

Title : The impact of pair production on Gamma Ray Burst prompt emission spectra

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Abstract : Gamma Ray Burst prompt emission is widely attributed to radiation from accelerated electrons within ultra-relativistic ejecta. Yet, the observed spectral shape is not always compatible with the most standard synchrotron prediction. The detection of high energy components (>100 MeV) in several GRBs, along with theoretical predictions of inverse Compton scattering, suggest the presence of abundant photons above the pair production threshold in the comoving frame. Under such conditions, photon-photon interactions lead to significant production of electron-positron pairs. By modelling numerically the coupled evolution of photons and leptons, we investigate the impact of secondary pairs on the emergent spectrum in the optically thin regime. We find that the emission from these pairs can drive substantial deviation from the standard synchrotron prediction in the soft gamma-ray range, including changes of both low and high energy photon indices. The recent launch of SVOM and Einstein Probe opens up new perspectives for the study of prompt low energy emission. In particular, the spectral shape above 4 keV can be precisely measured by the combination of ECLAIRS and GRM onboard SVOM. This could prove crucial in measuring these effects and improving our understanding of the prompt emission mechanisms. In rare cases, the annihilation of the secondary pairs can produce a narrow emission line above 1 MeV. We explore the physical conditions required for the emergence of this annihilation line and investigate the possibility to reproduce the MeV line reported in the BOAT GRB221009A.