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Comparison of different methods for magnetic field measurements in solar flares

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We present comparative study of magnetic field measurements for several solar flares and a non-flare region. Data of three methods for magnetic field diagnostics were compared: a) classical “center of gravity” method; b) analysis of shape of bisectors in $I + V$ and $I - V$ profiles; c) LTE and non-LTE synthesis of line profiles using Baranovsky's (1993) program.

These methods were applied for interpretation of spectral observations of several flares, namely, of 25 October 2004, 5 November 2004, and 4 August 2005 of importance C7.0/1N, M4.1/1B and C8.4/1N, respectively. The non-flare region in a sunspot penumbra of 22 September 2005 was studied as well (for comparison). About ten spectral lines were used for magnetic fields and thermodynamical conditions diagnostics. We found that results of all the named methods, in general, were in the satisfactory agreement. In particular, “center of gravity” method (a) gives obvious evidences to the sign-changeability magnetic field gradient in vertical direction of flare volume. Contrary, outside flares this gradient is, as a rule, negative, without changes of sign. These conclusions agree with results of method (c). The latter method allows us to obtain magnetic field distribution in vertical direction. It was found that in all the flares one or two narrow magnetic field peaks existed at photospheric high range. Similar peculiarities did not observe outside flares. In addition, analysis of bisectors (method (b)) gives a possibility for small-scale magnetic field diagnostics both in photosphere and chromosphere. From such a study follows that local magnetic fields in chromosphere reach kG range in some bright flare knots.