A Report on the FES Scattered Light Anomaly

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On 29 July 1991, Day 210, IUE encountered the first shadow of Shadow Season 28. Upon exiting shadow, the satellite was maneuvered to the 12th magnitude offset star for the US1 target, at $\beta \sim 96$. The staff noticed in an FES1ROM image that the offset star was barely visible due to a large amount of scattered light. A FESPNT 300 revealed the star was 170 counts brighter than it was the previous US 1 shift. As a result, FESPNT 100s were obtained at the four points in the FES field we have been monitoring since the scattered light anomaly was first detected. The average of these four points was 294 (s/o). This is an increase of almost 200 counts over the amount of scattered light we had been experiencing at these β.

As a result of this dramatic increase in the background scattered light, we have begun intensively monitoring the background to characterize the dependance of the scattered light with β angle. The results of our monitoring of this phenomena since it was first detected reveal that two sudden changes in the character of the scattered light have been noticed. The first was on Day 51, the second on Day 211. It is interesting to note that the anomaly was first detected after the start of shadow season 27, decreased dramatically with the end of shadow season 27,(Day 51) and returned with a vengeance with the start of the shadow season 28 (Day 211). Another noteworthy point is that for $\beta \geq 80$, the scattered light seems to have been much worse during Shadow Season 28 (Day 210-232, 1991) than during Shadow Season 27 (Day 25-51, 1991). (All the data presented here is a combination of the data obtained at GSFC and at VILSPA; this information is passed between the two stations daily at handover.)

Figure 1a shows the data obtained since Day 38 and Figure 1b displays the data obtained since Day 211. The dependance with β for the data in Figure 1b is much steeper than that in Figure 1a for those points obtained during shadow (triangles). The small cluster of points in Figure 1b obtained during Shadow 28 (Day 211-Day 231) between β 80-100 with unusually low count rates for those βs indicate that there was a large range of variation in the β dependance of this phenomena during Shadow Season 28. Apparently, sometime near Day 213, the background counts dropped to near pre-shadow levels, then within a few days, went back up to the extremely high values we had been detecting. After shadow, the background scattered light dropped in intensity, however it remained at somewhat higher levels than before Shadow Season 28. (Figure 2). Of further interest are the three points labeled by asterisk in Figure 2. These points were obtained during a lunar shadow which occurred on day 251. After the onset of this shadow, the scattered light increased to levels similar to those observed during shadow season, then within a day or two, decreased to the level it had attained before the lunar shadow.

There now exists enough data to examine the dependance of the scattered light with time, within a given range of β. Figure 3 shows the time dependance of

the scattered light in the range $80 \leq \beta \leq 100$. As expected, we see between Day 51 and 211, the level of the scattered light remained relatively constant, before day 51 and after day 211, it increased dramatically and after day 231 it decreased, with the exception of the lunar shadow of day 251.

During the course of this anomaly, we have also been monitoring two stars near the North Ecliptic Pole ($\beta \sim 90$) in order to understand the time dependance of this phenomena. Figure 4 displays the results of this monitoring, with star A denoted as triangles and star C as squares. We see that for both objects, the counts increased by over 300 counts during shadow season, then returned to their pre shadow levels after day 231.

In conclusion, although we are not in a position to determine the direct cause of the scattered light in the FES, the data strongly indicate that it is directly related to shadow. One of the major impacts of shadow season is an increase in thermal stress on the satellite, so in order to understand what role temperature variations may have on the background scattered light, we have begun recording the temperature of the telescope tube along with the scattered light measurements. Despite the presence of this scattered light in the FES, it has had no effect on IUE's ability to acquire targets. In order to assess the effect of the scattered light on spectral images, background exposures at high β angles have been obtained with exposure times of 2 to 7 hours, both during and after Shadow Season 27. A faint spectrum, which filled the aperture, was detected in the longest of these exposures, which was taken at β 110 on day 42, which was during Shadow Season 27. No spectrum was seen in shorter exposures obtained during and after Shadow Season 27.

