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Quantum Mechanical Formalism of Charged-Particle Beam Optics

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Quantum Mechanical Formalism of Charged-Particle Beam Optics

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A formalism of Quantum Charged Particle Beam Optics is being developed since 1989 for both nonrelativistic and relativistic situations based on the nonrelativistic Schrödinger equation, Klein-Gordon equation, and the Dirac equation. This article gives glimpses of the basic framework of this formalism with the examples of round magnetic lens. This formalism has further led to quantum methodologies for treating light beam optics including polarization. The use of quantum methodologies results in an elegant 6×6 matrix differential operator for transition from the Helmholtz scalar wave optics to the Maxwell vector wave optics. We explicitly obtained this matrix differential operator in a series and exponential form respectively. The operator works for all types of light beams and its action is demonstrated to obtain the cross polarization in Gaussian light beams.

Keywords: Quantum Mechanics, Charged Particle Beam Optics; Light Polarization.

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