WEAKLY BOUND QUANTUM CLUSTERS AT ULTRA LOW TEMPERATURES: RIGID OR LIQUID?

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Weakly bound clusters provide a unique environment to study phenomena such as superlfuidity and quantum dynamics at the nano-scale. Recent experiments on doped helium clusters have shown that superfluity evolves in a non-trivial way with cluster size and these findings are consistent with theoretical predictions. Molecular hydrogen clusters are expected to exhibit more rigidity than helium ones due to the stronger intermolecular interactions. We wish to understand the size dependent properties of molecular hydrogen clusters at ultra low temperatures in terms of solid, rigid and liquid behavior. We focus on pure (paraH_2)$_N$ and (orthoD_2)$_N$ ranging from 3 to 40 molecules. We will first review the recent literature and show the results of variational path integral calculations at absolute zero. We present the size dependence of energetic and structural properties and discuss the use of various indicators of liquid versus solid behavior. We show that some of these indicators have a non-trivial size evolution.