An Experimental Study on Intense Relativistic Electron Beam Driven Strong Turbulence

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We observed, by using spectroscopic and particle diagnostics, that an unmagnetized plasma became a strong Langmuir turbulence state when an intense relativistic electron beam was injected into it. From Stark shift measurements the high frequency electrostatic fields of as high as about 100 kV/cm were found to exist in the plasma. Using a plasma satellite method to measure the high frequency electrostatic fields at the same time, we found that the strong field regions occupy a few percent of the beam volume. Measurements of the energy broadening and the angular spread of the beam electrons after passing the plasma supported the results of the spectroscopic measurements.

We also observed high-power broadband microwave radiation with frequency above the plasma frequency. We found that the strong Langmuir turbulence was a necessary condition for the radiation, and that the wider the energy and angular spreads, the stronger the microwave radiation. It was also found that a ratio of the plasma density to the beam density was an important parameter for the microwave radiation, although the reason is not yet clear.