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Search for superstrong magnetic fields in active processes on the Sun using spectro-polarimetry within 15 angstroms around the D3 line

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We critically review our prior study on this topic (see refer: https://doi.org/10.1016/j.asr.2022.04.012) with a focus on two key points: (i) we extended the wavelength range around the D3 line examined, up to ±15 Å, a significant increase from the previous ±2.5 Å, and (ii) a larger volume of observational data was analyzed, including an additional *X* limb flare. Specifically, our study concerns the 2004 July 12 active prominence and the 2014 June 10 limb flare of X1.5 class. Observational data were obtained with the Echelle spectrograph of the horizontal solar telescope of the Astronomical Observatory of Taras Shevchenko National University of Kyiv. For the mentioned limb flare, we found reliable and oppositely polarized peaks of the *V* parameter located at distances of -4.5 Å and +2.7 Å from the line center. If these features are interpreted as manifestations of the magnetic splitting of the line together with its Doppler shift, than corresponding magnetic field is $\approx 2.2 \times 10^5$ G, and radial velocity -46 km s^{-1}. Similar spectral peaks were found in the active prominence too, but these are situated more symmetrically relative to the line center. For comparison with the theory, the spectral features of the Paschen-Back effect at magnetic fields up to 100 kG were also studied. It turned out that the theoretical width of the splitting components is relatively small, 0.3 Å, while the width of the observed peaks can be significantly larger. This may indicate a considerable dispersion of magnetic strengths and Doppler velocities in regions with particularly strong magnetic fields. On the basis of model calculations, it is shown that alternative explanations for the observational data could be available, which incorporate much weaker magnetic fields (5.5-7.1 kG) and significant macroscopic velocities of varying directions, at the level of 50-60 km s^{-1}.