Physics with Cold Magnesium Atoms

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We are currently cooling and trapping magnesium atoms for cold collision studies. The cooling transition, $^1S \rightarrow {}^1P$, is a closed two-level transition which provides a strong radiation force [1]. Furthermore the narrow magnesium intercombination line $^1S \rightarrow {}^3P$ allows interesting clock aspects and lower temperature [2]. From a theoretical view the simple level structure of magnesium makes it ideal for cold collision studies [3].

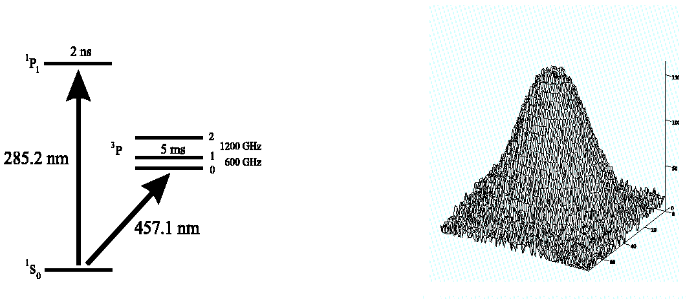

Figure 1: Left: Simplified level scheme of Mg. Right: ^{24}Mg MOT with strongly attenuated light intensity.

We have constructed a setup for cooling and trapping magnesium atoms using the 285.2 nm transition. To generate the intense cw UV light needed for this purpose we have build a highly efficient frequency doubling cavity. The cavity is a four mirror ring cavity with a BBO crystal locked using a Hänsch-Couillaud scheme and provides a UV output of more that 100 mW with an input of 600 mW. The magnesium trap is a standard magneto-optical trap loaded from a thermal atom beam. With the MOT we have demonstrated cooling and trapping of each of the three magnesium isotopes ^{24}Mg, ^{25}Mg and ^{26}Mg. For ^{24}Mg, which has an abundance of 80%, a conservative estimate of the number of atoms in the trap, based on fluorescence measurements, is 2×10^5. Furthermore we have observed that the loss from the trap due to two-photon ionization is rather small.

In addition, we have studied resonant two-photon ionization of Mg in a thermal beam by 285.2 nm light. In this case a UV laser beam crosses a thermal Mg beam and a channeltron detects the produced ions. We have studied the dependence of the ionization rate on intensity, detuning and polarization of the UV light. The observed polarization effects is in good agreement with theory [4]. These experiments are performed in collaboration with M. Drewsen *et al.* (see contribution to this conference by N. Kjærgaard *et al.*).

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[2] H. Katori et al, *Phys. Rev. Lett.* **82** 1116 (1999).
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[4] T. N. Chang and X. Tang, *Phys. Rev. A* **46** R2209 (1992).