

Description of the supplementary material

Video 1 shows a shorter version of the simulation of the beam with electron density $n_b=1 \times 10^9 \text{ m}^{-3}$ (Table 2), which is simulated in section 3.1. The top panel shows the time evolution of the total electric field (E_t^2 defined in section 2). In this panel is also placed the theoretical Langmuir decay threshold (blue line) given by the Eq. (3) and the parameters described in section 3.1. The second panel from the top shows the background ion density variation ($\Delta n_i(x,y)$). The third panel from the top presents the background electron density variation ($\Delta n_e(x,y)$). The bottom panel shows the electric field ($E(x,y)$). It is possible to observe enhancement in the variations of the background electron density which imply enhancement of Langmuir waves. It is also possible to observe enhancement in the variations of the background ion density, which imply Langmuir decay process and enhancement of ion acoustic waves. The enhancement of the ion acoustic waves starts around the time when the total electric field crosses the theoretical Langmuir decay threshold ($t \sim 36 \mu\text{s}$).

Video 2 shows a shorter version of the simulation of the beam with electron density $n_b=5 \times 10^9 \text{ m}^{-3}$ (Table 6), which is simulated in section 4. The top panel shows the time evolution of the total electric field (E_t^2). In this panel is also placed the theoretical Langmuir decay threshold (blue line) given by the Eq. (3) and the parameters described in section 4. The second panel from the top shows the background electron density variation. The third panel from the top presents the background ion density variation. The bottom panel shows the electric ($E(x,y)$). It is possible to observe enhancement of the variations of the background electron density which imply Langmuir wave enhancement. No enhancement is observed in the variations of the background ion density, which imply that Langmuir decay process is not triggered. The total electric field never crosses the Langmuir decay threshold.