1989 DAILY RADIATION STATISTICS

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Abstract

The IUE satellite has on board an instrument to detect and monitor the flux of particles which contribute to the increased background and general fogging of long exposure astronomical spectra. This important instrument, called the Flux Particle Monitor (hereafter FPM), has been important in the successful *real time* observing conducted by IUE. This report presents the results of the daily peak radiation values, as recorded by the FPM, for 1989.

1 Introduction

Each day the orbit of the IUE brings the telescope to a perigee distance of 5.6 Earth radii (Fireman, G.F. 1989 NASA IUE *Newsletter* **40**, 30). At this distance the spacecraft passes through the outer portions of the Van Allen belts. Particles (mainly electrons) trapped in the Van Allen belts cause an increase in the fogging rate of the IUE cameras. The rate at which the cameras will fog can be directly monitored by the staff of the IUE observatory using the FPM. The FPM is an Geiger counter type detector, which can detect electrons with a threshold energy of 960 KeV and protons with a threshold of about 15 MeV. The flux of particles which produce the fogging can thus be monitored as a voltage of the FPM. In order to convert this voltage into a fogging rate the following formula is used.

$$DN/hour = constant \times 10^{FPM},$$

where the constant depends on the camera being used, and FPM is measured in volts. For the LWP camera (the most sensitive of the three functioning cameras) the constant has a value of 1.3, and the constant equals 1 and 0.7 for the SWP and LWR cameras (Sonneborn et. al. 1987, NASA IUE *Newsletter* **32**) (note the value for the LWR is for the reduced operating voltage of 4.5 KV, and the values of the constant are for high dispersion).

As IUE operates during the current maximum in the eleven year solar cycle the FPM has become a very important tool in the *real time* observing conducted by the IUE. While the overall trend in the 1989 radiation values has seen a reduction in the daily peak FPM values, the day to day peaks have swung from very low to very high, depending on solar activity. The days of very low radiation can be explained as a compression of the Earths' magnetic field lines by the solar wind. In this case IUE spends more of its time outside the Van Allen belts, and in turn encounters a smaller electron density leading to less fogging of the cameras.

Figure 1 depicts the daily peak values as recorded by the FPM. Several interesting features are present in this plot. The solar rotation period is present during the first 200 days of 1989.

A second prominent feature is the large spike occurring near day 294. This peak marks an intense solar flare with a corresponding high flux of protons (for a more through discussion of proton flares and IUE the reader should see Fireman, this issue). It should be noted that during the large proton flare it was discovered that the FPM was not reading values consistent with the fogging rates of the cameras, the fogging rates were higher then expected, indicating that the cameras were being influenced by particles outside the energy threshold of the FPM. Protons below the 15 MeV threshold of the FPM could affect the IUE cameras (a discussion of the effects of protons on the IUE cameras is given by Imhoff, this issue).

