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A SYNCHROTRON/INVERSE COMPTON INTERPRETATION OF A SOLAR BURST PRODUCING FAST PULSES AT 3 MM AND HARD X-RAYS

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ABSTRACT. The recently discovered new class of solar burst emission component exhibiting very fast pulses (durations ≃ 60 ms) at mm-wave ($\lambda \lesssim 3$ mm) and at hard X-rays, poses serious constraints for interpretation. Ultrarelativistic electrons are likely to be accelerated in order to produce su a high turnover frequency. The time scales appear to be too small to be explained by synchrotron losses, or by bremsstrahlung producing hard X-rays, unless extremely large ambient plasma densities are assumed. In the present interpretation we combine earlier suggestions on a synchrotron emission component to explain "white-light" flare emission (Stein and Ney, 1963), and on hard X-rays produced by inverse Compton process (Shklovsky, 1964). The mm-wave emission is in the optically thick part of a spectrum peaking somewhere in the infrared range of frequencies, and the electron energies are reduced primarily by inverse Compton quenching on the synchrotron source photons. The model explains self-consistently the X-rays/sub-mm flux ratio and the short time scales. According to this interpretation, the burst sources must be short lived (~ 60 ms), very small (~ 10^6 cm) and with high brightness temperature (~ 10^{10} K). As these sources vanish, the electrons decay into lower energy levels and might still be able to produce the better known longer lasting emissions at microwaves and X-rays. This study raises the need of further theoretical studies on the nature of the primary accelerating sources, on their location in the solar atmosphere, and on the relative contribution from other loss mechanisms intrinsic to primary bust source. A number of crucial observational tests are needed, specially in the sub-mm and infrared simultaneous high spatial and time resolution.

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