SPECTRAL ANALYSIS OF S5 1803+784
Joseph Omomola, Andrew Chen, on behalf of the Fermi-LAT Collaboration
School of Physics, University of the Witwatersrand

Introduction
Mechanisms and processes responsible for relativistic jet launching, collimation and particle acceleration are not fully understood (Zhang et al. 2015; Böttcher 2019). However, there seems to be agreement on the most likely source of power responsible for relativistic jets via gravitational potential of the accreting matter. In blazars, the structure of the relativistic jet, including the matter density and particle acceleration, the magnetic field evolution and the composition of the jet are needed to fully understand the physics of the gamma ray emission region and the evolution of the emission region in the jet. There is still no consensus on how these various components interact with each other and with the accretion disk of the black hole. Here we examined the spectral characteristics of S5 1803+784 in both the quiescent and flaring states of the blazar in the framework of a magnetic dissipation model. S5 1803+784, a low synchrotron peak (LSP) blazar is categorized as a BL Lac (Ghisellini et al. 2010). Evidence abounds in literature that LSP blazars do not fit well with single zone SSC model without contributions of seeded photons from sources external (EC) to the jet (Paggi et al. 2011). Here we present the results of phenomenological spectral model fits of the four observed flaring states of S5 1803+784 in the framework of a leptonic jet model using a single zone SSC + EM model. The implication of the SED parameters to acceleration and emission processes is also discussed.

Results
The bulk of external photons for the gamma ray emission observed during the flaring states emanate from the reflected infrared photons from the dusty torus. This agrees with the fact that S5 1803+784 is a BL Lac with a very weak BLR and often shows no clear cross-correlation between the radio and the γ-ray emission (Nesi et al. 2021).

From the SED the bulk of the external photons for the inverse Compton process of this blazar come from the dusty torus. Our result agrees with the conclusion of Lei & Wang 2015 that the location of the γ-ray dissipation may be distinct in different states of the source. The mechanism of particle acceleration may be distinct also in different states of the source.

We suggest particle acceleration as a result of magnetic dissipation (and magnetic reconnection in the case of flare A Omomola et al. in prep). If the γ-ray emission is as a result of magnetic dissipation by reconnection then the emission region should be close to or within a region of magnetic turbulence. This would place the emission region of flare A further out from the central engine although the γ-ray dissipation region, size and position is still poorly debated.

Conclusions

Panel 1: Part of the jet model and the magnetic field during the flaring and quiescent states.

Panel 2: Plot of the ratio of magnetic energy density and the particle energy density (EC_DT) vs. the photon index. The data are shown as points with error bars.

From plots in panel 1, 2 & 3 it is clear that the flares from S5 1803+784 have distinct characteristics. From panel 1, 2 & 3 we can infer that the first flaring states of S5 1803+784 shows evidence of magnetic dissipation (Zhang et al. 2015), which hints at the possible mechanism of particle acceleration. The low magnetization observed from flare C hints at shock acceleration as a possible mechanism (panel 3, Böttcher 2019). The magnetic field has an inverse relation with the emitting region size (panel 1) which could imply that powerful flares from this source (e.g. flare A) come from a compact region of the jet and the higher magnetization of flare C (panel 3) hints at the possibility of magnetic reconnection enhancing particle acceleration during the flare.

Panel 1: 1/3rd of the jet model and the magnetic field during the flaring and quiescent states.

Panel 2: Plot of the ratio of magnetic energy density and the particle energy density (EC_DT) vs. the photon index. The data are shown as points with error bars.

Panel 3: Part of the jet model and the magnetic field during the flaring and quiescent states.