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Evidence of strong magnetic fields in the active prominence on July 24, 1999 observed at 07:00:10 UT

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The active prominence on July 24, 1999 was already studied by the two authors of this report in a paper published in Advances in Space Research, 2022. Vol. 69, Iss. 12, P. 4408-4418 (DOI: https://doi.org/10.1016/j.asr.2022.04.012). In the mentioned paper, the 6:49 UT moment was considered. It was shown that at the indicated moment the $I \pm V$ and V profiles of the H-alpha line does not reveal clear signs of the presence of particularly strong magnetic fields of the 10^4 G level. Since observational data were also obtained for this prominence at a later time, 07:00:10 UT, here we examined these observational data to test the above conclusion. The observation material for our work was obtained on the Echelle spectrograph of the horizontal solar telescope of the Astronomical Observatory of Taras Shevchenko Kyiv National University.

The prominence spectrum at 07:00:10 UT was slightly different from that at 6:49 UT. At this later time, the H-alpha line was stratified, it contained both a narrow component at a height of 11-13 Mm, and a wide and asymmetric component at a height of 15-20 Mm (Fig. 1).

Fig. 1. General appearance of the H-alpha line in the studied spectrogram in two polarizations corresponding to combinations of Stokes parameters I+V and I-V.

The spectrogram under study was scanned using the Epson Perfection V 550 scanner. The blackening was converted into intensity taking into account the characteristic curve of the photomaterial of the spectrogram and the nonlinearity of the scanner itself. To measure the Zeeman splittings, the $I + V$ and $I - V$ spectra were "tied" by wavelengths using telluric lines.

It was found that the bisectors of the $I \pm V$ profiles are non-parallel to each other in those places of the prominence that correspond to broad emission in the H-alpha line (Fig. 2). This indicates the inhomogeneity of the magnetic field: with a uniform magnetic field, the bisectors should be parallel. Moreover, the maximum splitting of bisectors is observed not only in the core of the line (which was noted earlier by other authors), but also in the far wings, at distances from the center of the line in the range of 1.5-2.0 angstroms.

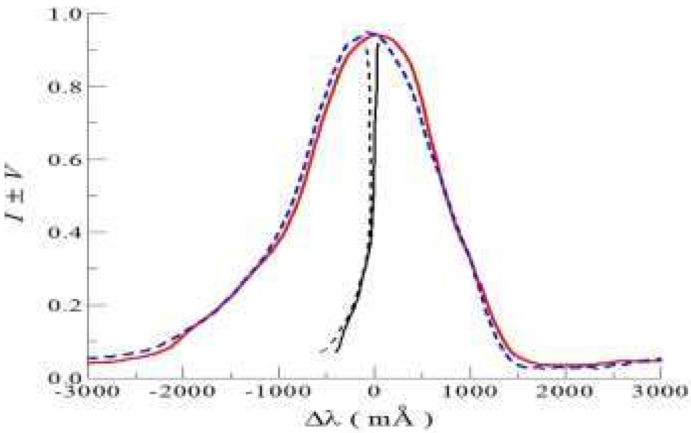

Fig. 2. $I \pm V$ profiles of the H-alpha line in the prominence, which correspond to a height of 15 Mm. It can be seen that the splitting of the bisectors is maximal not only in the core of the line, but also in its far wings. The latter may indicate particularly strong magnetic fields with an intensity of almost 10^5 G.

The specified maximum splitting of the bisectors corresponds to stresses of about 3000 G, but this value should be considered only as a lower estimate of the local magnetic fields. In particular, the second maximum of bisector splitting may indicate that the actual value of Zeeman splitting in small-scale structures with a small filling factor reaches the above value of 1.5-2.0 A. This corresponds to the field value of almost 100 kG, that is, close to those found in the above-cited article. The results of the conducted research are another argument in favor of the reality of such extremely strong fields and indicate that the phenomenon of such fields may not actually be a rare phenomenon, but a rather common one, which, however, can be recorded only under certain favorable observational conditions.

Analysis of the array of discovered exoplanets on the subject of the possibility of the existence of earth-type life

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The analysis of the necessary basic conditions for the origin and development of terrestrial life on exoplanets was presented. Based on information from the open database https://exoplanet.eu, with the help of specially developed software in the Python programming language, the selection from all confirmed exoplanets, as well as from all candidates for exoplanets was made. In the research, the influence of parameters of the exoplanet and external factors on the evolution of exoplanet were analyzed, that is parameters of the star: spectral class of central star and its metallicity; parameters of the exoplanet: temperature of surface, mass, radius and its density; and also orbital parameters of the exoplanet: semi-major axes and its eccentricity. According to our ideas, fulfillment of all these restrictions makes possible the origin of terrestrial life on an exoplanet.

Using the program in Python language, we sifted out unsuitable exoplanets and got the most curious candidates where Earth-like life is possible. These exoplanets deserve more detailed study using, for example, modern telescopes (JWST and others) to analyze their atmosphere.