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Time profile of the 2.223 MeV gamma-line emission and some features of the 16 December 1988 solar event in conception of a flare magnetic loop

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We continue to study the formation of 2.223 MeV gamma-ray line arising from solar flare neutron captures on hydrogen at the photospheric and adjoining levels. Time history of the 2.223 MeV emission depends on a number of characteristics of the flare and surrounding medium. Applying the results of model simulations to the solar flare 2.223 MeV line data and involving also the 4-7 MeV data enables us to deduce the most probable solar plasma density altitude profile in the period of a flare and the spectral index of accelerated initial charged particles. It is also possible to determine both parameters in dynamics during the flare.

Preliminary application of the method to the third (last) gamma-emission peak of the 16 December 1988 solar flare (by the SMM/GRS data) leads us to the conclusion about some density enhancement in the entire thickness of the photosphere in the period of this burst - so that the density at the top of photosphere is one order higher than in the standard model of quiet photospheric density. Also, the density enhancement is found to be absent during the rising phase of gamma emission, and it appeared only with the beginning of the decay phase.

Energy spectrum of accelerated particles (protons) was shown to evolve during the third gamma-emission burst. Specifically, assuming stochastic mechanism of acceleration, or Bessel spectrum presentation, the characteristic spectral parameter (a product of energy gain rate by effective time of particle containment in the acceleration vol-

ume) was found to be 0.03 if averaging on the total burst duration. At the decay stage of the burst, this parameter increased from 0.005 to 0.1 with the time, i.e., the proton spectrum has become harder. From the other hand, at the rising phase the spectrum is harder than at the beginning of the decay phase.

In the present work we improve our model: we make allowance the flare charged particle motion in a flare magnetic loop. These conditions lead us to the secondary neutron emission with determined energy, angular and altitude distributions. We apply the consideration to the analysis of the 16 December 1988 solar flare and compare results with the previous conclusions.