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Roles of nonthermal distributions in generating solar radio bursts

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Nonthermal solar radio emissions are produced by collective processes and by incoherent single-particle processes, both of which depend sensitively on the electron distribution function present. For example, metric type II and III bursts are produced by the collective ``plasma emission'' processes, while decametric and metric continua are produced by (incoherent) gyrosynchrotron emission. Kappa electron distributions, which appear power-law at high energies, qualitatively alter the spectral shape for the incoherent processes and increase the total flux (due to the increased number of high energy electrons). Kappa distributions are also vital for collective processes, due to the increased number of fast electrons (and so energy available) and also due to the greatly increased level of the nonthermal background distribution on which is superposed the distribution of fast particles producing Langmuir waves and thence radio emission.

These reasons are illustrated for type II bursts. For type II bursts the level and frequency-time structures (above background) of predicted radio emission change qualitatively when kappa rather than Maxwellian background electrons are assumed, due to the increased numbers of fast electrons reflected by the type II shock.