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Role of Broken Gauge Symmetry in Transport Phenomena Involving Neutral and Charged Particles in Finite Lattices SCOTT CHUBB, Remote Sensing Division, Naval Research Laboratory — As opposed to the conventional, approximate theory of electrical conduction in solids, which is based on energy band, quasi-particle states in infinite lattices, a rigorous theory exists that can be used to explain transport phenomena, in finite lattices, at reduced temperature, through the effects of a broken gauge symmetry: The loss of translational invariance with respect to Galilean transformations that maintain particle-particle separation. Implications of this result in areas related to the transport of hydrogen (H) and its isotopes in nano-crystalline structures of palladium (Pd) and of neutral, coherent atomic waves in finite, optical lattices are presented. These include: 1. The prediction of a novel variant of a known, phenomenon, Zener/Electronic Breakdown in insulators, in which ions in nano-scale palladium-deuteride (PdD) crystals (as opposed to electrons in insulating crystals) that initially, effectively, are confined to particular regions of space, begin to move, spread-out, and conduct charge after they are subjected to an applied, external (constant) electric field for a sufficiently long period of time; and 2. A rigorous treatment of scattering at low temperatures that can be used to identify critical time- and length- scales for problems related to the transport of neutral atomic matter waves in finite, optical lattices, in the presence of gravitational fields.

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