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A wind environment and Lorentz factors of tens explain gamma-ray bursts X-ray plateau

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Gamma-ray bursts (GRBs) are known to have the most relativistic jets, with initial expansion Lorentz factors of 100< Gamma_i <1000. Many of these objects have a plateau in their early X-ray light curves (up to thousands of seconds). In this phase, the X-ray flux decreases much slower than theoretically expected which has puzzled the community for many years. Here, we show that the observed signal during this phase in both the X-ray and the optical bands is naturally obtained within the classical GRB "fireball"model, provided that (i) the initial Lorentz factor of the relativistically expanding jet is of the order of a few tens, rather than a few hundreds, and (ii) the expansion occurs into a medium-low density "wind"with density typically up to two orders of magnitude below the expectation from a Wolf-Rayet star. Within this framework, the end of the "plateau" phase marks the transition from the coasting phase to the self-similar expansion phase. We also show that difference in the Lorentz factor not only manifest itself in the afterglow phase, but also manifest in the prompt emission. Here, we discuss the implication of the results on the properties of GRB progenitors and the resulting jets, and show how they provide a novel tool to infer the physical properties inside the jet.

Track

GRBs

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