Radioastronomers Ryle and Hewish win Nobel Physics Prize

Two Cambridge University radioastronomers, Sir Martin Ryle and Antony Hewish, share this year's Nobel Prize for Physics. Ryle is cited for his "pioneering work" in radioastronomy, especially the development of antenna synthesis, and Hewish for the discovery of pulsars in 1967.

This is not only the first Nobel Prize to be presented for contributions to radioastronomy—it also marks the first time the committee has awarded the prize to fulltime astronomers of any description. The other examples that come to mind—Albert Michelson for optical interferometry, especially his stellar interferometer (1907) and Hans Bethe for his work on nucleosynthesis in the interiors of stars (1967)—are of physicists cited for astronomical applications of their research. Ryle and Hewish will share the prize valued this year at $124 000; the ceremony is to take place in Stockholm on 10 December.

HEWISH AND RYLE

Ryle, now 56, worked on radar during World War II and began his career as a radioastronomer with a German "Wurzburg" radar dish at Cambridge in 1946. Wartime radar work had given radioastronomy a flying start in several European centers at that time with discoveries such as the solar radio emissions investigated by J. S. Hey in 1942.

Ryle's major contribution to observational technique since then has been in the development and improvement of "aperture-synthesis" telescopes, and the closely related radio interferometers, for continually higher angular resolution. "Aperture synthesis" refers to the use of two or more relatively small antennas that can be moved to occupy successively the positions of individual components in a much larger array, so boosting the effective aperture of the instrument to something approaching the maximum separation of individual elements.

Starting with relatively simple combinations of linear fixed reflectors and single movable elements, Ryle added his one-mile interferometer (consisting of three 60-foot diameter paraboloids, one of them movable) in 1968. The rotation of the east–west baseline of this instrument over a 12-hour period allows for the synthesis of an aperture equivalent to that of a one-mile diameter paraboloid; the steerable elements can follow any point in the northern skies visible from Cambridge's latitude.

The eight-element, five-kilometer interferometer completed in 1972 represents the latest improvement in observational power. Its angular resolution, at wavelengths from 3 to 21 cm, is about

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Future of US medium-energy facilities is uncertain

Low budgetary levels through the 1970's might force the shutdown of at least one of four new US medium-energy physics facilities, according to a report issued by the Atomic Energy Commission and the National Science Foundation. This survey of US medium-energy science, prepared at the request of the two agencies, details the consequences of low, intermediate and high-funding levels on program priorities and on the new installations, which are currently in transition from construction to operation. A 15-member *ad hoc* committee, headed by Roger H. Hildebrand (University of Chicago), prepared the report, which also includes recommendations for the orderly transition from older to newer machines (having greater intensity, energy range and resolution), an outline of opportunities for different nuclear-structure studies at higher energy machines and recommendations for international cooperation in medium-energy research.

The report is the first to examine the field (covering roughly 100 to 1000 MeV) in a number of years and because it was completed shortly before the FY 1976 budget is to be finalized, the report will be an important source of advice for NSF and AEC (which provide principal support for the medium-energy field) in coordinating and planning medium-energy programs.

The older facilities in the report are the 184-inch synchrocyclotron at the Lawrence Berkeley Laboratory and the synchrocyclotron at the Space Radiation Effects Laboratory (SREL) in Newport News, Virginia. The newer facilities include the newly rebuilt Nevis synchrocyclotron at Columbia University, expected to be operational next year; the linear accelerator at the Clinton P. Anderson Meson Physics Facility in Los Alamos, New Mexico (LAMPF), recently operational at low

Medium-energy research budgetary levels

	(millions of FY 1975 dollars)				
	FY 1975	FY 1976	FY 1977	FY 1978	FY 1979
High level	35.2	44.8	49.0	50.2	52.1
Intermediate level	34.9	38.2	42.2	45.9	46.9
Low level	29.7	30.0	31.1	32.2	32.7

Budgetary levels were assumed by the ad hoc committee to review US medium-energy science. Figures include machine operation, capital equipment, minor construction, in-house research, service to all laboratory users, users, nuclear-structure research at high-energy machines and research at foreign accelerators.

intensities and expected to produce very intense beams at 200 to 800 MeV in 1975; the isochronous cyclotron at Indiana University, which will have the unique capability of producing variable energy, highly-resolved beams of various particles, is scheduled to begin operation in 1975; and the electron linear accelerator at the Bates facility at MIT with full operation expected in 1975.

