physical sciences space sciences

From our reporter at the International Quantum Electronics Conference in Montreal

Measuring atmospheric hydroxyl

The hydroxyl radical (OH) exists in the atmosphere in extremely small concentrations, approximately one part in 10^{13}. In spite of its rarity, atmospheric chemists suspect that it plays a crucial role in the production of smog and the oxidation of carbon monoxide to carbon dioxide. But current techniques cannot measure the hydroxyl concentration accurately enough.

E. L. Baarsden and R. W. Terhune of the Ford Motor Co. suggest that it may be possible to measure the OH using fluorescence stimulated by light from a dye laser. They have done laboratory experiments with an artificially produced concentration of hydroxyl in a nitrogen atmosphere with 50 percent relative humidity. Light from the laser excited a narrow absorption line of the hydroxyl. The energy absorbed was then reemitted as fluorescent light at a frequency different from the absorption line. The experiments lead Baarsden and Terhune to conclude that with one of the more powerful dye lasers now in existence it would be possible to detect OH concentrations down to 1 in 10^{13}.

Design of laser dyes

In the last few years the use of fluorescent organic dyes as lasing materials has contributed an important new class of lasers that can be tuned over a wide range of wavelengths. Other kinds of lasers generally produce one or a few single wavelengths and cannot be tuned.

When dye lasers began, their developers used whatever dyes happened to be available. Now it is becoming desirable to design dyes specifically for laser use, and K. H. Drexhage and collaborators did a study of the necessary qualities of an optimum laser dye.

The parameters they evolved provide a challenge to dye chemists, especially because the molecules of laser dyes have to be nonrotatable. This requires that different parts of the molecule be connected by two or more linkages, usually of different chemical character.

In the course of the investigation Drexhage and his associates have found new dyes for the wavelength range between 4,200 and 7,400 angstroms that are as efficient as the best dye so far known, rhodamine 6G. Efficient laser dyes may not be possible below 3,000 angstroms or above 15,000, but work is going forward to reach both these limits.

CO_2 laser at atmospheric pressure

Carbon dioxide lasers that use flowing gas as the lasing material promise to achieve high powers efficiently and thus are regarded as a possible power source for future work in laser-induced thermonuclear fusion.

Usually these lasers have operated at low pressure because higher pressures caused difficulties with the electrical discharges that energize them. But high pressures would give greater power production per unit volume of gas. R. McLeary and W. E. K. Gibbs of the Australian Defence Standards Laboratories at Maribyrnong report that they have overcome the difficulties sufficiently to operate a CO_2 laser at atmospheric pressure, 15 times that achieved previously.

Space telescope gets green light

The National Aeronautics and Space Administration announced last week its plans to proceed with a large, multipurpose optical space telescope. The telescope would be launched and serviced by the space shuttle in the 1980's. This is in accord with the 1971 recommendations of the National Academy of Sciences' Space Science Board (SN: 3/14/71, p. 179) which gave it a first priority rating.

The mirror of the Large Space Telescope (LST) will be about 3 meters in diameter. The telescope will be able to look at galaxies 100 times fainter than those seen by the most powerful ground-based optical telescopes. It will be capable of holding onto a target for extended periods within 0.005 seconds of arc, a pointing accuracy equivalent to looking at a dime on the Boston Commons from Washington, D. C. When Mars is at its closest approach to earth, the telescope will be able to resolve surface features such as craters as small as 13 kilometers.

US/USSR joint space science meetings

It took over a year to accomplish, but it represents some kind of first in space science—two series of meetings between U.S. and Soviet scientists in accord with specific recommendations of the space agreement of Jan. 21, 1971 (SN: 5/1/71, p. 303). The meetings, one on the natural environment and the other on lunar mapping, were held last week at NASA headquarters.

The sessions on the natural environment were to report progress and results of remote sensing experiments that were to be conducted by each country over analogous and complementary sites in the U.S. and U.S.S.R. The lunar mapping meetings were to exchange lunar maps and discuss mapping techniques so that a common reference and coordinate system could be established. Most of the U.S. representatives were from the military.

Convection in zero g

During Apollo 14, four experiments were activated inside the spacecraft to examine the effects of zero gravity on certain physical processes (SN: 1/2/71, p. 2). The results of one—on the effects on heat transfer and convection in liquids and gases—is reported in the May 5 SCIENCE.

For years, convection, the circulatory motion that occurs in fluids at a non-uniform temperature, was generally thought linked solely to gravity. Now Philomena G. Grodzka of Lockheed Missiles and Space Co., Inc., and Tommy C. Bannister of NASA's Marshall Space Flight Center report that convection can occur solely as the result of surface tension gradients. This had been predicted by J. R. A. Pearson in 1958. For the experiment they used Krytox (a lubricant) with a suspension of aluminum powder. They found that a certain temperature had to be reached, however, before convection was observed. In a second experiment they used three fluids: carbon dioxide gas, water and a sugar solution. No surface tension was involved in these (because the containers were not open), but convection still occurred. "There was a fluid flow caused by some forces that we do not yet completely understand," says Grodzka.