

Okinawa Institute of Science and Technology  
Graduate University

Thesis submitted for the degree  
Doctor of Philosophy

Descriptive and unique thesis title

by

Author McWrity

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January, 1900

# Declaration of Original and Sole Authorship

I, Author McWrity, declare that this thesis entitled *Descriptive and unique thesis title* and the data presented in it are original and my own work.

I confirm that:

- This work was done solely while a candidate for the research degree at the Okinawa Institute of Science and Technology Graduate University, Japan.
- No part of this work has previously been submitted for a degree at this or any other university.
- References to the work of others have been clearly attributed. Quotations from the work of others have been clearly indicated, and attributed to them.
- In cases where others have contributed to part of this work, such contribution has been clearly acknowledged and distinguished from my own work.
- None of this work has been previously published elsewhere, with the exception of the following: (provide list of publications or presentations, or delete this part). (If the work of any co-authors appears in this thesis, authorization such as a release or signed waiver from all affected co-authors must be obtained prior to publishing the thesis. If so, attach copies of this authorization to your initial and final submitted versions, as a separate document for retention by the Graduate School, and indicate on this page that such authorization has been obtained).

Date: January, 1900

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# Abstract

## **Descriptive and unique thesis title**

Maximum 400 words, not to exceed one A4 page.

No figures or tables. No references. Just aims, brief methods, results, brief conclusions.

Avoid over-detailed technical method descriptions.

Should be readable to a literate science reader familiar with your general area, but not necessarily experts-only material

This will be published online within 3 months of award of the degree, as a minimum.

The entire thesis must be published within one year, unless restrictions apply (as above).

# Acknowledgment

Theses must acknowledge assistance received in any of the following areas:

- Designing the research
- Executing the research
- Analyzing the data
- Interpreting the data/research
- Writing, proofing, or copyediting the manuscript

Where co-authors have contributed to papers arising from the work, you should not include their data unless it is essential for the scientific narrative. In such cases, full disclosure of the contribution is required. Acknowledge any work performed by others, whether at OIST or outside OIST.

# Abbreviations

All abbreviations used in the thesis should be listed here, with their definitions, in alphabetical order. This includes trivial and commonly used abbreviations (at your own discretion), but not words that have entered into general English usage (such as laser or DNA). In particular, non-standard abbreviations should be presented here. This is an aid to the reader who may not read all sections of the thesis.

PPT	positive partial transpose
SRPT	Schrödinger-Robertson partial transpose

# Glossary

Dipole Blockade	Phenomenon in which the simultaneous excitation of two atoms is inhibited by their dipolar interaction.
Cavity Induced Transparency	Phenomenon in which a cavity containing two atoms excited with light at a frequency halfway between the atomic frequencies contains the number of photons an empty cavity would contain.

# Nomenclature

$c$	Speed of light ( $2.997\,924\,58 \times 10^8 \text{ ms}^{-1}$ )
$\hbar$	Planck constant ( $1.054\,572\,66 \times 10^{-34} \text{ Js}$ )
$k_B$	Boltzmann constant ( $1.380\,658 \times 10^{-23} \text{ JK}^{-1}$ )
$Z_0$	Impedance of free space ( $376.730\,313\,461 \text{ }\Omega$ )
$\mu_0$	Permeability of free-space ( $4\pi \times 10^{-7} \text{ Hm}^{-1}$ )

If desired, an optional and short dedication may be  
included here.



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# Introduction

This is the introduction. You might want to leave it unnumbered, as it is now. If you want to number it, treat it like any other chapter.

# Chapter 1

## Guidelines on the preparation of theses

These guidelines set out the organization and formatting requirements of the OIST Ph.D. thesis, in order to assist students in the preparation of theses for submission. The academic requirements of the thesis are defined in full in the document “PhD Completion Requirements”.

