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**Constraints on the Source for Gamma-ray bursts from Observed X-Ray Afterglows**[1] GRANT MATHEWS, U. Notre Dame, REMO RUFFINI, Univ. Rome, ICRANet — X-ray afterglows from long-duration gamma ray bursts (GRBs) are associated with energetic type Ic supernovae and the late time behavior of the afterglow from all GRBs follows the same universal normalization and power-law behavior at late times ($\sim 10^4$ - $10^7$ sec) when plotted relative to the time of the initial GRB trigger. We describe constraints from this afterglow on the engine for GRBs in the context of simple model for X-ray emission from accelerated relativistic electrons within an outgoing relativistic shock. We show that this universal scaling imposes 3 constraints: 1) The shock breakout energy is the same ($\sim 10^{51}$ ergs) for all bursts independently of the observed GRB luminosity; 2) After breakout, the shock propagates through an optically thin low-density ($\sim 1 - 10$ g cm$^{-3}$ medium; 3) The energy radiated by the shock is a small fraction of the total shock energy. These suggest that the late-time power-law afterglow emission derives from the underlying energetic supernova with a similar total shock energy. The correlation of the of the observed GRB energy with the luminosity of the plateau suggests a GRB engine occurring at different radii within the expanding SN consistent with the induced gravitational collapse paradigm.

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