D.C. Kim

Quantum Mechanics

supplementary note

October 13, 2022

Chung-Ang University

Contents

Acronyms

Use the template *acronym.tex* together with the document class SVMono (monograph-type books) or SVMult (edited books) to style your list(s) of abbreviations or symbols.

Lists of abbreviations, symbols and the like are easily formatted with the help of the Springer-enhanced `description` environment.

ABC   Spelled-out abbreviation and definition
BABI   Spelled-out abbreviation and definition
CABR   Spelled-out abbreviation and definition

Chapter 1
Spin

1.1 Spin이 무엇인가?

고전적으로 비교할 만한 것이 없는 전자의 새로운 자유도이다. 전자는 $s = 1/2$인 intrinsic angular momentum을 갖는다.

1.2 Disjoint Set

경로 압축을 통한 `find` 연산의 최적화와 랭크에 의한 합치기를 통한 `union` 연산의 최적화로 상호 배타적으로 이루어진 집합을 합치거나 어떤 원소의 집합을 판별하는 작업을 거의 $\mathcal{O}(1)$에 해낼 수 있다.

1.3 Section Heading

Use the template *chapter.tex* together with the document class SVMono (monograph-type books) or SVMult (edited books) to style the various elements of your chapter content conformable to the Springer Nature layout.

1.4 Section Heading

Instead of simply listing headings of different levels we recommend to let every heading be followed by at least a short passage of text. Furtheron please use the LaTeX automatism for all your cross-references and citations.

Please note that the first line of text that follows a heading is not indented, whereas the first lines of all subsequent paragraphs are.

Use the standard `equation` environment to typeset your equations, e.g.

$$a \times b = c \ , \tag{1.1}$$

however, for multiline equations we recommend to use the `eqnarray` environment[1].

$$|\nabla U_\alpha^\mu(y)| \le \frac{1}{d-\alpha} \int \left| \nabla \frac{1}{|\xi - y|^{d-\alpha}} \right| d\mu(\xi) = \int \frac{1}{|\xi - y|^{d-\alpha+1}} d\mu(\xi) \tag{1.2}$$

$$= (d-\alpha+1) \int_{d(y)}^{\infty} \frac{\mu(B(y,r))}{r^{d-\alpha+2}} dr \le (d-\alpha+1) \int_{d(y)}^{\infty} \frac{r^{d-\alpha}}{r^{d-\alpha+2}} dr \tag{1.3}$$

1.4.1 Subsection Heading

Instead of simply listing headings of different levels we recommend to let every heading be followed by at least a short passage of text. Further on please use the LaTeX automatism for all your cross-references and citations as has already been described in Sect. 1.4.

> Please do not use quotation marks when quoting texts! Simply use the `quotation` environment – it will automatically be rendered in the preferred layout.

1.4.1.1 Subsubsection Heading

Instead of simply listing headings of different levels we recommend to let every heading be followed by at least a short passage of text. Furtheron please use the LaTeX automatism for all your cross-references and citations as has already been described in Sect. 1.4.1, see also Fig. 1.1[2]

Please note that the first line of text that follows a heading is not indented, whereas the first lines of all subsequent paragraphs are.

---

[1] In physics texts please activate the class option `vecphys` to depict your vectors in ***boldface-italic*** type - as is customary for a wide range of physical subjects.

[2] If you copy text passages, figures, or tables from other works, you must obtain *permission* from the copyright holder (usually the original publisher). Please enclose the signed permission with the
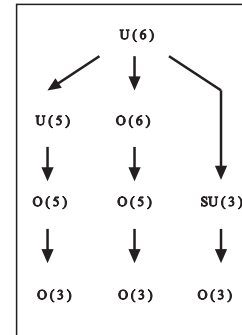
Paragraph Heading

Instead of simply listing headings of different levels we recommend to let every heading be followed by at least a short passage of text. Furtheron please use the LaTeX automatism for all your cross-references and citations as has already been described in Sect. 1.4.

Please note that the first line of text that follows a heading is not indented, whereas the first lines of all subsequent paragraphs are.

