Hot Water Source in Space May Act as Maser

Water molecules have been found in the interstellar medium and appear to be acting like masers, according to a research team at Berkeley (Albert C. Cheung, David Rank, Charles Townes, Douglas Thornton, William Welch) and the Naval Research Laboratory (Cornell Mayer and Stephen Knowles). By microwave observations with the 20-foot Hat Creek radio telescope and then the 85-foot NRL radio telescope, which gave more directivity, the group found water in eight different regions (*Nature* **221**, 626, 1969 and *Science* 163, 1055, 1969).

The most remarkable of the sources, W 49, shows an effective radiation temperature that is at least as high as 10^9 K. Consequently, Townes told PHYSICS TODAY, they are not observing equilibrium thermal radiation at all; rather, the water is acting like a maser. The intensity of some of the radiation from W 49 varies by a factor of two over the course of a week.

The possibility of maser action has also been suggested for the puzzling interstellar OH sources (PHYSICS TODAY, November 1967, page 69). The OH and H_2O sources show some sort of relationship, Townes says. "In some cases there is OH and not water, and in some cases water and no OH. But in most cases they're associated."

To establish the sizes of the water sources more exactly, measurements with long-baseline interferometers would be valuable. Such observations are being discussed by groups at Berkeley, NRL and the National Radio Astronomy Observatory at Green Bank.

H_2O is the second polyatomic molecule found in space. The first, NH_3, was also found by the Berkeley group (*Phys. Rev. Letters* **21**, 1701, 1968), late last year. —GBL

More Electron Rings: LRL Forms Them; Dubna Starts Extraction

A group from the Joint Institute for Nuclear Research, Dubna, is doing experiments to extract an electron ring from an electron-ring accelerator (smokatron), according to V. P. Sarantsev, who spoke at the March Particle Accelerator Conference in Washington. A 1.5-MeV electron beam is injected into the Dubna device and forms a doughnut, which is then compressed (PHYSICS TODAY, February 1968, page 51 and November 1968, page 61). Then hydrogen is injected, becomes ionized, and protons are trapped inside the ring.

By placing surfaces close to the ring the group expects to obtain extra focusing due to image effects. Then by varying the magnetic field with time they have tried to slide the ring out.

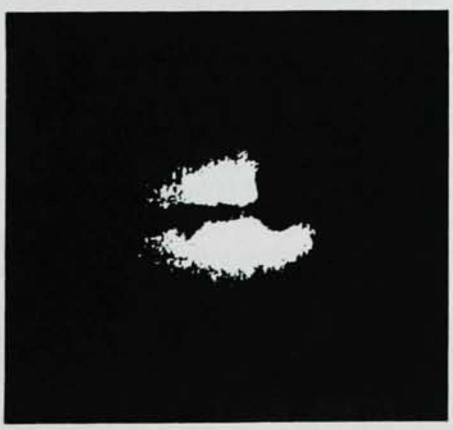
As experiments on ring extraction had begun only a few days earlier, Sarantsev explained that it is not yet clear whether the ring held together after extraction, and if so, whether protons had been accelerated. However, the experimenters did observe relativistic electrons leaving the compressor system and emerging from the bore of the accelerating solenoid.

At the same session Denis Keefe of Lawrence Radiation Laboratory, Berkeley, reported that his group has used 3.3-MeV electrons to form rings that were then compressed to a final radius of 3.5 cm and 19.0-MeV electron energy.

The group measured electron distribution inside the ring and found that the rms minor radius was about 2 mm. One powerful technique was to photograph the intense synchrotron light from the compressed ring. They were regularly able to compress rings containing 4×10^{12} electrons.

These observations correspond to a peak electric holding field of 12 MV/m, which Keefe said is certainly strong enough for a practical proton or heavy-ion accelerator. The experimenters varied the number of protons injected into the ring and found that they could achieve a high proportion of protons, much more than 1%. The rings were remarkably durable, too, lasting as long as 7 millisec. —GBL

V. P. SARANTSEV heads the Dubna group that has started experiments to extract an electron ring from their electron-ring accelerator. They have observed relativistic electrons emerging.



ELECTRON-RING CROSS SECTION was photographed (by the Berkeley group) with its own synchrotron light. Black dot and line are caused by camera grid. Height of photo represents 9 mm.

British and Dutch Build New Radio Telescopes

Two new radio telescopes are under way in Europe. At Westerbork in northeast Holland a 1.6-km interferometer array nears completion, and in England the Science Research Council has given the go-ahead for a 5-km interferometer at Cambridge.

The Dutch instrument, built by the Netherlands Foundation for Radio Astronomy and financed by the Netherlands Organization for the Advancement of Pure Research, consists of 12 parabolic reflectors, each 25 m in diameter. Ten of them are equally spaced along an east–west line, and the two others move along a 300-m rail track at the eastern end of the 1.6-km baseline. First observations will be made at 21-cm wavelength, for which the resolution will be 22 sec of arc. The telescope will be used for counts of radio sources, investigation of the structure and spectra of these sources, and work on the distribution of radiation and polarization in nearby spiral arms of our own galaxy.

