A GIANT POST-FLARE CORONAL ARCH OBSERVED BY SKYLAB

Zdeněk Švestka

Center for Astrophysics and Space Sciences, University of California at San Diego, La Jolla, California, USA, and SRON Utrecht, The Netherlands

and

Stanislava Šimberová

Astronomical Institute of Czechoslovak Academy of Sciences, Ondřejov, Czechoslovakia

Abstract. The limb event of 13 August 1973, observed by Skylab in soft X-rays, exhibited typical characteristics of the giant post-flare arches observed by HXIS and FCS on board SMM in the 1980s. We present here examples of the processed Skylab images which yield 4 times better angular resolution than the SMM experiments and thus, for the first time, make it possible to distinguish the real fine structure of a giant post-flare arch.

1. Introduction

After the detection of 10 giant post-flare arches in SMM data (see, e.g., Hick, 1988, p. 15), observed either in X-ray continuum below 3.5 Å or in X-ray lines of Mg XI (9.2 Å) and O VIII (20.0 Å), it became obvious that these structures should also have been observed by Skylab soft X-ray telescopes which imaged the Sun in similar energy bands: 2 - 54 Å in the S-054, and 8 - 47 Å in the S-056 experiment. Until recently, however, any search for such structures was unsuccessful, due to the high background of scattered light which did not allow long enough exposure times, and which also does not allow accumulation of images which made these relatively weak structures recognizable in projection on the solar disk in the SMM data (where the background noise was very low).

However, there is one conspicuous event in Skylab data which was observed on the limb, where the background does not have this disturbing effect, and which appears to be essentially the same phenomenon as the giant post-flare arches observed by the SMM. This event occurred on 13 August 1973 and was first detected by Tandberg-Hanssen et al. (1975) who considered it to be a coronal condensation. Later on, Vorpahl, Tandberg-Hanssen, and Smith (1977) and MacCombie and Rust (1979) classified it as a long-duration X-ray event and included it among other eruptive flares with growing systems of loops. However, the event actually has all characteristics of the giant post-flare arches detected by the SMM, as has been demonstrated by Švestka (1991).

2. Characteristics of the Arch

We will mention here the three most essential characteristics which strongly indicate that the event on 13 August 1973 was a giant post-flare coronal arch (see Švestka, 1991, for more extensive evidence):

(1) According to Vorpahl, Tandberg-Hanssen, and Smith (1977), the Skylab feature reached an altitude of 180 000 km. This is an altitude typical for giant arches (cf. Švestka, 1984), but much higher than (post-)flare loops in eruptive flares (e.g., Moore et al., 1980).
(2) The top of the Skylab structure was rising with a very low speed of about $0.55 \text{ km/s}$ which was rather constant for 10 hours (MacCombie and Rust, 1979). While flare loops have higher speeds early in their development, and the speed of their growth is gradually decreasing, giant arches show a wide spectrum of speeds, from less than $0.5 \text{ km/s}$ (Hick and Švestka, 1985) to more than $8 \text{ km/s}$ (Švestka, 1984) and the speed in all observed cases was found to be constant.

Fig. 1. Above: Time development of flux, temperature ($T$), and emission measure ($Y$) in the giant post-flare arch observed by HXIS on board SMM in 3.5 - 8.0 keV X-rays on 6 November 1980 (after Švestka, 1984). Below: time development of flux, temperature, and density (emission measure) in the limb structure of 13 August 1973 observed on Skylab in 8 - 16 Å X-rays (after Vorpahl, Tandberg-Hanssen, and Smith, 1977).