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Principle of Least Action and Gauge Compatibility for a Charged Particle in an Electromagnetic Field DONALD H. KOBE, University of North Texas — The Principle of Least Action is used for a single nonrelativistic charged particle in an external electromagnetic field. The Hamiltonian used requires a choice of gauge for the vector and scalar potentials. The trial wave function used requires a choice of a space- and time-dependent phase that is a gauge choice for the wave function. These two gauge choices may not be compatible. We generalize the original trial function by multiplying it by an arbitrary space- and time-dependent phase factor. When this generalized wave function is used in the principle of least action and the action is varied with respect to the phase, we obtain an equation of continuity. From this equation of continuity we can determine the new phase that is compatible with the gauge of the Hamiltonian. Equivalently, we can determine a new gauge for the potentials in the Hamiltonian that is compatible with the gauge of the original wave function. We apply the method to a charge particle in the electric dipole approximation with a real trial wave function and a Hamiltonian in the Coulomb gauge. For a real trial wave function, the Hamiltonian must have new potentials that are in the electric field gauge. For a Hamiltonian in the Coulomb gauge, the phase of the trial wave function is determined. When the Hamiltonian is time independent and the trial wave function has only time dependence Et in its phase, the principle of least action reduces to the energy variational principle.

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