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Studies on the VHE γ -ray/X-ray correlation in high-synchrotron peak BL Lacs

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Many multi-wavelength campaigns have been carried out to study high-synchrotron peak BL Lacs (HBL). In particular the activity in the gamma-rays and X-rays seems to be correlated in many observations but, not 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 on different time scales and different levels of activity of the source. We show that, independently of the time scale, there exists a robust correlation, consistent between instruments and that can be described as a linear function. However, a breakdown of the correlation is clearly evident at high states of activity with fluxes comparable with three times the one of the Crab 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. We present a theoretical interpretation of these results within the leptonic SSC scenario and extend our studies to other HBL.

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