IV. ATOMIC RESONANCE AND SCATTERING

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1. OPTICAL FREQUENCY STANDARD

JSEP

Joint Services Electronics Program (Contract DAAB07-75-C-1346)

Riad N. Ahmad, Walter P. Lapatovich, David E. Pritchard

Work on our prototype system continues. The reproducibility of our system has been improved so that the drift is ~50 MHz per hour and the day-to-day reproducibility is ~±500 MHz. These figures represent stabilities of 0.1 and 1.0 ppm, respectively. We are now trying to reduce the day-to-day variations to the 50-MHz design objective. We are also beginning some studies of molecular spectra using a molecular beam to reduce the Doppler widths, since the I_2 cell which is now being used has a Doppler width of 800 MHz and will soon be a limiting factor in our frequency calibration.

2. NEW METHODS FOR RADIATION DETECTION

Joint Services Electronics Program (Contract DAAB07-75-C-1346)

Daniel Kleppner

We continue to work on the application of highly excited atoms to a photon counting detector in the infrared and millimeter-wave regions. A communications receiver has been designed for detecting signals on a CO_2 laser line at 10 μm. Operation is pulsed with a 100-Hz repetition rate and 0.5 μs observation window. The detector bandwidth is 50 MHz, the antenna half-angle is 15°, the quantum efficiency is 6%, and the noise is 0.2 counts/pulse. Detectors have also been designed for use in the 0.5-1 mm region. Experimental work has begun on the interaction of highly excited atoms with radiation at 10 μm and 4 mm.

JSEP

3. RESEARCH ON HIGHLY EXCITED ATOMS

U.S. Air Force Office of Scientific Research (Contract F44620-72-C-0057)

Daniel Kleppner

We have developed methods for producing copious numbers of highly excited alkali atoms and detecting them with essentially 100% efficiency. A detailed study of the Stark structure has been undertaken; good agreement between theory and experiment has been obtained. Work is under way on tunneling rates. Many applications for high Rydberg atoms have been studied; these include radiation detection for communication astronomy and plasma diagnostics, and also fundamental investigations of atomic structure, such as problems of core polarization and multiply excited atoms.