THE HERMANN KÜMMEL EARLY ACHIEVEMENT AWARD IN MANY-BODY PHYSICS

The International Advisory Committee of the International Conferences Series on *Recent Progress in Many-Body Theories* is pleased to announce that the inaugural, 2007 HERMANN KÜMMEL EARLY ACHIEVEMENT AWARD IN MANY-BODY PHYSICS is awarded to Dr. Frank Verstraete of Universität Wien, Austria,

"For his pioneering work on the use of quantum information and entanglement theory in formulating new and powerful numerical simulation methods for use in strongly correlated systems, stochastic nonequilibrium systems, and strongly coupled quantum field theories."

This award honors Prof. Kümmel's long and distinguished career as a leader in the field of many-body physics and as a mentor of younger generations of many-body physicists. This inaugural award will be presented to Dr. Verstraete at the 14th International Conference on *Recent Progress in Many-Body Theories*, to be held in Barcelona, Spain, 16-20 July 2007. More details on Dr. Verstratete' achievement will be given below.

HONORABLE MENTIONS

The International Advisory Committee is impressed with the many extraordinary gifted nominees for this award and wishes to congratulate and mention also Dr. Gregory Astrakharchick,

"For his most accurate microscopic calculation of the BEC-BCS crossover in dilute Fermi gases using quantum Monte Carlo techniques whose predictions have been recently confirmed by experiments,"

and Dr. Robert Zillich,

"For defining future directions of quantitative many-body theory by combining correlated basis functions methods with large scale Quantum Monte Carlo simulations to explore yet uncharted areas of strongly correlated quantum fluids physics."

Dr. Frank Verstraete's Achievements

During his still brief career as a theoretical physicist Frank Verstrate has left a a massive imprint on the field of many-body physics that will influence the subject in the future. He was the first to realize that the insights from entanglement theory could give rise to very powerful numerical simulation methods that apply to a broad range of phenomena, both in quantum and classical systems. His outstanding work includes:

1. The discovery that all numerical RG methods for 1D systems can be reformulated as variational methods in the class of matrix product states.

2. A demonstration that the ground states of local 1D hamiltonians can effectively be represented by matrix product states, even for critical systems.

3. Exploitation of quantum parallelism to simulate exponentially many realizations of random many-body systems in parallel.

4. Generalizations of matrix product states to higher dimensions through the concept of projected entangled pair states (PEPS).

5. A generalization of the Jordan-Wigner transformation to higher dimensions and to graphs.

6. Construction of exactly solvable critical quantum systems in 2D whose entropy of entanglement obeys a strict area law.

Abridged Curriculum Vitae

Dr. Frank Verstraete was born in Belgium in November, 1972. He received his Ph. D. degree in 2002 at the University of Leuven under supervision of Profs. B. De Moor and H. Verscheld. From 2002 to 2004 he was a research fellow in the theory group of I. Cirac at the Max-Planck Institut für Quantenoptik, Garching, and from 2004 to 2006, a research scholar in the Institute for Quantum Information headed by J. Preskill at Caltech. Since October 2006, he is a Professor at the Fakultät für Physik at the Universität Wien. Starting in 2001 he delivered numerous seminars and colloquia and

over ten invited conference talks. He has also organized three international conferences in his field

Dr. Verstraete has already published over 50 papers, 17 in Phys. Rev. Lett., which as a whole have received around 1000 citations. Representative papers for his work are:

- Verstraete F, Porras D, Cirac JI: Density matrix renormalization group and periodic boundary conditions: A quantum information perspective. PHYSICAL REVIEW LETTERS 93: Art. No. 227205 (2004).

  In this paper the density matrix renormalization group method is analyzed from a quantum information perspective leading to spectacular improvements for problems with periodic boundary conditions.

- Verstraete F, Wolf MM, Perez-Garcia D, Cirac JI: Criticality, the Area Law and the Computational Power of projected Entangled States. PHYSICAL REVIEW LETTERS 96: Art. No. 220601 (2006)

  In this paper the concept of PEPS is explained and applied to link thermal states of 2D classical spin models with ground states of quantum spin models.

- Verstraete F, Popp M, Cirac JI: Entanglement versus correlations in spin systems. PHYSICAL REVIEW LETTERS 92: Art. No. 027901 (2004).

  In this highly cited paper (more than 100 citations so far) the concepts of localizable entanglement and localization length are introduced and related to decay of correlations and quantum phase transitions.