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Multiwavelength study of 2020 and 2021 flares of S5 1803+784

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We report the spectral and temporal analysis of S5 1803+784, a low synchrotron peaked (LSP) BL Lac object, during the 2020 and 2021 flaring states. The spectral energy distributions (SEDs) were studied in the framework of the single-zone leptonic jet model and broken power-law leptonic electron distribution. BL Lacertae objects (BL Lacs) high energy emissions can often be modelled as a single-zone emitting region undergoing synchrotron self-Compton (SSC) emission intrinsic to the jet, without the need for soft photons from sources external to the jet (external Compton or EC). However, the synchrotron+SSC-only emission may not be applicable to S5 1803+784, which has weak but observable optical emission lines. Fitting the multiwavelength spectral energy distribution (SED) to leptonic single-zone models can provide a constraint on the emitting region size and structure, the γ-ray emission process, and the possible driver of particle acceleration as well as the intrinsic jet parameters. A flare was reported on 12 April 2020 in the jet of S5 1803+784. We use two approaches to model the SEDs, namely, the SSC-only and SSC + EC scenarios during the flare using both multiwavelength simultaneous and archival data. We show that the X-ray emission during the flare in both cases is dominated by the upper tail of the synchrotron emission.

In contrast, the quiescent state is dominated by the low-energy part of the inverse-Compton component. The transition of the inverse Compton process from the Thomson regime (in the quiescent state) to the Klein Nishina regime in the flaring state as a result of the acceleration of the emitting particles is an interesting feature of S5 1803+785 during this flare. It could explain the high spectral curvature of the γ-ray emission. We show that in the quiescent state, the SSC + EC model is a statistically significant improvement over the SSC-only model, which indicates that external inverse Compton photons originating from the dusty torus (DT) may dominate the γ-ray emission in S5 1803+784.

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