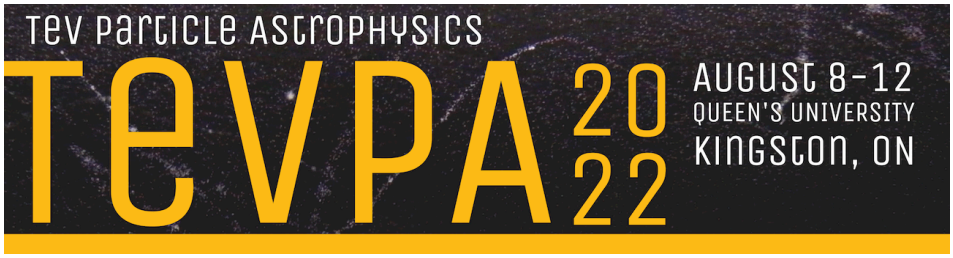

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Multi-messenger characterization of Mrk501 during historically low X-ray and γ-ray activity

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As highly energetic physics laboratories, blazars are prime candidates to reveal the mysteries of the most energetic parts of our universe. For many of them, the very-high-energy (>0.2 TeV, VHE) γ-ray band as well as the X-ray bands are especially interesting since they host the most variable part of their emission.

We present a multiwavelength (MWL) data set of Mrk 501 obtained from 2017 to 2020 revealing a historically low activity in exactly these bands. Using the comprehensive VHE data set collected by the two MAGIC telescopes, we can identify a low-state lasting for two years with a stable and historically low VHE flux (>0.2 TeV) of 5% that of the Crab Nebula. We use this unprecedented opportunity to investigate, additionally using constraints set by public IceCube data, the nature of the low-state which can be attributed to the MWL emission of leptonic, lepto-hadronic as well as purely hadronic scenarios. This potential baseline emission can be explained by a standing shock while the more variable emission before the low-state can be connected to an additional traveling shock region. The patterns appearing in this variable emission show a significant correlation between VHE γ-rays and X-rays for the first time also during low activity states for Mrk 501. Extending the data set to 12 years, we identify several significant correlations, such as a correlated behavior between HE γ-rays and X-rays supporting a common origin between these bands and the claim that the variable emission originates from relativistic leptons.

Collaboration name

for the Multi-wavelength collaborators and the MAGIC and Fermi-LAT-Collaboration

Authors: ARBET-ENGELS, Axel (Max-Planck-Institut für Physik, D-80805 München, Germany); PANEQUE, David (Max-Planck-Institut für Physik, D-80805 München, Germany); HECKMANN, Lea Alina (Max-Planck-Institut für Physik, D-80805 München, Germany); CERRUTI, Matteo (Institut de Ciències del Cosmos (ICCUB), Universitat de Barcelona (IEEC-UB), Martí i Franquès 1, 8 E08028 Barcelona, Spain); SAHAKYAN, Narek (ICRANet-Armenia, Marshall Baghramian Avenue 24a, Yerevan 0019, Armenia); GASPARYAN, Sargis (ICRANet-Armenia, Marshall Baghramian Avenue 24a, Yerevan 0019, Armenia)

Presenter: HECKMANN, Lea Alina (Max-Planck-Institut für Physik, D-80805 München, Germany)

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