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GRBs: The Reverse Shock Renaissance

Abstract

Gamma-ray bursts (GRBs) are the most luminous explosions in the Universe, and thus serve as unique laboratories for high-energy astrophysics and compact-object formation, as well as premier probes of the high-redshift universe. One of the key unsolved questions in the GRB physics is the nature of the ejecta, whether baryonic or magnetically dominated, and reverse shock signatures (which indicate baryonic outflows) are expected to be the key discriminating factor. Locating and tracking reverse shock emission, which peaks in the mm and cm-bands, further allows us to infer the initial Lorentz factor and jet magnetization, providing critical clues to the nature of the ejecta and central engine. With the VLA, ATCA, and ALMA, we have recently made the first unambiguous detections of GRB reverse shocks. In this MeerKAT program, we propose to exploit the southern-hemisphere synergy between ATCA, ALMA, and MeerKAT to search for reverse shock emission in GRBs, and to explore the physical conditions under which these signatures are produced. We will support these MeerKAT data with on-going and proposed programs on VLA, ATCA, and ALMA extensive optical follow-up (Gemini, Magellan, MMT, Keck, ESO), and X-ray monitoring (Swift, Chandra, XMM).