sources of hard and soft x-ray emission in solar flares: mhd simulation

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Primordial energy release during the solar flare on height 15000–30000 km is explained by appearance of the current sheet in the magnetic field of the solar corona above the active region. The energy ~1032 erg, which is necessary for solar flare is accumulated in the magnetic field of the current sheet. Fast energy release at the current sheet transfer to unstable state causes the observational manifestations, which are explained by the electrodynamical model of the solar flare. The model is based on the observations and on the results of numerical magnetohydrodynamical simulations. At the numerical simulations it is not used any assumptions about the solar flare. All initial and boundary conditions are taken from the observations. To stabilize numerical instabilities the specially developed finite-difference scheme is used, which is realized in the numerical code PERESVET. According to electrodynamical model the source of soft thermal X-ray emission must appear in the current sheet due to plasma heating at magnetic field dissipation. The source of hard beam X-ray emission is located in the place of crossing with the solar surface of magnetic lines which are enter from the current sheet. They appear as the result of electrons beams interaction, which are accelerated in field-aligned currents, with dense plasma of low layers of solar atmosphere. Electrons acceleration is caused by the Hall electric field in the current sheet. The method of search of current sheet position is developed. It is based on the property of the current sheet according to which the maximum of absolute value of the current sheet density is located in the center of the current sheet. The current sheet position, which is found, is coincides with the observed position of soft X-ray source for flare May 27, 2003 at 02:53 which is occur in the active region NOAA 10365. To search the source of hard X-ray emission the system permits to draw projections of magnetic lines in arbitrary chosen plane. The Figure demonstrates coincidence with precision of several angle seconds of the hard X-ray source position with points of intersection of magnetic lines, which are passed near the current sheet on the small distance (~3000 km), with the solar surface. The projections of such three lines on the plane, which is perpendicular to solar surface, are shown on the left panel. On the right panel the places of intersection of lines with the solar surface are marked by sign + on the map of observed hard X-ray, obtained by spacecraft RHESSI (http://rhessidatacenter.ssl.berkeley.edu).

