이학박사 학위논문

On the PhD Dissertation at Seoul National University

서울대학교의 이학박사학위 학위논문에 관하여

2023년 8월

서울대학교 대학원

물리·천문학부 천문학전공

Gildong X. Hong

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지도교수 김 박 사

이 논문을 이학박사 학위논문으로 제출함

2023년 6월

서울대학교 대학원

물리·천문학부 천문학전공

홍 길 동

홍길동의 이학박사 학위논문을 인준함

2023년 8월

위 원 장	Professor N. One	(인)
부 위 원 장	Likely Ur. Supervisor	(인)
위 원	Another Professor	(인)
위 원	Another Doctor	(인)
위 원	Yet Another	(인)

On the PhD Dissertation at Seoul National University

By

Gildong X. Hong

A dissertation submitted in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

in

Astronomy

College of Natural Sciences
Department of Physics and Astronomy
Seoul National University
Astronomy Major

Supervised by Baksa F. Kim

August 2023

Committee:

Chair	Professor	Professor N. One
Vice Chair	Professor	Likely Ur. Supervisor
Examiner	Professor	Another Professor
Examiner	Doctor	Another Doctor
Examiner	Doctor	Yet Another

Abstract

Starting from February 2021, SNU students are no longer required to submit a printed dissertation; only a digital version is necessary (printed version is actually not allowed). Consequently, the library no longer enforces strict rules for page size, margin size, fonts, and font sizes. They replied "중앙도서관에서 LaTeX 양식은 별도로 제공하고 있지 않으며, word / 한글 양식만 제공하고 있는 점 양해 부탁드립니다. [...] 현재 저희가 제공하고 있는 작성 요령 및 내용 구성 등은 기본적으로 따르되, 많이 문의해주시는 논문의 규격(본문 크기, 여백 등), 서체(활자 종류 및 크기)에 대해서는 엄격하게 규정해두고 있지 않은 점 알려드립니다." - email by libit@snu.ac.kr on 2022-12-05 to ysBach.

Their guidance is to "follow the template" but you can modify as you wish. Therefore, all parameters (including code lines) within this TeX source code, especially indicated by `%%%%[Free to change]%%%%` block, can be adjusted by the student as desired, as long as it doesn't significantly compromise readability. Please look into the main manuscript TeX file. Prior to Feb 2021, regulations were based on the commercial HWP processor. Among them, regulation for main text: (I repeat again: **regulations stated below can be adjusted by the student as desired**, as long as it doesn't significantly compromise readability)

1. Print the text in 38 characters x 25 lines.
2. The amount of text is free based on the size of the paper (19 cm × 26 cm).
3. Text: font size around 11pt, line spacing 170 or more (in HWP), justification (horizontal separation of characters in HWP) 100, ruled (vertical separation of characters in HWP) 0
4. Footnotes: font size 9 10pt
5. Typeface: Myeongjo (명조체) or neo-myeongjo (shin-myeongjo 신명조체) type
6. Font color: Black (color is available for included materials)
7. Paper margins: top 20, bottom 15, header 15, footer 15, left 30, right 30 (in HWP)
8. Page marks should be centered at the bottom of each side.

and regulation for the Abstract (which seems to include title pages too):

1. The abstract should be written in one of the following languages: English, Japanese, French, or German if the main text is in Korean.
2. If the paper is written in non-Korean, it must be accompanied by a Korean abstract.
3. The length of the abstract should be within 2-7 pages.
4. The title of the abstract should be in the original language. If this is not possible to make it one-line, the second line should be centered.
5. The subtitle should be centered at the bottom of the title.
6. Include your full name, major, department, and school name at the bottom of the title.
7. At the bottom of the abstract, include within(?) 7-8 keywords that indicate the topic of your paper.

