

## Optical and Mechanical Characterisation of Ion-Plated Coatings for use in Future Gravitational Wave Detectors

Highly reflective mirror coatings of low mechanical and optical losses are essential for interferometric gravitational wave detectors. Advanced LIGO (aLIGO) currently operates with an absorption requirement of  $<0.5\text{ppm}$  at  $1064\text{nm}$  and 3rd generation detectors are hoping to be able to, in tandem, measure at room temperature and cryogenic temperatures while also upgrading the measuring wavelength to  $1550\text{nm}$ . Coatings of low optical absorption and mechanical loss must be designed operate in these conditions.

As thermal noise arising from the thermal vibrations inside these coatings has become a limiting factor on the performance of current and future gravitational wave detectors, any proposed coating material must have optimally low mechanical and optical loss properties.

Ion plated coatings boast high packing density, which, in theory should produce favourably low optical and mechanical loss coatings. The results presented here detail the optical absorption at  $1064$  and  $1550\text{nm}$  for ion plated  $\text{Ta}_2\text{O}_5$  deposited on silica substrates; comparing the effects of annealing in both oxygen rich and deprived atmospheres at  $400^\circ\text{C}$ , linking to high optical absorption. Mechanical loss measurements of ion-plated  $\text{Ta}_2\text{O}_5$  and  $\text{SiO}_2$  are also presented

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**Session Classification:** Poster session