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Interaction of Ions, Atoms and Small Molecules with Quantized Vortex Lines in Superfluid ^{4}He[1] JUSSI ELORANTA, DAVID MATTEO, Chemistry Dept., Calif. State University Northridge, GARY WILLIAMS, UCLA — The interaction of a number of impurities (H_2, Ag, Cu, Ag_2, Cu_2, Li, He_3^+, He* (^3S), He_2^* ($^3\Sigma_u$) and e^-) with quantized rectilinear vortex lines in superfluid ^{4}He is calculated using density functional methods at 0 K. The technique yields the impurity radius as well as the vortex line core parameter. The core parameter at 0 K (0.74 Å) obtained either directly from the vortex line geometry or from the trapping potential fitting is smaller than previously suggested but is compatible with a re-analysis of the Rayfield-Reif experiment. All of the impurities have significant binding energies to the vortex lines below 1 K where the thermally assisted escape process becomes very inefficient. Even at higher temperatures the trapping times, especially for larger clusters, are sufficiently long that the observed metal nanowire assembly in superfluid helium can take place at vortex lines. The binding energy of the electron bubble is predicted to decrease as a function of both temperature and pressure, which allows adjusting the trap depth for either permanent trapping or thermally assisted escape. A new scheme for determining the trapping of impurities on vortex lines by optical absorption spectroscopy is outlined and demonstrated for He*.

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