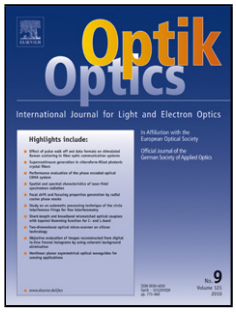


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Author: Sameen Ahmed Khan

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# Hamilton's Optical-Mechanical Analogy in the Wavelength-dependent Regime

Sameen Ahmed Khan[1]
Department of Mathematics and Sciences
College of Arts and Applied Sciences (CAAS)
Dhofar University
Post Box No. 2509, Postal Code: 211
Salalah, Sultanate of Oman.

**Abstract**

Hamilton's optical-mechanical analogy between the trajectory of material particles in potential fields and the path of light rays in media with continuously variable refractive index played an important role in the development of Schrödinger's wave mechanics. We shall examine how the Hamilton's analogy between charged-particle beam optics and light beam optics is extended to the wavelength-dependent regime. Brief accounts of the quantum prescriptions of charged-particle beam optics along with the non-traditional prescriptions of light beam optics are also presented. These prescriptions have been instrumental in seeing the analogy in the wavelength-dependent regime.

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**Keywords and phrases:** Hamilton's optical-mechanical analogy, light beam optics, Helmholtz optics, Maxwell optics, Charged-particle beam optics, Polarization, Wavelength-dependent effects.

## 1 Introduction

The analogy between geometrical light optics and the classical theories of charged-particle beam optics has been known and exploited for a very long time (for comprehensive and historical accounts see [1]-[3]). Hamilton's optical-mechanical analogy played a significant role in the initial development of Schrödinger's wave mechanics [4]. It is also called as 'optico-mechanical

[1]**E-mail address:** rohelakhan@yahoo.com
**URL:** http://orcid.org/0000-0003-1264-2302.