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Reducing coating thermal noises in Gravitational wave detectors using AlGaAs crystalline mirrors

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The first gravitational wave detections occurred with the LIGO detector in the United States and the Virgo detector in Europe, opening the way to the field of gravitational astronomy and providing information on black holes, neutron stars and relativity theory of Einstein that were inaccessible before. These detectors are based on giant laser interferometers several kilometers long. It is essential to improve their sensitivity to progress in this area.

One of the main limitations of the sensitivity comes from the thermal fluctuation that occurs within the mirrors used in these giant laser interferometers. This fluctuation depends on the temperature and is known as thermal noise. Detailed studies show that the main cause is the reflective multilayer coating deposited on the surface of the mirror.

The goal of this research is to develop new mirrors based on monocrystalline coatings to reduce thermal noise and improve the sensitivity of gravitational wave detectors. More precisely, the project comprises the production of crystalline mirrors based on GaAs / AlGaAs stacks as well as their optical and mechanical characterization.

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