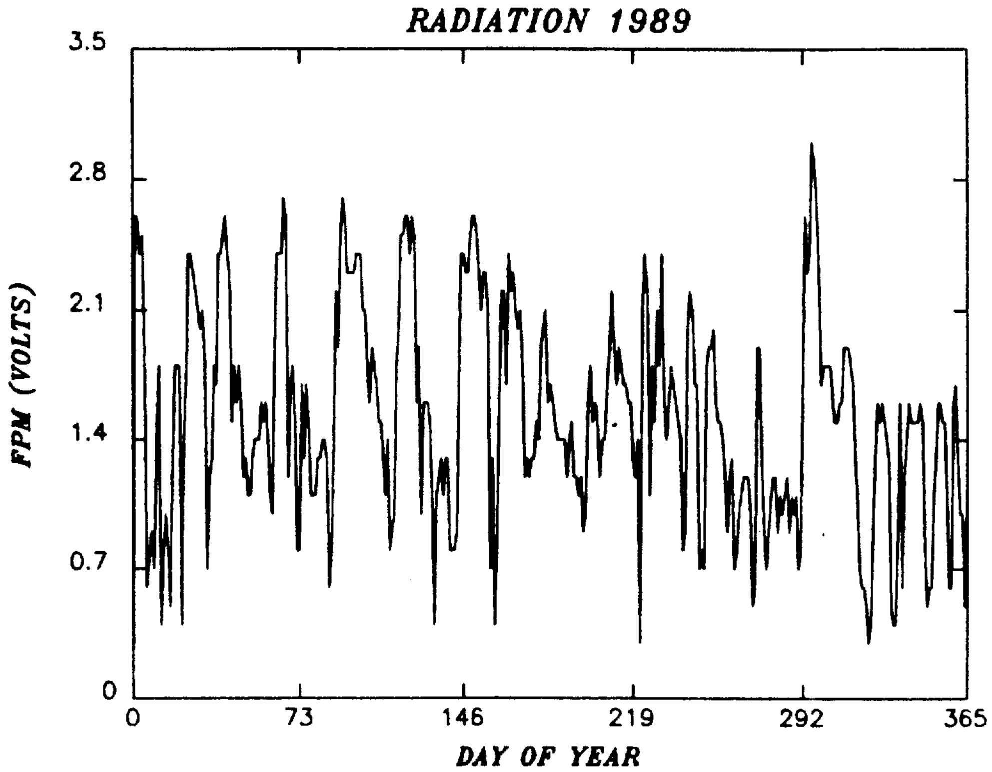

Figure 1
Daily peak values for the for FPM expressed as volts

Table 1(a) shows the number and percentage of days reaching a given peak FPM value for the year 1989. From the table, one can see that on very few days did the FPM reach values much greater then about 2 volts, the exception being those days in October when the sun was extremely active.

Table 1a

Peak FPM	1989 JAN	FEB	MAR	APR	MAY	JUN	Totals No. of Days	%
fpm < 1.0	9	1	4	2	5	3	24	11.5
1.0 ≤ fpm < 1.7	5	17	15	7	13	9	66	41.6
1.7 ≤ fpm < 2.0	6	4	6	5	2	3	26	16.5
2.0 ≤ fpm < 2.4	5	1	1	7	2	13	29	14.8
2.4 ≤ fpm < 2.8	6	5	5	9	9	2	36	15.6
2.8 ≤ fpm < 3.0	0	0	0	0	0	0	0	0
fpm ≥ 3.0	0	0	0	0	0	0	0	0

Peak FPM	1989 JUL	AUG	SEP	OCT	NOV	DEC	Totals for Year No. of Days	%
fpm < 1.0	1	3	8	7	10	8	61	16.7
1.0 ≤ fpm < 1.7	22	13	13	11	14	23	162	44.4
1.7 ≤ fpm < 2.0	6	8	7	6	6	0	59	16.1
2.0 ≤ fpm < 2.4	2	5	2	2	0	0	39	10.7
2.4 ≤ fpm < 2.8	0	2	0	3	0	0	42	11.5
2.8 ≤ fpm < 3.0	0	0	0	1	0	0	1	0.3
fpm ≥ 3.0	0	0	0	1	0	0	1	0.3

Number of Days Reaching Peak FPM Values

Table 1b shows the fogging rate that one could expect from a given FPM level.

Table 1b

Range in FPM	Fogging Rate (dn/hr)
fpm < 1.0	< 10
1.0 ≤ fpm < 1.7	10 - 50
1.7 ≤ fpm < 2.0	50 - 100
2.0 ≤ fpm < 2.4	100 - 250
2.4 ≤ fpm < 2.8	250 - 500
2.8 ≤ fpm < 3.0	500 - 1000
fpm ≥ 3.0	> 1000

Fogging rate for a given FPM

Bear in mind that the FPM values quoted in this report are **daily peak** values. Generally the FPM peaks during the US2 shift, and high radiation lasts for roughly half the shift. Unfortunately the value and duration of the maximum radiation for a given day can not be predicted with any degree of certainty. Observers must wait until the day or two before their observations to see the daily trend. And even then one is never sure until the observation commences.