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# Plasma-based Mass Separation by Oscillating Electric and Magnetic Fields

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Standing or evanescent electromagnetic waves can accelerate charged particles by the ponderomotive force. This is demonstrated by solving the equation of motion for an arbitrary phase between the electric and the magnetic fields of the wave. Under forces by the electric and magnetic fields of a uniform-in-space travelling wave, the velocity and energy of charged particles oscillate with no net energy exchange. However, if the phase between the electric and magnetic field is as in a standing (or evanescent) wave, charged particles can be accelerated. Such a secular term of the particle velocity evolves in a magnetized plasma, when an additional steady magnetic field is present, but also in an un-magnetized plasma, in the absence of such a steady field. In both magnetized and un-magnetized plasma, the direction of acceleration is mass dependent. The direction of acceleration depends on whether the cyclotron frequency of the particle in the steady magnetic field is larger or smaller than the wave frequency. Schemes for mass separation can be proposed based on the different dynamics of particles of different mass. For a significant yield, the space-charge fields of the plasma have to be considered. A shear Alfven wave can be used. Contrary to previous analyses, we calculate the dynamics by including ionization and plasma flow. Possible configurations for mass separation for industrial needs, based on the ponderomotive force, will be discussed.

# Bio – Amnon Fruchtman

Amnon Fruchtman is Professor at the Physics Department of H.I.T. - Holon Institute of Technology. He earned his B.Sc. from Tel-Aviv University and his M.Sc. and Ph.D. (1984) from the Hebrew University in Jerusalem, all in Physics. He was a Post-Doctoral Fellow at Courant Institute (1983-1986), and Senior Scientist and Associate Professor at the Weizmann Institute of Science (1986-1995). He spent sabbaticals at Princeton University in the US (1994-5) and at Ecole Polytechnique in France (2004). His areas of interest are free electron lasers, high-power pulsed plasmas, helicon and other plasma sources, and electric propulsion. Professor Fruchtman is a Fellow of the American Physical Society.