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Ponderomotive forces and wave dispersion: two sides of the same coin

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Presented here is a general view on adiabatic and resonant wave-particle interactions leading to a uniform description of nonlinear ponderomotive effects in very different environments, from low-temperature plasmas to relativistic plasmas or even atoms in laser light. Treating the wave-particle interaction as a classical mode-coupling problem, this theory shows the inherent connection between the ponderomotive forces and the properties of waves causing those forces. The adiabatic Lagrangians are derived for single particles and nonlinear waves, possibly carrying trapped particles, and yield both the dynamic equations and the nonlinear dispersion relations in the general case.

Subjects: **Plasma Physics (physics.plasm-ph)**; Mathematical Physics (math-ph); Quantum Physics (quant-ph)

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