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LISA Optical Metrology Challenges

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The space-borne gravitational wave observatory LISA aims to measure sources in the 0.1 mHz to 1 Hz frequency range. Core to this measurement is the optical readout of differential path lengths between free-floating test masses aboard three satellites orbiting the sun in a tilted cartwheel formation. On average, the satellites'positions form an equilateral triangle of 2.5 million km arm-length, but the enormous distances paired with orbit dynamics give rise to continuous arm-length changes on the order of 1% as well as angular variations of about 2 degrees over the period of a year. The overall displacement readout noise goal of about 10pm/sqrt(Hz) within this 'breathing' interferometer entails a number of challenges for the required optical metrology. In this presentation we will give an update on current investigations at the Albert Einstein Institute in Hannover, Germany that focuses on high dynamic range phase readout for the long-arm interferometry and on the compensation of the breathing angle, which requires an intra-satellite phase comparison between two optical benches, often referred to as backlink.

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