

High-Energy Emission Measurements of the 20 January 2005 Solar Flare onboard CORONAS-F

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The Solar flare of 20 January 2005 (X7.1/2B) was detected by the SONG instrument onboard the CORONAS-F observatory during its passage near Earth equator which allowed us to observe a significant gamma-ray emission in 0.05 - 300 MeV energy range during time interval 06:43:30-06 54:00 UT on the very low background level. Four different phases can be distinguished in the time curves of the emission. During the first phase of slightly more than a minute (named phase A), a bremsstrahlung continuum up to photon energy 20 MeV and the indication of the intensity of pion-decay gamma-ray emission not more $1\cdot 2\cdot 10^{-4}\text{cm}^{-2}\text{s}^{-1}\text{MeV}^{-1}$ are observed. The phase B shows an abrupt increase of high-energy gamma-ray emission up to photon energy 300 MeV at 06:45:37 UT with the rise time not more than 100 s. The shape of the emission spectrum allows us to attribute high-energy emission to neutral pion decay, implying ion acceleration up to at least 300 MeV. The delayed 2.222 MeV neutron capture line was also measured in phase B. A slow decline of continuum emission, pion-decay emission and 2.222 MeV line-emission is measured in phase C until 06:53:30 UT. Close to the end of the flare a new acceleration episode of electrons up to 200 keV took place. CORONAS-F observations of the gamma-ray emission with the characteristic spectrum of pion-decay process gave a unique opportunity to compare the acceleration time of protons with $E_p > 300 - 400$ MeV to the release time of high-energy protons measured at ground level by the neutron monitor (NM) network. Proton arrival time to the Earth is consistent with the time of pion decay high-energy gamma-ray emission appearance at the Sun. While CORONAS-F is moving along its orbit from the equator to the high magnetic latitudes SONG begins to measure high-energy protons at the magnetic shell $L \sim 1.35$, that corresponds to proton energy ~ 6 GeV. The NM network observations show also that the highest energy of protons accelerated in this flare was about 6 GeV.