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The March 2000 AD Leo Flare Campaign

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Abstract. Flares are by their nature random and unpredictable events and flare observations are often the serendipitous result of programs designed for other scientific endeavors. Thus, few observations of flares covering multiple wavelength regimes, with both spectroscopic and photometric information, are available to test stellar flare models. Occasionally, a bold and reckless team will put together a flare campaign, employing suitable statistical arguments to convince the relevant telescope allocation committees that such a campaign will prove fruitful, while hoping desperately for the combination of clear weather, working instruments and cooperative star necessary to warrant the herculean organizational effort. We report here on one such campaign, conducted during March, 2000 on the dM3e flare star AD Leo.

1. Introduction

The March 2000 AD Leo flare campaign was planned to include the FUSE, HST and EUVE satellites, ground-based optical sites including the McDonald Observatory, the Dominion Astrophysical Observatory, the Stephanion Observatory and the Crimean Astrophysical Observatory, and the Jodrell Bank radio telescope facility. Unfortunately, FUSE went into safe mode shortly before our observation was scheduled, but we obtained excellent data with HST/STIS, EUVE and several of the ground-based telescopes. We show here our preliminary results from the STIS spectra and EUVE/optical photometry.

2. Discussion

Figure 1 illustrates the time coverage of the various instruments which participated in the campaign. The times of the 8 largest flares we observed are indicated. Figure 2 shows the U band light curves obtained at McDonald Observatory during the 4 nights of the campaign, while Figure 3 gives the integrated UV continuum (from STIS) light curves on an expanded scale for several of the flares. The varying morphology of the flares is evident, with several hav-

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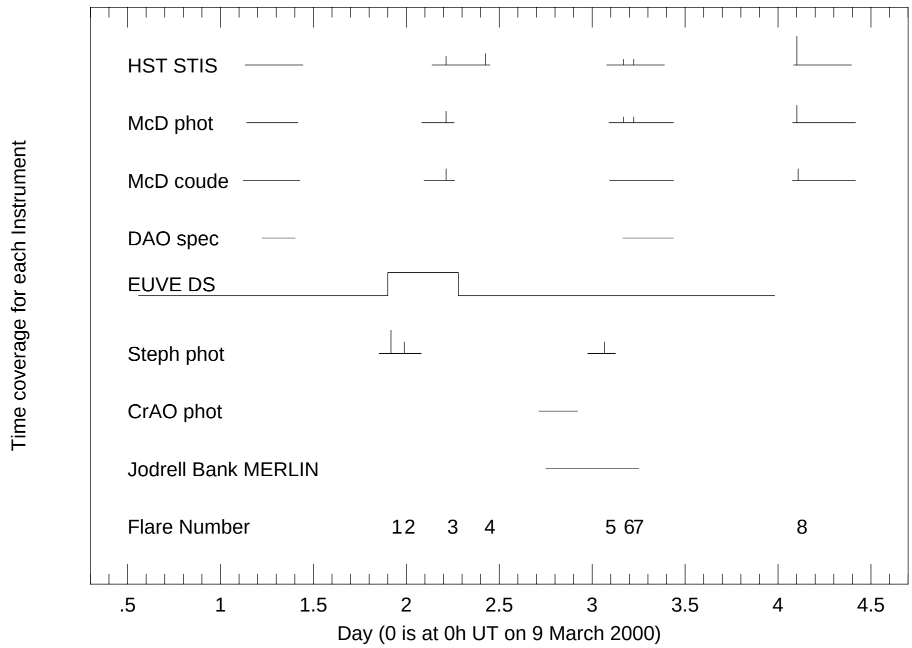

Figure 1. These are the observatories that participated in the flare campaign and the time coverage each instrument obtained. The 8 largest flares are indicated by vertical lines, and numbered chronologically.

ing extended decay phases and secondary peaks. In Figure 4, the EUVE data during flares 1-3 are shown with the photometric flares superposed. There is evidence for a Neupert effect (Neupert 1968) as we found in our March 1993 AD Leo campaign (Hawley et al. 1995). Finally Figure 5 shows the CIV line flux (in red) compared to the mean velocity. The peak redshift is seen about 30 seconds after the peak line flux, which is consistent with models of downflows (i.e. “chromospheric condensations”) in the chromospheric evaporation process (Fisher 1989). The downflow speed can be used to constrain the energy flux driving the chromospheric evaporation. When combined with similar analyses of spectral lines emitted at coronal and chromospheric temperatures, we will be able to construct a very detailed picture of flare evolution, along with good estimates for the flare area coverage.