For abstract and keywords, there's another set of notes as of 2023 Aug:

1. Keywords are words or phrases that indicate the core content of the paper.
2. Select within(?) 7-8 keywords that can be used as index words when searching for a paper. Present them at the end of the abstract.
3. Keywords should be written in the same language as the abstract.
4. The most relevant keyword to the topic of the paper should come first.
5. In English, the first paragraph is usually not indented, and later paragraphs are indented.

For specific formatting details, please consult the official announcement from the library. However, note that you do not need to adhere to their guidelines "exactly," especially since they do not even provide a LaTeX template. I have seen hundreds of theses which goes completely against the official format. The "tradition" among your department upper classmates is the most reliable format.

Normally, the order of contents should follow:

1. Outer cover (Not necessary after Feb 2021)
2. Blank page (Not necessary after Feb 2021)
3. Title page
4. Approval page (called "인준지")
5. Abstract (in the language of the main text)
6. Table of contents (including list of tables, list of figures, etc.)
7. Main text
8. References
9. Appendices, index, other (if necessary)
10. Second language abstract (Korean abstract if the text is in a non-Korean language)
11. Acknowledgments (may be omitted)
12. Blank page (Not necessary after Feb 2021)
13. Back cover (Not necessary after Feb 2021)

Please be aware that regulations may change in the future. It is your responsibility to verify the regulations in effect at the time of your submission.

Keywords: Asteroids, Regolith, Thermal modeling, Radiation Pressure, Polarimetry—Optical, Polarimetry—Infrared

Student Number: 2000-12345

Contents

List of Figures

List of Tables

List of Acronyms

AR: Asteroid Regolith
IAU: International Astronomical Union
NEOs: Near-Earth Objects
NEAs: Near-Earth Asteroids
NEATM: Near-Earth Asteroid Thermal Model
NIR: Near-InfraRed
PCA: Principal Component Analyses
PPC: Polarimetric Phase Curve, $P_{\rm r}(\alpha)$
SSSB: Small Solar System Bodies
STM: Standard Thermal Model
TPM: ThermoPhysical Model
YORP: Yarkovsky–O'Keefe–Radzievskii–Paddack (effect)

Dedication goes here

Other dedication if you want

Free to add more here?

—Louis Pasteur

Part I

Backgrounds

Chapter 1

Introduction

Natura non facit saltus.

— Gottfried Leibniz

This is the introduction. For `itemize` or `enumerate`, you may tune the separations:

- This is the original itemize. Enumerate should look similar, but with numbers for `\item`.
- This is a long item to show how it will look like. This is a long item to show how it will look like. This is a long item to show how it will look like.
- Short item.
- Short item.
- Short item.

You may add something like `[itemsep=-5pt, topsep=0pt, partopsep=0pt]` to make it tighter:

- This is the original itemize. Enumerate should look similar, but with numbers for `\item`.
- This is a long item to show how it will look like. This is a long item to show how it will look like. This is a long item to show how it will look like.
- Short item.
- Short item.
- Short item.

In this thesis, the preamble includes

- Font STIX: "`usepackage[notextcomp]{stix}`"

- natbib: "`usepackage[round,semicolon,authoryear]{natbib}`"
- Small caption: "`usepackage[font=small]{caption}`"
- Some useful packages: siunitx, physics, rotating (The package to rotate table by sidewaystable), csquotes (for "displayquote" environment), listings
- Then a preamble for URLed A&A bibliography (see § 3.1.2).
- Then a preamble for cleveref (see § 3.2).
- Then a preamble for List of Figures & List of Tables.
- Then a preamble for the first language abstract.
- Then a preamble for the page numbering, page margin, `setlength`, etc, as well as MACROs.

Chapter 2

Figure and Table

> *God does not care about our mathematical difficulties.*
>
> — Albert Einstein

This chapter briefly describes how to insert figures and tables (especially those that are rotated 90 degrees, which are very common in theses).

2.1 Figure

When you want to create a TikZ figure, you can use the online tool `Mathcha.io`[a].

2.2 Table

A frequent usage is to use `tabular` inside `table`, as in Tab. 2.1.