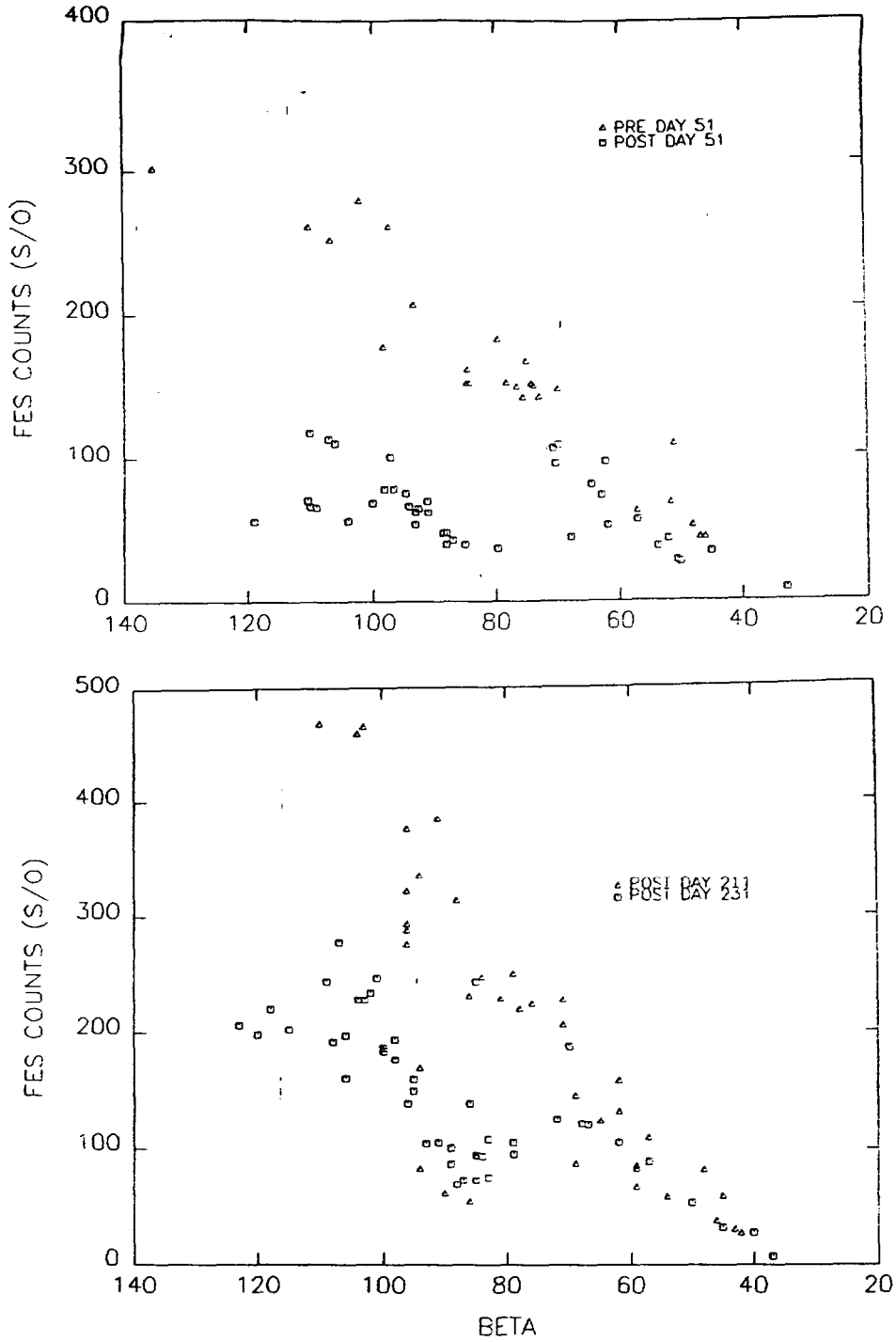

Figure 1(a & b). The top panel displays the background scattered light measurements during and after Shadow Season 27. The bottom panel displays the background scattered light measurements during and after Shadow Season 28.

