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Multi-messenger characterization of Mrk501 during historically low X-ray and γ-ray activity

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Blazars are among the brightest objects in the γ-ray sky. Nonetheless, even after decades of γ-ray and multi-wavelength observations, they are far from being understood.
In this contribution, we introduce a multiwavelength data set of the archetypal blazar, Mrk 501. The data set spans the period from 2017 to 2020 and is complemented by a 12-year data set that starts in 2008 for some of the wavebands. This comprehensive data set allows us to, for the first time, identify significant correlations between HE γ-rays and X-rays that occur on both long (˜year) and short (˜days) time scales. These correlations support a leptonic scenario as the mechanism responsible for the variable part of the blazar's emission. Additionally, we find a significant correlation between the HE γ-ray and radio wavebands, with the radio lagging the γ-rays by at least 100 days.
In the most variable wavebands, very-high-energy (>0.2 TeV, VHE) γ-rays and X-rays, we identify a two-year period of historically low activity with stable VHE emission at the level of 5% that of the Crab Nebula. Using leptonic, hadronic or leptohadronic models to explain this possible baseline emission of Mrk 501, we can reproduce the observations, including public IceCube data. The baseline emission could be attributed to a standing shock, while the more variable emission could be connected to relativistic leptons accelerated by a traveling shock.

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