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Electromagnetically induced transparency and precision measurement of atomic transitions in a laser-cooled sample of cesium atoms[1]

CHIN-CHUN TSAI, MING-DA TSAI, MEI-JU LU, RAY-YUAN CHANG, Center for Quantum Information Science and Department of Physics, National Cheng-Kung University — Electromagnetically induced transparency (EIT) has observed in a cascade system of laser-cooled Cs atoms and the atomic energy levels have been measured to an accuracy of 0.0003 cm^{-1}. In our experiment, Cs atoms are loaded into the magneto-optical trap (MOT) from a background vapor that has a pressure of 10^{-9} torr. The number of Cs atoms is estimated using a CCD camera to be 10^7 occupying a roughly spherical volume having a radius of 2 mm and the temperature of the atom cloud is measured using a time of flight technique to be about 100 μK. A diode laser excites the Cs atoms from $|6\,^2S_{1/2}, F = 4\rangle$ state to $|6\,^2P_{3/2}, F = 5\rangle$ state, then a dye laser couples the $6\,P_{3/2}$ state to the higher excited, $|9\,^2D_{3/2}\rangle$, $|9\,^2D_{5/2}\rangle$, $|10\,^2D_{3/2}\rangle$, $|10\,^2D_{5/2}\rangle$, and $|11\,^2S_{1/2}\rangle$ atates. The signal is monitored by detecting the trap loss while changing the pump or coupling laser frequency. The effect on the EIT signals by changing the pump laser detuning and the coupling laser power is also discussed. The line positions are measured by comparing the saturation absorption spectrum of molecular iodine (accuracy < 3 MHz).

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