The OIST standard organization in L<sup>A</sup>T<sub>E</sub>X is shown in this template. Points not referenced here (for example page sizes) are already defined in this template.

### 1.1 Guidelines on the preparation of theses

**Title Page:** This page is the first printed page, and can be duplicated in whole or part as the front cover in the final bound version.

**Choice of Title:** Select a descriptive and unique title that clearly communicates your research. Avoid brief or misleading titles. The title will be displayed on your graduation testamur. The title should be unique within OIST, to distinguish your thesis from those of others working on similar topics.

**Declaration of Original Authorship:** You must declare that the work is your own, and original, by signing and including the declaration.

**Plagiarism and Fraud:** Students are reminded that they must take all necessary

precautions to avoid plagiarism and fraudulent misrepresentations of data.

**Co-authorship:** Co-authors are not permitted on an OIST PhD thesis. All research and analysis should be your own work. Where co-authors have contributed to papers arising from the work, you should not include their data unless it is essential for the scientific narrative. In such cases, full disclosure of the contribution is required. Acknowledge any work performed by others, whether at OIST or outside OIST.

**Main body:** The main body may be arranged as a single body of material, divided into sub-sections of Introduction (including a statement of the problem), Methods, Results, Discussion, or if preferred, in chapters that each deal with a smaller part of the research, each one itself divided into sub-chapters of Introduction, Methods, Results, Discussion (or similar), as appropriate.

**Reference List:** Provide a complete numbered list of all material cited in your thesis using BibTeX or BibLaTeX.

**Appendices (published papers):** The printed versions of the thesis may include, as an appendix, published papers; unpublished manuscripts that have been submitted for publication; and manuscripts ready for, or very close to, journal submission. These should be placed immediately after the final pages of the thesis, and separated from the thesis itself by a single dividing page with the text: “Previously published articles associated with the research described in this thesis”, or similar. These published papers are included solely for completeness of the bound thesis as a historical record of your achievement, and are for future reference of yourself and the supervisors. They will not be included in the on-line version of the thesis. Papers co-authored during the period of the thesis that do not include material presented in this work should not be included.

## 1.2 Formatting Requirements

**Equations:** Equations are considered to be part of the text; they should be formatted consistently throughout the thesis, following the advice of the student’s supervisor.

**Spelling:** American spelling should be used.

**Printing:** Theses should be printed on one side of a page only (so that when bound, the right hand page is the printed page). This avoids text and image bleed through. Temporary bindings may use any reasonable white bond paper, in A4 size. Laser printing (in black ink wherever possible, and colour for images where necessary), should be used exclusively, rather than alternatives such as ink-jet, dye sublimation, or wax transfer (for durability of the print). Bound copies should use acid free paper (also known as archival paper) to ensure longevity of the thesis in the collection.

**Colors:** Colors may be used in images and charts where necessary to enhance comprehension, but should not be used for normal text or headings. Avoid the exclusive combination of red and green for binary images, to assist those who have difficulty discriminating hues. All text should be in black unless color-coding is necessary for meaning or contrast.

**Word length:** No minimum word length is imposed on OIST graduate theses. However, be concise in your language and succinct in your expression. The average length of a PhD thesis will vary between fields and between authors, but typical PhD theses are 200-400 pages in length (approximately 40-80,000 words of main body text).

**Citations:** All papers that you reference in your work must be referenced in full using a style relevant to your field. Provide the full title, a complete list of authors, and the article location and year of publication in the same style for all papers. Use one of several styles you have been introduced to in previous writing. Refer to papers in the text by either a numerical superscript, a bracketed number or by reference to (Author et al., 1999). Be consistent in your citation style throughout all sections of your thesis. Provide a complete list of all papers, books, and proceedings cited in your thesis at the end of the main body of text. Do not include papers in this list that were not cited in the thesis. Reference manager software such as Endnote or similar programs that offer “Cite-While You Write” functionality can assist this process greatly if you are using Word. Use or BibLaTeX if you are using LaTeX.



