improve the frequency standard by two orders of magnitude. With newly available inexpensive diode lasers and flashlight batteries, Hall prognosticates, one could in perhaps three years have "profoundly better" atomic clocks, cheap and portable.

Various groups have been striving to achieve Bose condensation with spin-polarized atomic hydrogen (PHYSICS TODAY, June 1980, page 18). Because atomic hydrogen is the only substance that remains a gas at absolute zero, these experiments do not require laser cooling. But the achievement of sufficiently high density appears now to be thwarted by recombination into molecular H_2 at the walls of the cryogenic vessel. Phillips suggests that one might solve this problem by replacing the physical walls with one or another of the atomic-trap designs that are now coming to fruition. —BMS

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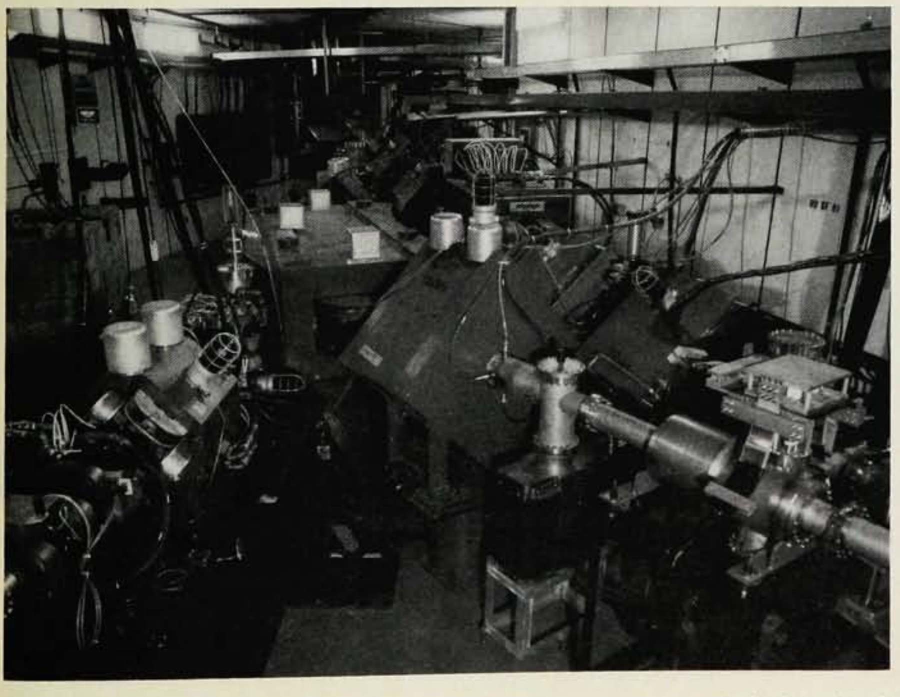
Storage ring intensifies Los Alamos neutron source

The new Proton Storage Ring built to enhance the neutron-beam generating capability of the LAMPF (Los Alamos Meson Physics Facility) proton linac has received its first beam. When the $22-million ring is fully commissioned by the end of next year, the Los Alamos Neutron Scattering Center will become the country's most intense spallation source of neutrons, comparable to the new SNS spallation source at Britain's Rutherford Laboratory. Construction of the Los Alamos storage ring began in 1982.

The LAMPF high-intensity linac has been directing 800-MeV protons at the Weapons Neutron Research spallation target since 1979, generating a broad spectrum of neutron energies (from 10^{-2} to 10^{+8} eV) for condensed-matter, nuclear and military research. Neutron fluxes have, however, been severely limited until now because high-intensity proton pulses from the half-mile-long LAMPF linac are of much longer duration—750 μsec—than neutron experimenters would like. To get clean starting times for time-of-flight measurements, neutron experiments require beam pulses no longer than a few hundred nanoseconds. Thus, in the absence of some sort of beam-compressing system, only a very small fraction of the LAMPF proton beam could usefully be directed at the WNR spallation target.

The purpose of the new 90-meter-circumference storage ring is to provide just this sort of beam compression. It will accumulate protons during the 750-μsec linac output pulse and compress them into a 270-nsec pulse for the spallation target. On the average, each 800-MeV proton hitting this tungsten target will generate about 20 neutrons, to be directed into the facility's various neutron-beam lines. The new storage ring will provide 12 compressed proton pulses per second, each generating a peak flux of 10^{16} neutron/cm^{2}sec.



The new Proton Storage Ring at Los Alamos is designed to increase greatly the intensity of spallation neutrons generated by the 800-MeV protons coming from the LAMPF linac. At the right one sees a portion of the 90-meter-circumference storage ring, fed by the beam line at the left from the proton linac. The storage ring accumulates protons from the relatively slow-spill linac pulses and compresses them 3000-fold into 270-nanosecond output pulses to be directed at spallation targets, where they generate neutron beams for condensed-matter, nuclear and military research. Neutron time-of-flight measurements require such very short pulses. Without the compression provided by the accumulator ring, most of the protons produced by the linac go to waste.

Although measurements of direct military applicability will require only about 20% of neutron beam time at the facility, the DOE Office of Military Applications has borne the construction cost. Full beam intensity is not expected until September 1986, but condensed-matter and nuclear researchers will already have access to neutron beams this year. The existing experimental hall dedicates 12 beam lines for neutron-scattering experiments.

The 100-microamp design current of the Los Alamos storage ring should yield peak neutron intensities 60 times those now available at the Argonne National Laboratory's Intense Pulsed Neutron Source (IPNS I), yielding 20 times as many neutrons in a second. In the late 1970s, planning for the next generation of spallation sources for materials sciences engendered an intense rivalry between Argonne's IPNS II proposal and the Los Alamos plan for the new proton storage ring. The Los Alamos plan won the day (see PHYSICS TODAY, November 1982, page 19), primarily because it was less expensive to augment the existing LAMPF facility, and because the weapons research program that shared the LAMPF spallation target was willing to foot the bill.

Low-energy neutrons are particularly well suited to probe crystalline, glassy and biological materials. The de Broglie wavelength of a thermal neutron is of the same order as the interatomic spacing. Because its electromagnetic interaction is limited to its magnetic moment, a neutron can penetrate material deeply without much disruption, and it serves as an excellent probe of magnetic structure. Furthermore, the anomalously high scattering cross section off hydrogen makes neutron beams particularly useful for studying biological and polymer systems. —BMS □