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Quantum Diffraction Without de Broglie Waves A.M. KADIN, Princeton Junction, NJ, S.B. KAPLAN, Yorktown Heights, NY — It is well established that composite particles, from neutrons to atoms to large molecules, sometimes behave as de Broglie waves, with wavelength $\lambda = h/p$, where p is the total momentum of the given composite particle. The primary evidence of these de Broglie waves is the observation of diffraction patterns from diffracting objects such as crystal lattices or one or more orifices. Indeed, it is generally believed that such de Broglie waves are universal quantum aspects of all matter. It is argued here (see also [1]) that only primary quantum fields such as electrons are truly de Broglie waves. In contrast, composite particles are small confined quantum waves that follow essentially classical particle trajectories, without extended wavelike behavior given by the de Broglie relation. For example, a neutron is properly a particle on the fm scale, not an extended wave on the nm scale. The momentum change of such a quasiclassical particle during a collision is constrained by quantum transition rules of the crystal lattice or other extended object. In particular, for elastic scattering from a crystal lattice with reciprocal lattice vectors $\mathbf{G}_i$, the allowable momentum changes are $\Delta\mathbf{p} = h\mathbf{G}_i/2\pi$, which reproduces the standard crystal diffraction pattern. This corresponds to emission of a degenerate phonon with zero energy. This provides a logically consistent picture of the microworld, avoiding most of the paradoxes associated with the orthodox interpretation of quantum mechanics. [1] A.M. Kadin, "Waves, Particles, and Quantized Transitions: A New Realistic Model of the Microworld", http://arxiv.org/abs/1107.5794 (2011).

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