operation in groups with up to four power supplies. Three power supplies were used to attain the 140-kG field.

Edward R. Schrader, engineering leader of magnet design for RCA's superconductive devices development department, explained that over 200 electrical leads are included in the design for sensing voltages and magnetic fields as well as current to the many modules. Radial and axial slots in the module walls allow cooling of the magnet and access for the leads. The complete assembly is 46 cm long with a 56-cm outside diameter.

James C. Laurence, chief of the cryophysics and magnetics branch at Lewis, told PHYSICS TODAY that NASA is interested in large, high-field electromagnets such as this for future applications in aerospace propulsion and power generation. This magnet, in particular, will also be used for solid-state physics and biomedical studies. Another large magnet at Lewis, of more conventional design, has produced fields of 200 kG in a 11.5-cm bore, when operated at liquid-neon temperatures.

140-kG SUPERMAGNET. Above magnet proper is the dewar-lid assembly.

Research on Neutron Electric Dipole Moment

Experiments searching for a neutron electric dipole moment are being carried out at Oak Ridge and Brookhaven National Laboratories. At Oak Ridge, Norman F. Ramsey, of Harvard, with Philip Miller, William Dress and James Baird, is now engaged in an experiment similar to the neutron magnetic resonance experiment of James H. Smith, Edward M. Purcell and Ramsey, reported in *Phys. Rev.* **78**, 807 (1950) and *Phys. Rev.* **108**, 120 (1957). However, much slower neutrons are used even though the moderator is at room temperature or somewhat above. Those few neutrons which have a velocity of approximately 70 m/sec are selected out of the total Maxwellian velocity distribution. The loss in intensity by this severe velocity selection is compensated to some degree by the fact that totally reflecting neutron pipes can be used to overcome partially the loss of intensity that goes inversely with the square of the distance from the source. Such neutron pipes have been used previously by Heinz Maier-Leibnitz and others, but not at such extremely low velocities.

The low velocities have the advantage of providing a narrower resonance and hence greater sensitivity as well as diminishing the apparent magnetic field which accompanies the motion of the neutron through the electrostatic field. In the experiment a separated oscillatory magnetic field is tuned to a frequency on the steep slope of a neutron beam magnetic resonance. A strong electric field is then successively turned on and off to see if there is a change in beam intensity accompanying the modulation of the electric field, as would be the case if there were a neutron electric dipole moment. At present preliminary observations would correspond to a neutron electric moment with $(-2 \pm 3) \times 10^{-22}$ cm for μ_e/e. It is hoped in the near future that the precision of this limit can be increased.

At Brookhaven, Ramsey is in collaboration with Edgar Lipworth, Victor Cohen, Henry Silsbee and Robert Nathans in an experiment that is somewhat similar to the Oak Ridge experiment except faster neutrons are used. They make possible a more rapid modulation of the radio-frequency field. In this experiment, as well as the one at Oak Ridge, no neutron electric dipole moment significantly larger than the experimental error has been observed so far.

A third experiment has been carried out at Brookhaven by Clifford Shull of MIT and Nathans of Brookhaven Laboratory. This experiment depends upon the scattering of polarized neutrons. Insofar as is known the results of this experiment are also consistent with no neutron electric dipole moment.

Cornell Synchrotron Makes 3-GeV Electrons in Tests

Cornell's 10-GeV synchrotron has successfully accelerated electrons to 3 GeV in preliminary tests. Earliest operation was limited by lack of sufficient power and water at the site, but utilities have now been completed and operation at full energy is anticipated in October. After the first of the year a significant fraction of the machine time is expected to be available for experiment. Qualified experimenters from other institutions can use it.

Boyce D. McDaniel has succeeded Robert R. Wilson as director of the synchrotron laboratory with Wilson's resignation to become director of the 200-GeV accelerator to be built at Weston, Ill.

Berkeley Experimenters Find New Lithium, Boron Isotopes

Recent measurements at Berkeley's Lawrence Radiation Laboratory show evidence for a surprisingly high degree of stability for some hitherto unknown isotopes of light elements including Li^{11}, B^{14}, and B^{15}. This work was reported by Arthur Poskanzer, Sam K. Cosper, Earl K. Hyde and Joseph Cerny in a paper in *Phys. Rev. Letters* **17**, 1271 (1966), where data for a complete range of helium, beryllium, boron and carbon isotopes were presented.

