facility, available to all experimenters, just as the high-field magnets at the laboratory. Construction was supported by the Office of Naval Research and the Damon Runyon Fund.

The room is roughly spherical, but is actually a rhombicuboctahedron (26 sides) whose outside diameter is 3.8 meters and inside diameter is 2.8 meters. Shielding is achieved with five layers; three of them are made of a high-permeability alloy made of nickel, molybdenum and iron. The inner two layers are screwed onto aluminum shells; the aluminum provides mechanical rigidity and eddy-current shielding. The floor and its supports are mechanically isolated from the room itself.

To increase the permeability of the shield, Cohen uses "shaking," a process in which an alternating magnetic field is applied to the alloy, keeping domains in continuous motion and decreasing their "friction." By this technique the shielding factor (ratio of the amplitude of the external **B**-vector to the amplitude of the **B**-vector at the center of the shielded volume) can be increased by a factor of six or more. With shaking the shielding factor is 900 at frequencies below 0.1 Hz, rises rapidly with frequency and passes through 10 Hz at 10^5, apparently still rising, Cohen said. He has not yet finished measurements at higher frequencies because of the difficulties involved with such high shielding factors. He says that under many ambient conditions the ac level in the room is now less than 10 nanogauss (rms).

The dc level at the room center has been made arbitrarily small (limited by dc sensitivity of magnetometers) by passing current through coils in the room walls. Gradients are gradually being decreased by degaussing and are now less than 10^{-5} gauss/meter. The most sensitive experiments are done during evenings and weekends when the high-field magnets of the laboratory are not running.

In the magnetocardiogram measurements Cohen, Edgar Edelsack (Office of Naval Research) and James Zimmermann (National Bureau of Standards, Boulder) used a single point-contact SQUID in a configuration of high mechanical stability, which was recently developed by Zimmerman. The magnetocardiograms had a noise level of several nanogauss (rms). The experimenters note that their magnetocardiograms approach good medical electrocardiograms in clearness.

SHIELDED ROOM now operating at MIT has residual magnetic field of 100 nanogauss. It uses three layers of high-permeability alloy and two layers of aluminum. When photo was taken, three sets of double doors had not yet been installed.

One project under way, supported by the American Cancer Society, is to find out if magnetic detection of the natural brain alpha-currents can show the presence of brain tumors. Another project, supported by NSF, will investigate whether or not the steady currents of the human heart can be detected through the steady magnetic fields that they produce. Injured hearts are said to produce heavy steady currents, but these can not presently be detected by skin electrodes because of local potentials. —GBL

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Quests and Questions Concerning Quarks

Some seven months after the announcement of evidence for quarks by Charles B. A. McCusker and his colleagues at the University of Sydney,[1] more evidence has come forth from a second experiment.[2] William T. Chu and Young S. Kim of Ohio State University, W. J. Beam of Rose Polytechnic Institute and Nowhan Kwak of the University of Kansas claim to have observed one track that could be interpreted as a quark after examination of cosmic-ray tracks in 10 000 pictures exposed in the Argonne 40-inch heavy-liquid bubble chamber.

In such pictures, the bubble density depends on the time when the track is formed; so it is necessary to compare bubble density on contemporary tracks. The age of a track was determined by the size of the bubbles. Chu and his colleagues found two contemporary tracks where the bubble density on one track was about half that on the other. The ionization on this possible quark track was consistent with that expected of a charge-2/3 particle if its mass is less than 6.5 GeV.

Meanwhile, the observation of quark tracks by the Sydney group has not gone unchallenged. In particular, Robert K. Adair of Yale and Henry Kasha of Brookhaven,[3] and David C. Rahm and Robert I. Louttit of Brookhaven[4] feel that the low-density ionization of five tracks seen in cloud chambers by the Sydney group can be explained by the presence of low-energy electrons and muons and does not necessarily imply the existence of fractionally charged particles.

At the same time, Hans Frauenfelder, Ulrich E. Kruse and R. D. Sard of the University of Illinois[5] assert that both the velocity spectrum of shower particles and the fluctuation in droplet formation along the tracks must be experimentally determined before one can make a definitive statement about the existence of quarks. Adair, Kasha, Rahm and Louttit make similar assertions.

These critics say that the Sydney group may have underestimated their statistical error by using the total number of ions developed. Because one ion pair produced by a primary ionizing collision may in turn produce other ion pairs, the number of primary ionizing collisions, the statistically independent events, is less than the total number of ions. However, McCusker told us that they count drops, or conglomerations of droplets; hence they get a number that is less than the number of independent ionizing events.