The Science Research Council has agreed to meet the estimated £2-million ($4.8-million) cost of the 5-km (3-mile) interferometer at the University of Cambridge. The new telescope will be built at Lord's Bridge, site of the existing 1-mile interferometer, along the roadbed of a now disused railroad that runs along the northern boundary of the Mullard Radio Observatory, a few miles outside Cambridge. Eight 12.8-m-diameter paraboloids will comprise the interferometric array; four of them will be fixed and four movable along the east–west axis of the instrument.

The existing 1-mile interferometer has a resolution of 20 sec of arc. The planned instrument is expected to see structure as fine as 1–2 sec of arc. It will be used for observations of quasi-stellar objects and radio galaxies; as with the present instrument radio astronomers from any British university will have access to it.

Check of T Invariance in Electromagnetic Interaction

An apparent violation of time-reversal invariance in the electromagnetic interaction was reported at the New York American Physical Society meeting by David Bartlett, K. Goulianos, Carl Friedberg, Ira Hammerman and David Hutchinson of Princeton. The group compared angular distributions for $n+p\rightarrow\gamma+d$ with data from other sources on the inverse reaction $\gamma+d\rightarrow n+p$ to test reciprocity and hence check time-reversal invariance. In the experiment, neutron energies from 160 to 680 MeV were studied. At lower values of energy the angular distributions for both of the reactions matched. But at about 600 MeV, which corresponds to formation of the N* resonance, the curves did not match. Michael Longo (University of Michigan) and his collaborators in a similar experiment do not see the large effect reported by the Princeton experimenters. Although many particle physicists are excited about the observations, a typical attitude is, "Interesting if true." —GBL

Polar Cap May Have A Geoelectric Field

During the period of high solar and geomagnetic activity in late May 1967 the Air Force satellite OV1-9 detected energetic proton fluxes coming up the magnetic field lines from the earth at high magnetic latitudes ($\lambda \geq$ 65–70 deg). Ludwig Katz and Paul L. Rothwell of Air Force Cambridge Research Laboratories suggest that, because the flux is highly collimated along magnetic-field lines, there may be a radial polar electric field of about 0.14 volts/meter (*Phys. Rev. Letters* **21**, 1764, 1968). Electric fields had been suggested earlier as a possible explanation for aurora or other polar-cap particle precipitation.

Polarized Targets Used To Study Spin Effects

By hitting targets of aligned Ho^{165} with a polarized neutron beam, experimenters are now able for the first time to study the dependence of total cross section on the relative orientation of neutron spin and nuclear spin.

In recent work at Stanford (*Phys. Rev. Letters* **20**, 502, 1968), the target is a cylinder of polycrystalline holmium metal (1.6-cm diameter, 7.4 cm long), mounted inside a dewar that is provided with thin windows for the passage of a fast-neutron beam; the cylinder is thermally anchored to a bath of pumped He^3 at a temperature of 0.3 K. An external magnetic field of 18 000 oersteds along the axis of the cylinder is provided by a superconducting solenoid. The large hyperfine interaction between the nuclear magnetic moment and the atomic electrons causes a nuclear polarization of 55%. This method of producing systems of oriented nuclei is a common one, but applying it to a target suitable for experiments with fast neutrons is new.

The Stanford group, consisting of Thornton R. Fisher, J. S. McCarthy, R. S. Safrata (now at the Nuclear Research Institute, Rez, Czechoslovakia), E. G. Shelley (now at Lockheed Palo Alto Research Laboratories), finds that over the range 0.3–15 MeV total cross section depends strongly on nuclear orientation. The

IN BRIEF

The Serpukhov alternating gradient synchrotron is now producing 10^{12} protons/pulse at 70 GeV, according to Yuri Ado, who spoke at the March Particle Accelerator Conference in Washington. The space-charge limit on intensity is about 2×10^{12} protons/pulse.

Argonne has successfully operated the world's largest superconducting magnet, which will provide an 18-kG field for the 3.7-meter bubble chamber nearing completion. The magnet consists of a 110-ton stack of circular coils inside a 1600-ton steel yoke.

An experiment on OGO-5 has detected low-frequency fluctuating electric fields generated in the earth's bow shock. R. W. Fredricks, Charles F. Kennel, Frederick L. Scarf, G. M. Crook and I. M. Green (*Phys. Rev. Letters* **21**, 1761, 1968) of TRW Systems Group found that the turbulence is strongly correlated with time variation in the magnetic field.

A new candidate for the standard wavelength is the 3.39-micron rotation–vibration line of methane. R. L. Barger and J. J. Hall of the Joint Institute for Laboratory Astrophysics locked two lasers independently to the transition with a reproducibility of $\pm$ 1 part in 10^{11} (*Phys. Rev. Letters* **22**, 4, 1969). This reproducibility is two orders of magnitude better than the present length standard, the 605.6-nanometer line of Kr^{86}.

The compressibility of nuclear matter in S^{32} is about 200 MeV, according to calculations (*Phys. Rev. Letters* **21**, 1479, 1968) by Werner Scheid, Rainer Ligensa and Walter Greiner (University of Virginia and the University of Frankfurt). They used O^{16}–O^{16} scattering data from Yale.

The new 2.7-m (107-inch) reflector at the McDonald Observatory, University of Texas, is currently the world's third largest optical telescope. To be used largely for planetary astronomy, the instrument was paid for by NASA.