SOME STATISTICAL PROPERTIES OF ELLERMAN BOMBS

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Abstract. One hundred seventy-eight Ellerman bombs were identified and studied with on- and off-band Hα filtergrams of two active centers, one near disk center and the other near the east limb. The photographs, taken through a ½ Å bandpass filter, occasionally attained resolution as fine as 0.3". The mean duration of bombs at Hα−2 Å was about 13 min near disk center and 11 min near the limb; these times increase slightly when we observe closer to the core of Hα. Eighty-six percent of the bombs in the near-limb region and 56% in the disk-center region were seen to be accompanied by ejections of dark material; the ejections were 3−30" long. The ejection length appears to be proportional to the bomb size times the bomb lifetime.

1. Introduction

McMath et al. (1960) were the first to confirm the identity between Ellerman bombs (Ellerman, 1917), ‘petits points’ (Lyot, 1944) and moustaches (Severny, 1956). An Ellerman bomb is a transient brightening at a point with dimensions of some few hundred kilometers in the solar atmosphere. The spectrum of Ellerman bombs is characterized by very thin and elongated emission wings, called moustaches, emerging from normal Fraunhofer lines. The phenomenon apparently takes place in the low chromosphere at depths in the range 0<τ<0.4 (Severny, 1964). Rust (1968, 1972) and Roy (1973) have pointed out the coincidence of some bombs and surge activity with satellite polarities on maps of longitudinal magnetic fields. Bruzek (1972) found a close connection between bombs and some continuum facular granules.

We investigated properties of bombs such as their lifetimes as a function of wavelength near the Hα line and their position in active regions and their association with material ejection.

2. Observational

Engvold and Maltby (1968) found the intensity maxima (about 5−10% above the local continuum) in profiles of moustaches to occur in the range 0.5−2.0 Å off Hα with strong central absorption. Bombs are hardly visible in the core of Hα because of interposing chromospheric material.

To circumvent this problem, we used high resolution observation (≈½") obtained
with a Lyot birefringent Hα filter having a tunable passband of $\frac{1}{4}$ Å. The filtergrams of two active regions, Mt. Wilson (MW) regions 18468 and 18522, were taken by one of us (JRR) with the 75-cm vacuum telescope at Sacramento Peak Observatory. Table I summarizes the observing parameters. Bomb activity in MW 18468, photographed near disk center, was associated with a small developing region with an arch filament system. The bomb activity in MW 18522, studied near the east limb (Figure 1), appeared related to the growth of the following portion of the active center.

### Table I

<table>
<thead>
<tr>
<th>Region</th>
<th>Magnetic class</th>
<th>Data (1971)</th>
<th>Time of observation (UT)</th>
<th>Position</th>
<th>Length of filter sequence</th>
<th>Wavelength shift from Hα ± 0 Å</th>
</tr>
</thead>
<tbody>
<tr>
<td>MW 18468</td>
<td>βp</td>
<td>6/29</td>
<td>1550–1638</td>
<td>W13 N15</td>
<td>25 s</td>
<td>$-\frac{1}{2}, -\frac{1}{6}, -\frac{1}{8}$</td>
</tr>
<tr>
<td>MW 18522</td>
<td>αp</td>
<td>8/04</td>
<td>1311–1416</td>
<td>E65 S10</td>
<td>20 s</td>
<td>$+\frac{1}{8}, +\frac{1}{10}$</td>
</tr>
</tbody>
</table>

Fig. 1. Filtergram at Hα + $\frac{1}{8}$ Å of region Mt. Wilson 18522 (E65 S10) on 4 August 1971, 1345 UT. About 20 Ellerman bombs are visible.