Equilibrium statistical mechanics of self-consistent wave-particle system

YVES ELSKENS\textsuperscript{1}, umr6633 CNRS-univ. Provence, Marseilles (FR)

The equilibrium distribution of $N$ particles and $M$ waves (e.g. Langmuir) is analysed in the weak-coupling limit for the self-consistent hamiltonian model

$$H = \sum_r p_r^2/(2m) + \sum_j \omega_j I_j + \varepsilon \sum_{r,j} (\beta_j/k_j) \cos(k_j x_r - \theta_j) \quad [1].$$

In the canonical ensemble, with temperature $T$ and reservoir velocity $v < \inf_j \omega_j/k_j$, the wave intensities are almost independent and exponentially distributed, with expectation

$$\langle I_j \rangle = k_B T/(\omega_j - k_j v).$$

These equilibrium predictions are in agreement with Monte Carlo samplings \textsuperscript{[2]} and with direct simulations of the dynamics, indicating equivalence between canonical and microcanonical ensembles.

\textsuperscript{1}Y. Elskens and D.F. Escande, Microscopic dynamics of plasmas and chaos (IoP publishing, Bristol, 2003).

\textsuperscript{[2]} M-C. Firpo and F. Leyvraz, 30th EPS conf. contr. fusion and plasma phys., P-2.8 (2003).

\textsuperscript{1}elskens@up.univ-mrs.fr