Dottorato di Ricerca in Fisica dell'Università degli Studi di Messina
10 Maggio 2012, ore 15.00, Sala Seminari, IPCF-CNR,
V.le F. Stagno d'Alcontres 37, S. Agata, Messina

Seminar title:
Revisiting supercooled water…and more

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Abstract

In spite of decades of efforts, the puzzle of understanding the anomalies of liquid water remains unsolved. Several plausible theoretical scenarios are proposed, but distinguishing among them requires accessing temperatures below the homogenous nucleation temperature, Th, which is a thermodynamic space not-accessible for bulk samples. The current controversy concerns on the identification of the so-called "no man's land" as a region of metastable thermodynamic equilibrium or just as a kinetically accessible region.
The conventional path adopted to estimate the thermodynamical accessibility of a metastable state at a given temperature consists in the evaluation of the excess entropy of the metastable system respect to the stable phase at the same temperature.
In this talk, the results of a new calorimetric experiment on supercooled bulk water down to 248K are presented and discussed. It will be shown how the choice of the stable phase at the same temperature of the metastable phase as the reference is misleading in principle. A different perspective is suggested to rationalize the process that drives the transition from the metastable state, at a given temperature, towards the corresponding macroscopic stable state. This have led us to revisit the definition of metastable state for any macroscopic system. Our result indicates that approaching a minimum temperature (identified as the Kauzmann temperature) the volume in the phase space, corresponding to the macroscopically observed metastable phase, vanishes so that the residence time of the system within that limited volume vanishes too. Besides water, the result turns out valid for any complex metastable system.
The conjecture is formulated that the process which drives the system from the metastable state towards the macroscopically stable configuration can be described as a Markov chain of reversible steps which eventually results in a catastrophic evolution of the system.