Far-infrared observations of γ–ray bursts and possibilities with FIRST

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The Infrared Space Observatory observed the field of the γ–ray burst (GRB) of May 8th, 1997 (GRB 970508) with the CAM and PHT instruments on May 21 and 24, 1997 and with PHT in three filters in November 1997. These observations were part of a program to make the first 'rapid response' studies of GRBs at far-infrared wavelengths and were made possible by the rapid and accurate GRB localisation capability of the instruments aboard the Italian-Dutch *BeppoSAX* satellite and the coincidence of ISO being simultaneously in-orbit. A source at $60\,\mu$m (flux in May of 66 ± 10 mJy) was detected near the position of the host galaxy of this γ–ray burst. The source was detected again in November 1997, at a marginally lower flux (43 ± 13 mJy). A Galactic cirrus origin and a stellar origin for the emission can be ruled out on the basis of the infrared colours. The marginal evidence for variability of the $60\,\mu$m flux between May and November is not sufficient to warrant interpretation of the source as transient fireball emission. However, the infrared colours are physically reasonable if attributed to conventional dust emission from a single blackbody source. The probability of detecting a $60\,\mu$m source by chance in a PHT beam down to a detection limit of 50 mJy is $\sim 5 \times 10^{-3}$. If the source is at the redshift of the host galaxy of the γ–ray burst the fluxes and upper limits at wavelengths from $12\,\mu$m to $170\,\mu$m indicate it is an ultraluminous infrared galaxy ($L_{ir} \sim 2 \times 10^{12}\,L_\odot$). The star formation rate is estimated to be several hundred solar masses per year, depending significantly on model-dependent parameters. If this source is associated with the host galaxy of GRB 970508, progenitor models which associate GRBs with star-forming regions are favoured. However, further observations of GRB host galaxies in the far-infrared (e.g. with FIRST) could provide further evidence to support the connection between GRBs and star-forming regions.
Many issues regarding the production of the GRB afterglows remain uncertain, despite the advances of the last 3 years. For example, recent theoretical work by Sari & Mészáros has indicated that in a refreshed shock scenario, transient fireball emission should reach a maximum in the far-infrared to mm band a few days after the burst event, with a flux of tens of mJy. Such predictions will be testable with missions such as FIRST.
The prospects for obtaining precise GRB locations while FIRST is in orbit are examined in this paper along with the scientific returns to be expected from the detection of the transient and quiescent far-infrared/submm emission of GRBs.