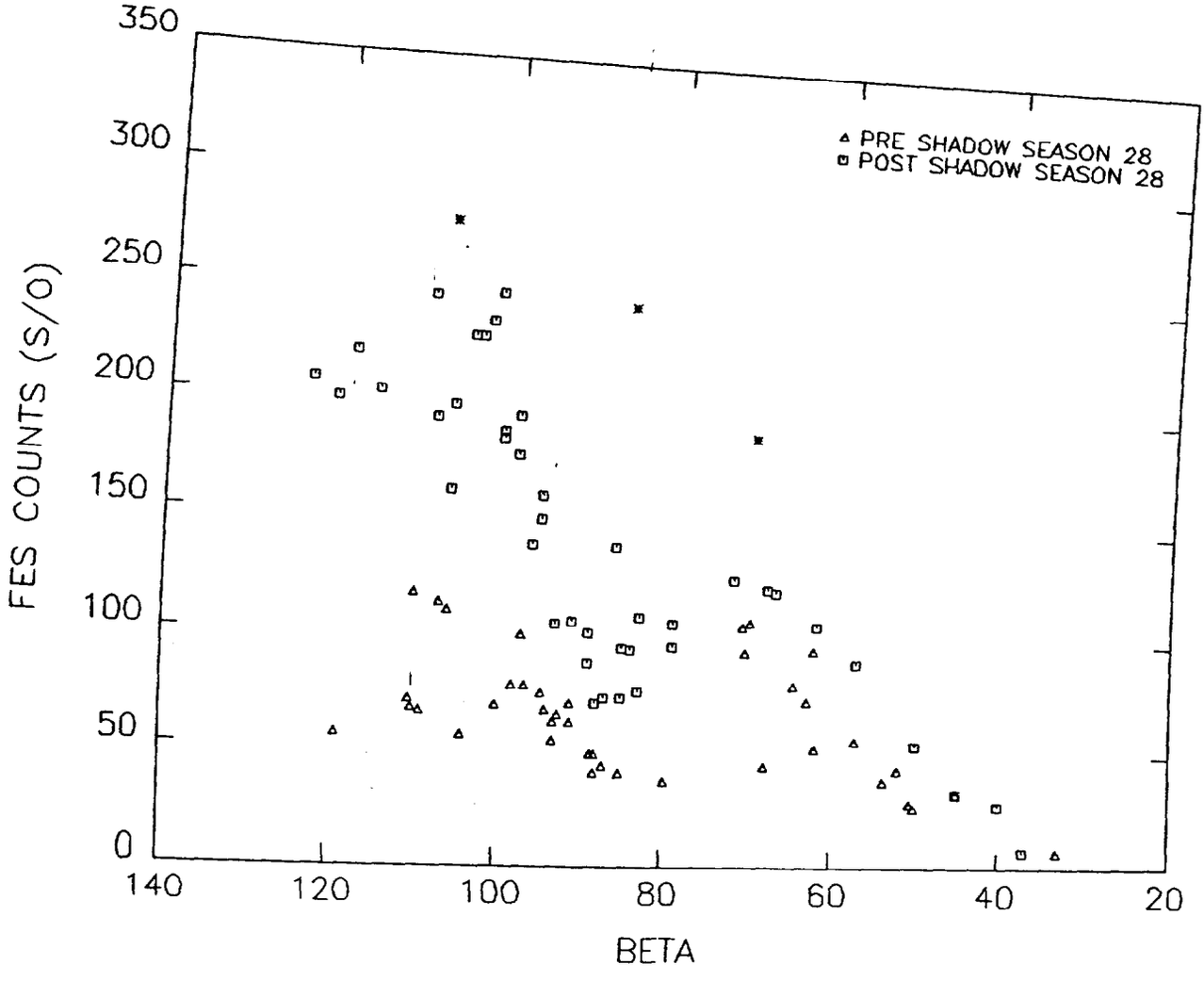

Figure 2. The scattered light measurements between Shadow Season 27 and 28, and after Shadow Season 28.

