Constraints on the Synchrotron Shock Model for the Fermi GBM Gamma-Ray Burst 090820A

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Discerning the radiative dissipation mechanism for prompt emission in Gamma-Ray Bursts (GRBs) requires detailed spectroscopic modeling that straddles the νF_{ν} peak in the 100 keV - 1 MeV range. Historically, empirical fits such as the popular Band function have been employed with considerable success in interpreting the observations. While extrapolations of the Band parameters can provide some physical insight into the emission mechanisms responsible for GRBs, these inferences do not provide a unique way of discerning between models. By fitting physical models directly this degeneracy can be broken, eliminating the need for empirical functions; our analysis here offers a first step in this direction. One of the oldest, and leading, theoretical ideas for the production of the prompt signal is the synchrotron shock model (SSM). Here we explore the applicability of this model to a bright {\it Fermi} GBM burst with a simple temporal structure, GRB {\it 090820}A. Our investigation implements, for the first time, thermal and non-thermal synchrotron emissivities in the RMFIT forward-folding spectral analysis software often used in GBM burst studies. We find that these synchrotron emissivities, together with a blackbody shape, provide at least as good a match with the data as the Band GRB spectral fitting function. This success is achieved in both time-integrated and time-resolved spectral fits.

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