Citing one reference can be done like so: [1] and multiple references in one go like so [2–4].

**Editing:** The thesis should be entirely your own work. Minimal editing may be provided by your supervisor(s) or peers but only as a review of initial drafts. Do not seek assistance from OIST internal or paid external editing services, unless directed to do so by the Dean in revision stages.

## 1.3 Intellectual property and copyright

The student will retain copyright of the published work, in perpetuity. The student acknowledges that OIST remains the owner of the intellectual property generated by the research presented in the thesis and that publication of the thesis under the author's copyright does not diminish this claim. The thesis will be published online in electronic form within one year of graduation.

## 1.4 Submission of temporary and bound versions

The thesis will be submitted first in printed form in a style formatted to assist the examination process (single side printing, double spacing, temporary binding). Two copies of the examination version must be bound in temporary form (using the comb binder available in the graduate school office, or with a glued spine cloth). Soft plastic end covers may be used. This version should include (inserted after the thesis itself) any papers published during the tenure of the thesis that are relevant to the material therein, for the convenience of the examiners. A digital version of the same file (without the “published papers” appendix) should also be sent to the Grad School with your submitted version, which will be kept as a backup.

The two external examiners will examine the written thesis and prepare a report. This report may ask for minor revisions, but it is not expected that major revisions will be

undertaken at this point. When the two copies of the marked thesis are returned (with annotations) the student will be asked to make any required minor revisions, and must then confirm with the Graduate School that the revisions are accepted and complete within one month. Once the final version of the thesis is approved, the student will then be eligible to defend the thesis. No additional changes may be made at that point. The final version of the thesis must be submitted as an electronic file in PDF format. Once the thesis defense has been concluded, and the degree awarded, the electronic file will be published online by the graduate school in the OIST Institutional repository.

The student should also prepare a permanent bound version of the final approved thesis (essentially the same as the PDF with altered margins) to present to the supervisor(s), according to the format described below (appendix 1, 2, and 3). The bound version must be submitted before the degree may be awarded, and may be submitted either before or after the defense. The graduate school will cover necessary costs for binding the supervisor copy (or copies).

# Chapter 2

## Figures, tables and images

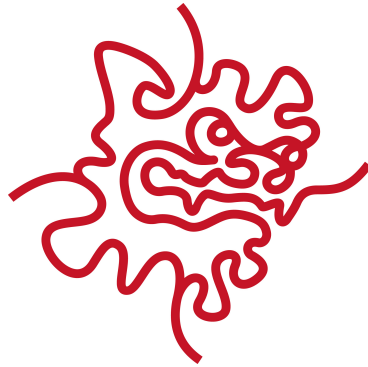
### 2.1 Figures

Figures should appear as close as possible to the first mention of them in the text. All figures must be referred to in the text by either a parenthetical mark-up (Figure 2.1) or a phrasing such as “Sequencing data, shown in Figure 2.1, shows that...”. A parenthetical mention, but not an in-text mention, may be abbreviated as (Fig. 2.1). The number of the chapter should be part of the Figure number.

Figures must be accompanied by a caption that describes the material clearly and succinctly. Figure captions may start with a brief title in bold, which can then be referenced in the list of figures.



**Figure 2.1:** Short caption (if wanted). Full caption with all the details here.



This secret image won't be numbered and won't appear in the List of Figures because of the \*

**Table 2.1:** Short heading for the List of Tables.

Parameter	Value
$\Delta$	0, 150
$\alpha$	85
$\epsilon$	6
$\kappa$	6.8
$\gamma$	0.2

Full caption with all the details here.

Figures should not have captions that run across pages, as a general rule. If a figure and its caption will be larger than a page, consider rewriting the caption, or reorganizing the figure. If this cannot be avoided, the figure caption should continue on the immediate next page, with a reference comment at the start of the text to the fact that it is a continuation of the caption from the previous page. No other main body text should then appear on that page.

