

When helium-4 is cooled to low temperatures it does not solidify as most pure substances do, but instead undergoes a phase transition to a remarkable state of matter known as a superfluid which exhibits macroscopic quantum mechanical phenomena. The superfluid helium is characterized by zero viscosity and thus dissipationless mass transport without entropy. Recent advances in nanofabrication technology have allowed for the creation of extremely narrow channels, with nanoscale diameters through which superfluid helium can be forced to flow. The technical difficulty of performing experiments on these channels limits the available measurements that can be made and a theoretical understanding of confined helium-4 is still lacking. In this study, we employ an exact high performance numerical simulation technique known as path integral quantum Monte Carlo to study the effects of such dimensional confinement on superfluid properties inside the channel. We present results utilizing two different measurements of the superfluid density, one originating from a quantum correction to the moment of inertia of helium, while the other relies on the exact calculation of a topological invariant.