Polarization-dependent ponderomotive force in a standing wave

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Polarization-dependent ponderomotive force in a standing wave

Paper 8079A-34 of Conference 8079A
Date: Wednesday, 20 April 2011
Time: 9:20 – 9:40

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In a certain sense, the electromagnetic standing wave may be considered the prototype field configuration in which ponderomotive (gradient) forces play a dominant role, since in between the nodes of the wave the field changes from zero to maximum, leading to large field gradients. Nevertheless, up to now most analytical work concentrated on the ponderomotive force in running waves rather than standing waves, leading to the well-known Gapanov-Miller force [1] proportional to the field gradient and directed towards low field regions. However, in 2005 Kaplan and Pokrovsky [2] derived time-averaged equations of motion for an electron in examples of standing waves, showing that in some configurations the ponderomotive force changes direction towards high field regions, contrary to the Gapanov-Miller force. We derive the ponderomotive force formula for the general standing wave of nonrelativistic intensity. We thereby generalize the results of Ref. [1], which follow directly from our formula. It is shown that the ponderomotive force is still of gradient form, but contains additional polarization-dependent terms. Depending on the configuration, the ponderomotive force can point to low field regions, to high field regions and it can even vanish completely despite the large field gradients in the standing wave. Our theory predicts the full three-dimensional ponderomotive force, and it admits non-ideal standing wave fields that are not fully plane and also have gradients parallel to the nodal planes. [1] A.V. Gaponov and M.A. Miller, Sov. Phys. JETP 7, 168 (1958). [2] A.E. Kaplan and A.L. Pokrovsky, Phys. Rev. Lett. 95, 053601 (2005).

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