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A hadonic synchrotron mirror model for blazars - Application to 3C279

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Blazars show variability across the electromagnetic spectrum on a variety of time scales. In some cases, flaring events in one frequency band are not accompanied by flaring in other bands. Such events are termed "orphan flares". The causes of this variability and conditions in and location of the high-energy emission region are not entirely understood. The hadronic synchrotron mirror model is suggested as a possible explanation for rapid orphan gamma-ray variability. We apply this model to a very-high-energy gamma-ray orphan flare of 3C279, which was observed by H.E.S.S. on the 28th of January 2018. A primary flare was observed 11 days earlier by Fermi-LAT. In our model, the Fermi-LAT spectrum is reproduced by proton synchrotron emission, which constrains the parameters of the ultra-relativistic proton population in the jet. A VHE orphan flare results from photo-pion interactions of this relativistic proton population with electron synchrotron radiation reflected back into the jet by a cloud acting as a mirror. We present both analytical estimates of the viability of the hadronic synchrotron mirror model and detailed numerical simulations. These demonstrate that a VHE orphan flare can be produced by this model, in accordance with observations, accompanied by only a very moderate Fermi-LAT flux enhancement. The photo-pion induced cascade component of the spectrum is in agreement with observations.

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