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Reconcilement of the VHE γ-ray/X-ray correlation studies in Mrk 421 and break-down at high VHE fluxes

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The blazar Mrk 421 is one of the closest, brightest and fastest varying source in the extragalactic X-ray/TeV sky. In the last years, many multiwavelength campaigns have been carried out to study the correlation between the VHE γ-ray and X-ray fluxes of this source and, although the activity in these two energy ranges seems to be correlated in many observations, no conclusive results have been achieved yet. In this work we present a robust and comprehensive study of the (VHE) γ-ray/X-ray correlation of Mrk 421 with data taken with different VHE experiments (i.e. Whipple, HEGRA CT1, Milagro) on different time scales and different levels of activity of the source. We show that at monthly time scales the correlation is robust, consistent between instruments and that can be described as a linear function. Furthermore, most of the fluxes on shorter time scales are consistent with the correlation within 3σ. However, a breakdown of the correlation is clearly evident at high states of activity with fluxes greater than 2.5 10^{-10} cm^{-2} s^{-1} at energies above 400 GeV independently of the time scale, observational period or instrument. The breakdown is observed as an arbitrary decrement in the X-ray flux while the source remains in a high state of activity in VHE γ-rays. Even for single flares, the X-ray and VHE γ-ray emissions lie on the correlation until the VHE γ-ray flux reaches values higher than the mentioned above. The results are interpreted and discussed within the standard SSC model

Collaboration

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688

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