ROCK AND ROLL IN HE NANODROPLETS: AGGREGATION AT ULTRACOLD CONDITIONS.

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Helium nanodroplets provide a unique environment to study intermolecular interactions. Their large pickup cross section allows the embedding of low vapor pressure compounds in the 10^{-7} to 10^{-4} mbar range. Evaporation of He atoms cools droplet and dopant molecules to 0.37 K typically within 1 ns. The superfluid He acts as soft matrix that shifts energy levels only slightly compared to gas phase values. Aggregation of molecules with large dipole moments in a typical droplet with radius of 5 nm is dominated by long range electrostatic interactions, e.g dipole-dipole interactions. Famous examples are HCN aggregates with up to 12 monomers or formic acid dimer where the formation of a polar acyclic structure was observed.

In contrast, the interaction energy governing the step by step aggregation of molecules with small or even vanishing dipole moment in helium nanodroplets is small compared to the thermal energy at 0.37 K. In these cases short range interactions and even rotation will stabilize certain conformers while at the same time preventing the formation of others. Examples for both aggregation processes obtained from high resolution infrared spectroscopy in combination with extensive calculations on different levels of theory will be presented.

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