Austerity level. At the low level budget—termed an "austerity" level (see table) in the report—the committee found a number of "disagreeable consequences." One of the most important of these is that "sustained funding at the given low level without reasonable expectation of improvement (or funding even for one year below that level) will ... force the complete shut-down of at least one of the new machines." In addition the number of operating shifts and accessible beams per shift at the new facilities would be cut to less than half the number needed for efficient operation. All major new construction of beams, experimental areas and auxiliary apparatus would be halted. Laboratories would be able to provide only minimal support for outside users, with the fraction of outside users falling to about half of the desirable number under an intermediate or high-level budget. The committee further concluded that there would have to be an immediate phase out of medium-energy support for either the LBL 184-inch or the SREL 500-MeV cyclotron.

The intermediate-budget level considered by the committee would not threaten the survival of the new machines. However, delays would be necessary in most of the proposed machine additions and improvements, and no major new construction would be possible until FY 1976. The committee concluded that several projects could be completed or initiated during FY 1976–FY 1979, including a second experimental area at Bates, the initiation of a high-duty factor electron accelerator, a polarized source and initiation of tandem injector at Indiana, an increased beam at Nevis, and a staging area, improved duty factor and mass separator at LAMPF. Under this budget the number of shifts of operation and available beams would more than double that for the low funding level and university groups would be able to make independent contributions to the program rather than working mainly as collaborators with in-house groups.

The high-level budget "would allow a vigorous program with nearly full exploitation of new machines by the end of the decade," according to the report. The high level, while not an affluent level, would allow construction of facilities on a much more favorable time schedule, the committee said; they recommended that plans for existing machines should be modified as new-beam opportunities develop. It also recommended that a study be conducted in two years to examine the state of research with medium-energy electrons, the possible programs to develop a medium-energy high-duty-factor electron accelerator and to determine the appropriate laboratory for this development. Recommendations at this high-level budget may be moot since NSF and AEC spokesmen point out that budgets are likely to be more in line with low or intermediate levels through FY 1979. The budget this fiscal year is close to the intermediate level.

Encouragement. The committee also noted that there appears to be no manpower shortage in the medium-energy field. However, "the related theoretical effort is at a lower level than seems appropriate," according to the report, "and special encouragement may be desirable during the next year or two."

—*Madeleine Jacobs*

Paul Flory wins Nobel Prize for Chemistry

Paul J. Flory, the first winner of the APS High-Polymer Physics Prize in 1962, has added the 1974 Nobel Chemistry Prize to his list of accolades. For 40 years Flory's research into the physical chemistry of macromolecules has been of fundamental importance. The Nobel Prize comes just one year after his winning the American Chemical Society's top award, the Priestley Medal.

Flory's early work dealt with the relation between polymerization kinetics and molecular-weight distribution. He delineated the role of chain transfer in free-radical polymerization and described the features of polymer network formation, where the entire system becomes one huge molecule. He made major contributions to the understanding of rubbers including an analysis of swelling, which he revealed to be a powerful probe of polymer properties. The key to concentrated-solution thermodynamics, he showed, was a consideration of the number of ways a volume could be filled with polymer chains without their overlapping.

In dilute solutions, Flory focused his attention on the excluded-volume prob-

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lem—the effect of the relative repulsion between polymer units in a good solvent. He found the answer by treating an individual molecule as a swollen mass and then he pointed out that the problem could be experimentally simplified at a particular temperature, now called the Flory Theta temperature. At that temperature a solvent would be so poor that it induced forces just as repulsive as the polymer's own units, and the molecule would exist as if it were in a non-interactive, ideal state, analagous to the Boyle point of a real gas. This was the key to the interpretation of many polymer characteristics. Furthermore, it led to Flory's wide-ranging research on the relation between microscopic forces and macroscopic configurational properties of synthetic polymers and biopolymers.

Flory's more recent work is concerned with configurational statistics. He and his students have devised versatile methods for averaging configura-

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