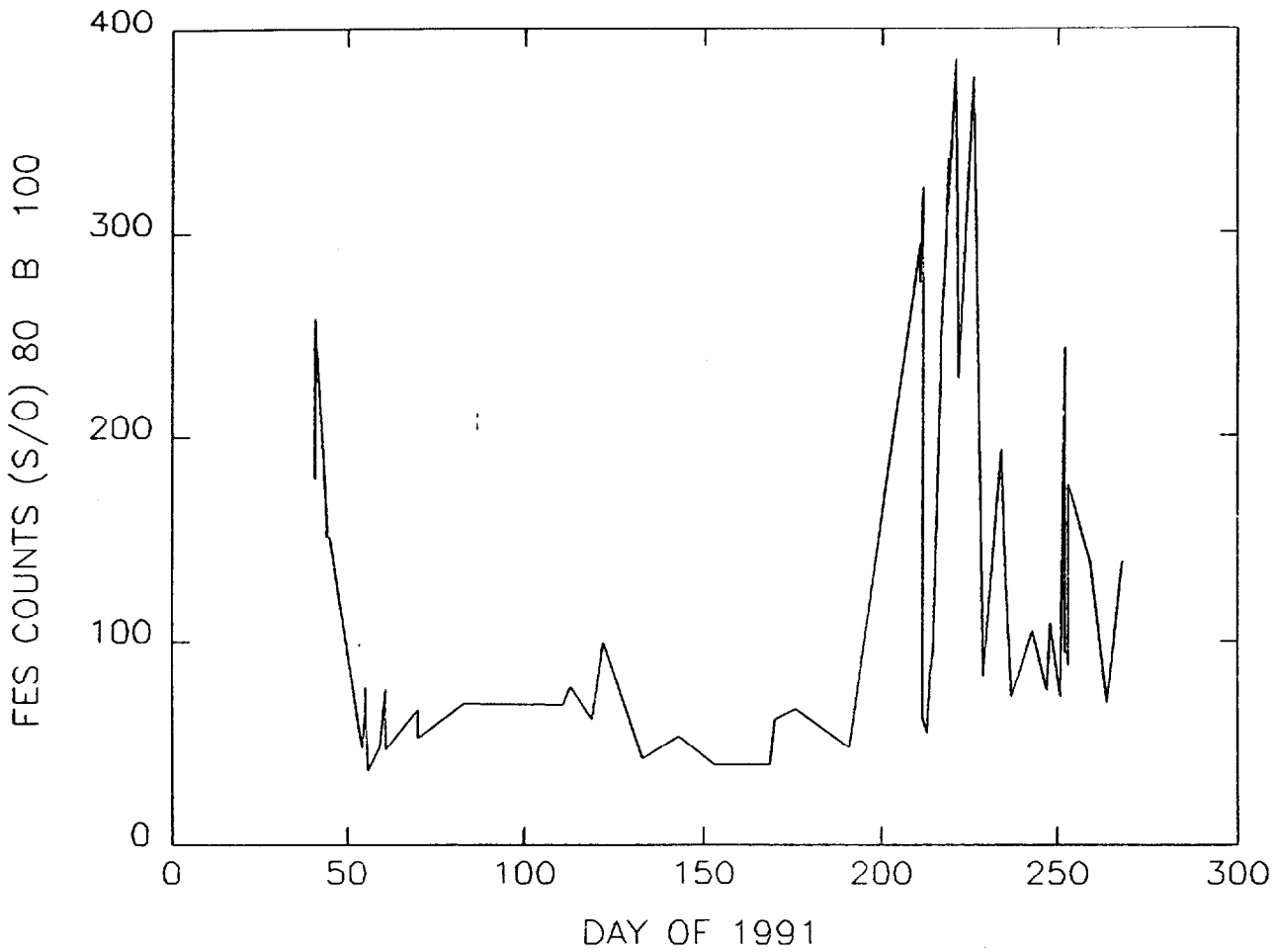

Figure 3. The background counts between β 80 and 100 since Day 38.

