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Line profiles and magnetic field in the x17.2/4B solar flare of October 28, 2003. Comparison of spectral observations in photospheric and chromospheric lines

V.G. Lozitskiy, N.I. Lozitskaya

Kyiv University Astronomical Observatory, Observatory st. 3, Kyiv, UA−04053, Ukraine
e-mail: lozitsky@observ.univ.kiev.ua, nloz@observ.univ.kiev.ua

The exclusively powerful solar flare X17.2/4B of October 28, 2003 was observed by authors with the Echelle spectrograph of the horizontal solar telescope at the Astronomical Observatory of Kyiv Shevchenko's National University. Stokes I ± V and V profiles of the FeI, FeII, D_3 HeI, D_1, D_2 NaI and Hα lines have been analyzed. The interest was focused on a bright flare knot outside sunspots where the averaged magnetic field B_{eff} measured in the FeI 6302.5 line was 200−400 G and had S polarity. For this place, we have found certain differences between magnetic field strengths measured by "center of gravity" method in different spectral lines, in particular, $B_{eff}(6301.5)/B_{eff}(6302.5) = 0.6$, $B_{eff}(D_2)/B_{eff}(6302.5) = 3.2$, and $B_{eff}(D_3)/B_{eff}(6302.5) = 2.0$. The strongest field values (about 2 kG) were measured by splitting of emission peaks of FeI lines formed near the temperature minimum zone. For instance, the ratios $B_{eff}(5233)/B_{eff}(6302.5) \approx 5$ and $B_{eff}(5528)/B_{eff}(6302.5) \approx 6$ were found. Such essential differences indicate very sharp magnetic field changes in vertical direction, exactly, strong non-monotonous magnetic field distribution versus the depth in atmosphere.

The second interesting effect is the spectral evidences to the subtelescopic magnetic field of 8–10 kG range and opposite (N) polarity. This conclusion follows from anomalous shape of Stokes I ± V and V profiles of FeI 5233 and 5397 lines. We are planning to study this effect in detail using other suitable non-blended lines. The named conclusion agrees with FeI 6301.5/6302.5 data which give evidences of the presence of spatially unresolved mixed-polarity magnetic field structures of kG range on the level of middle photosphere too.