

# Introduction to Quantum Computation

## Übung 7

19.12.2002

- 7.1** Show that the quantum syndrome computation for the Steane code is unitary. Recall this is the operation

$$|v\rangle \otimes |0\rangle_{anc} \mapsto |v\rangle \otimes |H_{PC}v\rangle_{anc}$$

where  $H_{PC}$  is the parity-check matrix of the code.

- 7.2** Convince yourself that all the circuits given in class for the Steane code do what they are advertised as doing.
- 7.3** Go through all the considerations given in class about the Steane code, in our design and discussion of a useful QECC, for the Shor 9-bit code in [NC].
- 7.4** Write out the quantum circuit for syndrome measurement and bit-flip error correction for the Steane code. It will be big and complex, the three classical bit lines from the measurement will control quantum gates doing the error correction....
- 7.5** Verify that the tensor product of seven copies of the Hadamard matrix does the same thing on the coded basis  $\{|0\rangle_{code}, |1\rangle_{code}\}$  of the Steane code as a single Hadamard does on a single qubit in the computational basis (e.g.,  $H^{\otimes 7}|0\rangle_{code} = \frac{1}{\sqrt{2}}(|0\rangle_{code} + |1\rangle_{code})$ ).