ever, mainly because of unavailability of parts. Last February the accelerator produced its first beam, and in May Yale physicists took their first experimental data.

Money for the accelerator and associated research instrumentation—$3.1 million and $2 million respectively, came from AEC. The building to house the equipment was paid for by the Yale Alumni Development Fund ($1.5 million) and NSF (0.5 million).—GBL

Slow electrons—not relativistic?

Two recent publications have cast doubt on the importance of relativistic effects in the scattering of slow electrons (2 to 200 eV). The claim that relativistic factors played an important part in such reactions was made by H. N. Browne and Ernst Bauer [*Phys. Rev. Letters* **16**, 495 (1966)] and reported in PHYSICS TODAY, May 1966, page 82. Objections have been entered by Manuel Rotenberg [*Phys. Rev. Letters* **16**, 969 (1966)] and by Larry Spruch [*Phys. Rev. Letters* **16**, 1137 (1966)].

Rotenberg bases his doubts on what he claims is an improper mixture of potentials and wave equations in Browne and Bauer's calculations. Browne and Bauer had calculated phase shifts for the scattered electrons from the Schrödinger and Dirac equations and obtained a difference that they put down to relativistic effects. In both equations, however, they used the same potential, obtained from Hartree-Fock or a similar approximation. Rotenberg contends that they should have used different potentials, which Rotenberg calculates by using expressions that reproduce experimental level structures. One of the parameters in the expression varies depending on whether a relativistic or nonrelativistic potential is being studied. The variation in this parameter seems to be enough to compensate for the effect reported by Browne and Bauer.

Spruch endorses Rotenberg's argument but goes on to present one of his own that he says is broader and not dependent on details of the potential. He assumes that the atom and the impinging electron can form a bound state with very small binding energy and calculates phases shifts for relativistic and nonrelativistic cases. He calls his argument "very specialized . . . and . . . not conclusive." He says that "It proves only that regions of strong interaction need not lead to significant R[elativistic] effects, not that they cannot." Nevertheless since Browne and Bauer's reported calculations for a given element and incident energy differ among the various models by amounts sometimes far larger than that claimed for the difference between relativistic and nonrelativistic treatments, Spruch ends his paper with the remark: "In fact, one suspects that R[elativistic] effects are probably much smaller in general, than present uncertainties in NR [nonrelativistic] calculations."

Neither Rotenberg nor Spruch makes a strong claim for the importance or unimportance of relativistic effects on the scattering of slow electrons. They argue only that Browne and Bauer provide no real basis for their claim that relativistic effects are large.

Star-pointing space telescope

Early in August the NASA Goddard Space Flight Center at Greenbelt, Md. reported that on 15 July it had successfully operated a telescope with a star-pointing device above the earth's atmosphere. NASA claims that this is the first time such a feat has been accomplished.

The device, called the "STRAP" (Star Tracking Rocket Attitude Positioning) system was flown to an altitude of 144 km by an Aerobee 150 rocket at the White Sands Missile range. It was recovered undamaged about 90 km from the launch site and will be flown again in the fall.

During the flight STRAP pointed its 32.8-cm telescope at three different stars: Vega, ζ Scorpionis and ζ Ophiuchi. (Almost 80 sec of ultraviolet data were obtained from the three stars.)

STRAP operates with a star-tracking device that seeks a star and points the telescope at it (with an accuracy of about 20 sec of arc) for a specific time. At a predetermined time gas jets are turned on to maneuver the rocket toward the next star to be observed. On the 15 July flight STRAP accomplished turns up to 85 deg.

Current plans call for launching two or three STRAP payloads a year. Future flights will observe up to five different stars each. More than 200 stars are being considered for observation with the STRAP system.

Matter-antimatter asymmetry

New experiments on the decay of an η° meson into π^+, π^- and π^0 find no statistically significant asymmetry between matter and antimatter. An earlier experiment by Paolo Franzini and his collaborators at Columbia and Stony Brook (PHYSICS TODAY, August, page 71) found an asymmetry of $7.2\%\pm2.8\%$, implying a violation of charge-conjugation invariance in intermediate-strength interactions.

At the Berkeley High-Energy Physics conference last month three groups reported on their observations of eta decay. G. Finocchiaro discussed a CERN experiment that found 10 665 decays of η^0 into three pions. Calculating $N+$, the number of events for which the positive pion had more energy than the negative pion, and $N-$, the number of events for which the negative pion had more energy than the positive pion, the group found an asymmetry $A=0.3\% \pm 1.0\%$, where $A = (N+ - N-) / (N+ + N-)$. To produce the π^0, the group used $\pi^- + p \rightarrow n + \pi^0$; the energy of η^0 was inferred by measuring the neutron time of flight. Pion energies were obtained by an array of spark chambers, rather than the bubble-chamber photographs used by Franzini.

