Book Chapter outline Thermal noise

1. Introduction

To include discussion of the relevance of thermal noise in a wide range of precision experiments as well as for gravitational wave detectors.

2. Historical perspective

Discussion of the roots of the theory in the field (fluctuation-dissipation theorem etc) through to the developments by Levin of how to apply this to physical systems.

3. Sources of thermal noise

An overview of the various forms of thermal noise of interest (Brownian, thermoelastic, thermorefractive etc)

4. Thermal noise in mirror substrates

To include discussion of the techniques for evaluating thermal noise in mirror substrates and the most relevant sources of thermal noise in substrates (bulk loss and the various processes that can contribute to it (phonon-damping, internal friction due to detects etc); surface loss; the significance of spatial inhomogeneity in calculating thermal noise)

5. Thermal noise of optical coatings

Review of techniques to calculate thermal noise in optical coatings, brief discussion of state of the art and forward pointer to Gregg’s chapter?

6. Thermal noise in suspension systems

Review of the important sources of thermal noise most relevant in suspension elements (eg thermoelastic loss and surface losses) and the evolution and status of techniques for calculating suspension thermal noise (and forward pointer to Norna and or Gregg’s chapter?)

7. Design choices and a forward look

Summary and implications for future design choices and interesting research avenues arising from our current state of knowledge in this area