attocube ANR240 - exploring outer space

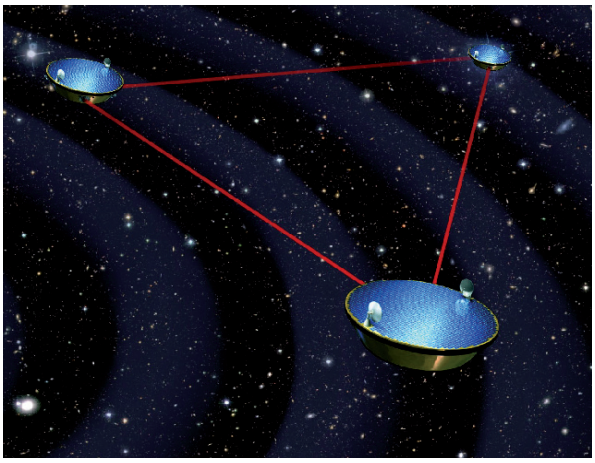
Laser Interferometer Space Antenna - LISA mission

In this application, attocube systems' nanopositioners are literally lifted up to space in a joint-mission by the European ESA and the US NASA. In the ambitious project with the name 'Laser Interferometer Space Antenna' or LISA, three identical, laser-equipped satellites are launched into an Earth-like heliocentric orbit, one astronomical unit from the Sun, trailing the earth by 20°. The three spacecraft mark the vertices of an equilateral triangle with five million km edge length, forming a giant Michelson interferometer in space.

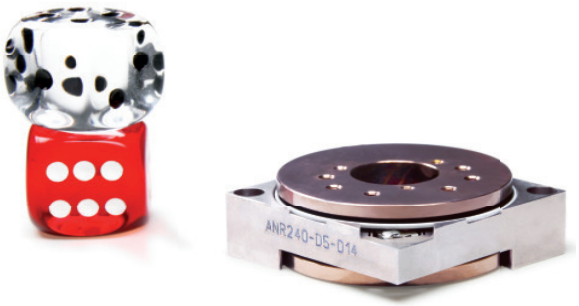
The purpose of the LISA mission is to detect gravitational waves as caused by massive black holes, binary star systems, and other sources of cosmological origin. The spacecraft separation sets the range of gravitational wave frequencies LISA can observe (from 0.03 milliHertz to above 0.1 Hertz). In every spacecraft, a 1 W diode-pumped 1064 nm Nd:YAG laser is used to precisely determine distance fluctuations between the spacecrafts with a resolution of $4x10^{-11}$ m, corresponding to a relative displacement of $x/\Delta x=10^{18}$.

In case of a malfunction of this Nd:YAG laser, a second, identical laser can be coupled into the beam path by means of an attocube ANR240 nanopositioner which rotates a lambda plate. The ANR240 was specifically designed to operate reliably under the extreme conditions in space and to endure the high accelerations imposed during launch phase. attocube systems' ANR240 has been developed in close cooperation with the Precision Motion Systems and Space departments of TNO, the Netherlands Organisation for Applied Scientific Research.

The ANR240 allows rotational movement of optical components in UHV conditions with a wobble of less than 0.1 mrad and is therefore perfectly suited for experiments where extremely accurate positioning in combination with a rugged design is required.



Artistic impression of the three LISA satellites forming a Michelson interferometer in space. Image courtesy of NASA / JPL.



This rotator was specifically designed for the rotation of large samples with ultra low wobble. The 12.7 mm aperture further enables optical transmission experiments.

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