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Solar mass ejections in March 1989

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SOLAR MASS EJECTIONS IN MARCH 1989

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Kinematic features of mass ejections observed on 11 and 13 March 1989 in NOAA 5395 have been investigated. Sequences of H_α filtergrams at time intervals when two X-ray flares occurred were analyzed.

Ejections from the solar surface have an appreciable mass and energy and seem to be associated with periodic processes of energy storage and magnetic field reconstruction in active regions (AR). Solar ejections have been extensively studied, but up to now the role played by mass ejections in flare phenomena is not quite clear in detail.

We investigated kinematic features of ejections observed on 11 and 13 March 1989 in the south part of NOAA 5395. This group was very active and gave many X-ray and H_α-flares and geomagnetic effects when crossing the solar disc. Sequences of filtergrams in the H_α line center and wings up to ± 3 Å at time intervals when two X-ray flares occurred were considered.

On 11 March a N-polarity spot group having a common penumbra was surrounded by a chain of small S-polarity spots (Figure 1). On 13 March the group structure significantly changed and became more complex.

On 11 March near the maximum of 1N/M2.0 flare (N27, E18, 0330-0344-0406 UT) from the region of the small S-spots, plasma clouds were ejected being visible in far blue H_α-line wings. In Figure 1 a schematic drawing of the observed events at 0343 UT is shown. It represents a superposition of filtergrams taken 1.5 Å to the red and 1.5 Å to the blue of the H_α line center within an interval of 15 s. The blue and red plasma clouds are shown by solid and dotted lines respectively. To determine an ejection velocity we used its trajectory observed in the picture plane and its line of sight velocity evaluated by the maximum H_α-intensity contrast of the ejection image. The estimated velocities were several hundreds of km s^{-1} and in some cases reached the escape speed. Between 0321 and 0345 UT a large mass cloud was observed descending into the chromosphere with a velocity of ~ 120 km s^{-1}. Its motion was investigated in more detail.

On 13 March soon after the maximum of the flare 3N/X1.2 (N28, WO2, 0259-0320-0417 UT) a surge ascending with a velocity of about 85 km s^{-1}, increasing its dimension and changing its shape, was observed for 10 minutes. Soon later a diffused cloud was seen further south descending to the solar surface. These ejections seem to move along a big loop beginning in the AR and ending ~ 25–$28°$ to the south from the AR. Between 0340 and 0346 UT near the leading
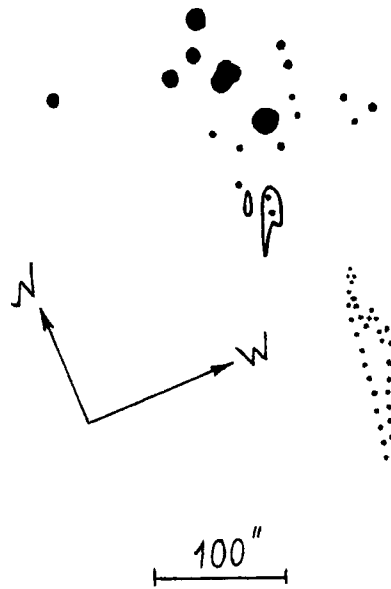
Figure 1 A schematic representation of the observed events at 0343 UT on 11 March 1989.

spot a diffused cloud was seen both in the blue and red H_α-line wings. In this case material seemed to move upward from the solar surface and simultaneously some material fell back along the identical trajectories.

So the kinematic features of the ejections on 11 and 13 March in NOAA 5395 have been investigated at a time when two X-ray flares occurred. The ejections were observed for 6–23^m and had dimensions of 20–170″ and velocities in the range from 50 to 270 km s^{-1}. In some cases the velocities were near to or greater than the escape speed. The greatest speeds seemed to be during the flare peak. The velocities of the front edges, central point and separate mottles were followed. Different ejection details have been established to move with different velocities. The ejections reached heights of 15–30 · 10^3 km above the solar surface and their velocities were inclined to it at angles not greater than 45°. The ejections masses were evaluated to be about 10^{15}–10^{16} g, and energies were 10^{29}–10^{30} erg.