2.3 Large Figure/Table

If the figure is large, you can rotate it using `\begin{sidewaysfigure}[!ph]` as in Fig. 2.2. Similarly, if the table is large, you can use `\begin{sidewaystable}[!ph]` as in Tab. 2.2.

[a] https://www.mathcha.io/editor

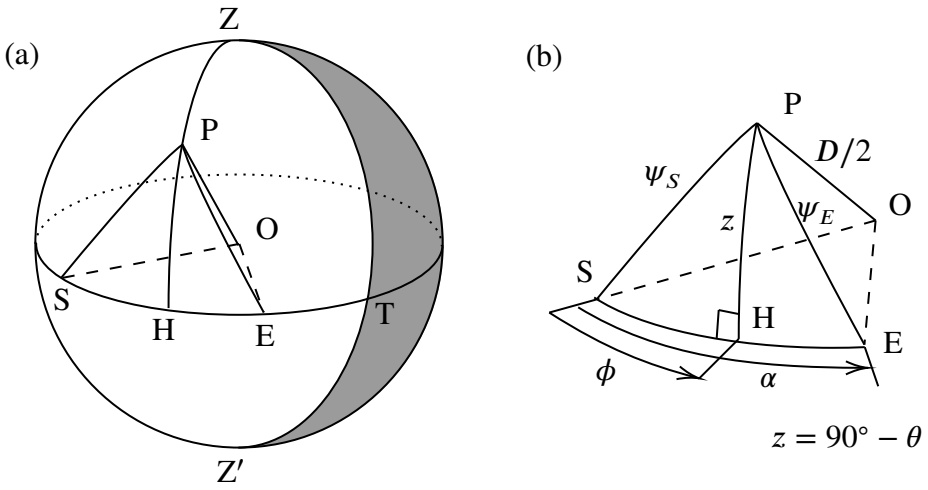

Figure 2.1: The schematic diagram for the NEATM formalism. (a) blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah. (b) blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah. Figure from Bach Y. P. PhD thesis (2023)

Table 2.1: Brief explanation, blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah. Table from Bach et al. (2022).

Parameter	Detector	Ishiguro et al. (2011) Motor ON	Ishiguro et al. (2011) Motor OFF	This work (mean ± std)	Adopted value in `NICpolpy`
R/g [ADU]	J-band	4.7 ± 0.5	5.4 ± 0.5	$3.7(\pm < 0.1)$	(3.7)
	H-band	8.8 ± 0.6	7.7 ± 0.4		
	K-band	N/A	8.8 ± 0.6		
g [e/ADU]	J-band	9.8 ± 0.2	9.2 ± 0.2	9.9 ± 1.0	9.9
	H-band	9.5 ± 0.2	9.8 ± 0.2	9.8 ± 0.9	9.8
	K-band	N/A	9.4 ± 0.2	9.5 ± 0.9	9.5
R [e]	J-band	46 ± 5	50 ± 4	37 ± 4	37
	H-band	84 ± 5	75 ± 4	36 ± 3	36
	K-band	(> 250)	83 ± 5	35 ± 3	35

