Thermal Noise in Advanced LIGO mirrors

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The range of an advanced gravitational wave detector depends critically on the noise in mirror coatings. In order for gravitational wave astronomy to become a flourishing field, new mirror technologies and materials must be developed which exhibit substantially lower thermal noise than those used in the current generation of LIGO. These current mirrors have dielectric coatings made of alternating layers of fused silica and tantalum pentoxide. While these materials have excellent optical properties, mechanical losses in the tantala layer are the dominant source of thermal noise. Our project is part of a large ongoing collaboration to develop mirror coatings that have lower levels of mechanical loss while still exhibiting good optical qualities. One candidate material is tantalum pentoxide with a titanium doping. Preliminary studies have shown that the addition of this dopant reduces the level of internal friction. This summer we received a set of mirrors with prototype coatings incorporating the doped tantalum pentoxide. Our goal is to measure the broadband thermal noise in these coatings directly. We report on progress and results to date of this project and what it means for advanced LIGO.