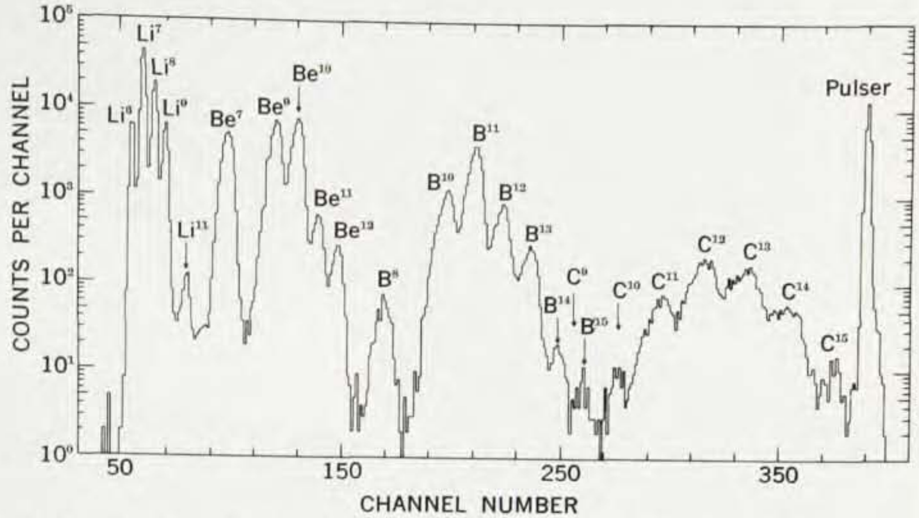
The technique for producing these neutron-rich isotopes has been previously established—the 5.3-GeV proton beam from the Bevatron is scattered in a thin uranium foil target—but as so often happens in physics the successful identification of the products awaited a suitable detector. This was achieved by Fred Goulding, Donald Landis, Cerny and Richard Pehl, who used it to demonstrate the existence of He^8. The method uses several semiconductor detectors to measure the energy loss rate and total energy of nuclei ejected from the target with a circuit that identifies charges and mass numbers of the nuclei. By measuring the energy losses in two separate transmission detectors and thereby getting two separate identifications of each event, the Berkeley experimenters acquire improved isotopic resolution; they reject events in which the two identifications do not agree.

Among the isotopes identified are He^6, and He^8, Li^9 and Li^{11}, and B^{14} and B^{15}. These nuclides are all particle stable; they decay only through weak-interaction processes by beta emission with relatively long half-lives measured in the tens of milliseconds. Some predictions by Gerald Garvey and Itzak Kelson suggested the existence of B^{14} and B^{15} but L^{11} was predicted to be particle unstable.

The significance of the work at LRL, Poskanzer stated, is twofold. First, the determination of which nuclei are particle stable and which are particle unstable sets certain limits on their masses that are useful in testing mass relations. For instance, the particle stability of Li^{11} indicates that its mass is at least 2.5 MeV lower than the most reliable prediction. Thus, one has the surprising result that the configuration of three protons and eight neutrons appears to be considerably more stable than one would predict by extrapolation from nuclei closer to beta stability.

The second reason is in the demonstration of the technique developed for the identification of nuclei. The accompanying graph demonstrates the type of identification now possible. It shows all the isotopes from Li^6 to C^{15} with the exception of only C^9. This technique has application in fields such as cosmic-ray and heavy-ion studies. In particular the LRL group will study the details of the production of these nuclei at the Bevatron to determine whether a fragmentation or an evaporation mechanism is a better description for their production.

It is almost as interesting to note the isotopes which did not appear, for example Li^{10} and Be^{13}. These are predicted to be particle unstable by Garvey and Kelson and there is no trace of them in the energy-loss spectrum.



ENERGY-LOSS SPECTRUM obtained with multichannel analyzer shows a peak for every isotope produced in the proton scattering process.

3-km Radio Telescope to be Built by Univ. of Maryland

A unique radio telescope with an aperture of over 3 km is being built by the University of Maryland at Clark Lake near Borrego Springs, Calif. The construction, which will take approximately two years, is being supported by the National Science Foundation and the Maryland school.

Its design is quite different from the radio telescopes now in use. Approximately 1000 individual antennas will stretch across the dry lake bed in the shape of a large T. The Maryland telescope will be fully steerable even though it will have no moving parts. Instead of a mechanical tracking system, sophisticated electronics will be used to steer the device. This unique characteristic will help radio telescopists detect many weak sources in the decameter range and monitor more than one radio source simultaneously. William Erickson, the project director, said that this new instrument will be the first steerable array telescope of its kind. It is comparable to a dish-type telescope with a 3-km diameter; at present the largest dish radio telescopes have diameters of 183 to 305 meters.

Planned projects for the Maryland radio telescope include cataloging and measuring 8000 known extragalactic radio sources to better understand the mechanism of radio emission. A study of supernova remnants, believed to be an important source of cosmic rays, also will be undertaken. Other research will include solar observations that should produce a complete picture of the sun's radio emissions each second, measurements of the scattering of radio waves in the solar corona and correlation of this information with that obtained optically from spacecraft or balloons.

The radio telescope will also monitor the planet Jupiter, as yet the only positively identified planetary radio source emitting decameter wavelengths. Because of the sensitivity of the new telescope similar radio signals emanating from other planets may be found.

JPL Suggests Bouncing Off A Planet to Reach Another

Space-age Tarzans will substitute gravity for vines. Just as the Jungle Boy uses the tension in a conveniently placed suspension to lose potential energy he doesn't want and gain a momentum directed toward the place he wants to reach, interplanetary explorers should use gravitational acceleration from appropriately placed planets to whip them around into the trajectory they need. So says Gary Flandro of Jet Propulsion Laboratory, who has