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A New Ion beam Instability, Its Connection to Electron Beam Instabilities, and Radio Emission Driven by Shocks

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Decades of observational evidence and theoretical analyses demonstrate that shocks can accelerate beams of electrons and ions into their upstream regions and that these particles drive multiple types of plasma waves, including Langmuir and ion acoustic waves. In addition, the electrons and Langmuir waves often lead to the production of radio emission near the electron plasma frequency f_p and near $2f_p$. This presentation is in three parts. The first is a new theoretical description of a so-called "reactive" or "fluid-type" instability for the growth of ion acoustic waves by a cold, relatively, slow ion beam. Although investigated here in connection with NASA Parker Solar Probe observations near the Sun, this instability may also be relevant in foreshock regions upstream of shocks. The second part demonstrates that the new ion acoustic instability has the same theoretical form as the reactive or "cold" electron beam instability for the growth of Langmuir-like waves on a closely beam-like mode with $\omega \approx \mathbf{k}.\mathbf{v}_b$. The third part describes the production of f_p and $2f_p$ radiation upstream of Earth's bow shock, produced from Langmuir waves driven by shock-accelerated electron beams. The particular focus is to predict the shape of the radio sources. These predictions are also relevant to solar and interplaneyary type II solar radio bursts.