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Path integral studies of methane rotations in ^{4}He clusters[1] NIKOLAY MARKOVSKIY, CHI MAK, University of Southern California — Path integral simulations have been carried out to study the rotations of a methane inside a single shell of ^{4}He atoms at 0.3 K to address the question of whether dopant molecule rotations can be used to probe the quantum statistics and superfluidity of the shell. We examined the effects of the probe molecule on the ^{4}He exchanges and their counter effects on the renormalized rotation constant of the probe systematically by varying the intrinsic moment of inertia of the methane. The observed effects show strong dependence on the intrinsic moment of inertia of the rotating probe, with a heavy probe favoring stronger templating of the ^{4}He density and a corresponding suppression of exchanges in the shell, as well as a large renormalization in the probe's effective rotation constant, while a light probe shows almost no effect on the shell density or the effective rotation constant. These results can be rationalized in terms of a rotational smearing effect and suggest that there is no clearly quantifiable relationship between the superfluid fraction of the shell and the renormalized rotation constant of the probe for cases where the probe molecule has weak anisotropic interactions with the ^{4}He atoms.

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