

## ASIRI NANAYAKKARA

Institute of Fundamental Studies

Kandy

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### WORK EXPERIENCE

#### **Physical and Computational Science Research Unit**

Institute of Fundamental Studies, Sri Lanka

- 2009 – Research Professor
- 2004 – 2009 Associate Research Professor
- 2000 – 2004 Senior Research Fellow
- 1997 – 2000 Senior Lecturer Grade I,  
**Department of Physics / University computer Center,**  
University of Sri Jayawardenapura, Sri Lanka
- 1994 – 1996 Computational Scientist  
**CRAY Research Inc. USA**
- 1991 -1994 Postdoctoral Research Associate,  
**Supercomputer Computations Research Institute,**  
University of Florida USA.
- 1990 – 1991 Postdoctoral Research Associate,  
**Ames Laboratory** (US Department of Energy), USA
- 1989 - 1990 Postdoctoral Research Associate,  
**Department of Theoretical Chemistry,**  
University of Bristol, UK
- 1983 – 1988 Teaching / Research Assistant,  
**Department Of Physics,** Iowa State University, USA.
- 1980 - 1981 Assistant Lecturer,  
**Department of Mathematics,**  
University of Colombo, Sri Lanka

## **(B) EDUCATION**

- PhD Iowa State University, USA. (Physics) 1988
- MS Ohio University, USA (Physics) 1983
- B.Sc (Honors) University of Colombo (Mathematics) 1980

## **(C) RESEARCH INTERESTS**

Main area of interest: Fundamental aspects of Quantum to Classical Transition (Quantum Decoherence, Quantum-Classical Hybrid systems), Quantum computation, Quantum time and Quantum non-locality.

Other research areas and research interests in the recent past: Energy Focusing Phenomena (Single Bubble Sonoluminescence), Brain Computer Interface, Non Hermitian Quantum & Classical Systems and Quantum Chaos.

## **RESEARCH AND OTHER EXPERTISE**

### **(a) Quantum Mechanics**

Developed a new semi-classical quantization method (Asymptotic Energy Expansion method) based on quantum action variable theory. Investigated non-Hermitian Hamiltonian systems quantum mechanically and classical mechanically.

Selected publications:

Asiri Nanayakkara and Thilagarajah Mathanaranjan, **Explicit energy expansion for general odd degree polynomial potentials**, Phys. Scr. 88, 055004 (2013)

Asiri Nanayakkara, **Dynamical tunneling-like effects in 1D classical systems**, J. Phys. A : Mathematical and Theoretical 45, 444025 (2012)

Asiri Nanayakkara and Thilagarajah Mathanaranjan, **Equivalent Hermitian Hamiltonians for some non-Hermitian Hamiltonians**, Physical Review A - Atomic, Molecular, and Optical Physics, 86, 022106 (2012)

Asiri Nanayakkara, **Classical trajectories of 1-D complex non-Hermitian Hamiltonian systems**, J. Phys. A.: Mathematical and Theoretical 37, 4321 (2004)

Asiri Nanayakkara, **A new asymptotic energy expansion method**, Phys. Lett. A 289, 39 (2001)

## **(b) High performance and parallel computing**

Experience in implementing Molecular Dynamics and Monte Carlo methods on multi core - multi-processor computer clusters. (My research group has a computer workstation cluster)

Worked as a computational scientist at CRAY Research Inc. Have experience in parallelizing following software for CRAY T3D and T3E massively parallel supercomputer systems.

- (a) Implemented the parallel SCF part of the QCHEM (Electronic Structure software) software package.
- (b) Parallel implementation of AMBER (Molecular dynamics code for simulating the energetics and motions of proteins and nucleic acids)
- (c) XPLOR (X-Ray crystallography code for determining structures of large molecules such as proteins and nucleic acids).
- (d) Implemented the parallel version of the X-Ray crystallography code *Shake and Bake*.

