Detection of a supernova signature associated with GRB 011121

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Abstract Using observations from an extensive monitoring campaign with the Hubble Space Telescope we present the detection, light curves, and broad-band spectral evolution of an intermediate time flux excess (a “bump” which is redder in color relative to typical afterglow emission) in the afterglow of GRB 011121, currently distinguished as the gamma-ray burst with the lowest known redshift. The red bump is remarkably well described by a redshifted Type Ic supernova, with a luminosity about half that of SN 1998bw, which occurred contemporaneously with the gamma-ray burst event. Given the simplicity of the model, we argue against alternative models for intermediate-time bumps (such as dust echoes) which require fine tuning to reproduce the observations. Instead, these results serve as compelling evidence for a massive star origin of long duration gamma-ray bursts. We further exclude the (related) supranova model and discuss the relationship between spherical core-collapse supernovae and gamma-ray bursts.