MAGNETIC FIELDS IN FLARES AND ACTIVE PROMINENCES

II: The Field Configuration in some Active Prominences

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Abstract. We study the longitudinal magnetic field in a number of active limb prominences showing fields in excess of 30 G. The objects fall into three groups: surges, caps and active region prominences. There appears to be an upper limit of 150-200 G for the field strength in prominences.

A model of surges is presented in which a pre-surge axi-symmetric magnetic field is established by a line current in the corona. We observe particle acceleration in surges that indicates \( v \times B \neq 0 \) in these objects during periods comparable to the Alfvén transit time.

The strong fields observed in caps seem to run between parts of active regions in accordance with Hale's law of sunspot group polarities.

1. Introduction

The polarimeter at Climax (Lee et al., 1965; Lee et al., 1970) recorded the circular polarization in selected spectral lines which were observed either in absorption on the disk or in emission above the limb. Measurements of circular polarization may be interpreted in terms of the longitudinal component, \( B_\parallel \), of a magnetic field. In a previous paper (Malville and Tandberg-Hanssen, 1969; hereafter referred to as Paper I) we studied the location of some active region filaments relative to the magnetic polarities in plage regions, and showed that the two ends of the prominence terminated in regions of opposite magnetic polarity.

For the present study we concentrate on prominences seen in emission above the limb which satisfy the condition \( B_\parallel > 30 \text{ G} \), averaged over the aperture of 10" by 10". This criterion ensures that the majority of the prominences of our sample are active prominences (Tandberg-Hanssen, 1970), since quiescent objects only occasionally show fields of this strength. For several of the prominences of our sample we also have spectra to help determine whether they are active prominences (Zirin and Tandberg-Hanssen, 1960). During the period of observation, 1968-1972, longitudinal fields were measured at Climax in more than 700 limb prominences. Of these about 2% had internal fields which somewhere significantly exceeded 30 G. We have

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selected nine events for a closer investigation in this paper. Some of them show characteristics related to the active region filaments studied in Paper I. We return to this point later.

The nine prominences may be placed in the following three groups.

(a) Surges: series of surges emanating from a single region; strong He II emission,
(b) Caps: bright, low-lying limb features showing little internal structure in Hz; strongest measured fields,
(c) Active region prominences: more motion and alteration of form than in a normal quiescent, but persistent for several days.

Before proceeding to discuss each of these groups of objects in more detail note that in three years of observations, the strongest measured prominence field was 136 G. This upper limit to the longitudinal component of the field is consistent with the previous work of Harvey (1969) in which the strongest observed field was 200 G ± 100 G. Other studies with the Climax magnetograph (Rust, 1966; Malville, 1968a, b) have similarly failed to measure fields exceeding 150–200 G. The first measurements of magnetic fields in active prominences (Zirin and Severny, 1961) indicated fields of 200 G.

2. Surges

With few exceptions, the quiescent prominences which have been observed with the Climax magnetograph have shown no reversal of the polarity of the longitudinal field across the visible face of the prominence at the limb, (Rust, 1966; Harvey, 1969). The two surge events of August 16, 1970 (Figure 1) and May 26, 1971 (Figure 2)