GAMMA-RAY BURSTS: SHOULD COSMOLOGISTS CARE?

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Abstract. Gamma-Ray Burst (GRB) locations are distributed isotropically on the sky, but the intensity distribution of the bursts seems clearly incompatible with spatial homogeneity. Of the scenarios that attempt to provide an explanation, there are two that enjoy current popularity: (1) GRBs are produced by high-velocity neutron stars that have formed an extended (~100 kpc) spherical halo or "corona" around our galaxy. (2) The bursters are at cosmological distances, with redshifts near unity for the weaker events. The major evidence used to argue for or against each of these scenarios remains inconclusive. Assuming, not unreasonably, that the cosmological scenario is correct, one can discuss the advantages and disadvantages of studying GRBs as opposed to other objects at moderate redshift. We find that the advantages of GRBs—high intensity, penetrating radiation, rapid variability, and no expected source evolution—are offset by observational difficulties pertaining to the extraction of cosmological information from GRB data. If the cosmological scenario proves to be correct and if the observational difficulties are overcome, then cosmologists certainly should care.

1. Introduction

Cosmic Gamma-ray bursts (GRBs), discovered in 1973, remain one of the great "unsolved mysteries" of astrophysics. Amazingly, with approximately two thousand bursts observed and new bursts being detected at the rate of nearly one per day, astrophysicists remain divided over absolutely the most basic issue of whether the bursters are galactic or extragalactic (or some of each). A recent AIP Conference Proceedings volume devoted exclusively to GRBs (Fishman et al. 1994) contained 67 pages on cosmological models.
The basic premise behind the most popular Galactic scenario is that neutron stars born with high velocities (~1000 km/s) have populated an extended (~100 kpc) spherical Galactic halo, or "corona". There is no direct physical evidence for such a corona, but a recent finding (Lyne and Lorimer 1994) that radio pulsar velocities seem to average 450 km/s supports such a notion. Furthermore, although the evidence is less than overwhelming, GRB time scales, energetics, and certain spectral features have long suggested a neutron star origin. The intense 1979 March 5 event has recently