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Demystifying the Prompt Emission of Gamma Ray Bursts

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Gamma Ray Bursts (GRBs) are the most powerful explosions in the universe, emitting more energy in a few seconds than our sun will emit in its entire lifetime. As a result, these explosions are excellent laboratories for exploring the interplay between matter and radiation in extreme environments. This interplay is integral to understanding astrophysical jets and the various compact objects that are thought to power GRBs. Recent advances in simulating the initial prompt emission of GRBs attempt to simulate this interplay between the jet properties and the resulting electromagnetic signature; this has resulted in various successes in reproducing observational aspects of GRBs. Here, we present the open source Monte Carlo Radiation Transfer (MCRaT) code. MCRaT propagates and Compton-scatters individual photons that have been injected into the collimated outflow in order to produce mock observed light curves, spectra, and polarization measurements from optical to gamma rays. These light curves and spectra allow us to compare our results to GRB observational data. We find excellent agreement between our mock observed GRBs and real GRB observations in terms of spectra and polarization measurements. Furthermore, we can understand the mock observations in terms of the jet structure and what real observations of GRBs can tell us about their jet structures. There are various improvements that can be made to MCRaT, but this code paves the way to connecting observed GRB radiation to the properties of the GRB jet in a way that was not previously possible.

Track

GRBs

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