Contents

1 **Toward Gravitational Wave Astronomy** 1
Giovanni Losurdo

2 **The Science Case for Advanced Gravitational Wave Detectors** . . . 21
Andrea Viceré

3 **Interferometer Configurations** 57
Gabriele Vajente

4 **Pre-stabilized Lasers for Advanced Detectors** 97
C.-Nary Man

5 **Input Optics System** 115
Matteo Tacca

6 **Readout, Sensing, and Control** 153
Gabriele Vajente

7 **An Introduction to the Virgo Suspension System** 193
Franco Frasconi and Piero Rapagnani

8 **Thermal Noise in Laser Interferometer Gravitational Wave Detectors** 225
Raffaele Flaminio

9 **Thermal Effects and Other Wavefront Aberrations in Recycling Cavities** 251
Alessio Rocchi

10 **Stray Light Issues** 275
Julien Marque and Gabriele Vajente

11 **A Basic Introduction to Quantum Noise and Quantum-Non-Demolition Techniques** 291
Stefan Hild

12 **The Parametric Instability in Advanced Gravitational-Wave Interferometers** 315
Pierre-François Cohadon and Slawomir Gras

13 **A Third Generation Gravitational Wave Observatory: The Einstein Telescope** 333
Michele Punturo, Harald Lück and Mark Beker

14 **Low Temperature and Gravitation Wave Detectors** 363
Fulvio Ricci