## 2.2 Tables

All tables should be referred to in the text by number (for example) “Table 2.1 describes all particles found in...”. Tables may be printed in landscape mode rather than portrait mode, but must then be printed on a separate page (with continuing and sequential pagination). Tables may extend for more than one page, but should then have the table

Parameter	Value
$\Delta$	0, 1500
$\alpha$	850
$\epsilon$	60
$\kappa$	68
$\gamma$	2

This secret table won't be numbered and won't appear in the List of Figures because of the \*

header row repeated on each page. Do not use font sizes smaller than 9 point. Tables should have a heading and may have a caption. The number of the chapter should be part of the Table number.

## 2.3 Images

Images are vital to the presentation of scientific data. Ensure that all textual annotations are correctly labeled, and that legends (if provided) are clear and legible. Use small symbols on charts for data points. Ensure that axis marks and axis labels are large enough to read clearly. Use all the white space where possible. Provide meaningful headings for charts, as well as a caption explaining the data. Be aware of the expected standards covering image manipulation and the standard practice for image presentation in your field, and adhere to them. In particular, avoid excessive density, contrast, and hue manipulation of photographic images. Where extensive manipulation of images is required for data extraction or analysis, this must be clearly explained as part of your methods, and explicitly in the caption for each figure.

# Conclusion

This is the conclusion. You might want to leave it unnumbered, as it is now. If you want to number it, treat it like any other chapter.

# Appendix A

## Appendices and Supplementary Data

Unlike a journal article, no data or discussion may be presented separately as unpublished supplementary documents or data. Appendices should be used instead for material that is tangentially relevant to the thesis but does not fit in the main narrative. If you need to refer to large volumes of data that cannot be printed (such as an annotated genome, or a simulation with moving images), lodge the data on an OIST repository or a public database and provide the URL of the dataset in the thesis.

# Bibliography

- [1] Hwang Lee and Marlan Scully. The physics of eit and lwi in v-type configurations. *Found. Phys.*, 28:585–600, 1998. ISSN 0015-9018. URL <http://dx.doi.org/10.1023/A:1018709621908>. 10.1023/A:1018709621908.
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- [4] H.A. Kramers. Scattering of light by atoms. *Atti Cong. Intern. Fisica Como*, 2: 545–557, 1927.



# Published articles

Authority:

- Approved by the President
- OIST School Corporation Act

## **Chapter 1. WHO WE ARE: Founding and Governing Principles**

### **1.1 FOUNDING OF THE OIST GRADUATE UNIVERSITY**

The Okinawa Institute of Science and Technology Promotion Corporation (OIST PC) was established on September 1, 2005, pursuant to the Independent Administrative Institution Okinawa Institute of Science and Technology Promotion Corporation Act (Act No. 26 of 2005), in order to prepare the way for an international graduate university (the University) dedicated to science and technology. Following the successful establishment and operation of OIST PC, the OIST School Corporation Act (Act No. 76 of 2009) was enacted to provide the institutional basis for the University and to establish a framework for transitioning from a research institute to a fully functioning graduate university.

The express objectives of the OIST School Corporation (OIST SC) are to conduct outstanding international research and education in science and technology, and by this means to:

- ~contribute to the sustainable development of Okinawa; and
- ~to advance science and technology in Japan and the rest of the world.

#### **1.1.1 OBJECTIVES OF THE OIST GRADUATE UNIVERSITY**

The founding documents established five central concepts to guide the University:

**Best in the World** - Be a leading center for education and research, which requires a culture where creativity, uniqueness, and diversity are encouraged.

**International** – Aim that more than half of the faculty and students will be non-Japanese and that English, as the international language of science and technology, will be the University's official language.

**Flexible** – Encourage innovation, creativity, and adaptability (academically and administratively), accommodate new initiatives, establish an interdisciplinary academic structure, and treat every student as a unique individual.

