WHAT CAN BE LEARNT FROM FULL DISK X-RAY OBSERVATIONS OF STELLAR FLARES?

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The **Einstein Observatory** demonstrated the existence of hot envelopes, i.e., stellar coronae, around most classes of normal stars (Vaiana et al. 1981). The coronae of late type stars of spectral type F through M are generally thought to be solar-like, i.e., structured and organised by the magnetic field topology and heated by some process(es) involving magnetic energy. Here the property "solar-like" does not refer to the optical appearance of a star, but rather to the role played by magnetic fields in the outer stellar envelope (Linsky 1985). Since it is difficult to measure magnetic fields on other stars directly, a number of indirect indicators is used in order to infer whether a corona should be considered "solar-like" or not.

Stellar flares are thought to be an excellent indicator of the magnetic nature of the underlying corona (Linsky 1985); in addition, the flare X-ray light curve and spectrum allow a determination of physical parameters such as density, temperature and scale size of the flaring plasma. As pointed out by Haisch (1983) most stellar flares observed so far in X-rays (with the possible exception of HD 27130) seem to be similar to solar flare events, except that the derived plasma densities in stellar flares are far higher than those of their solar counterparts.

The analysis procedures used to interpret stellar flares are rather crude, and further, only full disk observations with rather low spectral resolution and low signal to noise ratio (SNR) are available. Solar flares on the other hand are typically observed with rather high spatial, spectral and temporal resolution with good SNR, and we simply do not know what solar flares would look like if observed with the same instrumentation used on other stars.

Using the **Einstein Observatory** Imaging Proportional Counter (IPC) we have studied in detail solar X-ray light scattered in the upper atmosphere, i.e., data taken when the X-ray telescope was pointed at the Sun-lit Earth. By computing the propagation and scattering of solar X-rays in a realistic atmosphere model, we can determine the scattered X-ray flux as a function of viewing geometry and hence flight time; by comparing the expected and observed bright Earth X-ray light curves we can assess whether the incident solar X-ray flux was constant or not. In fig. 1 we show an example of a solar flare observed in scattered X-ray light; the medium panel shows the observed light curve as function of time, the lower one the hardness ratio increase during the flare. In fig. 2 we compare (upper panel) the observed and best fit light curve, and give in the lower panel the flare light curve of a fiducial observer, i.e., an observer in the subsolar point looking downwards.

Scattered solar X-ray light provides us with full disk low spectral resolu-

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tion observations obtained with the same instrumentation used for stellar flare observations. Employing the same data analysis and data interpretation techniques, we find extremely good agreement between physical flare parameters derived from our IPC observations and "known" properties of compact solar loop flares, and hence full disk low resolution IPC observations can accurately reveal temperature and density of solar flare plasma. Thus we are confident that the interpretation of stellar X-ray flare observations is on a physically sound basis, and therefore stellar X-ray flares constitute an important diagnostic tool for the determination of physical conditions in stellar coronae. A detailed account of this work will be published elsewhere.

Haisch, B.M., 1983, in Activity in Red Dwarf Stars, ed. P.B. Byrne and M. Rodono, Reidel Publishing Company, Dordrecht.
Linsky, J.L., 1985, Solar Physics, 100, 333.
Vaiana, G.S. et al., 1981, Ap. J. 245, 163.

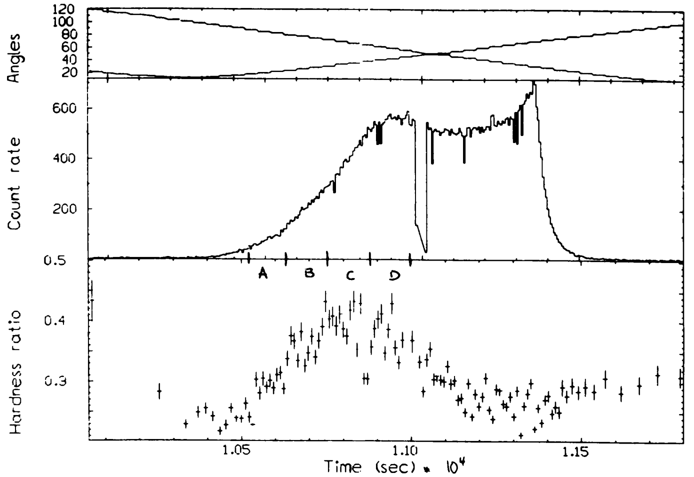

Fig. 1: X-ray light curve of bright Earth data segment on July 21, 1980 (medium panel) and hardness ratio (lower panel).

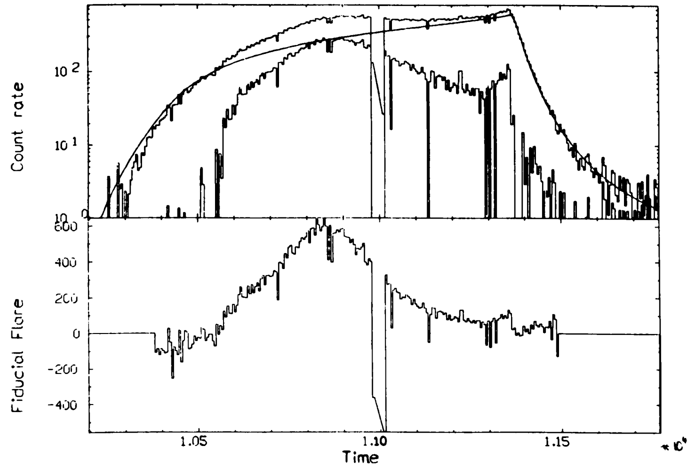

Fig. 2: X-ray light curve, best model fit and residual for the same data segment as in Fig. 1 (upper panel) and fiducial observer flare light curve (lower panel).