Carried out parallel Implementation of cc-MBPT code (Fourth order Many Body perturbation theory) on both workstation clusters and IBM POWER4 shared memory cluster at Supercomputer Computations Research Institute.

## **(c) Computational Physics and Chemistry**

- Investigated Single Bubble Sonoluminescence through hydro-chemical simulations.
- Have several years of postdoctoral experience in computational chemistry.
- Member of the development team of **GAUSSIAN 94**, **GAUSSIAN 98** and **GAUSSIAN 03** Computational Chemistry software package.
- Investigated contributions to one electron properties from electronic correlation functional in Density Functional Theory (DFT).

**Recent submissions:** (Please see the publication list for previous papers)

Manoj Wijesingha and Asiri Nanayakkara, **Theoretical and computational analysis of reactions involving HONO at temperatures below 10,000K**, *Can. J. Chem* (in review)

Manoj Wijesingha and Asiri Nanayakkara, **Determination of reaction mechanisms and rates involving SO and NO radicals**, (to be submitted)

Vibodha Bandara, Prabhath Herath, and Asiri Nanayakkara, **Temperature dependence of single bubble sonoluminescence threshold in sulfuric acid: An experimental study**, *Phys. Rev. E* (in review)

Asiri Nanayakkara, **Blackbody Emission from Sonoluminescing Rare Gas Bubbles**, *Phys. Rev. E* (in review)

#### **(d) Artificial Intelligence**

Developed new mental tasks for controlling computer cursor in Brain Computer Interface systems.

Supervised the design and the construction of EEG/EMG/EOG amplifier and the filter system. Developed software for data acquisition, signal processing and classification using machine learning techniques.

Currently we are developing a complete portable brain computer interface system which can be used in real time.

Selected publications

Zahmeeth Sakkaff and Asiri Nanayakkara, **Determination of Optimal Frequency Ranges Using Common Spatial Pattern Images**, 8th IEEE International Conference ICIS (2013)

Zahmeeth Sakkaff and Asiri Nanayakkara, **New set of cognitive tasks in EEG based Brain Computer Interface**, IEEE International conference (ICIAfS) 2010  
**(Received the best paper award in the area of machine learning)**

Asiri Nanayakkara and Zahmeeth Sakkaff, **Automated dimensionality reduction in EEG based Brain Computer Interface**, IEEE International conference (ICIAfS) 2010

### **Current Research Students**

- Mr. Thilagarajah Mathanaranjan - Ph.D. (Mathematical Physics)  
(Thesis submitted)
- Mr. Prabhath Herath – M.Phil. (Physics)
- Mr. Manoj Wijesingha – M.Phil. (Computational Chemistry)
- Mr. Dammika Wijethunga – MPhil (Artificial Intelligence)
- Mr. Vibodha Bandara – MPhil (Artificial Intelligence)

### **Completed Research Student**

- 2007 Mr. Senathirajah Selvarajan - MPhil (Neural Modeling)
- 2010 Ms. Zahmeeth Sakkaff – MPhil (Brain Computer Interface)
- 2013 Mr. Sanjeeewa Karunawansa - MSc (Computer Science)
- 2013 Mr. Prashath Karunasiri – MSc (Computer Science)

### **EXPERT CONTRIBUTIONS**

**Served** as a council member of National Research Council (**NRC**). (NRC is the main research funding organization in Sri Lanka) (2004-2011)

**Served** as a member for the National Committee on Basic Research at the National Science Foundation (**NSF**) of Sri Lanka. (2005-2013)

**Served** in a National committee for giving recommendations and guide lines for a Cabinet Paper to increase research productivity in Sri Lankan Government Institutions. (2001)

**Member** of Research Evaluation Committee of Sir Arthur C. Clarke Institute for Modern Technologies (2001-2002)

**Served** as the Chairman of the committee for Computerization of Department of Import-Export control Sri Lanka(1999)

**Served** as the Chairman of the computer advisory committee of University of Sri Jayewardenpura (1997-2000)