**Global Networking** – Increase research and education opportunities and enhance the visibility of the University through

hosting, attending at and participating in international meetings, conferences, workshops, collaborations, and the like.

**Collaboration with Industry** – Recognize that the research outcomes generated by the University’s research in science and technology may be developed and applied by industry for the benefit of society in general as well as to facilitate sustainable development of Okinawa and the competitiveness of Japan.

### **1.1.2 SCHOOL CORPORATION & UNIVERSITY MANAGEMENT STRUCTURE**

In keeping with the mandate of the OIST School Corporation Act, OIST SC and the University present a unified management structure:

The ultimate authority and responsibility for the management and operation of the OIST SC is vested in its Board of Governors (BOG). The BOG selects a Chief Executive Officer (CEO) for OIST SC, and the CEO also serves as the President of the University. The BOG entrusts the day-to-day management of the University to the President. Additionally, the BOG appoints the Senior Level Executive, who is also the Vice-CEO.

The President, in consultation with the BOG, establishes a management structure for the University, a structure which is to be an efficient and effective vehicle for operating a distinguished international graduate university and which will ensure transparency and accountability in its administrative and fiscal operations.

## **1.2 MISSION STATEMENT**

The University shall conduct internationally outstanding education and research in science and technology, and thus contribute to the sustainable development of Okinawa, and promote and sustain the advancement of science and technology in Japan and throughout the world.

## **1.3 CORE VALUES**

Integrity, honesty, fairness, respect for others, and dedication to the OIST mission are the values that inform the activities and behaviors of individuals working for, or asserting an affiliation with, the University. The University promotes diversity and provides equal opportunities for all community members without regard for race, color, religion, national origin, ancestry, physical or mental disability, medical condition, marital status, gender, sexual orientation, or age.

In addition, the University operates within the principles established by the following policies:

### **1.3.1 OPENNESS IN RESEARCH**

The University's central functions of teaching, learning, researching, and publishing depend upon an atmosphere in which freedom of inquiry, thought, expression, scholarship and peaceable assembly are given full protection and support. Therefore, it is University policy that expression of the widest range of viewpoints is to be encouraged within the University.

In order to support the open and free exchange of ideas, the University as a matter of policy also encourages participation in the research enterprise by a diverse body of highly qualified individuals. Except in extraordinary circumstances as determined by the President [\[link: 2.4.1\]](#), participation in University research by otherwise qualified individuals will not be limited by citizenship, nationality, or ethnicity. Similarly, participants in University research shall not be denied access - based on citizenship, nationality, or ethnicity - to the intellectually significant portions of their research.

Additionally, because the University's research is intended for dissemination within the interested scientific community and throughout the world, only time-limited publication and disclosure restrictions based on contractual and/or legal obligations, such as those required for purposes of peer review and patentability review, may be imposed on the research.

### **1.3.2 RESPECTFUL WORKPLACE**

#### **OIST Graduate University Respectful Workplace Policy**

The University is committed to providing a work environment that promotes education, research, and productivity through working relationships based on respectful communication. This commitment calls for a workplace where the following core values are upheld:

1. Everyone at OIST without exception has an important contribution to make toward the overall success of the University's mission.
2. This mission will be carried out in an atmosphere where all employees, in all types of jobs, value each other and treat each

other with respect. Communication between employees should be polite at all times. This will be true even in situations of high pressure and urgency.

3. Diversity among employees is celebrated at OIST and employees must at all times exercise tolerance and respect for cultural, gender, ethnic and other differences. Special consideration should be given to those employees with physical or mental impairment.
4. Managers, supervisors and others in positions of authority should consider themselves as role models in the promotion of these core values, without in any way abdicating their responsibility to direct their employees to perform work effectively.
5. In the same spirit, employees, irrespective of their job title, are encouraged to discuss issues of concern without fear that those discussions will result in negative treatment or punitive consequences from any other employee of the University.
6. To promote mutual understanding and avoid unnecessary conflicts, an atmosphere where native English speakers are considerate of non-native speakers, and vice versa, is expected so that no language-related barrier restricts employees from participating in discussions or in asking questions.
7. In response to staff input, the University will make reasonable changes to improve the work environment and productivity at OIST.

