Quantum Locking Aircraft: Towards the Development of Magnetically Assisted Landing and Take-off Systems via Flux Pinning

Sauer, Julienne

Quantum locking is the application of flux pinning to create a stable form of levitation which pins a superconductor within a strong magnetic field allowing movement only along regions of constant flux. The advantages of integrating quantum locking into the development of new landing and take-off systems for aircraft have yet to be fully explored. This research focused on studying the kinetics of a quantum locked superconductor as it travels through a non-uniform magnetic field. A magnetic track consisting of a series of neodymium magnets with varying gap sizes was constructed to generate a varying magnetic field along the motion of the superconductor. Changes to the superconductor motion were captured using a high speed camera. It was found that larger magnetic field variation (larger gap sizes) resulted in a greater reduction of kinetic energy of the quantum locked superconductor and that the relationship was non-linear. Furthermore, computing the correlation coefficient between the tested variables showed that this loss of energy was independent of both the mass and incoming velocity of the superconductor. A theoretical approach was used to correlate the magnetic field profiles throughout each gap with the observed reduction of kinetic energy. It was found that loss of energy can be estimated by integrating the magnitude of the rate of change of the magnetic field throughout each gap and that this mathematical relationship matches the observed experimental results closely. Lastly, a prototype test track was constructed to test the capture and slowing of incoming aircraft. Superconductors were attached to a Styrofoam glider plane which successfully landed on the magnetic track even when it was rocked from side to side to simulate conditions on an aircraft carrier.

Awards Won: