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Nota di contenuto	Intro -- Supervisor's Foreword -- Preface -- Acknowledgements -- Contents -- Acronyms -- List of Figures -- 1 Introduction -- 1.1 Motivation -- 1.2 Gravitational Waves -- 1.3 Interferometric Gravitational Wave Detectors -- 1.4 Power Noise in Gravitational Wave Detectors -- 1.5 Introduction to Laser Power Fluctuations -- 1.6 Review of Power Stabilization Schemes -- 1.6.1 Traditional Power Stabilization Scheme -- 1.6.2 Alternative Schemes -- 2 Sensing Laser Power Fluctuationspg Via an Alternative Observablepg of the Light Field -- 2.1 Phase Transfer Schemes -- 2.1.1 Optical Kerr Effect -- 2.1.2 Cascaded Kerr Effect -- 2.1.3 Radiation Pressure -- 2.2 Phase Readout Schemes -- 2.2.1 Michelson Interferometer -- 2.2.2 Optical Cavity -- 2.3 Polarization Transfer and Readout Schemes -- 2.4 Summary -- 3 Fundamental Limits of Power Stabilization via a Radiation Pressure Transfer Scheme -- 3.1 Quantum Noise Limit -- 3.1.1 Mathematical Framework -- 3.1.2 Traditional Scheme -- 3.1.3 Radiation Pressure Scheme -- 3.2 Thermal Noise Limit -- 3.3 Total Fundamental Limit -- 3.4 Frequency Noise Imprinted in the Out-of-Loop Beam -- 3.5 Comments on Ponderomotive Squeezing -- 3.6 Summary -- 4 Power Stabilization via Radiation Pressure-Experimental Setup -- 4.1 Choice of the Movable Mirror -- 4.2 Experimental Setup -- 4.2.1 Laser Preparation -- 4.2.2 In-vacuum Breadboard -- 4.2.3 Vacuum System

Sommario/riassunto

This book offers a comprehensive and complete description of a new scheme to stabilize the power of a laser on a level needed for high precision metrology experiments. The novel aspect of the scheme is sensing power fluctuations via the radiation pressure driven motion they induce on a micro-oscillator mirror. It is shown that the proposed technique can result in higher signals for power fluctuations than what is achieved by a direct power detection, and also that it enables the generation of a strong bright squeezed beam. The book starts with the basics of power stabilization and an overview on the current state of art. Then, detailed theoretical calculations are performed, and the advantages of the new scheme are highlighted. Finally, a proof-of-principle experiment is described and its results are analyzed in details. The success of the work presented here paves a way for achieving high power stability in future experiments and is of interest for high precision metrology experiments, like gravitational wave detectors, and optomechanical experiments. Nominated as an outstanding PhD thesis by the Gravitational Wave International Committee.