Abstract of My Thesis

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This thesis presents a novel approach to sensing gravitational gradients using a magnonic system. The work builds on the established principles of quantum gravity gradiometry, leveraging the interaction between magnons—quantized spin waves—and gravitational fields to achieve high-precision measurements. Magnons are excited in a ferromagnetic sample, such as a Yttrium Iron Garnet (YIG) sphere, and their coupling to external magnetic fields is utilized to detect variations in gravitational gradients.

We derive the theoretical framework for magnon-gravity coupling, extending previous studies on the interaction of spin systems with gravitational waves. The Hamiltonian governing the system is formulated using spin operators and bosonic excitations, showing how gravitational gradients influence magnon dynamics. The study integrates these theoretical insights into an experimental setup involving a microwave cavity coupled to a YIG sphere, where magnons interact with photons to enhance detection sensitivity.

Key results from the system's output power analysis reveal a clear dependence on gravitational gradient components, offering a promising method for precision gravity sensing. The setup is optimized for detecting Earth's gravitational field, with potential applications in geophysics and navigation. This work contributes to the growing field of quantum sensing technologies and lays the groundwork for future advancements in gravity gradiometry using magnonic systems.