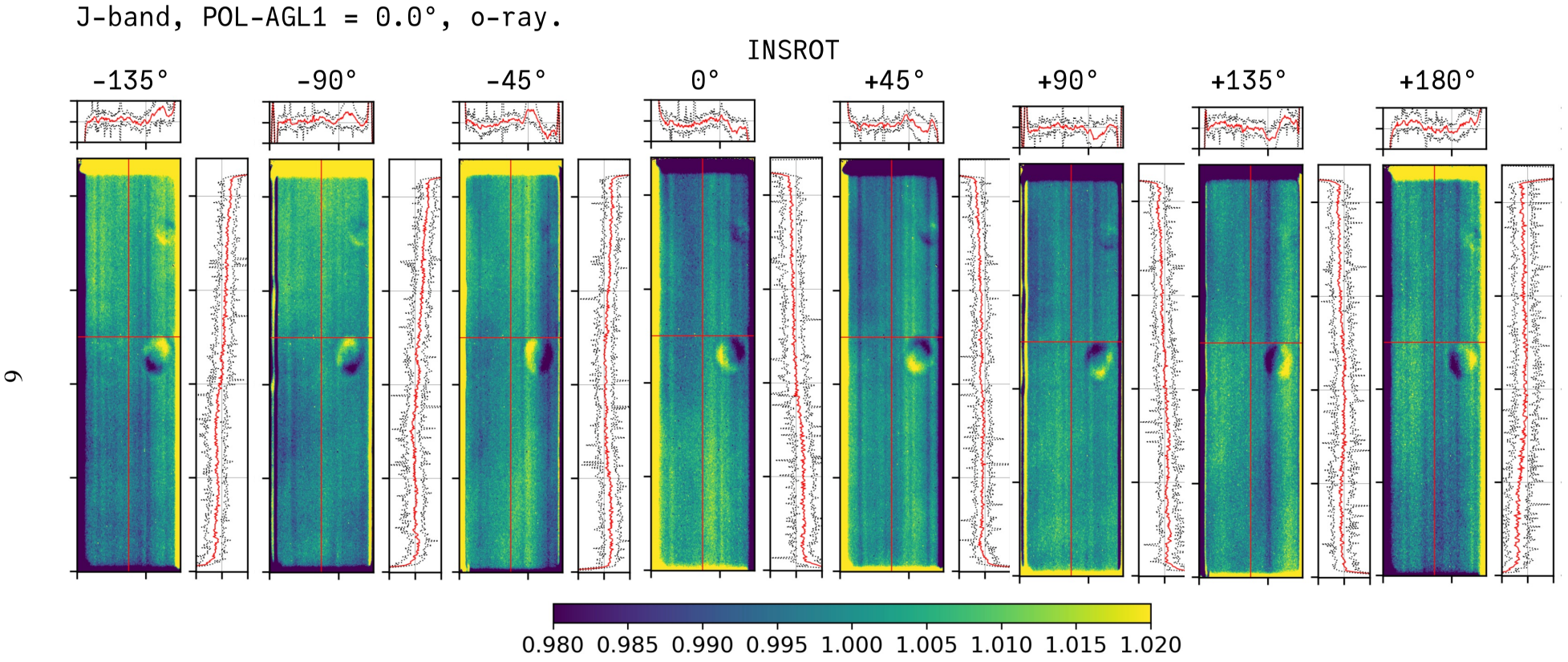

Figure 2.2: Explanation, blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah. Figure from Bach et al. (2022).

Table 2.2: Explanation blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah blah Table is from Bach et al. (2019).

Category	Symbols	Description	Value and Unit
Magnitudes	$V_\odot$	Visual magnitude of the Sun	-26.762(mag)
	V, ΔV	Visual magnitude and its uncertainty	(mag)
	$H_\mathrm{V}(\alpha)$	Reduced magnitude	(mag)
	H_V	Absolute magnitude ($:= H_\mathrm{V}(0)$)	(mag)
	G	Slope parameter	—
Ephemerides	r_hel, r_obs	Heliocentric/geocentric distance	m or au
	α	Phase angle	(° or rad)
	t	Time on the target (light-time corrected)	s or JD
	(λ, β)	Ecliptic coordinate (longitude, latitude)	(° or rad)
Physical parameters	S_proj	Total projected area viewed at $\alpha = 0$	m^2
	D	Effective diameter	m or km
	p_V	Geometric albedo in visual (V) band	—
	A_5	Albedo at the phase angle of $\alpha = 5°$	—
	I	The irradiance of the object of interest	$\mathrm{W/m}^2$
	F	I of a Lambertian reflector at normal incidence	$\mathrm{W/m}^2$
	I/F	The radiance factor	—

Chapter 3

Reference and Code

> *He integrates empirically.*
>
> — Albert Einstein, after saying "God does not care about our mathematical difficulties."

