Meteorology

Tracking nitric oxide in its lair

A balloon-borne laser has been used in what Bell Laboratories researchers call the first real-time measurements of pollution in the stratosphere. Lofted from the National Center for Atmospheric Research balloon facility in Palestine, Tex., the experiment provided data for the first half of a two-part study on how stratospheric nitrogen and oxygen combine and separate in response to solar ultraviolet radiation.

The concentration of nitric oxide in the stratosphere is of concern because of its role in the chemical cycle of ozone, which keeps otherwise hazardous amounts of ultraviolet radiation from reaching the earth below.

In the first-stage experiments, says Kumar Patel, director of the Bell Labs Electronic Research Laboratory, a laser-and-computer gas spectroscopy system was carried by balloon to an altitude of 92,000 feet, where it measured the nitric oxide concentration before, during and after sunrise. According to Patel, the daytime value, about four parts per billion, was more than 20 times greater than the pre-dawn value. Later this year, additional flights will chart the variation of nitric oxide as the sun sets. In the nighttime absence of UV radiation, nitric oxide is believed to recombine with ozone to form nitrogen dioxide, Patel says.

The low, low voice of CAT

For years meteorologists have sought a way to detect clear air turbulence, violent but invisible air movements that can be a serious hazard to aircraft. Eric Posmentier, of the University Institute of Oceanography of the City College of New York, suggests that a possible key may be infrasound—sound waves too low to hear but still recordable on instruments—radiated by the mysterious CAT.

In Posmentier's study, infrasounds from 1 to 16 hertz were recorded for 75-second periods, six times a day for six weeks. From the resulting data, four records of extremely low-amplitude sounds and four of highly coherent, strong-amplitude sounds were selected. A lengthy search was made for meteorological conditions such as wind speed and directional shear that seemed to be consistent within each group.

The conclusion, Posmentier reports in the April 20 JOURNAL OF GEOPHYSICAL RESEARCH, is that the low-amplitude records came from periods when conditions made CAT unlikely, while the high-amplitude records coincide with times when CAT was highly probable.

"This relationship suggests the enticing possibility of the remote passive acoustic detection of CAT," he says.

Cycling through the troposphere

Yet another regular cycle has been found in the behavior of earth's atmosphere. This time it is a 14- to 16-day cycle in the circulation pattern between the troposphere and the stratosphere over the northern hemisphere.

The cycle was first theorized eight years ago, based on observed regular changes in the height of the 10-millibar level in the cyclonic air mass over the North Pole. Its existence has now been confirmed by Alvin J. Miller of the NOAA Air Resources Laboratories in Silver Spring, Md. Regular variations in the energy of eddies in the lower stratosphere, says Miller in the April JOURNAL OF THE ATMOSPHERIC SCIENCES, result from a vertical exchange of energy from the troposphere beneath.

Astrophysics

A numerical model for pulsars

Many students of pulsars agree on the hypothesis that these swiftly pulsating celestial radio sources are rotating neutron stars with magnetic fields. To turn such a hypothesis into believable theory requires making mathematical derivations and putting numbers into the equations to see if they come out consistent with observation. One such endeavor is presented in the May 6 PHYSICAL REVIEW LETTERS by L. G. Kuo-Petravic and M. Petravic of Oxford University and K. V. Roberts of the Culham Laboratory in Abingdon, England.

They find a solution for a case where the magnetic and rotational axes of the star are aligned. Around the so-called light radius, the distance from the center of the star at which a particle rotating with the star would have a linear speed equal to that of light, and in the plane of the star's equator, calculation shows a region of high energy density. This could be the source of the radio emission.

When numbers appropriate to the Crab nebula pulsar are used, the model predicts that particles streaming out from the neutron star will carry away 5×10^{37} ergs per second of energy. This is in agreement with what is observed. The three physicists could say that they have a model that fits observation, but do not go quite so far because the number used for the magnetic field strength is uncertain.

Black holes as energy converters

A black hole represents a fantastically condensed piece of matter with an enormously strong gravitational field. To a general relativist a black hole is thus a place of extremely sharply curved space-time, and many unusual things occur under such conditions. One of them, says Ulrich H. Gerlach, a mathematician at Ohio State University, is the conversion of electromagnetic to gravitational energy if the black hole is electrically charged. His derivation is in the May 6 PHYSICAL REVIEW LETTERS.

Gerlach finds that electromagnetic and gravitational vibrations traveling away from a charged black hole will beat against each other and exchange energy with each other so that at alternating distances there are alternating bunches of gravitational and electromagnetic energy. Gradually the exchange favors the gravitational mode and "all electromagnetic radiation, regardless of how it is produced, will ultimately be converted totally into gravitational radiation," provided it stays in the black hole's background electric field long enough.

To X-ogen add Y-ogen

For a couple of years now molecular astronomers have been recording a radio emission from interstellar gas clouds that they call the X-ogen line because they can't identify the emitting substance with anything so far studied in the laboratory (4/21/73, p. 258). Now a group of mystery lines, apparently not related to X-ogen, has been observed coming from the Orion nebula by L. E. Snyder of the Joint Institute for Laboratory Astrophysics and David Buhl of the National Radio Astronomy Observatory. The lines are around 3.48 millimeters wavelength and apparently represent the first celestial maser in the millimeter range of the spectrum. The source may be another unidentified substance or some interaction of water and hydroxyl. The report is in the just received April 1 ASTROPHYSICAL JOURNAL LETTERS.