Nb_3Sn they can produce 800 GHz. Since the energy gaps in the quasiparticle spectrum of superconductors correspond to a frequency span of 1–1000 GHz, the new technique seems to have great potential.

If one wants to improve the efficiency of detection, Dayem says, one can simply increase the area of the tunnel diode and decrease the separation of the two diodes.

All you need to make superconductors act as phonon generators is to excite quasi-particles somehow, Dayem remarks. He is now preparing to do this optically, using a laser as the energy source. —GBL

1.5-GeV Electrons, Positrons To Circulate Soon at Adone

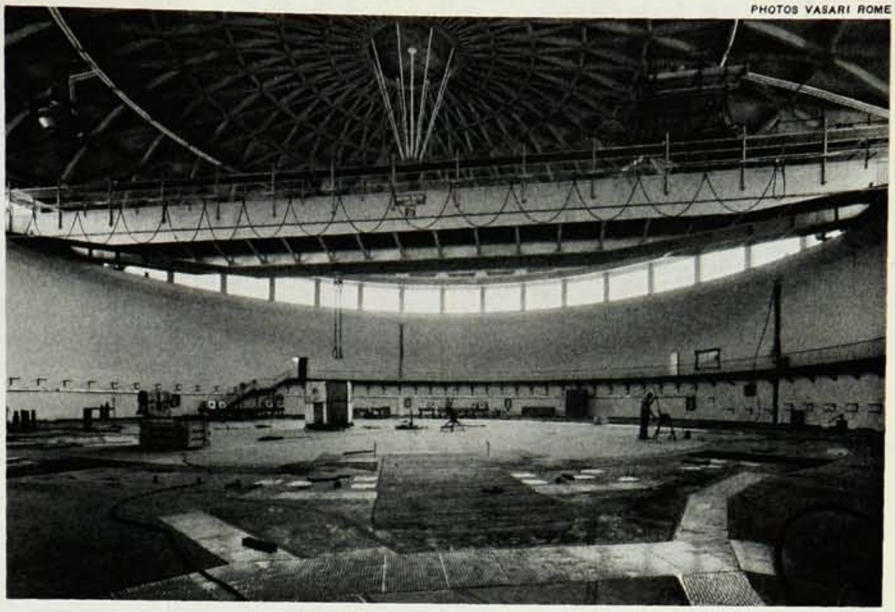
Beam testing in the 1.5-GeV Adone storage ring for positrons and electrons is expected to begin this year at Frascati Laboratories, run by the Italian Institute of Nuclear Physics (INFN). The ring, expected to store 2×10^{11} particles per beam, will be able to deliver a beam to any of four crossing regions that are free for setting up experiments. The ring has a mean radius of 16.7 meters, but the radii of the curved orbit sections (which alternate with straight sections around the circumference) is only 5 meters. Useful aperture will be 22 by 10 cm.

The ring will act as its own synchrotron. It is fitted with 12 bending magnets and 48 quadrupole magnets to produce strong focusing and two rf accelerating sections to compensate for energy radiated. The same rf accelerating sections will increase the energy of particles injected at 350–400 MeV to 1.5 GeV in about 1 sec.

The injector, an S-band linac built by Varian Associates, has been operating since last fall. It delivers electrons at 390 MeV (100 mA peak current), all of them within a 2% energy band, and about 60 mA within a 1% energy band. The average electron current is 80 microamp, equivalent to 5×10^{14} electrons per second. Power of the resulting beam is 31 kW.

Positrons are delivered at 360 MeV (1 mA peak current). About 0.6 mA are contained within a 2% energy band. Both positron and electron pulses last 3.2 microsec and occur at a frequency of 250 per second. Average positron current is about 0.8 microamp, equivalent to about 5×10^{12} positrons per second. The linac can supply beams directly to an experimental hall as well as feed the storage ring.

PHOTOS VASARI ROME



1.5-GEV ELECTRON-POSITRON STORAGE RING at Frascati is nearly finished. Upper photo shows ring building last July. Lower photo shows ring building (left), power station and laboratories.

The storage ring will be fed by 2 or 3 pulses per second, and filling is expected to take less than half an hour.