Asymmetry in Eta Decay

Experiment	*Number of events*	*Asymmetry* (%)
CERN	10 665	$+0.3 \pm 1.0$
Saclay-Rutherford	705	-6.0 ± 4.0
Duke	565	$+4.1 \pm 4.1$
Columbia-Stony Brook	1 351	$+7.2 \pm 2.8$
Total of other results	1 300	$+5.8 \pm 3.4$

A Saclay-Rutherford group reported

on 705 bubble-chamber events that showed the negative pions coming off, on the average, with more energy. And a Duke University group, with 565 events, found essentially no asymmetry.

The matter of matter-antimatter asymmetry is still up in the air, with feverish activity going on at many laboratories.

The table shows the latest scorecard in the π^+ vs. π^- game.

Shift in the Lamb shift

The Lamb shift in the first excited state of hydrogen is higher than the value found by Willis E. Lamb Jr, and his colleagues in 1953, according to a remeasurement by Richard T. Robiscoe and Barry L. Cosens of Yale University [*Phys. Rev. Letters* 17, 69 (1966)]. The new measurement disagrees even more with current theoretical predictions.

In their 1953 experiments, Lamb, Sol Triebwasser and Edward S. Dayhoff made an indirect measurement of the $P_{3/2}$-$P_{1/2}$ separation by determining the $P_{1/2}$-$S_{1/2}$ separation and the $S_{1/2}$ and $P_{3/2}$ separation. Their result for the $P_{1/2}$-$S_{1/2}$ separation was 1057.77 ± 0.10 MHz. Robiscoe and Cosens, determining the $P_{1/2}$-$S_{1/2}$ separation by a level-crossing technique, find it to be 1058.05 ± 0.10; this is 0.28 ± 0.14 MHz higher than Lamb's value. Lamb, who is also at Yale, together with Marvin Leventhal, Kenneth Lea and S. Kaufman, has also been busy remeasuring the shift. They are redetermining both hydrogen separations, and some separations for singly ionized helium, as well.

Robiscoe and Cosens remark that their higher value implies that α, the fine-structure constant, is higher than the value of 1/137.0388 currently accepted (if there is no change in the $S_{1/2}$-$P_{3/2}$ separation determined by Lamb). Vernon Hughes has measured α from the fine structure of the muonium atom, in which a muon and a proton mate, instead of an electron and a proton. His value agreed well with Lamb's. At present the most reliable determinations are from the fine structure.

In principle, the fine-structure constant could best be found from hyperfine structure. However, the theory of hyperfine structure is in poor shape. The problem is that theorists are not sure how to correct for proton structure. Sidney Drell recently suggested that the present correction for proton structure might be too large. At any rate, Norman Ramsey and Daniel Kleppner did determine α from hyperfine structure, using a hydrogen maser, and found it differed from the fine-structure value by 38 parts in 10^6.

Over the past twenty years the discrepancy between measurement and prediction of the Lamb shift has worsened. The latest theoretical value, calculated by Maximiliano Soto of Columbia University is 1057.50 ± 0.11 MHz—$0.55+.14$ MHz lower than Robiscoe and Cosens found. The experimenters remark that the "discrepancy may pose some fundamental questions in quantum electrodynamics."

Neutrino spiral—which way?

An experiment to observe the helicity of the neutrino has been proposed by S. G. Ryzhanov in an article in *JETP Letters* (Vol. 3, No. 2, 1 June 1966, page 299 in English, page 457 in Russian). Ryzhanov's suggestion describes a way in which a gedanken-experiment proposed by Jerrold Zacharias, namely observing the rotation of a macrobody covered with material undergoing beta decay, can be realized.

Helicity, the property expressing the neutrino's spin in relation to its direction of motion is important in processes involving (non)conservation of parity. According to theory the sense of spin of neutrinos emitted in beta decay should be the same as the sense of spin for the associated electrons. Ryzhanov proposes to get the neutrino helicity by measuring changes in the rotation of macroscopic droplets induced by the spins of beta electrons entering the droplets.

His method would use a gyroscope developed by the Orlando Division of Martin-Marietta. The instrument consists of a vacuum chamber in which microscopically charged droplets of diameter 2.5 to 250 microns are suspended in an electric field in such a way that they occupy an equilibrium position. Any change in their equilibrium position is registered opti-