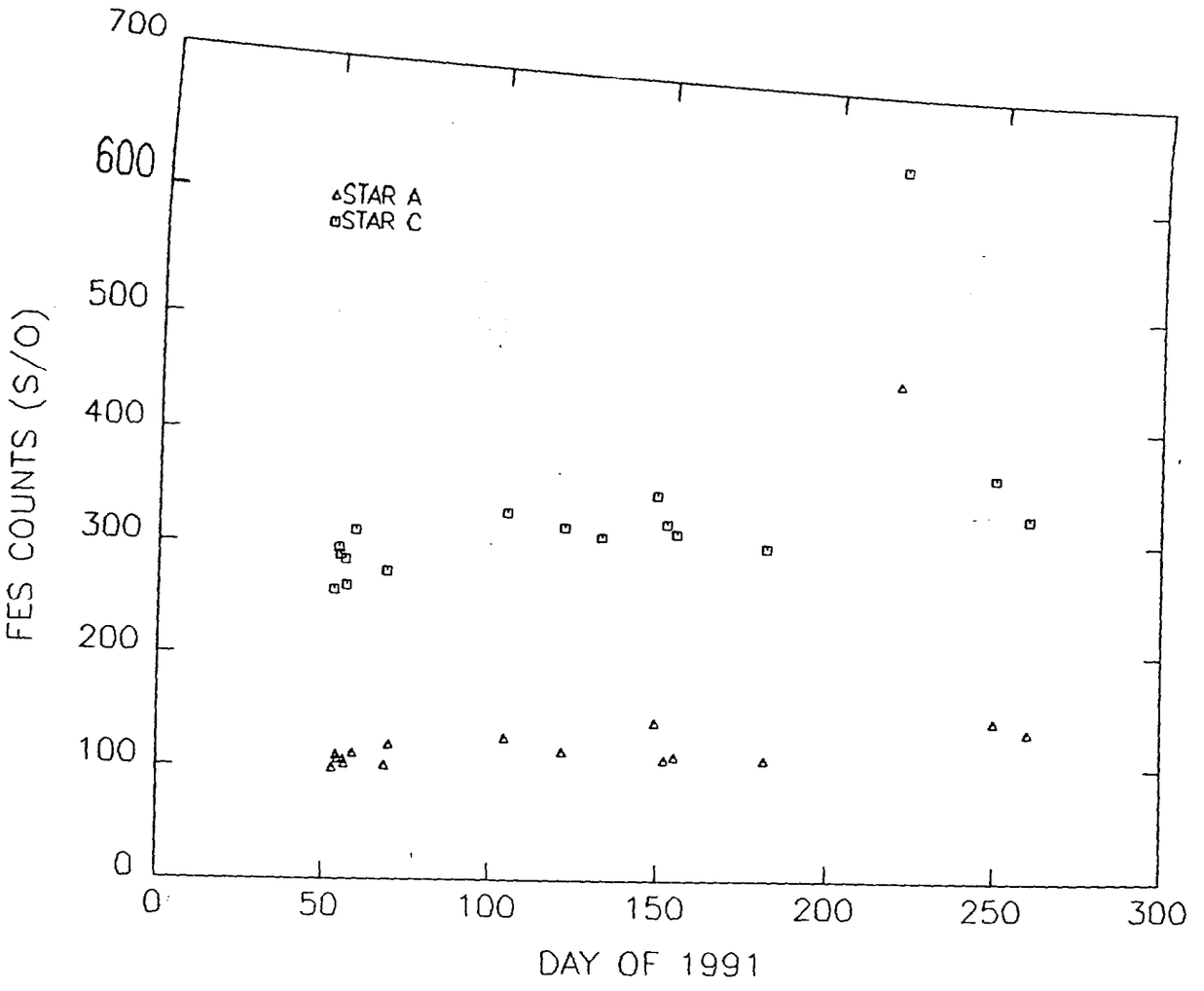

Figure 4. The variations of the North Ecliptic Pole Standard Stars over the course of the FES anomaly.