For typesetting numbered lists we recommend to use the `enumerate` environment – it will automatically render Springer's preferred layout.
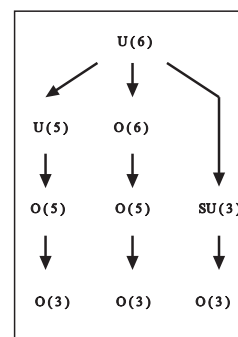
1. Livelihood and survival mobility are oftentimes coutcomes of uneven socioeconomic development.

   a. Livelihood and survival mobility are oftentimes coutcomes of uneven socioeconomic development.
   b. Livelihood and survival mobility are oftentimes coutcomes of uneven socioeconomic development.

2. Livelihood and survival mobility are oftentimes coutcomes of uneven socioeconomic development.

Fig. 1.1 If the width of the figure is less than 7.8 cm use the `sidecapion` command to flush the caption on the left side of the page. If the figure is positioned at the top of the page, align the sidecaption with the top of the figure – to achieve this you simply need to use the optional argument `[t]` with the `sidecaption` command

---

manucript. The sources must be acknowledged either in the captions, as footnotes or in a separate section of the book.

Fig. 1.2 Please write your
figure caption here

```
                    U(6)
                   ↙  ↓       ↘
        U(5)        O(6)
         ↓           ↓          ↓
        O(5)        O(5)       SU(3)
         ↓           ↓          ↓
        O(3)        O(3)       O(3)
```

Subparagraph Heading

In order to avoid simply listing headings of different levels we recommend to let every heading be followed by at least a short passage of text. Use the LaTeX automatism for all your cross-references and citations as has already been described in Sect. 1.4, see also Fig. 1.2.

Please note that the first line of text that follows a heading is not indented, whereas the first lines of all subsequent paragraphs are.

For unnumbered list we recommend to use the `itemize` environment – it will automatically render Springer's preferred layout.

- Livelihood and survival mobility are oftentimes coutcomes of uneven socioeconomic development, cf. Table 1.1.

  - Livelihood and survival mobility are oftentimes coutcomes of uneven socioeconomic development.
  - Livelihood and survival mobility are oftentimes coutcomes of uneven socioeconomic development.

- Livelihood and survival mobility are oftentimes coutcomes of uneven socioeconomic development.

Run-in Heading Boldface Version Use the LaTeX automatism for all your cross-references and citations as has already been described in Sect. 1.4.

Run-in Heading Boldface and Italic Version Use the LaTeX automatism for all your cross-references and citations as has already been described in Sect. 1.4.

Table 1.1 Please write your table caption here

Classes	Subclass	Length	Action Mechanism
Translation	mRNA[a]	22 (19–25)	Translation repression, mRNA cleavage
Translation	mRNA cleavage	21	mRNA cleavage
Translation	mRNA	21–22	mRNA cleavage
Translation	mRNA	24–26	Histone and DNA Modification

[a] Table foot note (with superscript)

Run-in Heading Displayed Version

Use the LaTeX automatism for all your cross-references and citations as has already been described in Sect. 1.4.

1.5 Section Heading

Instead of simply listing headings of different levels we recommend to let every heading be followed by at least a short passage of text. Furtheron please use the LaTeX automatism for all your cross-references and citations as has already been described in Sect. 1.4.

Please note that the first line of text that follows a heading is not indented, whereas the first lines of all subsequent paragraphs are.

If you want to list definitions or the like we recommend to use the Springer-enhanced `description` environment – it will automatically render Springer's preferred layout.

Type 1   That addresses central themes pertainng to migration, health, and disease. In Sect. 1.3, Wilson discusses the role of human migration in infectious disease distributions and patterns.

Type 2   That addresses central themes pertainng to migration, health, and disease. In Sect. 1.4.1, Wilson discusses the role of human migration in infectious disease distributions and patterns.

1.5.1 Subsection Heading

In order to avoid simply listing headings of different levels we recommend to let every heading be followed by at least a short passage of text. Use the LaTeX automatism for all your cross-references and citations citations as has already been described in Sect. 1.4.

Please note that the first line of text that follows a heading is not indented, whereas the first lines of all subsequent paragraphs are.

If you want to emphasize complete paragraphs of texts we recommend to use the newly defined Springer class option `graybox` and the newly defined environment `svgraybox`. This will produce a 15 percent screened box 'behind' your text.

