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IMAGING HARD X-RAY/γ-RAY OBSERVATIONS OF THE GALACTIC CENTER REGION

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ABSTRACT

Recent imaging hard X-ray/γ-ray observations have highlighted the energetic activity near the Galactic center. The Caltech Gamma-Ray Imaging Payload (GRIP) observed the Galactic center region in 1988 April and again in 1989 April, at energies from 30 keV to 10 MeV. The source 1E1740.7-2942 was shown by our measurements, from the 1988 observation, to be the dominant Galactic center source in the energy range 35-200 keV /1/. We present preliminary results on the spectrum of 1E1740.7-2942 for the 1989 observation. The question of source variability is of particular interest since 1E1740.7-2942 has been observed to exhibit short term time variability on time scales of days, with the appearance of a hard excess of emission above 200 keV /2/. Recent observations by *GRANAT* /3/ have shown that the source 1E1740.7-2942 transitioned into an extended "low" state in early 1991.

1. Observations

The 1989 April 3-4 observation of the Galactic center region was performed with the Caltech GRIP instrument in the same configuration as the 1988 April 12 observation /1/. GRIP is a balloon-borne coded aperture telescope using a rotating hexagonal-celled uniformly redundant array and a position sensitive NaI(Tl) detector with a 14° field of view and 1.1° angular resolution. The Galactic center region was observed for two 7 hour periods during a ~40 hour flight of the instrument from Alice Springs, NT, Australia.

2. Results

As shown in Figure 1, the energy spectrum of 1E1740.7-2942 measured during our 1989 flight is consistent with that measured in 1988. The extrapolation down to energies where the Spacelab-2 instrument observed this source in 1985 suggests that its hard X-ray luminosity was similar to that observed in 1988-90 /4/. In Figure 2 we present 95% confidence upper limits to the luminosity for ~ 1 hour segments of the data in the energy range 200-530 keV, where SIGMA observed an enhanced flux in the 1990 October observation /2/.

3. Conclusions

Based on the imaging observations from Spacelab-2, GRIP, and *GRANAT*, the source 1E1740.7-2942 has been shown to exhibit three distinct emission states. Our data combined with that from Spacelab-2 and *GRANAT* suggests that the "normal" state of the source is that shown in the GRIP results of Figure 1, while the recent evidence from *GRANAT* shows that the source exhibits variability on time scales from days to months. If this source is a system similar to Cygnus X-1, the variations and spectral changes may provide powerful diagnostic tools for studying the physics of accretion in the vicinity of stellar mass black holes.

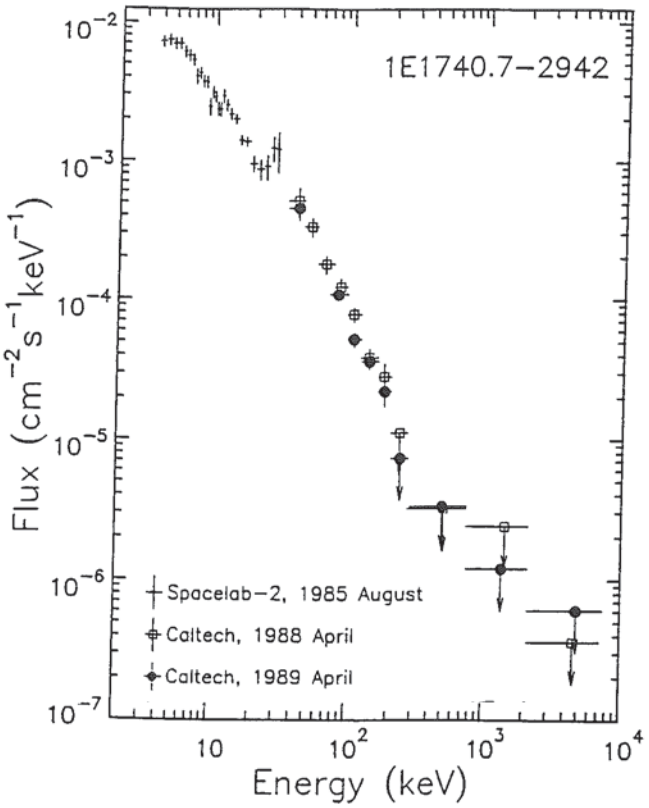

Figure 1. Differential energy spectrum, where error bars are $\pm 1\sigma$, and upper limits are at the 95% confidence level. The best fit power law to the 1989 April GRIP data yields a spectral index $\gamma = 2.1 \pm 0.2$ and normalization at 100 keV of $K = (7.0 \pm 0.4) \times 10^{-5}\gamma/(\mathrm{cm}^2\ \mathrm{s\ keV})$.

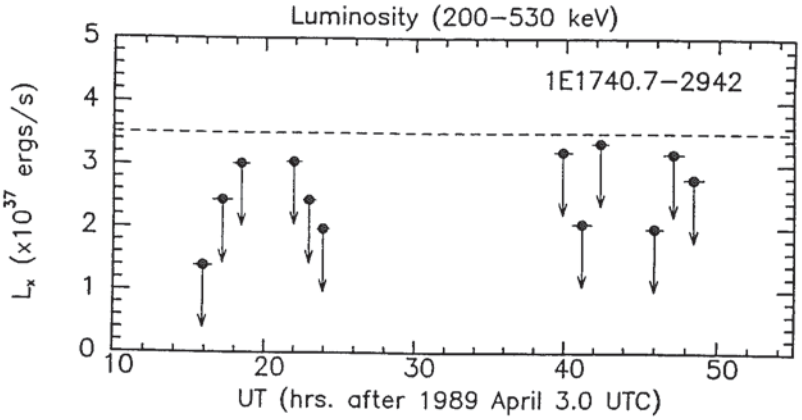

Figure 2. Upper limits (95% confidence) versus time for the 200-530 keV luminosity observed by GRIP in 1989 April 3-4, assuming a distance of 8.5 kpc to the Galactic center. The dashed line is the level observed by SIGMA on 1990 October 13.

4. References

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