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FINAL TECHNICAL REPORT REPORT FOR NAG 5-3014

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Final Technical Report for NASA Grant NAG5-3014

Reobserving the First Hours of Supernova SN1987A

Arlin P.S. Crotts

This project was designed to use archival data from the International Ultraviolet Explorer (IUE) to measure the flux from the shock breakout from SN 1987A, emitted in the first few hours of the event, reflected from neighboring dust clouds in the form of a light echo. Such hot flux from the initial moments of a SN had never been observed before, and this offers a unique opportunity to measure it in reflection.

Gilmozzi (1991, in "SN 1987A and Other Supernova") had reported such a detection of using IUE from observations made in 1988 and 1989. Our analysis of these data showed that this detection was very weak, and subject to changes comparable to the size of the signal according to various reasonable means of extracting the spectra. In fact, the features reported by Gilmozzi (1998 in "Ultraviolet Astrophysics Beyond IUE") are not found in a conventional NEWSIPS extraction or extended-source extraction of these data.

The 1995 and 1996 IUE data collected for Crotts and Gilmozzi shows a more robust signal (about 20σ) from a cloud that echoes brighter in the optical than the 1988 feature. This shows a well-detected signal of about $5 \cdot 10^{-16}$ ergs per s/cm^2/Å/arcsec^2 at 1300Å, with a declining slope to redder wavelengths. This surface brightness, while detected with confidence in both large and small SWP apertures, is still fainter than the reflected flux expected for most models of shock breakout.

We have also taken the opportunity to recover the echo signal from exposures taken on Astro-1 and Astro-2 flights of the Ultraviolet Imaging Telescope (UIT) while pointed towards SN 1987A. These data yield a complementary result on the reflected flux, an upper limit of about $5 \cdot 10^{-17}$ ergs per s/cm^2/Å/arcsec^2, spread over fainter optically echoing clouds, and over the same band where the signal was detected by IUE. While this appears in contradiction with the IUE result, it is made consistent by the corresponding strengths

of the echoes in the optical. Again, however, the UIT result challenges available models of shock breakout.

We have two papers nearly ready to be submitted, which will be forwarded in their final form when available:

"The Ultraviolet Echo of SN 1987A's Initial Shock Breakout as Observed by IUE" by S. Lawrence, A. Crotts and R. Gilmozzi.

"Limits on the UV Flux from SN 1987A's Initial Shock Breakout using Both Astro Flights of The Ultraviolet Imaging Telescope" by A. Crotts, T. Stecher, W. Landsman, W. Kunkel and the UIT Team.