

Summary of the Research done at MECIT*

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Dr. Sameen Ahmed Khan
Assistant Professor and *Assistant Head*,
Department of Mathematics & Applied Sciences (DOMAS)
Middle East College of Information Technology (MECIT)
Technowledge Corridor, Knowledge Oasis Muscat (KOM)
PO Box 79, Al Rusayl, Postal Code 124
Muscat, Sultanate of OMAN.

<http://www.mecit.edu.om/>

Now, at the Salalah College of Technology (SCOT), <http://www.sct.edu.om/>
Post Box No. 608, Postal Code 211, Salalah, Sultanate of Oman.

E-Mail: rohelakhan@yahoo.com

<http://SameenAhmedKhan.webs.com/>

<http://rohelakhan.webs.com/>

<http://sites.google.com/site/rohelakhan/>

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,
Chapter-6 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).
 (Digital Object Identifier (DOI), <http://dx.doi.org/10.1007/s10773-005-1488-0>).
2. Sameen Ahmed Khan,
An Exact Matrix Representation of Maxwells Equations,
Physica Scripta, **71**(5), 440-442 (2005).
 (<http://www.physica.org/>).
 (Digital Object Identifier (DOI), <http://dx.doi.org/10.1238/Physica.Regular.071a00440>).
3. Sameen Ahmed Khan,
The Foldy-Wouthuysen Transformation Technique in Optics,
Optik-International Journal for Light and Electron Optics, **117**(10), 481-488 (October 2006).
 (<http://www.elsevier-deutschland.de/ijleo/>).
 (Digital Object Identifier (DOI), <http://dx.doi.org/10.1016/j.ijleo.2005.11.010>).

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.

Lecture Notes:

1. Sameen Ahmed Khan,
Lecture Notes in Mathematics,
 Middle East College of Information Technology,
 Muscat, Sultanate of Oman (2005). <http://www.mecit.edu.om/>.
 The Notes cover the *Foundation Mathematics* and the Three-Semester Sequence of *Engineering Mathematics*, *College Mathematics*, *Calculus with Numerical Methods* and *Advanced Calculus*.
2. Sameen Ahmed Khan,
Lecture Notes in Physics,
 Middle East College of Information Technology,
 Muscat, Sultanate of Oman (2005).
<http://www.mecit.edu.om/>.
 The Notes cover the Two-Semester Sequence of *Physics* along with *Engineering Physics* and *Engineering Mechanics*.

Contributions to International Reports:

- ..., Sameen Ahmed KHAN, ..., (*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 arXiv: <http://arXiv.org/abs/physics/0607154/>.

Popular Writings:

I have a keen interest in the theme, *Science for Development*, resulting in over **130+** popular articles in Journals, Magazines, Bulletins/Newsletters and Conference Proceedings across the continents (<http://SameenAhmedKhan.webs.com/popular-writings.html>). About forty of these were during my stay at MECIT. Two of these are with my MECIT students.