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High frequency electron/electron modes in solar plasma: linear approach

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RHESSI and the spacecraft observations have shown that during solar flares a large amount of nonthermal electromagnetic radiation, up to the $\gamma-$ray range, is emitted from the corona. This implies the generation of energetic electron beams, eventually radiates X-rays through bremsstrahlung mechanisms. Kinetic turbulence exited by two-electron-streams (current-neutralized) configuration can essentially modify the distribution function and, consequently, generate emission. To understand the development of beam-plasma instability, we perform parametric studies by means of linear stability analysis in a wide range of possible parameters (density, temperature, velocity ratio). Earlier work in analysis of plasma-beam systems concentrated mainly on a limited one-dimensional case with a highly diluted electron beam, which was justified by the fact that the maximal linear growth rate of beam-driven mode is in parallel to the beam propagation direction (magnetic field). In this work, we study the linearly unstable modes of beam-plasma configuration with different densities, and also the general electromagnetic three-dimensional magnetized plasma, i.e. for arbitrary propagation angles, referred to the direction of magnetic field and drift velocity. In this configuration, in addition to the well-studied Langmuir mode, different high-frequency modes such as electron-acoustic waves become unstable as well. We discuss the possible role of such instabilities for generating the observed X-ray radiation.