important for the preparation and manipulation of molecules by laser light, in analogy to the role played by coherent population trapping in atomic physics in recent years. The lack of sensitivity of the EDSs to the coherence of the light preparing them makes their use especially promising. Potential implications to the possibilities of slowing down or cooling of molecules are be discussed.

We thank B. Chernobrod and I. Averbukh for useful discussions. This work was supported by grants from the Israel Science Foundation and the Minerva Foundation.

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QThJ5 **3:30 pm**

Electromagnetically induced transparency in cold atoms

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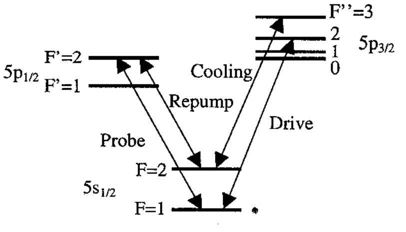
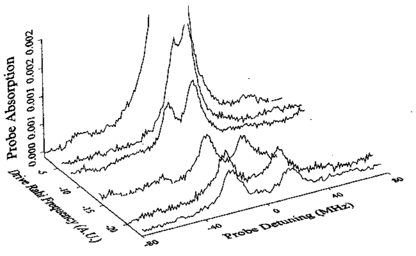
Coherence effects in driven three-level atomic systems have potential applications in the generation of short-wavelength coherent radiation, particle acceleration, and sensitive measurements of magnetic fields.[1] In recent experiments,[2] gain and lasing have been observed from atoms with significantly less population in the excited state than would normally be required in a two-level system. We report here measurements of electromagnetically induced transparency (EIT) in a sample of cold trapped Rb^{87} atoms. By using cold atoms, we avoid complications associated with Doppler broadening, which often exist in similar experiments performed with room-temperature vapors.

The measurements were made on an ~2-mm-diameter sample of $\sim 10^8$ laser-cooled Rb^{87} atoms collected in a standard magneto-optic trap. The cooling and trapping were done with a laser tuned to the $F = 2 \rightarrow F' = 3$ transition on the D_2 line and therefore did not couple to any of the transitions related to the EIT. A linearly polarized probe beam, tuned near the $F = 1 \rightarrow F' = 2$ transition on the D_1 line at 795 nm (Fig. 1), was focused into the cloud of atoms, and the absorption spectrum was measured with a photodiode as this probe was tuned over the transition. The coherence was generated by the addition of a strong, linearly polarized drive field, counterpropagating with the probe. This laser was focused into the trap and locked to the peak of the $F = 1 \rightarrow F'' = 2$ transition of the D_2 line, thereby creating a V-configuration with the probe. Finally, a circularly polarized, broadband ($\Delta\nu \sim 100$ MHz) repumping laser tuned to the $F = 2 \rightarrow F' = 2$ transition on the D_1 line was sent through the atom cloud in a direction perpendicular to both the probe and the drive. This broadband repumping radiation was retroreflected back through the trap to reduce the effects of optical forces on the cold atoms.



QThJ5 Fig. 1. Atomic-level diagram for Rb^{87} and laser tunings.



QThJ5 Fig. 2. Probe absorption spectra for several drive Rabi frequencies.

With both the drive and broadband repumping beam blocked, the small fraction of the atoms present in the $F = 1$ ground state generated a maximum absorption of ~0.6%. When the repumping field was added, atoms were optically pumped into the $F = 1$ ground state, thus increasing the probe absorption to 39%. If the repumping was increased above approximately one tenth of the saturation intensity, the atom cloud became unstable and the probe absorption dropped dramatically. The addition of the drive substantially reduced the probe absorption signal by pumping the atoms back into the $F = 2$ ground state and also generated the two-peaked Autler–Townes absorption profile shown in Fig. 2. With the drive polarization perpendicular to the probe, the peak splitting reached 40 MHz and the transparency between the peaks was almost complete. The line shape of the observed transparency has a non-Lorentzian character, which is consistent with coherence-induced EIT resulting from quantum interference between different probe absorption pathways.[3] Deeper transparency was measured when the drive and probe polarizations were mutually perpendicular than when they were parallel. Better control of the optical forces on the atoms accompanied by stronger repumping to populate the probe excited state appear to be necessary to create gain without population inversion on the probe transition.

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QThJ6 **3:45 pm**

Electromagnetically induced transparency-enhanced conversion efficiency of coherent VUV generation in krypton

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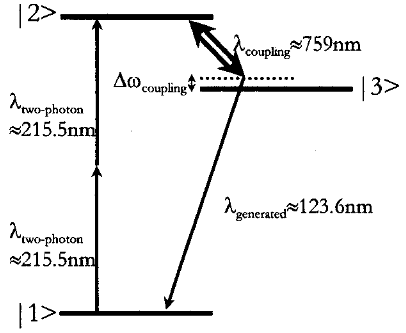
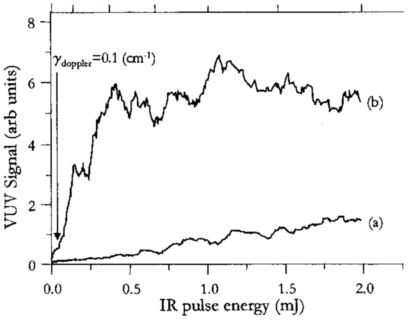
Resonant sum-difference frequency mixing has been investigated in krypton (Fig. 1). A two-photon resonant field tuned to 212.55 nm drove transitions between the $4p^6\,{}^1S\,|1\rangle$ ground state and the $4p^55p$ [0, 1/2] $|2\rangle$ excited state. This excited state was coupled to the $4p^55s$ [1,1/2] $|3\rangle$ state by a near-resonant field at 759 nm. The infrared coupling field was near transform limited and under these conditions should result in electromagnetically induced transparency (EIT)[1,2] at the frequency of the generated vacuum ultraviolet (VUV) field (123.6 nm). The predicted enhancement[1] in the conversion efficiency of the scheme was investigated by studying the dependence of the VUV signal on intensity and detuning of the coupling field.

The coupling field was produced by a KTP optical parametric oscillator (Continuum Mirage 800) pumped by an injection-seeded, frequency-doubled Nd:YAG laser. The system produced a 4-ns pulse with energies, after am-



QThJ6 Fig. 1. Energy-level scheme of resonant four-wave mixing in krypton.



QThJ6 Fig. 2. Plot of VUV signal vs. IR pulse energy (Rabi coupling) for a 50.0 cm^{-1} detuning of the coupling field and (b) the coupling field on exact resonance.