IV. ATOMIC RESONANCE AND SCATTERING

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A. OPTICAL FREQUENCY STANDARD

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Joint Services Electronics Program (Contract DAAB07-71-C-0300)

David E. Pritchard

We have developed a method for using the intracavity etalon in our single-mode continuous-wave dye laser as an interferometric wavelength standard. The key to our method was the determination of the free spectral range of this etalon with an accuracy exceeding one part in 10^4, using two photon transitions in sodium as a reference. This permits rapid adjustment of the laser wavelength with an accuracy of 0.1 Å.

By using a series of external reference etalons in addition to the intracavity etalon, we plan to get our accuracy down to the range 10^{-3} Å to 10^{-4} Å. The system will also be able to provide a series of marker pulses during a frequency sweep with comparable precision. We shall use the system to take precise molecular spectra; this will be helpful in understanding molecular structure and in providing convenient reference frequencies for other workers.

B. STUDIES IN OPTICAL PHYSICS AND EXCITED-STATE INTERACTIONS

Joint Services Electronics Program (Contract DAAB07-71-C-0300)

Daniel Kleppner

During the past year we have performed experiments measuring the Stark mixing of two excited states. We have extended our investigation of bound-to-free transitions in excited alkali dimers, and are constructing an apparatus for observing excited-state collision processes.

We now propose to study optical excitation processes in atoms that are part of a jet beam. These beams allow much higher intensity and much lower internal temperatures than conventional beams, and should make Doppler broadening negligible while still providing substantial signal strength.

Cross-section data and knowledge of atomic potentials are necessary in many areas JS

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of physics, atmospheric and ionospheric studies, plasma research, and so forth. Most accurate data come from scattering experiments in the ground state. Methods that are now available for making such measurements in the excited state give promise of a vast improvement in our knowledge of excited-state interactions. We propose to carry out such studies, using a combination of atomic-beam scattering and laser excitation techniques. The first studies will involve the alkalis.

By coherent population of atomic excited states, information on the level structure can be recovered through detection of "quantum beats" in the emitted photons. We plan to apply this technique to a previously unobserved hyperfine interaction in potassium.

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