

PHYSICS

General Relativity Tested

In a laboratory experiment now being conducted at Columbia University, a team of scientists is using masers to test Einstein's general theory of relativity.

A LABORATORY EXPERIMENT to test Einstein's general theory of relativity is now under way at Columbia University.

Dr. C. H. Townes, who is directing the tests, said that the experiments involved rotating two masers at right angles to each other. The equipment used, he said, is very similar to the set-up with which he and his co-workers last year confirmed Einstein's special theory of relativity with more precision than previously attainable.

He said the experiments confirming the special theory had been continued during the past year to make sure that there were no effects dependent upon the earth's position in its orbit around the sun. The year-long tests indicated there are no such effects.

An outline of the new experiment now being conducted by Dr. Townes' group is reported in the *Physical Review Letters* (Oct. 1) by Dr. Huseyin Yilmaz of the Institute for Advanced Study, Princeton, N. J. Dr. Yilmaz, on leave from the Sylvia Electronics Systems, Waltham, Mass., also suggests another experiment to test Einstein's general theory of relativity. At present there are no known plans to conduct this experiment.

The general theory, so-called because it is a generalization of Einstein's special theory, has as its fundamental basis the principle of equivalence, that is, the equality of the inertial and gravitational mass of a system. The experiment to test this theory using masers was first suggested by Dr. Townes, Dr. Yilmaz reports.

Einstein's special theory postulates that the velocity of light, 186,000 miles a second, is independent of its frame of reference or of the motion of the light source itself. This theory also applies to radio waves, which travel at the speed of light.

Maser is a term formed from the phrase, Microwave Amplification by Stimulated Emission of Radiation. The maser used by the Columbia group is a tubular cavity through which a beam of ammonia molecules flow, radiating radio waves at their natural frequency.

The experiments testing Einstein's theories are designed to detect any changes in wave frequency that occur when the stream of molecules in the maser travel in different directions in relation to the earth or the sun.

Dr. Yilmaz points out that it would have

been impossible to carry out the two experiments only a year ago. Now, thanks to the recent advances in maser techniques, they can be done without "too much difficulty."

He emphasizes that the proposed experiments are essentially independent of any theory, although it would have been difficult to present them without the aid of the general theory of relativity.

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TECHNOLOGY

Resistors Made on Glass With Sputtering Method

RESISTORS for electronic circuits can be put on glass or ceramic plates using a technique known as sputtering. Resistors are devices used to limit flow of an electric current.

D. A. McLean of Bell Telephone Laboratories told the Western Electronics Conference meeting in San Francisco that each resistor can be a line as thin as one-thousandth of an inch. Such small size resistors promise further reductions in the size of some electronic equipment, he said.

In the sputtering technique, ionized gas molecules bombard a metallic cathode. They dislodge atoms of metal that then redeposit on nearby surfaces. By depositing copper on a plate of glass, etching out the pattern wanted, sputtering on tantalum and then putting the plate in an etching bath, Bell engineers were able to produce fine lines of tantalum that can act as resistors.

In one experiment, a circuit occupying a standard printed circuit card three and one-half by seven inches in size was reduced to a ceramic square only two inches on a side.

One of the most important aspects of the development, Mr. McLean said, is production of capacitors and resistors from a single metal, complete with interconnections, to remove one of the greatest reliability hazards in miniaturized electrical circuitry.

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ENGINEERING

Predict Increased Use of Gas-Filled Transformers

A GRADUAL increase in the use of gas-filled transformers is predicted.

The advantages of gas as a transformer insulation rather than liquids were reported to the American Institute of Electrical Engineers meeting in Chicago by G. Camilli, L. G. Littlejohn and W. A. Woodridge of Pittsfield, Mass.

The three General Electric Company engineers said gases can be non-combustible, and that, although they may decompose during accidental internal arcs, the pressures developed are only a fraction of those produced by the same arcs in liquid-filled transformers.

Furthermore, the pressure-relief device in gas-filled transformers is much more reliable because of the small mass being moved during the fault and the compressible character of the gas.

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LAND-BASED RADAR—The first land-based radar antenna to combine height, distance and direction finding capability in a single unit is shown in final assembly at the General Electric ordnance department, Pittsfield, Mass. The seven-ton antenna is part of the SAGE continental air defense system.