ASYMMETRIC TOP ROTORS IN SUPERFLUID *PARA*-HYDROGEN NANO-CLUSTERS

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We present the first simulation study of bosonic clusters doped with an asymmetric top molecule. A variation of the path-integral Monte Carlo method is developed to study a *para*-water ($p\mathrm{H_2O}$) impurity in *para*-hydrogen ($p\mathrm{H_2}$) clusters. The growth pattern of the doped clusters is similar in nature to that of the pure clusters. The $p\mathrm{H_2O}$ molecule appears to rotate freely in the cluster due to its large rotational constants and the lack of adiabatic following. The presence of $p\mathrm{H_2O}$ substantially quenches the superfluid response of $p\mathrm{H_2}$ with respect to the space fixed frame. We also study the behaviour of a sulphur dioxide ($^{32}\mathrm{S}^{16}\mathrm{O_2}$) dopant in the $p\mathrm{H_2}$ clusters. For such a heavy rotor, the adiabatic following of the $p\mathrm{H_2}$ molecules is established and the superfluid renormalization of the rotational constants is observed. The rotational structure of the $\mathrm{SO_2}$-$p(\mathrm{H_2})_N$ clusters' ro-vibrational spectra is predicted. The connection between the superfluid response respect to the external boundary rotation and the dopant rotation is discussed.