INDICATIONS OF SUPERSTRONG MAGNETIC FIELDS IN A LIMB SOLARE FLARE AND AN ACTIVE PROMINENCE FROM SPECTRO-POLARIMETRIC OBSERVATIONS IN Hα AND D3 LINES

I.I. Yakovkin[1], V.G. Lozitsky[1]

[1]Astronomical Observatory of the Taras Shevchenko National University of Kyiv, Observatorna St. 3, Kyiv 04053, Ukraine, yakovkinii@gmail.com, lozitsky_v@ukr.net.

We present the indications of super-strong magnetic fields of 10^5 Gauss range in the 14 July 2005 limb solar flare. Such strong fields are found at altitudes of 10–20 Mm during the post-peak phase of the flare and are manifested as highly split peaks (up to 4 Å apart in wavelength) in the far wings of the Hα emission. The study of the Stokes V profiles shows the presence of a significant circular polarization which is antisymmetric with respect to the center of the broad emission. The shape of the Stokes V profiles significantly differs from the dI/dλ intensity gradient profiles which indicates the strong magnetic field regime. Similar spectral phenomena were also observed for a prominence of 12 July 2004 at heights of up to 25 Mm in the He I D3 line. If these spectral features are interpreted as manifestations of the Zeeman effect, the corresponding magnetic field strengths reach up to ~130 kG.

It should be noted that such spectral phenomena are very rare and are not present in the spectra of most flares and prominences, which we illustrate by performing similar analysis for an active prominence of 24 July 1999.

In order to investigate the possibility of interpretation of such highly split spectral features as the manifestation of magnetic fields of extremely high magnitudes we performed a theoretical study of the dependency of the line profiles on the magnetic fields of various strength. The calculations show that the fine structure of the spectral lines at such extremely high magnetic fields results in the profile shapes similar to the observed ones, which suggests that the observed patterns in the Stokes V profiles can indeed be a manifestation of extremely strong magnetic fields.