An estimate of the statistical error requires a careful determination of the relation between ionization and droplet formation under the conditions of the experiment, a determination that was not yet made by the Sydney group, claim the critics. The efficiency for droplet formation may well be less than unity and, indeed, saturation effects appear to set in at high ionization.

McCusker and his colleagues counted the number of drops on 1-cm track segments. The group at the University of Illinois has now found evidence for positive correlation between drop counts on different track segments. This correlation would increase the frequency of tracks with unusually few or unusually many drops.

Another factor entering the analysis is the relativistic rise of ionization: Particles with energy high compared to their rest mass will produce more heavily ionizing tracks than lower-energy particles of the same charge. Thus low-density tracks may result from low-energy electrons and muons. The Sydney group feels that this effect could only result from highly improbable large fluctuations among the small population of electrons and muons. Yet Adair, Kasha, Rahm and Louttit, by estimating the number of such particles expected in association with air showers, and by considering the effects of relativistic rise on track ionization, calculate a track density for low-energy electrons and muons that is consistent within statistical error with the five observed low-density tracks.

Adair and Kasha further object that the high quark flux implied by the Sydney experiment at 2×10^6 GeV is inconsistent with the null result obtained in their own[6] and other experiments at 5×10^4 GeV, even assuming that the quark-production cross section rises with energy E as fast as E^4. At the same time, John P. Dooher of Grumman Aerospace Corp.[7] has postulated a model that predicts a flux for quarks consistent with the Sydney experiment.

One way to explain the fact that quarks are seen in the Sydney experiment but not in their own, say Adair and Kasha, is to postulate that the quarks are all traveling with the core of the air shower. Then the quark tracks would have to be parallel to the other tracks in the shower core. However, the cloud-chamber photographs reveal that the five quark tracks are not parallel but deviate in the best case (event 66 240) by at least 20 milliradians from five other tracks that are parallel.

In photographs of air-shower cores, McCusker says, typical angular spreads are ± 4 deg. The spread is caused in part by gas movement during the expansion delay which may bend tracks through angles up to 5 deg. Larger spreads result from particles from secondary interactions, which may enter the chamber with angles up to 30 deg with the core axis.

Other groups are repeating the McCusker experiment and the Sydney group is continuing its analysis. —BGL

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Antihelium Is Produced At Serpukhov Accelerator

Five nuclei of antihelium-3 have been made by Yuri Prokoshkin and his collaborators at the Serpukhov 76-GeV synchrotron, according to a front-page report in *Pravda*. The group bombarded an internal target with protons, defined the momentum of outgoing particles by magnets and measured velocity by time of flight. Out of 2×10^{11} negative pions detected by the counters, five particles had the right mass to be He^3.

A CERN–Serpukhov collaboration last year produced antideuterons from an aluminum target (*Physics Letters* **30B**, 510, 1969). The first antideuterons were observed in 1965 at the Brookhaven AGS by Leon Lederman and his collaborators (*Phys. Rev. Lett.* **14**, 1003, 1965). Lederman believes that the production mechanism for antihelium-3 and antideuterons is similar—that successive proton collisions with nucleons yield antiprotons and antineutrons, which then stick together. Detailed calculations should give theorists a field day. —GBL

Missing X-Ray Telescope Data Recovered after Year at Sea

Instead of a bottle washed up on the shore with a message in it, the beachcomber found an instrument pod; the message it contained was on photographic film and it came from an x-ray source, Sco X-1. The pod was part of an MIT x-ray telescope launched in Australia and lost at sea in April 1969. It was given up for lost until it turned up on a New Zealand beach early in January.

Local police advertised for the owner unsuccessfully. Then the New Zealand Navy became interested, discovered US manufacturer's markings on two magnetometers inside the pod, and showed it to the American embassy. The manufacturer reported that the equipment had been ordered by William B. Smith of MIT, and Smith heard of the amazing recovery on 9 March.

Smith, Walter Lewin and Jeffrey McClintock had timed their x-ray observations to be simultaneous with optical observations made on Sco X-1 by O. Eggen and Allan Sandage, who used the 40-inch telescope at Australia's Siding Spring Observatory.

The x-ray data were all recorded on photographic film—counting rate, energy-channel settings, altitude, time and azimuthal direction. Lewin told PHYSICS TODAY that after a portion of the film was developed they found data for all the parameters except one—the azimuth. Azimuth readings are vital to the interpretation of the other data, and they were partly obscured by fog.

All hope is not yet lost, however; EG&G is developing the rest of the film and expects to be able to suppress the fog enough that all data will be readable, which would be the final miracle.

IN BRIEF

A Model EN 12-MeV Van de Graaff accelerator, purchased from High Voltage Engineering Corp., is now operating at Kansas State University. The machine is equipped with a diode ion source. □