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The 'Supercritical Pile' GRB Model: Prompt and afterglow emission

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Abstract content

We examine the prompt and afterglow emission within the context of the Supercritical Pile model for GRBs. For this we have performed self-consistent calculations by solving three time-dependent kinetic equations for protons, electrons and photons in addition to the usual mass and energy conservation equations. We follow the evolution of the RBW as it sweeps up circumstellar matter and assume that the swept-up electrons and protons have energies equal to the Lorentz factor of the flow. While the electrons radiate their energies through synchrotron and inverse Compton radiation on short timescales, the protons, at least initially, start accumulating without any dissipation. As the mass increases, however, they might become supercritical to the 'proton-photon pair-production - synchrotron radiation' network, and, as a consequence, they transfer explosively their stored energy to secondary electron-positron pairs and radiation. This results in a burst which has many features similar to the ones observed in GRB prompt emission. We have included in our calculations the radiation drag force exerted on the flow from the scattered radiation of the prompt emission on the circumstellar material. We find that this can break the flow on timescales which are much faster than the ones related to the usual adiabatic/radiative ones. As a result the emission exhibits a steep drop just after the prompt phase, in agreement with the Swift afterglow observations.

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Summary

Reference

Proceedings of the 30th International Cosmic Ray Conference; Rogelio Caballero, Juan Carlos D'Olivo, Gustavo Medina-Tanco, Lukas Nellen, Federico A. Sánchez, José F. Valdés-Galicia (eds.); Universidad Nacional Autónoma de México, Mexico City, Mexico, 2008; Vol. 3 (OG part 2), pages 1175-1178

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