I Quantum Information Theory

If you are writing the lecture notes using Latex, please use this template. Otherwise, try to mimic it as much as possible. In any case, lecture notes should be provided in English. Here are some useful usage examples including the so called *braket* notations, which you hopefully got used to by now.

If you mimic Latex using a word processor, take note of the Theorem numbering. The numbers refer to the section (and not subsection) in which the Theorem resides. There is a different counter for Theorems, Lemmas, Definitions, Examples, Remarks and Corollaries, but the format is the same except for the non-Italics font used in the Examples.

Definition I.1. *The fidelity between two states* $|\phi\rangle$ *and* $|\psi\rangle$ *is defined as*

$$F \triangleq |\langle\psi|\phi\rangle|^2 \tag{1}$$

Remark I.1. *The fidelity is bounded from above by* $F \leq 1$*, with equality if and only if* $|\phi\rangle = |\psi\rangle$ *up to a global phase factor.*

Here are two examples.

Example I.1. This is how we scribe examples, note that the font is not in Italics!

Example I.2. This is another example.

II Another Section

Here is a section including two subsections.

II.1 First Subsection

Quantum information theory extends the results of classical information theory, which was first introduced in [1]. Arguably the first paper to discuss a qubit as the fundamental resource of quantum information theory is [2], where quantum compression was first discussed.

II.2 Second Subsection

Theorem II.1. U *is a unitary operator if and only if*

$$U = \sum_i |v_i\rangle\langle w_i| \tag{2}$$

for some orthonormal bases $|v_i\rangle, |w_i\rangle$*.*

Corollary II.1. *In the outer representation (3), we have that* $|v_i\rangle = U|w_i\rangle$.

Here is another Theorem.

Theorem II.2. *Any density operator* ρ *can be written as*

$$\rho = \sum_i p_i |i\rangle\langle i| \tag{3}$$

where $p_i \geq 0\,, \sum_i p_i = 1$, *and* $|i\rangle$ *is an orthonormal basis for the state space.*

This is in case you need a Lemma.

Lemma II.1. *There is an infinite number of different ensembles giving rise to the same density matrix.*

The bibliography items appear on the next page,

Bibliography

[1] C.E. Shannon, "A Mathematical theory of communication," *Bell Sys. Tech Journal,* 27: 379-432, 623-656, 1948.

[2] B. Schumacher, "On Quantum Coding," *Phys. Rev. A*, 1993.