Il Prof. Satoshi Tanaka del Department of Physical Science, Osaka Prefecture University, Osaka, Japan, terrà, nell'ambito del programma di cooperazione internazionale CoRI 2014, un ciclo di lezioni/seminari sulla seguente tematica:

Theory of time-symmetry breaking dynamics in terms of complex spectral representation of Hamiltonian and Liouvillian dynamics and its application to nano-materials.

Abstract:

A fundamental problem in non-equilibrium statistical mechanics is to clarify how macroscopic irreversible processes are derived from reversible microscopic dynamics dictated by equations of motion with time-symmetry. Conventional thought is that, in order to derive an irreversible process, one relies on some subjective assumptions, such as Markovian approximation and coarse-graining etc. The purpose of this lectures is to explain that the time symmetry breaking occurs due to the resonance singularity in the reversible microscopic dynamics in terms of complex spectral representation both in Hamiltonian dynamics and Liouvillian dynamics.[1,2]

In the first half of these lecture, a decay process of spontaneous emission from an excited atom is studied in terms of complex spectral representation of Hamiltonian with use of Brillouin-Wigner-Feschbach projection method. In this formalism, the vector space is expanded from ordinary Hilbert space to an extended Hilbert space which makes an eigenvalue of Hermitian Hamiltonian to be complex. We can find that resonance singularity is the origin of the time-symmetry breaking. Time evolution of the decay process is clearly classified into Markov and non-Markov processes according to a complex pole and branch point effects in this formalism. The application of the theory to a charge transfer decay in one-dimensional quantum wire is also discussed.[3]

The latter half of the lectures are devoted to study the irreversible process of thermodynamic systems in terms of complex spectral representation of Liouvillian. After the introduction of Liouville-space formalism, some applications are introduced, such as non-equilibrium heat transfer through molecular wire and quantum sound wave transport in alpha-helix protein.[4,5]

References

[1] T. Petrosky, I. Prigogine, S. Tasaki, Physica A 173, 175 (1991).

[2] T. Petrosky and I. Prigogine, Adv. Chem. Phys. 99, 1 (1997).

[3] S. Tanaka, S. Garmon, and T. Petrosky, Phys. Rev. B 73, 115340 (2006).

[4] S. Tanaka, K. Kanki, and T. Petrosky, Phys. Rev. B 80, 094304 (2009).

[5] S. Tanaka, K. Kanki, and T. Petrosky, Phys. Rev. E 83, 051118 (2011).

I seminari/lezioni, indirizzati primariamente agli studenti della Laurea Magistrale in Fisica, ma di interesse anche per dottorandi, borsisti, assegnisti di ricerca e docenti interessati alla tematica di ricerca, si svolgeranno presso il Dipartimento di Fisica e Chimica, Via Archirafi 36, secondo il seguente calendario:

16 Novembre 2015, ore 15.00-16.30 - Aula A:
Decay process in terms of complex eigenvalue problem of Hamiltonian
17 Novembre 2015, ore 15.00-16.30 - Aula A:
Time evolution of the decay process: Markov and Non-Markov processes
19 Novembre 2015, ore 15.00-16.30 - Aula B:
Irreversible processes in thermodynamic systems: Liouville space formalism
20 Novembre 2015, ore 15.00-16.30 - Aula B:
Nonequilbrium heat flow through a molecular wire
23 Novembre 2015, ore 15.00-16.30 - Aula B:
Quantum hydrodynamic sound wave transport in alpha-helix protein

Al termine di ogni seminario, il Prof. Tanaka sarà disponibile per eventuali domande e discussioni sugli argomenti trattati.

Roberto Passante