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C3Po1B-08 [10]: Numerical study on low-temperature superconducting magnetic levitation

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A new terrestrial gravitational wave detector, Superconducting Omni-directional Gravitational Radiation Observatory (SOGRO), has been proposed in 2016 and seen as a competitive candidate of middle-frequency gravitational wave detector. In this detector, there are three pairs of 5 ton low-temperature superconducting test masses, which are separated by 50 meters and magnetically levitated by superconducting coils carrying persistent currents, and of which the displacement are measured by superconducting inductance displacement sensors. To get a sensitivity of 10-20 Hz-1/2⊠ the levitation frequency of the test masses need to be as low as 0.5 Hz, and to reduce the harmonics, the transfer function between test mass displacement and displacement sensor output needs to be as linear as possible. We numerically studied the levitation and displacement sensing of a system owning a similar structure with SOGRO, and found out a possible design of the superconducting levitation system which can reduce the levitation frequency to 0.1 Hz, and a design of the superconducting displacement sensor which can reduce the nonlinearity of the transfer function by 90%. This study will benefit the development of SOGRO.

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