MODELLING DOPANTS MICROSOLVATION IN ^{4}He DROPLETS: FROM SNOWBALLS TO BUBBLES

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The helium isotopes ^{4}He and ^{3}He are unusual among the elements of the periodic table in that they do not exhibit a triple point and consequently remain in the liquid state at atmospheric pressures down to the lowest temperature of T=0. They are also the only liquids exhibiting superfludity below $T_c = 2.18$ K (^{4}He) and $T_c = 2.4 \cdot 10^{-3}$ K (^{3}He). The many properties related to superfluidity have puzzled scientists for many years and it is now realized that superfluidity and superconductivity are closely related phenomena which are in fact rather ubiquitous and can occur in many different environments [1-3]and can be detected by a variety of spectroscopic tools.

About ten years ago it was found that finite sized droplets of helium could pick up atoms and molecules singly and that even specified mixtures of different species can be prepared inside helium droplets where, in order to remain inside, have to be cooled down to expected temperatures of 0.2-0.5 K [4-8].where spectra become drastically simplified.

It has therefore become clear from the intense experimental work following the earlier discovery that such containers provide the ideal study environments for probing the solvation process and several other chemical processes like reactions, excitations, clustering and fragmentations, at unusually low temperatures. The above phenomena can thus be analysed at the nanoscopic level and under special low-temperature conditions which can complement what we know about traditional solvation processes in classical solvents.

Theoretical analysis of such events can therefore provide a molecular picture for the quantum behaviour of heliophobic and heliophilic species and can also allows us to follow in detail the structural and dynamical evolution of the observed chemical events as a function of the changing sizes of these nanocryostats [9-11]. The effects of this special quantum solvent on anionic and cationic dopants are only beginning to be fully explored experimentally and only recently have been analysed theoretically, providing additional fascinating information on the solvation process at the molecular level.

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