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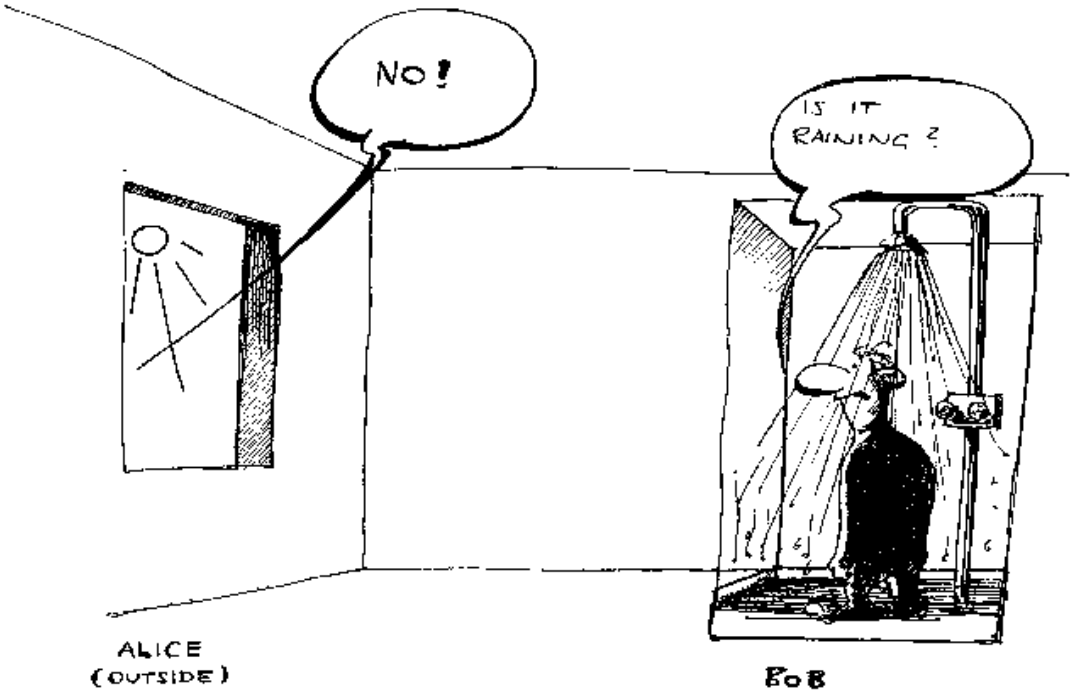

Quantum Information

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These are lecture notes for my courses on quantum information. The notes are being developed as we proceed. They are posted (and removed) somewhere in the directory "Teaching" on `http://www.quantum.physik.uni-potsdam.de`

The notes are neither complete nor original. They are full of mistakes, misprints and misconceptions. Their mere purpose is to remind me of what should be improved for the next course ...

In preparing the notes I found the following material useful

- Preskill lecture notes "Quantum Information and Computation" `http://www.theory.caltech.edu/people/preskill/ph219/`.
- MacKay lecture notes "Information theory, inference, and learning algorithm" `http://wol.ra.phy.cam.ac.uk/mackay/itprnn/book.html`
- Werner lecture notes "Quantum Information and Quantum Computing" `http://www.imaph.tu-bs.de/qi`.

Recommended reading for *quantum information theory*:

- *Quantum Computation and Quantum Information* by Michael A. Nielsen and Isaac L. Chuang, Cambridge University Press 2000 [ISBN 0 521 63503 9]. With 650 pages(!) truly an in-depth treatment of the subject. Comparble to J.D. Jackson "Classical Electrodynmaics", the book is likely to become *the* reference for the next couple of years.

Recommended reading for *classical information theory*:

- *Codes and Cryptography* by Dominic Welsh, Oxford Science Publications, Oxford University Press 1988 [ISBN 0 19 853287 3].

Recommended reading for *Quantum mechanics*

- *Quantum Theory: Concepts and Methods* by Asher Peres, Kluwer Academic Pub. 1995 [ISBN 0-7923-2549-4 (HB), -3632-1 (PB)]

Recommended reading for *fun*:

- *The Emperor's New Mind* by Roger Penrose, Oxford University Press 1989; reprint in Vintage Books, Random House, London 1990 [ISBN 0 09 977170 5]. A marvel on computers, minds and the laws of physics. Recommended source for easy-to-read material on Turing machines, Gödels incompleteness theorem, and its relation to physics in general and quantum mechanics in particular.

Further references will be given as the course proceeds ...just to start with one: *Information* is a many-facet notion with an interesting history of meaning and use from the old greeks to our times. A fair amount of references and even some own investiagtions may be found in the dissertation thesis

- *Quantentehorie der Information* by Holger Lyre, Springer 1998 [ISBN 3-211-83204-1].

The subtitle *Zur Naturphilosophie der Theorie der Ur-Alternativen und einer abstrakten Theorie der Information. Mit einem Geleitwort von Carl Friedrich von Weizsäcker* indicates what it is: a philosophically inclined reconstruction of a notion of information in the framework of a certain Neu-Kantian programme which was originally initiated by C.F. von Weizsäcker. The "Ur-Alternative" is what we call qubit these days. The Weizsäcker programme on the *Aufbau der Physik* could not really revive the natural philosophy – yet Lyres' thesis is still a valuable piece of work.

Contents

