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Generation of f_p and 2 f_p radiation in Earth's foreshock

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Earth's foreshock is well known to produce radio emission near the electron plasma frequency f_p and near $2f_p$. Conventionally the radiation is interpreted in terms of linear or nonlinear conversion of Langmuir waves driven by electron beams. This paper reviews theories for producing electron beams, Langmuir waves and f_p and $2f_p$ radio emission, integrates them into a semi-quantitative theory for the radiation, and compares the theory with observational data. Particular foci include (i) the role of stochastic growth theory (SGT) in producing the observed Langmuir field statistics and predicting the energy flow from electron beams into, (ii) the relative ensemble-averaged efficiencies and roles of linear mode conversion and nonlinear three-wave Langmuir wave processes in producing radio emission, (iii) the integrated theory predicting $2f_p$ fluxes within a factor of 10 of those observed by Geotail, Wind, and the ISEE spacecraft, and (iv) the solar wind conditions for large radiation levels. New theoretical predictions for foreshock f_p and $2f_p$ radiation from the other planets are also summarized: in decreasing order, Earth, Mercury, and Jupiter are predicted to have the most easily observed foreshock radiation.