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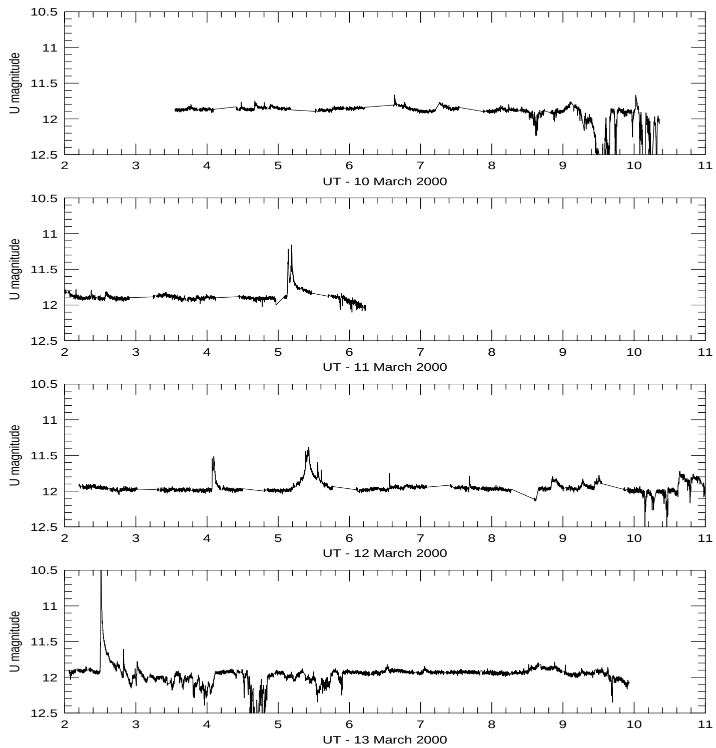

Figure 2. U-band light curves from the McDonald Observatory 82" telescope for the four nights of flare observations. Some periods of clouds are apparent, but the weather was mostly clear and photometric during the flares. The data are sampled every 4 seconds.

References

Fisher, G.H. 1989, ApJ 346, 1019

Hawley, S.L. et al. (10 others) 1995, ApJ 453, 464

Neupert, W.M. 1968, ApJ 153, L59

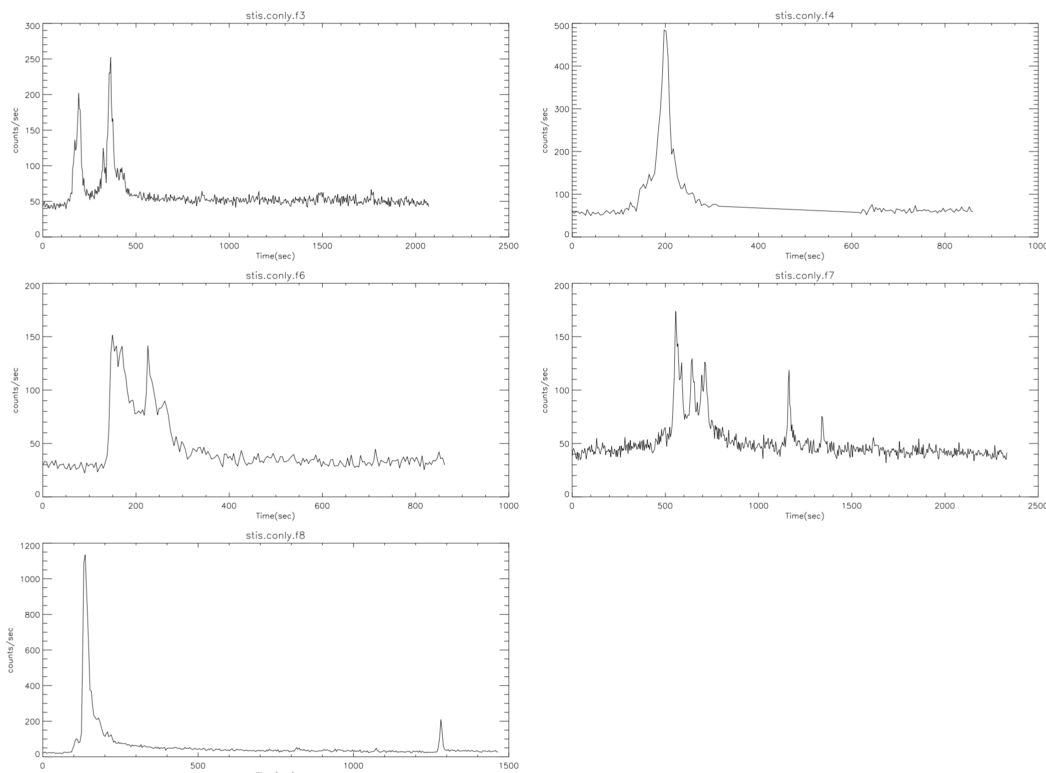

Figure 3. Integrated UV continuum (from STIS) light curves for five of the flares. The data are sampled every four seconds, showing that there is significant structure on very short timescales. Multiple bursts are quite common.

