Efficient internal state detection using stimulated Raman adiabatic passage

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The aim of the quantum logic experiments in Aarhus is to study and utilize entanglement between strongly confined and laser-cooled $^{40}Ca^{+}$-ions. The goal is to produce quantum gates, which can serve as basic elements of a quantum computer. In our work towards realizing this, detection of the ions internal state is an important issue. We use the two magnetic sublevels of the 2S ground state of $^{40}Ca^{+}$-ions trapped in a linear Paul trap as our quantum bit (qubit) states.

The detection scheme involves shelving of one qubit state via two STImulated Raman Adiabatic Passage (STIRAP) processes [1]. STIRAP is a robust method to adiabatically transfer population from one quantum state to another in a three level system using two counter intuitive laser pulses. We present our latest experimental results on Raman spectroscopy and efficient STIRAP population transfer exceeding 90%.

[1] K. Bergmann, H. Teuer and B. W. Shore, Rev. Mod. Phys. **70**, 1003 (1998).