If you want to emphasize complete paragraphs of texts we recommend to use the newly defined Springer class option and environment `svgraybox`. This will produce a 15 percent screened box 'behind' your text.

1.5.1.1 Subsubsection Heading

Instead of simply listing headings of different levels we recommend to let every heading be followed by at least a short passage of text. Furtheron please use the LaTeX automatism for all your cross-references and citations as has already been described in Sect. 1.4.

Please note that the first line of text that follows a heading is not indented, whereas the first lines of all subsequent paragraphs are.

Theorem 1.1 *Theorem text goes here.*

Definition 1.1 Definition text goes here.

Proof Proof text goes here.   □

Table 1.2 Table template 5

		A	B	C
A, C 스침	P 관성계	T	T	T
	Q 관성계	T	$T + \frac{2Lv}{c\sqrt{c^2-v^2}}$	T
B, C 스침	P 관성계	$T + \frac{2L}{v}$	$T + \frac{2L}{v}$	$T + \frac{2L\sqrt{c^2-v^2}}{cv}$
	Q 관성계	$T + \frac{2L}{v} - \frac{2Lv}{c\sqrt{c^2-v^2}}$	$T + \frac{2L}{v}$	$T + \frac{2L\sqrt{c^2-v^2}}{cv}$

Paragraph Heading

Instead of simply listing headings of different levels we recommend to let every heading be followed by at least a short passage of text. Furtheron please use the LaTeX automatism for all your cross-references and citations as has already been described in Sect. 1.4.

Note that the first line of text that follows a heading is not indented, whereas the first lines of all subsequent paragraphs are.

Theorem 1.2 *Theorem text goes here.*

Definition 1.2 Definition text goes here.

Proof Proof text goes here.   □

Trailer Head

 If you want to emphasize complete paragraphs of texts in an `Trailer Head` we recommend to use

```
\begin{trailer}{Trailer Head}
...
\end{trailer}
```

? Questions

If you want to emphasize complete paragraphs of texts in an `Questions` we recommend to use

```
\begin{question}{Questions}
...
\end{question}
```

> **Important**

If you want to emphasize complete paragraphs of texts in an `Important` we recommend to use

```
\begin{important}{Important}
...
\end{important}
```

⚠ Attention

If you want to emphasize complete paragraphs of texts in an `Attention` we recommend to use

```
\begin{warning}{Attention}
...
\end{warning}
```

Program Code

If you want to emphasize complete paragraphs of texts in an `Program Code` we recommend to use

```
\begin{programcode}{Program Code}
\begin{verbatim}...\end{verbatim}
\end{programcode}
```

Tips

If you want to emphasize complete paragraphs of texts in an `Tips` we recommend to use

```
\begin{tips}{Tips}
...
\end{tips}
```

Overview

If you want to emphasize complete paragraphs of texts in an `Overview` we recommend to use

```
\begin{overview}{Overview}
```

```
...
\end{overview}
```

Background Information

 If you want to emphasize complete paragraphs of texts in an `Background Information` we recommend to use

```
\begin{backgroundinformation}{Background Information}

...

\end{backgroundinformation}
```

Legal Text

 If you want to emphasize complete paragraphs of texts in an `Legal Text` we recommend to use

```
\begin{legaltext}{Legal Text}

...

\end{legaltext}
```

Appendix

When placed at the end of a chapter or contribution (as opposed to at the end of the book), the numbering of tables, figures, and equations in the appendix section continues on from that in the main text. Hence please *do not* use the `appendix` command when writing an appendix at the end of your chapter or contribution. If there is only one the appendix is designated "Appendix", or "Appendix 1", or "Appendix 2", etc. if there is more than one.

$$a \times b = c \tag{1.4}$$

Problems

3.20 A given problem or Excercise is described here. The problem is described here. The problem is described here.

3.21 Problem Heading

(a) The first part of the problem is described here.

(b) The second part of the problem is described here.

3.22 Generalized tension

일반적으로 실의 장력을 구하기 위해 가속도를 구하고 이를 이용하여 한 물체에 대한 힘을 분석하지만, 때때로 가속도가 포함되지 않은 식을 이용하는 것이 유용하다.

