

THE FORMATION OF A MOAT AROUND A SUNSPOT AS OBSERVED ON LONGITUDINAL-FIELD MAGNETOGRAMS (?)

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In this paper the dynamics of the photospheric magnetic field near the sunspot of the active region McMath 15508 is considered on the basis of longitudinal magnetic field $B_{||}$ magnetograms. The magnetograms were obtained at the panoramic magnetograph of the Sayan Observatory. The time taken to obtain one magnetogram was 5 min. The spatial resolution was 1.8" x 3.6". In the active region McMath 15508 a new bipolar spot group formed westward of the existing sunspot group on September 1; the next day the main sunspots had penumbras, and on September 3 the new sunspot group reached a maximum area and began decaying thereafter.

On September 1 and 2 there was the magnetic field emergence in the new part of the active region, the magnetic field had a bipolar configuration, the orientation of the polarities corresponded to the Hall rule, and the zero line $B_{||}$ ran parallel to the meridian and was shifted toward the preceding sunspot. The magnetic fields of opposite polarities were in close contact with each other until $\sim 5^{\text{h}}\text{UT}$ on September 2; after that, they began to separate, which led to the appearance - at the center of the active region - of areas with $B_{||} \approx 0$. The separation of the polarities means that the formation process of the active region ceases.

On September 2 between $04^{\text{h}}48^{\text{m}}$ and $10^{\text{h}}13^{\text{m}}$ UT there appeared magnetic field "lanes" with $B_{||} \geq 200$ G from the main hill of preceding polarity in the direction toward S and N-E (see Fig. 1). To this hill of $B_{||}$ there corresponds the preceding sunspot of the new sunspot group. A tendency to the formation of an "N-E-lane" was visible as early as at $04^{\text{h}}48^{\text{m}}$ UT on the 30 G isoline. The "S-lane" ran over the southern part of the main magnetic field hill. At $13^{\text{h}}03^{\text{m}}$ UT there exists a third "lane" in

the S-E direction (a tendency to its formation was visible at 10h13^m UT from the 30 and 60 G isolines). By that time the southern "lane" broke and formed a small magnetic field hill. Interestingly, the shape of the leading sunspot at 04h10^m UT on September 2 (see Fig. 1) is similar to that of the magnetic field hill at 14h03^m UT.

The next day, field hills of the same polarity as the sunspot are located around the preceding sunspot along the arc $\sim 180^\circ$ in extent. Three major hills lie at places that coincide with the ends of the "lanes", and one of them (N-E) still keeps its connection with the main magnetic field hill. At that place one can see magnetic features of the size 1.8" x 3.6" and the strength $B_{\parallel} \geq 200$ G. The fourth magnetic hill of a smaller size is located south-westward of the sunspot. It might be supposed that it is formed in the same way as the others. The radius of the arc exceeds twice that of the penumbra. According to the H_{α} -filtergram obtained at the Crimean Astrophysical Observatory, above the three "lanes" there are bright flocculi that are intersected by dark arcs. This means that the magnetic field emergence occurs there. One gets the impression that near the sunspot (or inside the sunspot) jet flows are produced, which carry away the emerging magnetic field loops. When the emergence of the new magnetic field to the surface ceases, this mass motion of the magnetic field along the "lanes" ceases also. In the present case the motion of the magnetic field away from the sunspot started not simultaneously in different directions and lasted ≤ 19 hours.

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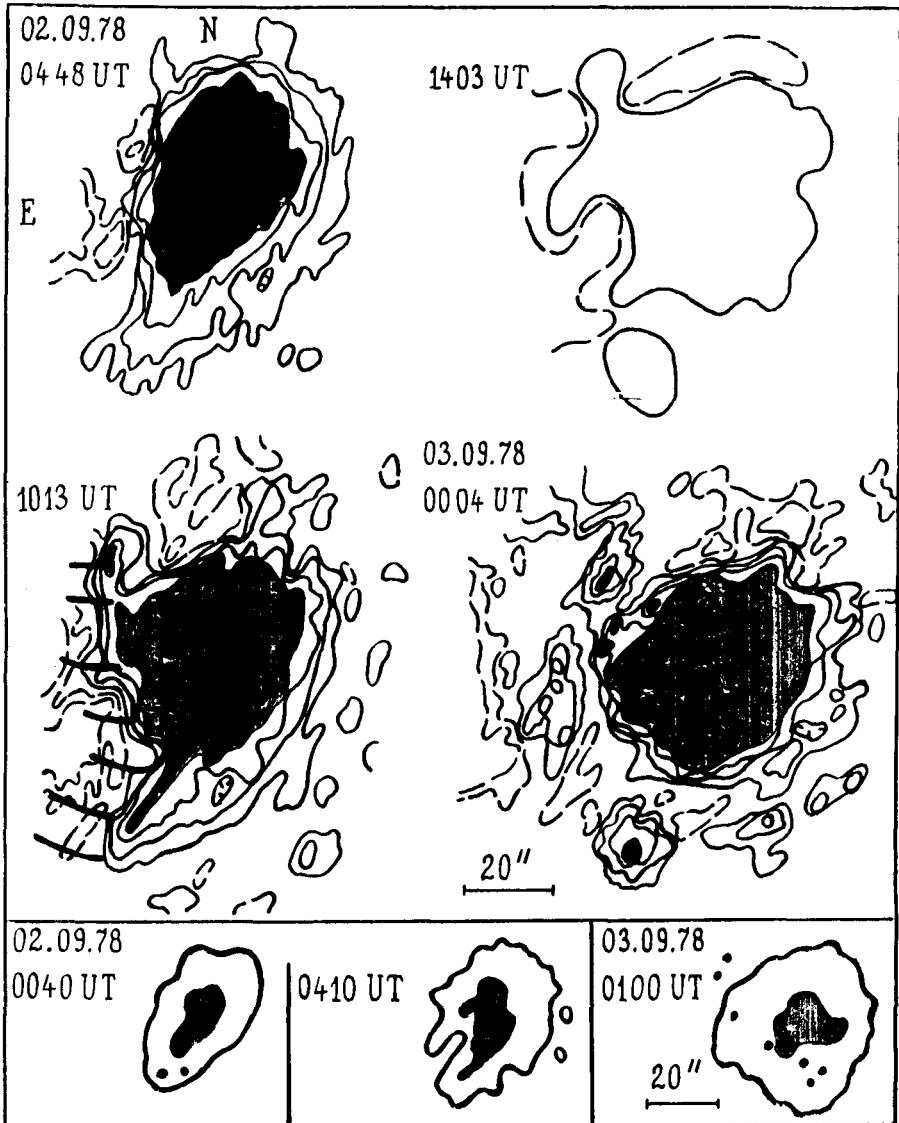


Fig. 1. The $B_{||}$ -maps and white-light images of the W-part of the McMath 15508 active region. preceding polarity, - - - - following polarity, 30, 60, 120 and 200 G isolines. For 14h03^m, contours of $B_{||}$ -hills visible on the magnetogram from the Kitt Peak Observatory, are given ("Solar-Geophysical Data"). The positions of H_{α} -fibrilles are marked on the $B_{||}$ -map for 10h13^m UT.