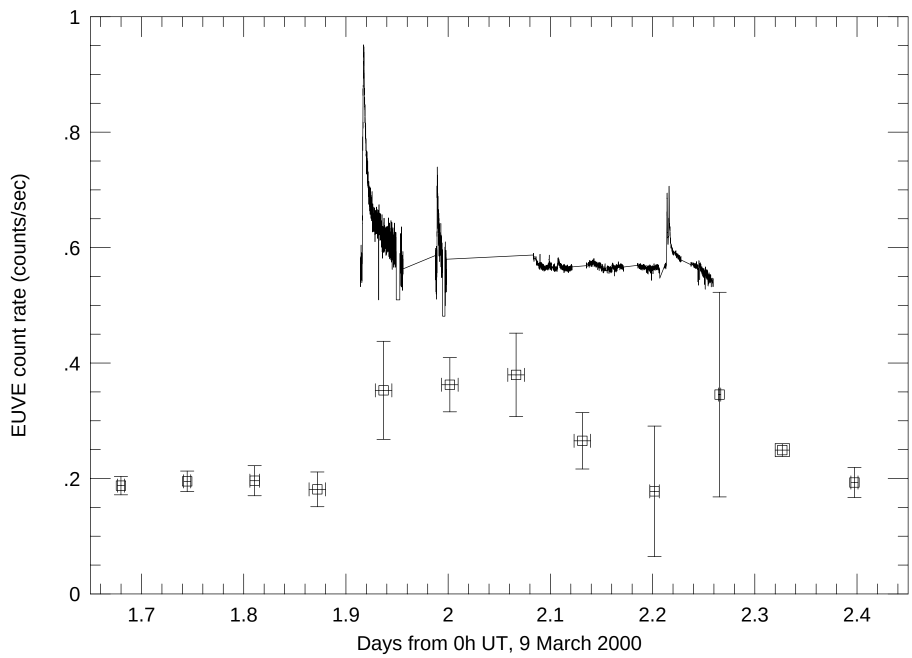

Figure 4. EUVE detected one significant flare, coinciding with the largest optical flare (2 magnitudes in the U-band), and encompassing optical flares 1-3.

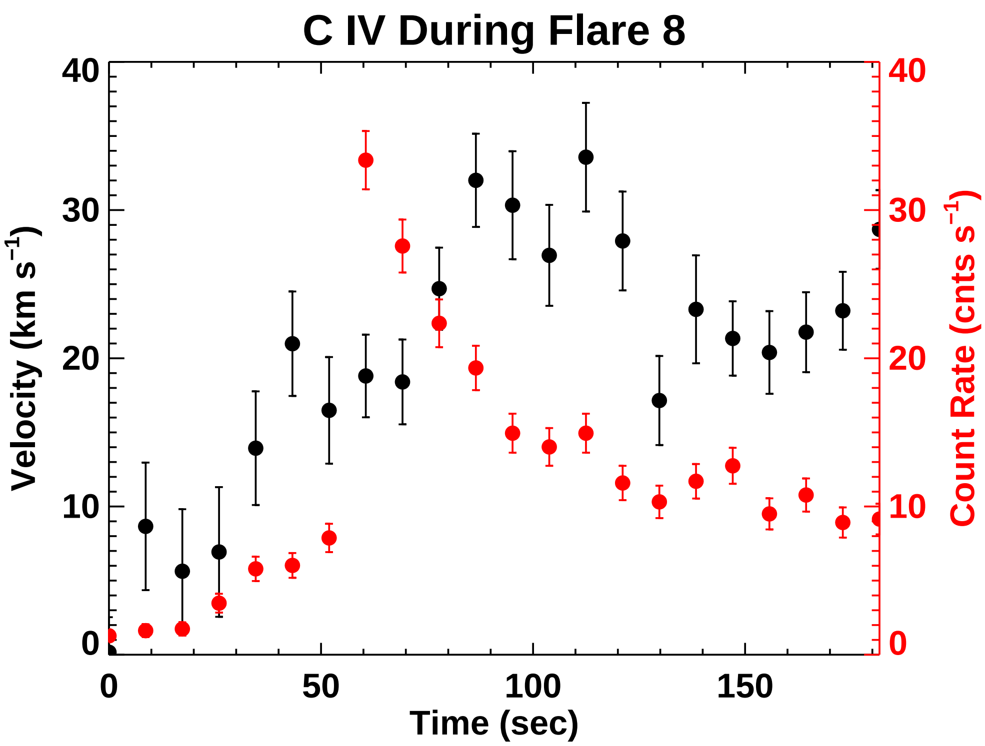

Figure 5. The C IV (1548) line flux (red points) superposed on the mean velocity of the line (black points) during flare 8. The time sampling is 8 seconds.