### **1.3.3 COMMITMENT TO STUDENTS**

The University's PhD program is at the heart of the University, and its participants are selected from the very best science and technology graduate students in the world. The University is committed to their success, both while in the thesis program and beyond. During their graduate training at the University, each student will work closely with world-class faculty pursuing unique, highly individualized programs of study in modern well-equipped laboratories. The University's international composition and interdisciplinary approach has been expressly designed to spark exploration, creativity, discussion and innovation, in order to assure that our students will advance the cutting edge of research in science and technology. By providing excellent conditions for thesis research (including good practical support for living and thriving in Okinawa), the University advances the goals of its

students and encourages them to become tomorrow's leaders.

## **1.4 UNIVERSITY CODE OF CONDUCT**

The Code of Conduct (Code) is a statement of our shared and mutual commitment to upholding ethical, professional and legal standards in conducting our lives and making decisions within the University community. The University values integrity, honesty, fairness, diversity, respect for others, and equality of opportunity; it strives to assure that no activity of the University undermines fundamental principles of human dignity. As members of the University community, all faculty, staff, students, University officers, members of the Board of Governors, and all University affiliates and volunteers are responsible for maintaining and demonstrating these values and for observing the ethical standards of both the University and the broader community in which it operates. The values contained in this Code of Conduct must be integral elements of the University's educational, research and business practices. Each of us also must be cognizant of, and comply with, the relevant external policies, standards, laws and regulations that pertain to our activities.

### **1.4.1 APPLICABILITY**

The University's Code applies to the following members of the University community:

- ~ Those who are paid by the University when they are working for the University, including faculty, staff, researchers and students;
- ~ Those doing business with the University, such as consultants, vendors, and contractors;
- ~ Those who perform services for the University as volunteers; and
- ~ Those who assert an association with the University (such as alumni).

### **1.4.2 BUSINESS TRANSACTIONS & OTHER ACTIVITIES**

Members of the community must transact University business in compliance with applicable laws, regulations, and University policies, rules, and procedures. Business transactions and other activities within the University may not always be subject to specific laws, regulations, or codes of ethics. In these instances, our core values will govern. The fact that a particular business or other practice is common, customary, or expedient will not justify its use at the University if that practice conflicts with the core values of the University or any other the requirements of the Code.

#### 1.4.3 **PROTECTION OF INFORMATION**

Community members receive and generate on behalf of the University various types of confidential, proprietary, and private information. It is imperative that each member of the University community understands and complies with Japanese law concerning access to and disclosure of various types of information. In addition, each member of the University community must comply with disclosure/nondisclosure agreements with third parties, and with University policies, rules and procedures [\[link: 12\]](#) pertaining to the use, protection and disclosure of such information. Be aware that, in some cases, these rules and procedures may continue to apply even after a person's relationship with the University has ended.

#### 1.4.4 **CONFLICT OF INTEREST/CONFLICT OF COMMITMENT**

Members of the University community who serve as faculty or staff owe their primary professional allegiance to the University and its mission. Outside professional activities, private financial interests, or the receipt of benefits from third parties can cause an actual or perceived divergence between an individual's private interests and the duty of allegiance to the University.

To help prevent such a potential conflict of interest or commitment (including the appearance of a conflict) from arising, faculty and staff who have other professional or financial interests shall disclose them in compliance with applicable conflict of interest/conflict of commitment policies and procedures set out in the Policies, Rules and Procedures Library at Chapter 22, Avoiding Conflicts of Interest & Commitment. [\[link: 22\]](#).