Unveiling the complex correlation patterns in Mrk 421

Executive summary

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In this contribution, we report on an extensive multi-wavelength observing campaign of the blazar Mrk 421 in 2017. Mrk 421 is one of the brightest and closest BL Lac type objects, making it an ideal target to better understand the physics of blazar jets. We study the intra-band correlations and interpret the evolution of the spectral energy distribution (SED) within theoretical models. For this, we make use of a dense temporal and energy coverage of the source. In addition, four multi-hour *NuSTAR* observations organised simultaneously with MAGIC allow us to obtain a precise measurement of the falling segments of the two spectral components. The very-high-energy (VHE; $E > 100\,\mathrm{GeV}$) versus X-ray flux correlation is investigated by binning the data into several sub-energy bands, and we reveal that the characteristics of the correlation varies substantially across the sub-energy bands. At lower energies, we find an atypical anti-correlation between the optical-UV and X-ray fluxes, indicating changes in the acceleration and cooling efficiencies of the electrons in the jet. During simultaneous MAGIC and *NuSTAR* observations, a clear change of the Compton dominance is detected without a simultaneous change in the synchrotron regime, indicating "orphan gamma-ray activity". Finally, we study an intriguing bright flare at VHE without a substantial flux increase in the X-rays. Within a leptonic scenario, this behaviour is best explained by the appearance of a second population of highly-energetic electrons spanning a narrow range of energies.