

OPTICAL PROPERTIES OF GAIN INCORPORATING PHOTONIC RESONONATORS

COMSATS UNIVERSITY ISLAMABAD



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Abstract

Abstract goes here

Dedication

To mum and dad

Declaration

I, **AHMAD BILAL CIIT/FA15-BPH-019/ISB** , hereby declare that this project neither as a whole nor as a part there of has been copied out from any source. It is further declared that I have developed this thesis and the accompanied report entirely on the basis of my personal efforts made under the sincere guidance of my supervisors. No portion of the work presented in this report has been submitted in support of any other degree of qualification of this or any other University or Institute of learning, if found I shall stand responsible.

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Date: _____

Acknowledgements

I want to thank...

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Chapter 1

Introduction

1.1 Resonators

Most of the time, using `mpmath` is simply a matter of setting the desired precision and entering a formula. For verification purposes, a quite (but not always!) reliable technique is to calculate the same thing a second time at a higher precision and verifying that the results agree.

1.1.1 Explanation

To perform more advanced calculations, it is important to have some understanding of how `mpmath` works internally and what the possible sources of error are. This section gives an overview of arbitrary-precision binary floating-point arithmetic and some concepts from numerical analysis. Most of the time, using `mpmath` is simply a matter of setting the desired precision and entering a formula. For verification purposes, a quite (but not always!) reliable technique is to calculate the same thing a second time at a higher precision and verifying that the results agree.

1.2 Optical Resonators

To perform more advanced calculations, it is important to have some understanding of how `mpmath` works internally and what the possible sources of error are. This section gives an overview of arbitrary-precision binary

floating-point arithmetic and some concepts from numerical analysis. Most of the time, using `mpmath`

1.2.1 Different Geometries

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1.3 Fabry-Perot Resonators

To perform more advanced calculations, it is important to have some understanding of how `mpmath` works internally and what the possible sources of error are. This section gives an overview of arbitrary-precision binary floating-point arithmetic and some concepts from numerical analysis.

1.3.1 Explanation

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1.4 Ring Resonators

To perform more advanced calculations, it is important to have some understanding of how `mpmath` works internally and what the possible sources of error are. This section gives an overview of arbitrary-precision binary floating-point arithmetic and some concepts from numerical analysis.

1.4.1 All-Pass

To perform more advanced calculations, it is important to have some understanding of how `mpmath` works internally and what the possible sources of error are. This section gives an overview of arbitrary-precision binary floating-point arithmetic and some concepts from numerical analysis.

1.4.2 Add drop

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1.4.3 Coupled Ring

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Chapter 2

Area of Study

2.1 The Fabry-Perot Interferometer

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2.1.1 Theory of Fabry-Perot interferometer

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2.1.2 Finesse, Q-factor

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2.2 Gain incorporation in Resonators

To perform more advanced calculations, it is important to have some understanding of how `mpmath` works internally and what the possible sources of error are. This section gives an overview of arbitrary-precision

2.2.1 Beer's Law

binary floating-point arithmetic and some concepts from numerical analysis. Most of the time, using `mpmath` is simply a matter of setting the desired precision and entering a formula. For verification purposes, a quite (but not always!) reliable technique is to calculate the same thing a second time at a higher precision and verifying that the results agree.

2.2.2 Beer's law study as gain

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2.3 Gain medium

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Chapter 3

Coupled Resonators with Gain

3.1 Coupled resontaor with Gain medium

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3.1.1 Gain element

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3.2 Calculation/Equations

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3.2.1 For single

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3.2.2 For coupled

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3.2.3 For triple

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3.3 Coupling Regimes

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Chapter 4

Electromagnetically Induced Transparency

4.1 EIT in Atoms

Most of the time, using `mpmath` is simply a matter of setting the desired precision and entering a formula. For verification purposes, a quite (but not always!) reliable technique is to calculate the same thing a second time at a higher precision and verifying that the results agree.

4.1.1 Two level Atoms

To perform more advanced calculations, it is important to have some understanding of how `mpmath` works internally and what the possible sources of error are. This section gives an overview of arbitrary-precision binary floating-point arithmetic and some concepts from numerical analysis. Most of the time, using `mpmath` is simply a matter of setting the desired precision and entering a formula. For verification purposes, a quite (but not always!) reliable technique is to calculate the same thing a second time at a higher precision and verifying that the results agree.

4.2 EIT in ring resonators

To perform more advanced calculations, it is important to have some understanding of how `mpmath` works internally and what the possible sources

of error are. This section gives an overview of arbitrary-precision binary floating-point arithmetic and some concepts from numerical analysis. Most of the time, using `mpmath` is simply a matter of setting the desired precision and entering a formula. For verification purposes, a quite (but not always!) reliable technique is to calculate the same thing a second time at a higher precision and verifying that the results agree.

4.3 EIT in Coupled resonators(CRIT)

To perform more advanced calculations, it is important to have some understanding of how `mpmath` works internally and what the possible sources of error are. This section gives an overview of arbitrary-precision binary floating-point arithmetic and some concepts from numerical analysis. Most of the time, using `mpmath` is simply a matter of setting the desired precision and entering a formula. For verification purposes, a quite (but not always!) reliable technique is to calculate the same thing a second time at a higher precision and verifying that the results agree.

4.4 CRIT with gain

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4.5 Results

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Chapter 5

Electromagnetically Induced Absorption

5.1 EIA concepts

To perform more advanced calculations, it is important to have some understanding of how mpmath works internally and what the possible sources of error are. This section gives an overview of arbitrary-precision binary floating-point arithmetic and some concepts from numerical analysis. To perform more advanced calculations, it is important to have some

5.1.1 EIA in atoms

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5.1.2 EIA Quantum phenomena

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5.2 EIA in resonators

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5.2.1 Coupled resonators induced Absorption

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5.3 CRIA with gain

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Chapter 6

Conclusion

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Appendix A

Abbreviations

EIT Electromagnetically Induced Transparency

EIA Electromagnetically Induced Absorption

CRIT Coupled Resonator Induced Transparency

CRIA Coupled Resonator Induced Absorption

FSR Free Spectral Range

MRR Micro Ring Resonator

MZI Mach Zehnder Interferometer

FWHM Full width at half maximum

CMT Coupled Mode Theory