The reference in a PhD thesis can easily go beyond 100 items. The management will be tricky if you do not plan beforehand.

3.1 Reference

3.1.1 ADS

For astronomers, NASA provides a handy tool called ADS[a], and its functionality, called "Library", is fantastic (though still in need of improvement). To use it efficiently, I have written a simple script called "`ads2bibtex`"[b].

3.1.2 Reference Style

The reference style is nothing more than personal taste. Here I used the "URL-ed A&A style"[c]" specified in the "`aa_url.bst`" file. The magenta link redirects to the URL (usually DOI), and blue link redirects to the ADS URL. I tweaked it a bit so that the bibliography shows the title of the publication in double quotes.

[a] https://ui.adsabs.harvard.edu/
[b] https://github.com/ysBach/ads2bibtex
[c] https://github.com/yangcht/AA-bibstyle-with-hyperlink

IMPORTANT NOTE: As of 2023-05-18, at least `@PHDTHESIS` must have `adsurl={}` and `adsnote={}` if they are not registered with ADS. If you don't have these fields, you will get the following error:

```
Extra }, or forgotten \endgroup.
```

3.1.3 `cite`

You may already be familiar with citation. For your information:

- `cite` makes Bach & Ishiguro (2021). If two arguments, Bach & Ishiguro (2021); Ishiguro et al. (2022).
- `citet` makes Bach & Ishiguro (2021). If two arguments, Bach & Ishiguro (2021); Ishiguro et al. (2022).
- `citep` makes (Bach & Ishiguro 2021). If two arguments, (Bach & Ishiguro 2021; Ishiguro et al. 2022).
- `citealt` makes Bach & Ishiguro 2021. If two arguments, Bach & Ishiguro 2021; Ishiguro et al. 2022.

With optional arguments, "`\citep[See, for example,][Figure 1]{2021A&A...654A.113B}`" becomes: (See, e.g., Bach & Ishiguro 2021, Figure 1).

3.2 `Cref`

`Cleveref` package provides multiple options for simple referencing. Please refer to the original documentation[d].

3.3 Code

In this thesis, you can use `lstlisting` environment:

```
# import nicpolpy package
import nicpolpy as nic

# Do not print useless warnings
import warnings
from astropy.utils.exceptions import AstropyWarning
warnings.filterwarnings('ignore',
    append=True, category=AstropyWarning)
```

[d] https://ctan.org/pkg/cleveref?lang=en

```
# Cell 0: Initialize the reducer
npr = nic.NICPolReduc(
    name="SP_20190417",
    inputs="_original_32bit/190417/raw/*.fits",
    mflats="cal-flat_20180507-lv1/*.fits",
    imasks="masks/*.fits",
    verbose=1
)
```

You may modify the preference settings at the preamble in the "`manuscript.tex`" file.

Part II

Concluding Remarks

Chapter 4

Summary and Future Works

4.1 Summary

Summary of this dissertation. (maybe 0.5–3 pages?)

4.2 Future Work

Some possible future works. (maybe 0.5–3 pages?)

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한국어 초록

본문이 비한국어인 경우 반드시 한국어 초록 첨부. (해당연도의 도서관 규정 필독). 폰트사이즈 일관성을 위해 여기 예시의 한국어초록은 "`\small`" 사용.

주 요 어: 소행성, 열적 모델링, 표토, 복사압, 편광—광학, 편광—적외선

학　　번: 2000-12345

Acknowledgement

Acknowledgement goes here. Hangul in Acknowledgement may use "\kr": Hong Gildong (홍길동).

ChatGPT says "Both acknowledgment and acknowledgement are correct spellings. The only difference is that acknowledgment is the preferred American English spelling, while acknowledgement is the preferred British English spelling. You can use either one based on your preference or the style guide you're following."