(a) 그림과 같이 마찰이 없는 수평면에 질량이 각각 m_A, m_B인 물체 A, B가 놓여 있고, 각각 반대 방향으로 힘 F_A, F_B가 작용한다. 편의상 물체의 가속도의 방향이 F_B와 같다고 하고, 가속도 a를 m_A, m_B, F_A, F_B에 대한 식으로 나타내라.

$$F_A \quad m_A \qquad m_B \quad F_B$$
$$\leftarrow \boxed{A} \quad\quad\quad \boxed{B} \rightarrow$$
$$\text{수평면}$$

(b) 이번에는 A에 작용하는 힘만을 고려하여 실의 장력 T를 m_A, F_A, a에 대한 식으로 나타내라.

(c) 앞선 두 결과를 이용하여 a를 소거하여 실의 장력에 대한 식을 얻어라. 그리고 이 식을 기하학적 의미를 해석하라.

(d) *(23학년도 9월 14번)* (가)와 (나)에서 실 q에 걸린 장력을 m, M, g, 빗면 가속도 a에 대해 나타내고 두 값이 동일함을 확인하라. (가)에서 실 q에 걸린 장력이 $4mg$임은 명백히 알 수 있다. (가)에서 p가 B를 당기는 힘의 조건이 필요 없음을 확인하라.

(e) *(22학년도 10월 13번)* 물체 A, B에 대해 각각 실에 걸린 장력을 물체와 추의 질량, 중력 가속도 g, 빗면 가속도 a에 대해 나타내라. 걸린 시간이 4초, 2초인 조건이 필요 없음을 확인하라.

Appendix A
Chapter Heading

All's well that ends well

Use the template *appendix.tex* together with the Springer document class SVMono (monograph-type books) or SVMult (edited books) to style appendix of your book.

A.1 Section Heading

Instead of simply listing headings of different levels we recommend to let every heading be followed by at least a short passage of text. Furtheron please use the LaTeX automatism for all your cross-references and citations.
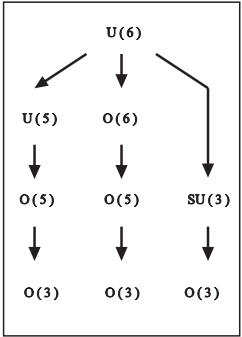
A.1.1 Subsection Heading

Instead of simply listing headings of different levels we recommend to let every heading be followed by at least a short passage of text. Furtheron please use the LaTeX automatism for all your cross-references and citations as has already been described in Sect. A.1.

For multiline equations we recommend to use the `eqnarray` environment.

$$\mathbf{a} \times \mathbf{b} = \mathbf{c}$$
$$\mathbf{a} \times \mathbf{b} = \mathbf{c} \tag{A.1}$$

Fig. A.1 Please write your
figure caption here

A.1.1.1 Subsubsection Heading

Instead of simply listing headings of different levels we recommend to let every
heading be followed by at least a short passage of text. Furtheron please use the
LaTeX automatism for all your cross-references and citations as has already been
described in Sect. A.1.1.

   Please note that the first line of text that follows a heading is not indented, whereas
the first lines of all subsequent paragraphs are.

Table A.1 Please write your table caption here

Classes	Subclass	Length	Action Mechanism
Translation	mRNA^a	22 (19–25)	Translation repression, mRNA cleavage
Translation	mRNA cleavage	21	mRNA cleavage
Translation	mRNA	21–22	mRNA cleavage
Translation	mRNA	24–26	Histone and DNA Modification

^{a} Table foot note (with superscript)

Glossary

Use the template *glossary.tex* together with the Springer document class SVMono (monograph-type books) or SVMult (edited books) to style your glossary in the Springer layout.

glossary term Write here the description of the glossary term. Write here the description of the glossary term. Write here the description of the glossary term.

glossary term Write here the description of the glossary term. Write here the description of the glossary term. Write here the description of the glossary term.

glossary term Write here the description of the glossary term. Write here the description of the glossary term. Write here the description of the glossary term.

glossary term Write here the description of the glossary term. Write here the description of the glossary term. Write here the description of the glossary term.

glossary term Write here the description of the glossary term. Write here the description of the glossary term. Write here the description of the glossary term.

Solutions

Problems of Chapter ??

3.20 The solution is revealed here.

3.21 Problem Heading

(a) The solution of first part is revealed here.

(b) The solution of second part is revealed here.