Laser experiment for solar radio emissions

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Electron beams from solar eruptions or interplanetary shocks produce intense radio emissions, mostly at the plasma frequency ω_p and its harmonic $2\omega_p$. It is generally accepted that electron beam instabilities initially drive Langmuir waves, but the conversion mechanism to radio-emission is debated. In particular, we study one scenario for the emission at $2\omega_p$: the Langmuir decay instability scatters Langmuir waves on ion acoustic waves, then the resulting counter-propagating Langmuir waves beat together to form an electromagnetic wave at $2\omega_p$.

In the solar wind, few experimental measurements are available at the source of the radio emissions. Our study achieved for the first time a characterization of the $2\omega_p$ emission in the laboratory, from a laser-plasma interaction experiment on the LULI2000 laser facility. Instead of an electron beam, a high-energy nanosecond laser produced Langmuir waves (by simulated Raman scattering) which, in turn, produced emission at $2\omega_p$. The experimental measurements provide insights on the source of this emission, on its directivity and polarization. It is supported by combined large-scale hydrodynamic and particle-in-cell simulations.