

n-type indium antimonide crystal and applied a strong magnetic field (varied from 20 to 100 kG) perpendicular to the laser beam.

Another way of generating tunable infrared radiation is to use Raman scattering from polaritons. Because a polariton, by definition, has both optical and mechanical character, the lattice vibration excited during the stimulated-scattering process radiates in the infrared. One can tune by varying the angles of incidence and emission. Experiments last year by groups at Bell Labs,² Stanford³ and the Institute of Optics at Orsay⁴ have demonstrated that the technique works.

Raman scattering occurs in the new experiments when the conduction electrons in the crystal flip their spins in the magnetic field. The frequency of the shifted light varies as $\omega_s = \omega_0 - g\mu_B B$; ω_0 is the pump frequency, μ_B is the Bohr magneton, B is magnetic field and g is the effective gyro-magnetic ratio of the electrons in indium antimonide.

Three years ago Patel, Richard Slusher and Paul Fleury produced spontaneous Raman scattering from the spin-flip process in indium antimonide, indium arsenide and lead telluride; the shifted-frequency light is, however, weak. Since then Patel has intermittently been trying to also produce stimulated Raman scattering, in which one builds up several photons per mode in the scattered radiation; these then begin to react back on the primary, and the process avalanches. Patel and Shaw have now achieved the stimulated scattering. About 10% of the primary power is emitted by the crystal at the shifted frequency.

The CO₂ laser can emit thousands of watts, but the Bell experimenters have made the stimulated Raman scattering occur with input power as low as 300 watts; Patel believes he may be able to reduce power much further. At 1-watt output the linewidth was less than 0.03 cm⁻¹. Laser pulses last about a tenth of a microsecond. Other pump lasers will probably also work, for example the carbon monoxide laser, which emits at 5 microns; if so, one could tune from roughly 5.5 to 7.5 microns.

In the experiment the indium antimonide provides electrons with a very high effective magnetic moment, 25 times higher than free electrons. The

energy change, and therefore the frequency range over which one can sweep, is proportionately multiplied. Indium antimonide is well behaved in other ways; it is sturdy and has very high optical transmission in the correct frequency range; so the efficiency of the Raman laser is high. Bell experimenters are now speculating about other suitable materials.

One puzzle raised by the experiment is why, when one tunes the magnetic field, the frequency of the spin-flip laser tracks exactly (within experimental limits). Because the crystal is an optical cavity for the radiation, one might expect that as the field is raised and one passes through the natural frequencies of the cavity, there would be some sort of nonlinear coupling that would pull the frequency. Although frequency was not affected by the cavity, power output was; it increased by about 10% at the natural frequencies.

An obvious application of the tunable spin-flip Raman laser is for infrared spectroscopy. Patel, Shaw and Rudy Kerl have already used the laser to obtain infrared absorption spectra for ammonia that have better resolution than any previously obtained with grating spectrometers. —GBL

References

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Berkeley Group Calls Element 105 Hahnium

The discovery of element 105 was reported by Albert Ghiorso (University of California, Berkeley) at the Washington APS meeting; he suggested calling it "hahnium" in honor of Otto Hahn, codiscoverer of nuclear fission.

Two years ago Georgi N. Flerov (Joint Institute for Nuclear Research at Dubna) had reported the discovery of element 105 (*PHYSICS TODAY*, December 1967, page 61). Ghiorso believes his experiment shows that Flerov's initial experiment was wrong, but not that a second recently reported Dubna experiment, in which Flerov found a spontaneous fission half-life of 2 sec, was necessarily wrong. The Dubna group has not proposed a name, however.

In the Berkeley experiment Ghiorso, Matti Nurmia, Kari and Pirkko Eskola and James Harris bombarded a 60-microgram target of Cf²⁴⁹ with 84-MeV N¹⁵ ions from the HILAC, producing ¹⁰⁵X²⁶⁰, which decayed with a half-life of 1.6 sec, according to Ghiorso; the alpha-decay energy was about 9.1 MeV.

Ghiorso is eagerly awaiting the modification of HILAC, which is to be shut down in February; six months later it is scheduled to become super-HILAC, which should be capable of accelerating ions as heavy as uranium. It is expected to make 10¹² ions/sec at 2 GeV.

To Interstellar Pollution List Add Carbon Monoxide

Carbon monoxide has been detected in the Milky Way. The eighth molecule to be found in space was reported in April (in an International Astronomical Union Circular) by Keith Jefferts, Arno Penzias and Robert Wilson of Bell Labs. Using the 36-foot telescope at Kitt Peak, the observers found a CO line in emission at 2.6 mm in at least five sources in our galaxy.

OH, CH, CH⁺ and CN molecules have been known for some time in interstellar space. Now that formaldehyde, ammonia and water have also shown up lately, one wonders where all this interstellar pollution is coming from. Where will it all end?

IN BRIEF

Mount Wilson and Palomar Observatories have a new name—the Hale Observatories, in honor of George Ellery Hale, famed American astronomer and founder of both observatories. The Hale Observatories, with a staff of over 120, are operated jointly by the Carnegie Institution of Washington and Cal Tech. Horace W. Babcock is director of the observatories. J. Beverly Oke has recently been appointed associate director.

The CERN-IHEP Boson Spectrometer, part of the second CERN-IHEP collaboration, was shipped to IHEP (Institute for High-Energy Physics), in Serpukhov at the end of March. In the experiment negative pions strike a hydrogen target, scintillation counters select desired events and then trigger a wide-gap spark chamber. W. Kienzle of CERN and G. Landsberg of IHEP lead the collaboration. □