Quantum Locking: Applications towards Controlled Frictionless Spatial Motion

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Quantum locking is a newly defined quantum effect which allows a Type II superconductor to levitate pinned in a strong magnetic field. This is very different than the Meissner effect (levitation by repulsion) used today. This research studies how external magnetic field strengths and superconducting area affect the weight a quantum locked superconductor can hold for push, pull, and shear forces. Neodymium magnet configurations were used to create various magnetic field strengths in which the cooled superconductor was quantum locked. For the push force, non-ferromagnetic weights were added on top until it could hold no more weight. For the pull and shear forces, the weight was hung from the superconductor. Vizimag software helped identify regions of constant flux around selected magnet configurations to help implement quantum locking into various joints. It was found that a quantum locked superconductor exposed to stronger magnetic fields was able to hold more weight and that the relationship was linear. Furthermore, a superconductor with a larger area could also hold more weight by affecting the slope of this linear relationship. Next, a t-test was used to analyze whether the differences between the push, pull, and shear forces were significantly different. Unexpectedly, there was no significant difference in the amount of weight held for each of these forces. Lastly, quantum locking was implemented into a revolute, a prismatic, and a spherical joint. Quantum locking can revolutionize many technologies. By providing stable low energy non-contacting connections, this phenomenon has applications towards the development of frictionless joints for energy conservation, and next-generation space systems for launching, docking, object manipulation, and satellite formations.