

Time Domain Simulations of Arm Locking in LISA

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Abstract

Arm locking is a technique that has been proposed for reducing laser frequency fluctuations in the Laser Interferometer Space Antenna (LISA), a gravitational-wave observatory sensitive in the milliHertz frequency band. Arm locking takes advantage of the geometric stability of the triangular constellation of three spacecraft that comprise LISA to provide a frequency reference with a stability in the LISA measurement band that exceeds that available from a standard reference such as an optical cavity or molecular absorption line. We have implemented a time-domain simulation of arm locking including the expected limiting noise sources (shot noise, clock noise, spacecraft jitter noise, and residual laser frequency noise). The effect of imperfect a priori knowledge of the LISA heterodyne frequencies and the associated “pulling” of an arm locked laser is included. We find that our implementation meets requirements both on the noise and dynamic range of the laser frequency.

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