controlled rotation of a half-wave plate selects the polarization direction of the light, and an adjustable lens matches the laser-beam diameter to the molecular-beam diameter.

The detecting is done by a mass spectrometer that selects fragments with the looked-for mass and rejects all others. Those of the looked-for fragments that recoil at a preselected angle with respect to the electric vector of the light are ionized and pass through the mass spectrometer to an electron multiplier, whose output pulses are counted every microsecond for 500 microsec after the laser is fired. From the time of arrival and the distance between the spectrometer and the point where the beams cross, the translational energy E_{tr} of the fragments is measured. And from the energy conservation relation

$$E_{\mathrm{par}} + h\nu = D_0{}^0 + E_{\mathrm{ele}} + E_{\mathrm{tr}}$$

(where E_{par} is the initial internal energy of the parent molecule, $h\nu$ is determined by the laser and $D_0{}^0$, the dissociation energy, is usually known) for a diatomic molecule, Wilson calculates the energies E_{ele} of the electronic states of the atomic fragments. For a polyatomic molecule, Wilson can determine the total internal energy—only for special cases can he distinguish between electronic, vibrational and rotational levels. The angular distribution of the recoiling fragments gives information about the dissociative molecular excited state, for example, its symmetry and lifetime.

Other chemical physicists have studied the recoil spectroscopy of photodissociating molecules. At Harvard, Richard N. Zare (now at Columbia) and Dudley R. Herschbach[2] showed theoretically that the angular distribution of recoiling photodissociated fragments is linked to the symmetries of the excited states. Jack Solomon and Richard Bersohn[3] (Columbia) have studied a variety of molecules with a method they call "photolysis mapping," which gives them the angular distribution of the fragments but not the translational energy. And Ronald Diesen, John Wahr and S. E. Adler (Dow Chemical Co) have reported[4] results on NO_2 and Cl_2 from a method similar to the one Wilson uses.

Some earlier errors in spectroscopy have been corrected with the recoil method. Iodine in its main visible continuum, for example, was thought to dissociate almost entirely from the $B^3\Pi_{0u}{}^+$ state into one excited and one ground-state atom, but the energy and angular distributions that Wilson finds indicate a major contribution from a $^1\Pi_{1u}$ state, giving two ground-state atoms. This preferential population of the ground state helps explain why no iodine photodissociation laser has yet been successful.

The sun produces in the atmosphere many of the reactions that Wilson reproduces in his laboratory; NO_2 and ethyl nitrite (C_2H_5ONO) for example, have been extensively studied, and some of Wilson's support is from the Government agencies that are interested in controlling air pollution. Photodissociation reactions are also of interest to atmospheric scientists because these reactions help shield the earth from uv radiation and maintain the heat balance in the upper atmosphere.

Within the next few months, Wilson expects to start experiments with a high-power ultraviolet laser (1 joule per pulse at 2655 Å). This laser will be used to study ozone, which Wilson finds particularly interesting because of the spin conservation problems in its breakup and the importance of its photodissociation both to air pollution and to processes occurring in the upper atmosphere. —MSR

References

1. K. R. Wilson in *Symposium on Excited State Chemistry* (J. N. Pitts, ed), Gordon and Breach, New York (1970).
2. R. N. Zare, Harvard University PhD Thesis (1964); R. N. Zare, D. R. Herschbach, Proc. IEEE **51**, 173 (1963); R. N. Zare, D. R. Herschbach, Appl. Opt. Suppl. **2**, 193 (1965); R. J. VanBrunt, R. N. Zare, J. Chem. Phys. **48**, 4304 (1968).
3. J. Solomon, J. Chem. Phys. **47**, 889 (1967).
4. R. W. Diesen, J. C. Wahr, S. E. Adler, J. Chem. Phys. **50**, 3635 (1969).

X-ray conversion

continued from page 17

interaction. Eisenberger and McCall were pleased to find that they could observe conversion even in their slightly imperfect crystal.

A major experimental difficulty was reducing the random Compton-scattered background radiation to allow discrimination between the background and the coincident 8.5-keV pairs. Sodium-iodide detectors were chosen for their combination of energy resolution and speed of response, but their energy resolution was not quite sufficient to ensure rejection of all the random 17-keV photons. The Compton rate was about 3000 per sec, whereas the coincidence count rate was about one per hour, so that great care in experiment design was needed.

McCall and Eisenberger are now attempting to do an experiment mixing x-ray and visible photons. Neither ordinary x-ray scattering experiments nor nonlinear techniques at visible frequencies give microscopic details about outer electrons because both are dominated by the bulk properties of the material. An experiment that mixed x rays and visible light would, however, allow the x rays to probe the outer-shell electron distortions produced by the visible light.

What about the relation of their work to the possibility of an x-ray laser? "I don't know how to make an x-ray laser," says McCall, "nobody does. . . but working in a related field just might help." —MSR

References

1. P. M. Eisenberger, S. L. McCall, Phys. Rev. Lett. **26**, 684 (1971).
2. I. Freund, B. F. Levine, Phys. Rev. Lett. **23**, 854 (1969).
3. P. M. Eisenberger, S. L. McCall, Phys. Rev. **A3**, 1145 (1971).

New telescope at Palomar

The first major addition to Mount Palomar since the 200-inch telescope was completed in 1948 is a 60-inch telescope, which was dedicated in October. A Raytheon 703 computer controls operation and acquires data. An unusual optical system of six mirrors and a corrector lens enables the telescope to combine the maneuverability advantages of a short tube (154 inches) and the higher magnifications possible with a long focal length of 1800 inches (at the coudé focus) or 525 inches (at the Cassegrain focus). The telescope, built largely in the Cal Tech shops, cost more than $1 million; funds came from NSF, the family of the late Oscar G. Mayer, NASA, Cal Tech and the Carnegie Institution.

The Hale Observatories operate the new telescope as well as the 200-inch and 48-inch Schmidt telescopes at Palomar and the 100-inch and 60-inch telescopes at Mount Wilson.

Paramagnetic temperature scale in 1–20 degree K range

A new temperature scale in the range from 1 to 20 degrees K has been developed by T. C. Cetas and Clayton A. Swenson of Ames Laboratory and Iowa State University. The new scale, which is preserved for use by germanium resistance thermometers, is based on precise susceptibility measurement of two paramagnetic salts, chromic methyl-ammonium alum and manganous ammonium sulfate. Based on the National Bureau of Standards 1955 platinum resistance thermometer scale, the Iowa scale is believed to be accurate to better than 1 millidegree K over the specified range. □