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**Final Technical Report**  
**"The Spectral Evolution of Gamma-Ray Bursts"**

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The proposed project was a continuation of our work on the spectral evolution of gamma-ray bursts begun when the Co-I on this proposal, Lyle Ford, was my graduate student. In the proposal we discussed two projects. The first was finishing and publishing the last chapter of Professor Ford's thesis. In this research effort we looked for correlations in the energies of pairs of counts recorded by the BATSE Spectroscopy Detectors within a short time of each other. A greater correlation within a short time would indicate that the observed broadband spectrum is really composed of narrowband spectral components which last for a short time and which rapidly sum to the observed spectrum. We did not find any evidence for such narrowband emission, and are setting limits on its presence. Professor Ford is revising the last chapter of his thesis for publication with my participation.

The second project was a continuation of my study of the cross-correlations between the gamma-ray burst lightcurves in different energy bands. I published a first study with this technique (1997, *Ap.J.*, **486**, 928) which showed that "hard-to-soft" spectral evolution is prevalent both within and between the bursts' intensity spikes. I proposed to continue developing this technique. However, I have been somewhat disillusioned about using this methodology quantitatively since it averages the spectral evolution on a given timescale over the entire burst. Nonetheless, I have been applying the technique to new bursts which are scientifically interesting for other reasons. Attached I include the cross-correlations for the burst GRB 990123, the burst during which ROTSE discovered an optical transient. The solid curve is the autocorrelation of BATSE's channel 3 (100-300 keV), while the dashed, dot-dashed and 3 dots-dashed curves are the crosscorrelations of channel 3 with channels 1 (25-50 keV), 2 (50-100 keV), and 4 (300-2000 keV). The order of, and separation between, the curves on the positive lag side indicate "hard-to-soft" evolution on all timescales, while the FWHM of the crosscorrelations shows that the intensity spikes are narrower at high energy than at low energy.

I have also been participating with my colleague on the BATSE team on other spectral evolution studies. Note that while I continue as a member of the BATSE team, I no longer receive funding from the team. For example, Preece *et al.* (1998, *Ap.J.*, **496**, 849) showed that the high energy spectral index varies during a burst, usually following a "hard-to-soft" trend. In addition, we have just submitted a catalog (Preece *et al.* 1999, *Ap.J.*, submitted) of time-resolved spectral fits.

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