VELOCITY FIELD IN A SMALL SOLAR FLARE

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The temporal variations of the line-of-sight velocities have been revealed in a small flare during its main phase. The measurements were made in 34 Fraunhofer lines formed in different photospheric layers. The downflow was observed in the photosphere 4 min after the chromospheric flare peak with the maximum velocity followed 12 min later. The largest velocity variations (up to 1.6 km/s) occurred in the layer 180–220 km. An enhancement of 5-min velocity oscillations was found.

INTRODUCTION

Fisher [3], Somov *et al.* [5], Livshits *et al.* [4] predicted the formation of the chromospheric condensation during impulsive phase of a solar flare. The condensation propagates from the upper into the lower solar atmospheric layers. The radial velocities of the downflow derived in [1, 2] from the Balmer lines were about 30 km/s, 20 km/s from the CaII K line, and 10 km/s from the NA–D_2 line. The velocity diminished with the depth. It is interesting to study the variations of the motion velocities at the photospheric level. In this paper we present the results of the investigation of the matter of the motion changes in the active complex Mc Math 16025+16030 during the main phase of small flare.

OBSERVATIONAL DATA

The flare under the study was of importance sf, it occurred on May 24, 1979 near the solar disk center at 12:56 UT and ended at 13:29 UT, the intensity maximum of the H_α line was reached at 13:02 UT. The spectral observations were made with the solar horizontal telescope ATsU–5 of the Main Astronomical Observatory, of the NAS of Ukraine. The first spectrogram was taken at 13:03.4 UT and the last one – at 13:27.8 UT. Fourteen spectrograms were received with about 1.5–min time intervals. The spectral regions $\lambda\lambda$ 541–543, 588–593, 629–633, 653–659 nm chosen for the investigation included 34 Fraunhofer lines FeI, TiI, CrI, SiI, NiI, CaI, CrII, TiII, and the H_α line. The lines are formed in photospheric layers from 100 to 500 km, they have different intensities and excitation potentials. Besides, we used the spectrum of the quiet photosphere for the comparison. Both the quiet photosphere region and flare kernel area were at the same distance from the disk center. Photometric sections of the spectra were made at the sites of the intensity maximum of the H_α line.

THE LINE–OF–SIGHT VELOCITY VARIATIONS

The line shifts in the AC spectra were determined with respect to their positions in the spectra of the quiet photosphere using telluric lines. In the AC spectra the lines are red–shifted. The line–of–sight velocity changes derived from Doppler shifts of the line core centers in the AC spectra. The largest measurement error was 0.17 km/s. The downflow was observed in the photosphere and chromosphere, its velocity changed both in height and time during the flare. The downward chromospheric motion of about 6 km/s is found from the H_α line obtained at the first observational moment. The downward velocity decreased to 4 km/s during this flare phase.

The velocity deviations reached 0.8 km/s in the upper layers (300–500 km) of the photosphere in the beginning of the observations, 1–4 min after intensity maximum of the H_α line. By the end of the flare they had diminished till 0.35 km/s. The variations of the line–of–sight velocity in the lower layers increased from 0.4 km/s to 0.9 km/s during this time interval. Such changes may be caused by the spread of the flare disturbance from the upper to lower photospheric layers. Possibly, this disturbance is the photosphere response to the passage of the chromospheric condensation and propagation of waves.

In the middle photosphere there was the layer with especially sharp velocity changes (up to 1.6 km/s) at the heights of 180–220 km. This layer is the transition region between the photospheric zones with convective and wave energy transfer.

The variations of the line–of–sight velocities had an oscillatory character with the period of a few minutes in the middle and lower layers. The amplitude of the oscillations was various at different levels: in the upper layers – about 0.6 km/s, in lower ones – about 0.8 km/s, and in layer 180 – 220 km – 1.4 km/s. It is known that the velocity amplitude of 5–min oscillations for the quiet photosphere does not exceed 0.3 km/s. In active regions its value is still less, therefore, it is possible to admit that the increase of the velocity oscillation amplitude obtained is due to influence of the flare disturbance.

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