Orbital Gravity Gradiometry Beyond GOCE: Mission Concepts

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Significant advances in the technologies needed for space-based cryogenic instruments have been made in the last decade, including cryocoolers, spacecraft architectures and cryogenic amplifiers. These enable considerably more complex instruments to be put into orbit for long-duration missions. One such instrument is the Superconducting Gravity Gradiometer (SGG) developed by Paik, et al. A magnetically levitated version is under consideration for a follow-on mission to GRACE and GOCE. With its inherently greater rejection of common mode accelerations and ability to cancel the coupling of angular accelerations into the gradient signal, the SGG can achieve 0.01 mE/$\sqrt{\text{Hz}}$ with requirements for attitude control that can be met with existing spacecraft. In addition, the use of a cryocooler for cooling the instrument will alleviate the previously severe constraint on mission lifetime imposed by the use of superfluid helium, enabling mission durations in the 5-10 year range. Studies are underway to determine requirements for orbit (polar vs sun-synchronous), altitude (which affects spacecraft drag), instrument temperature and stability, cryocooler vibration control, and control and readout electronics. These will be used to determine the SGG's sensitivity and ultimate resolution for gravity recovery. This paper will discuss preliminary instrument and spacecraft design, and top-level mission requirements.

G22: Bridging the Gap Between GRACE and a Follow-on Mission