Summary of the Research done at MECIT*

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MAIN FIELDS OF RESEARCH: *Mathematical Optics*
I am working towards a unified treatment of light beam optics and polarization, using the standard mathematical machinery of quantum mechanics. Dirac-*like* form of the Maxwell equations is well known in literature. Starting with the Dirac-*like* form of the Maxwells equations a unified treatment of light beam optics and polarization has been obtained. The traditional results (including aberrations) of the scalar optics are modified by the wavelength-dependent contributions. Some of the well-known results in polarization studies are realized as the leading-order limit of a more general framework of our formalism. The existing matrix representations of the Maxwells equations were found to be approximate for the formalism developed here; hence, an exact matrix representation of the Maxwells equations was derived.

A related study was made starting with the scalar approximation of the Maxwells equations. Using the analogy of the Helmholtz equation with the Klein-Gordon equation and the Feshbach-Villars approach to the Klein-Gordon equation a formalism utilizing the powerful techniques of quantum mechanics has been developed for scalar optics including aberrations. This provides an alternative to the traditional *square-root* approach and gives rise to wavelength-dependent contributions modifying the aberration coefficients.

PUBLICATIONS

A. Review Article

- Sameen Ahmed Khan,
  Wavelength-Dependent Effects in Light Optics,
  in *New Topics in Quantum Physics Research*,
  Editors: Volodymyr Krasnoholovets and Frank Columbus,
  (Nova Science Publishers, New York, 2006, http://www.novapublishers.com/).
  pp. 163-204 (30 December 2006).
  (ISBN-10: 1600210287 and ISBN-13: 978-1600210280).

*Updated on Friday the 13 April 2007

B. Refereed Publications

1. Sameen Ahmed Khan,
   Wavelength-dependent modifications in Helmholtz Optics,
   International Journal of Theoretical Physics, **44**(1), 95-125 (January 2005).
   (Kluwer Academic Publishers, https://www.editorialmanager.com/ijtp/).

2. Sameen Ahmed Khan,
   An Exact Matrix Representation of Maxwells Equations,
   Physica Scripta, **71**(5) 440-442 (2005).
   (http://www.physica.org/).

3. Sameen Ahmed Khan,
   The Foldy-Wouthuysen Transformation Technique in Optics,
   Optik-International Journal for Light and Electron Optics, **117**, Issue 10, pp. 481-488 (October 2006).
   (http://www.elsevier-deutschland.de/ijleo/).

C. In Proceedings

- Fathiya Khamis Al Rawahi, Sameen Ahmed Khan and Abdul Huq,
  Microsoft Excel in the Mathematics Classroom: A Case Study,
  in *Proceedings* of **The Second Annual Conference for Middle East Teachers of Mathematics, Science and Computing** (**METSMaC 2006**), The Petroleum Institute, Abu Dhabi, United Arab Emirates, 14-16 March 2006. *Editors*: Seán M. Stewart, Janet E. Olearski and Douglas Thompson, pp. 131-134 (2006).

The corrections to the traditional descriptions rigorously derived in the above articles have a significant bearing on the celebrated Scherzer Theorem in the wavelength-dependent regime in electron microscopy and the algebraically equivalent system of fiber optics. I shall be applying for a patent in the near future.

Contributions to International Reports:

- $\cdots$, Sameen Ahmed KHAN, $\cdots$, (*one of the 250+ Contributors, from 79 Institutions*),
  GLD Detector Outline Document (**GLD DOD**),
  GLD: A Large Detector Concept study for International Linear Collider for TeV Physics
  Report of the GLD Concept Study Group,
  World Wide Study of Physics and Detectors for future Linear e^+e^- Colliders, (March 2006).
  GLD: Gaseous tracker based Large Detector.
  E-Print: http://arXiv.org/abs/physics/0607154/.

Popular Writings:
I have a keen interest in the theme, *Science for Development*, resulting in over a hundred popular articles (thirty-five of these were during my stay at MECIT) in Journals, Magazines, Bulletins/Newsletters and Conference Proceedings across the continents (http://www.geocities.com/rohelakhan/popular-writings.html). Two of these are with my MECIT students.