The following were among the proposals discussed at a meeting on experiments with Adone, held at Frascati in February 1966:

ϕ-meson production (line shape and branching ratios),

single-neutral-boson production,

production of μ pairs,

production of π and K pairs,

wide-angle 2-γ annihilations and $\pi^0 \gamma$ production,

proton form factors from proton-antiproton production,

magnetic devices for analysis of many-body annihilations.

The Adone electron-positron ring was promoted by INFN and was funded mainly by the Italian National Committee for Nuclear Energy; the Italian National Research Council paid for the linac. Total foreseen cost (excluding experimentation) is about \$9 million, of which \$2.5 million are for the linac. The Frascati laboratory is located at the town of the same name 30 km southeast of Rome.

When the electron and positron

beams start circulating in Adone, it will be the most energetic electron-positron storage ring in operation. A 700-MeV electron-positron ring started running last year (PHYSICS TODAY, November, page 72) in Novosibirsk, as did a 500-MeV ring (called ACO) at Orsay. Three-GeV electron-positron rings have been proposed by CEA, SLAC and DESY.

Josephson Junction Yields Fundamental Constants

The first low-temperature physics experiment to determine a fundamental constant has yielded new values for e/h (ratio of electron charge to Planck's constant) and α (fine-structure constant). Until now the most reliable determination of α has utilized measurements by Willis Lamb, Sol Triebwasser and Edward Dayhoff on the fine-structure splitting in deuterium; the value is $1/137.0388 \pm 0.0006$. The new experiments (reported in the 20 Feb. issue of *Phys. Rev. Letters*), which use the ac Josephson effect to measure e/h directly, when combined with the measured values of other fundamental constants, yield for α the value $1/137.0359 \pm 0.0004$. This new value may remove the discrepancy between theoretical and experimental values for the hyperfine splitting in hydrogen.

In the experiment microwave radiation strikes a Josephson junction and produces a dc supercurrent whenever applied voltages satisfy the relation $2eV = nh\nu$ (where n takes on integral values). These dc supercurrents show up as regions of zero slope in the current-voltage characteristic. To determine $2e/h$ the solid-staters, William Parker and Donald Langenberg of the University of Pennsylvania and Barry Taylor of RCA Laboratories, simply measure the frequency of applied microwave radiation and the absolute voltage at which the current steps occur.

The method uses two types of Josephson junctions, in which two superconductors are weakly coupled; one is a sandwich (PHYSICS TODAY, September 1965, page 97) of two superconducting films separated by a thin insulating oxide layer; the other junction is a point contact (PHYSICS TODAY, November 1966, page 67) in which a superconducting wire with a fine point is pressed onto a flat superconducting plate. All measurements have been done between 1.2 and 1.6°K.

An X-band (8-12.4 GHz) oscillator generated microwaves. Frequency was measured with an electronic counter and microwave frequency converter to 1 part in 10^8; since the overall measurement had an rms error of 6 parts per million, frequency errors were negligible.

The difficult quantity to measure is the voltage; typically a millivolt has to be measured to an accuracy of a few parts in a million. To measure voltage the experimenters used a nanovolt potentiometer and six NBS-calibrated standard cells in a constant temperature bath. The potentiometer, a Julie Research Laboratories PVP 1001, is self-calibrating since the operator can measure all factors that contribute to the voltage accuracy and then make any necessary corrections; the instrument was calibrated with an uncertainty of between 3 and 4 ppm.

The experimenters find that $h/e = 4.135\,725 \pm 0.000\,026 \times 10^{-15}$ joule-sec/coulomb.

Compare with theory. When Jesse DuMond and E. Richard Cohen made their last least-squares adjustments of the fundamental constants, in 1963 (PHYSICS TODAY, October 1965, page 26), they calculated α from the measurements of fine structure in deuterium rather than from hyperfine splitting in hydrogen, even though Norman Ramsey, Stuart Crampton and Daniel Kleppner, using a hydrogen maser, measured the splitting to 2 parts in 10^{11}. The problem with hfs splitting is that the theory is uncertain. Although theorists know how to correct for the proton form factors, they do not yet know how large the proton polarizability is. Before the h/e determination of α, there was considerable discrepancy (amounting to about 20–40 ppm) between the predicted hfs splitting, using α determined from deuterium fine structure, and that actually found by Ramsey.

The new value of α, however, is compatible with hfs measurements, provided one uses a model of the pro-