C. GUPTA, Alok (Aryabhata Research Institute of Observational Sciences (ARIES)); BHATTA, Gopal (Institute of Nuclear Physics, PAN, Krakow, Poland); GAUR, Haritma (Aryabhata Research Institute of Observational Sciences (ARIES)); OSTROWSKI, Michal (Astronomical Observatory of Jagiellonian University, Krakow, Poland); DHIMAN, Vinit (Aryabhata Research Institute of Observational Sciences (ARIES))

Presenter: Ms NOEL, Angel Priyana (Astronomical Observatory of Jagiellonian University, Krakow, Poland)

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