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First measurements of bulk and shear mechanical loss in optical thin film materials MATTHEW ABERNATHY, Naval Research Lab, GREGORY HARRY, JONATHAN NEWPORT, HANNA FAIR, SAM HICKEY, American University, ANDRI GRETTARSSON, Embry-Riddle Aeronautical University, STEVE PENN, Hobart and William Smith Colleges , LIGO COLLABORATION — As advanced gravitational wave detectors come online, and the possibility of the first gravitational wave detection nears, plans for the next generation of gravitational wave detectors are already in the works. These new detectors, and those already planned for the future, are expected to be limited in their most sensitive frequency bands by the Brownian thermal noise generated within the optical thin films used to produce the interferometer mirrors. In order to fully predict the level of this Brownian noise, it is necessary to know the two independent mechanical moduli (Young modulus and Poisson ratio, Bulk and Shear moduli, etc.) as well as their associated mechanical loss parameters. Traditional measurements of the mechanical loss of thin films has measured only one linear combination of these two loss parameters. Here, we present measurements of the bulk and shear mechanical loss of tantalum pentoxide (tantala) thin films made by taking advantage of the differing ratios of elastic deformation in the various resonant modes of a coated silica disc. These results may have immediate implications for the ultimate sensitivity of currently operated gravitational wave detectors.

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