Taras Shevchenko National University of Kyiv
Astronomical Observatory

Astronomy and Space Physics in the Kyiv University

Book of Abstracts

International Conference

May 25 – May 28, 2021

Kyiv, Ukraine

8300 CCD camera were used for registration of about 8 Å spectral interval near Fe I 5434.5 Å line, where six metal lines are located with effective Landé factors g_{eff} from – 0.014 to 2.14. We found a surprisingly strong expansion of Fe I 5434.5 Å line in the investigated sunspot (at the level of tens of percent) with such interesting detail: largest expansion in line core was observed in sunspot penumbra, whereas peak expansion of line wings was observed in sunspot umbra. The semi-empirical sunspot model has an anomalous feature, namely, the maximum of micro-turbulent velocities in the region of the temperature minimum, i.e. where the minimum of these velocities is located in model of the quiet photosphere. The above features may indicate that the specified expansion of the line profile is due to the magnetic field, and not turbulent velocities. The corresponding estimates, taking into account the very small Landé factor of the line (about 0.01), lead to giant fields at a level of 10^5 G. Similar results were obtained by the authors earlier for another sunspot (Journal of Physical Studies, 2020, Vol. 24, DOI: https://doi.org/10.30970/jps.24.3905).

Comparison of different methods of magnetic field measurements in the solar flares

V. G. Lozitsky[1], I. I. Yakovkin[1], Ye. O. Kravchenko[2], V. P. Tarashchuk[3]

[1]Astronomical Observatory of the Taras Shevchenko National University of Kyiv, Ukraine
[2]Physical Faculty of the Taras Shevchenko National University of Kyiv, Ukraine
[3]Crimea Astrophysical Observatory, Nauchny, Crimea
yakovkinii@gmail.com, eliza.schedrina@gmail.com, lozitsky_v@ukr.net, veratar4@gmail.com

Magnetic fields in solar flares reach at least kilo-Gaussian values, and therefore, their measurements can only be performed on the basis of observations of the Zeeman effect (see, e.g., Yakovkin et al, 2021, https://doi.org/10.1016/j.asr.2021.03.036). Sometimes the Hanle effect is also used to measure solar magnetic fields, but the upper limit of its applicability is about 10^2 G . The Zeeman effect manifests itself in the splitting of spectral lines into a number of components and in the corresponding polarization of the splitting components. The complete separation of the Zeeman components is sometimes observed only in sunspots. In solar flares, as a rule, broad emissions are observed at the level of the chromosphere and solar corona, which leads to incomplete splitting of the components in the Zeeman effect. In this case, it is not the modulus of the magnetic field that is measured, but a value close to the longitudinal component, but only in a uniform magnetic field. In the case of an inhomogeneous magnetic field of the type of a set of discrete flux tubes, the measured value of the magnetic field turns out to be the smaller, the smaller the filling factor of the flux tubes. Additional difficulties in measuring local fields arise at different magnetic polarities in spatially unresolved flux tubes. In this case, the characteristic polarization in the Stokes parameters Q, U and V can be close to zero, but significant changes in the Stokes I parameter can be observed. Analyzing the corresponding line profiles, it was shown that it is possible to obtain an anti-correlation of kinetic temperatures and turbulent velocities (Yakovkin & Lozitsky, 2020, https://doi.org/10.18524/1810-4215.2020.33.216453). It was shown that this physically unrealistic anti-correlation may indicate the masked presence of very strong magnetic fields of 7-8 kG in the flare. An indirect estimate of magnetic fields is also possible from data on the temperature and concentration of particles in a flare (Tsuneta et al., 1984, Astrophys. J. 284, 827-832.). This method also produces very strong fields in some cases. In particular, in a very powerful solar flare on October 28, 2003 of X17.2/4B class, a very thin layer (3-5 km) was found in the chromosphere, where the concentration of neutral hydrogen reached 10^{18} cm^{-3} (Lozitsky et al. 2018, https://academic.oup.com/mnras/article-abstract/477/2/2796/4950618). If we apply the method of Tsuneta et al. (1984), then we obtain a magnetic field of about ~9 kG. Thus, both direct and indirect methods of measuring magnetic fields in flares result in magnetic field values that sometime exceed the well-known fields in sunspots.

Influence of reflected protons on the low-frequency turbulence excitation in the Earth bow shock foreshock region.

P.P. Malovichko, Yu.V. Kyzyurov

Main Astronomical Observatory, NAS of Ukraine, Kyiv, Ukraine

The key issue in understanding the processes of the pre-shock region formation is to explain the mechanisms of wave generation. There are different mechanisms for the low-frequency waves generation - resonant, current, compensated current, anisotropic, gradient instabilities. Of particular interest among them are instabilities that can lead to the Alfvén