University of the Basque Country

PhD Thesis

OWER BOUNDS ON QUANTUM
AETROLOGICAL PRECISIONS

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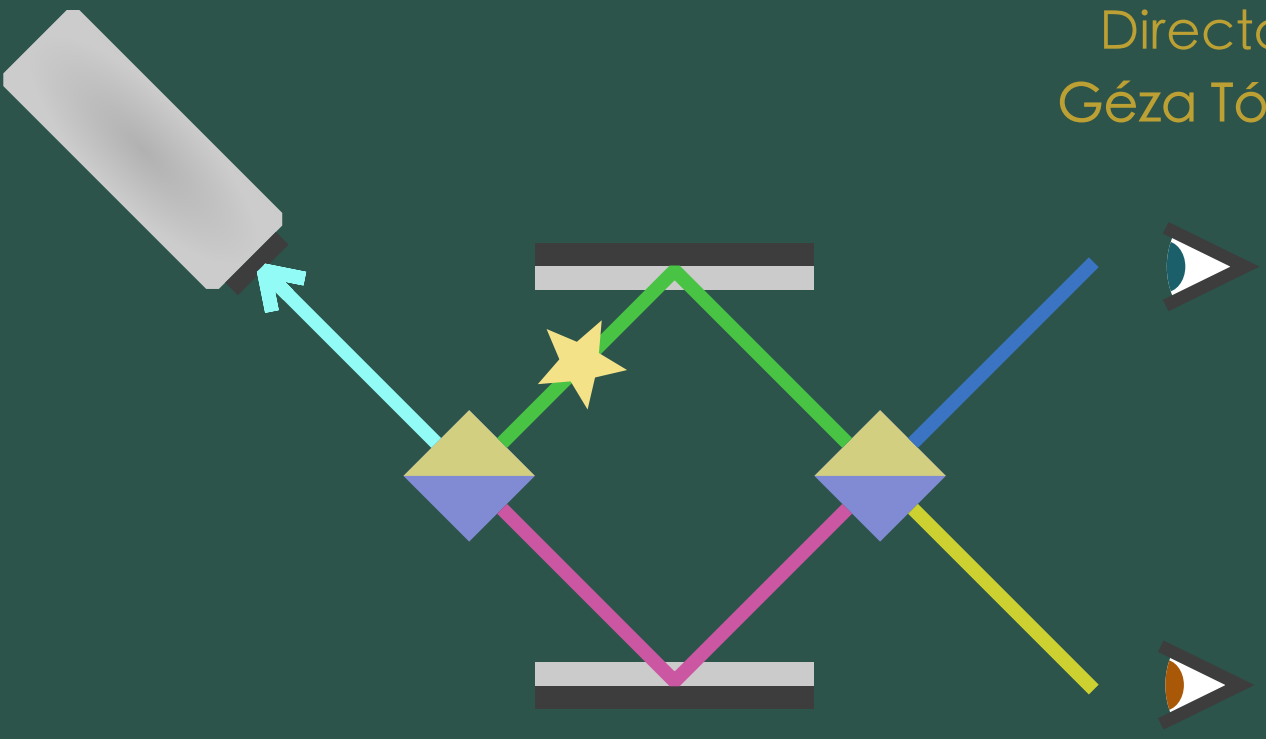

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Prologue

This work is part of the doctoral project of M. Sc. Iagoba Apellaniz in order to obtain the necesary qualification to promote himself to become a PhD. This work also tries to collect almost al the research discoveries done by the author on those previous years in a clear and concise way to make it understable for a general reader with a basic background in mathematics and physics.

The aim of this thesis is to present to the reader some important results of quantum metrology as well as guide possible interested ones into the fascinating field that is quantum metrology and its applications.

This is the prologe

Publications

Iagoba Apellaniz *et al* 2015 *New J. Phys.* **17** 083027
Detecting metrologically useful entanglement in the vicinity of Dicke states

Preprints

Out of the scope of this thesis

Géza Tóth and Iagoba Apellaniz 2014 *J. Phys. A: Math. Theor.* **47** 424006
Quantum metrology from a quantum information science prespective

Giuseppe Vitagliano *et al* 2014 *Phys. Rev. A* **89** 032307
Spin squeezing and entanglement for an arbitrary spin

Contents

Tables, figures and abbreviations used in this book

[Insert in a table]

SLD - Symmetric logarithmic derivative.

qFI - Quantum Fisher information

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Lower bounds on quantum metrological precisions

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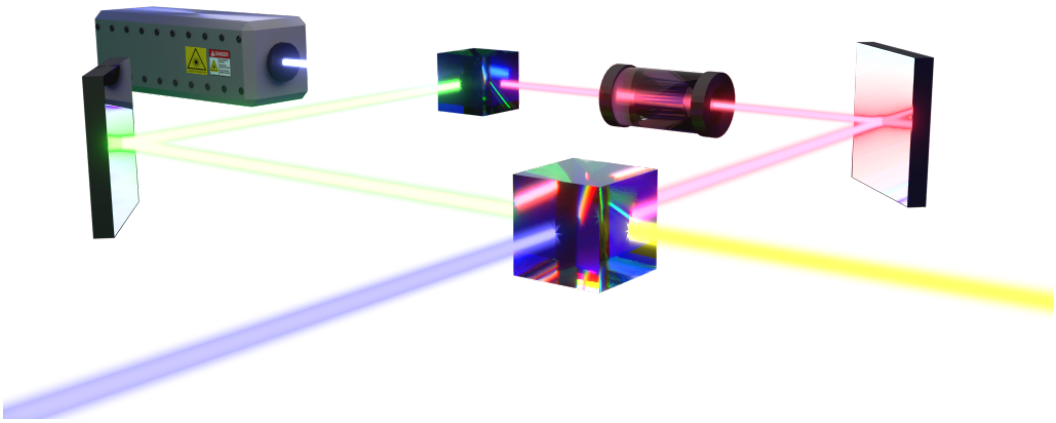

November 17, 2015

To my parents and my family

1 Introduction

Metrology has played an inportant role since [TODO: add historical reasons]. With the development of quantum technology, a more deep understanding of one of its aspect as the quantum metrology is needed. Therefore, many works appeared recently on the literature.

In this work the author, in collaboration with other researchers [TODO: see how to add reference to the rest of collavorators], has addressed some crucial questions regarding this field.

2 Background on Estimation and on Quantum Information Theories

This thesis is based on many previous works developed since long time ago. It is known that estimation processes are part of different aspects of the human been behaviour. From the estimation of the season on which one has to plant some vegetables to grow until the estimation of which route is the shorter to reach somewhere. All these processes usually involve a huge amount of data. So it has been developed a strongly consolidated theory around that.

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2.1 Classical estimation theory

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2.2 Step in quantum estimation theory

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2.3 Quantum Metrology

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3 Quantum metrology with Dicke like states

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4 Bounding quantum Fisher Information with observables

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5 Accuracy bound for gradient field estimation with atomic ensembles

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