state devices—for example, stored energy densities and characteristic line widths. So pulse durations shorter than tens of nanoseconds have not been produced with gas lasers. Some experimenters think they may be able to overcome these limitations, though. —GBL

Does the Microwave Background Have a Hump in its Spectrum?

The three-degree blackbody radiation may have a hump in its spectrum at about 1 mm, just where it peaks. Whether or not it's there, and if so, how it got there, is an intriguing mystery.

At the Washington APS meeting James Houck (Cornell University) described in an invited paper two rocket observations that he, Kandiah Shivanandan (Naval Research Laboratory) and Martin Harwit (Cornell) made.[1,2] With a broad-band spectrometer sensitive over 0.5–1.3 mm they found a flux 50 times higher than expected.

Houck says the extra signal "may have been due to instrumental effects, the thin atmosphere [in which the rockets flew—170 km above the earth], or some unexpected emission process in the solar system or our galaxy. There is also the possibility that the radiation is an unexpected feature of the 'Big Bang.'"

Subsequent balloon observations by Dirk Muehlner and Rainer Weiss[3] of MIT also suggest too much flux in the 0.8–1.0 mm range.

Although the funding situation has limited the number of flights, groups at Cornell, NRL and Los Alamos are planning more rocket flights soon.

Last year Patrick Thaddeus (Institute for Space Studies), John Clauser and Victor Bortolot (Columbia University),[4] by measuring interstellar optical absorption lines of CN, CH and CH^+, established upper limits at three wavelengths on the intensity of background radiation in the interstellar medium. At 2.64 mm Thaddeus, Clauser and Bortolot measured a temperature of 2.8 K; they inferred upper limits to the background temperature of 4.7 K, 5.4 K and 8.1 K at 1.3 mm, 0.56 mm and 0.36 mm, respectively.

The limits are consistent with three-degree blackbody radiation. They imply a flux that cannot be reconciled with the rocket and balloon observations, say Thaddeus, Clauser and Bortolot, unless the flux being observed is concentrated into a sharp line that happens to avoid the molecular resonances, or unless the flux originates locally.

How could most of the radiant energy in the universe be produced in the form of lines? If the excess flux comes from quasars, distant galactic nuclei and the like, one would expect fairly broad-band radiation. The three-degree background radiation has 100 times the energy density of starlight throughout the universe. If the rocket and balloon observations are correct, the hypothesized line source would be 2000 times the energy density of starlight.

Recently Thaddeus and Philip Solomon (Institute for Space Studies) have been looking at interstellar formaldehyde, a very sensitive radiometer already located in outer space. The formaldehyde is cold—colder than 3 K, and it is apparently absorbing out the three-degree blackbody radiation. What could be pumping it down? Thaddeus and Solomon believe that the best explanation for the formaldehyde behavior is that there are small departures from the blackbody spectrum, about a degree or even a tenth of a degree, in the vicinity of 2 mm or less. They are extremely skeptical, however, that the departures are anything like the magnitude observed in rocket and balloon flights.

An alternative mechanism for the cooling of the formaldehyde, involving collisions between formaldehyde and hydrogen atoms or molecules has been proposed by Charles Townes and Albert Cheung (University of California, Berkeley).[5] —GBL

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CERN Proposes Missing Magnets And 150 GeV for New Machine

The CERN 300-GeV project, plagued with foot-dragging, international intrigue, and tight money, and most recently confronted with Robert Wilson's announcement that the Batavia accelerator might yield a 500-GeV beam by 1 July 1971, has announced a new design approach that might salvage the project. In mid-April the new proposal was presented for discussion to European governments and European scientists; a decision is hoped for by October.

In the initial 300-GeV concept, conventional combined-function magnets were arranged in a 2.4-km-diameter ring. The new proposal is for a "missing-magnet" design, in which only half the magnets are installed originally in a 1.8-km-diameter ring. (The Batavia accelerator originally had a "missing-power" design, allowing for a larger power supply to be installed later, so that energy could then be raised from 200 to 400 GeV. It later proved possible to get all the power required for 500 GeV at a cost low enough to install from the start.)

The CERN machine would start out with a maximum energy of 150 GeV but could have its energy doubled by doubling the number of magnets. If pulsed superconducting magnets continue to look as promising as they do now, the spaces could be filled with superconducting magnets, allowing a maximum energy of about 400 GeV.

ADAMS

Then if the superconducting accelerator worked well, the whole ring could be filled with superconducting magnets, and the maximum energy could be about 800 GeV.

Because the new proposal calls for a smaller ring diameter the accelerator could be built across the road from the existing CERN-Meyrin site. The rock in which the machine tunnel would be bored is the same as has already proved satisfactory for the 28-GeV proton synchrotron and for the Intersecting Storage Rings, now nearing completion; CERN believes the site is suitable.

The advantages of the Meyrin site are at least twofold: The political debate over which of five contending sites to choose (The Federal Republic of Germany said that it would reconsider its support if its site at Drensteinfurt, Westphalia was not chosen) could be settled by not choosing any of those originally proposed. John B. Adams, director of the proposed accelerator, told PHYSICS TODAY that the Meyrin site would be cheaper than the others. The lower cost would be partially because development effort, overhead costs and services could be shared with the existing laboratory, but mainly because the existing proton synchrotron would be used as the injector of the 300-GeV machine and an existing experimental hall would be used as its first research area. With the lower cost there is hope that some of the nations that refused to support the 300-GeV project (such as the UK) might decide to put up the smaller amount required.

John Blewett, head of advanced accelerator design at Brookhaven, believes that pulsed superconducting magnets suitable for a synchrotron ring will be developed within a couple of years; so the new CERN proposal could eventually yield an accelerator of higher energy than Batavia. The magnets could probably be pulsed once every three seconds, Blewett said.

Brookhaven, Lawrence Radiation Laboratory, the Rutherford High-Energy Laboratory, Saclay and Karlsruhe have large programs in producing pulsed superconducting magnets. The problem with them is that although they are lossless during static conditions, they dissipate energy when the field is changing. Because this power must be removed at cryogenic temperatures, expensive refrigerators are required. If power loss can be kept small, the technique is feasible. —GBL

Principle for a Pi–Pi Collision Device Proposed

"Precetron" is the name for a new kind of storage and collision device proposed recently by Bogdan Maglic of Rutgers University and Robert Macek of the Los Alamos Meson Physics Facility (reported in the new Gordon and Breach journal *Particle Accelerators*, April 1970). Unlike the usual storage rings, which provide particle interactions through colliding beams of relatively high intensity, the precetron is a device in which particles interact over their entire orbit; the orbits themselves are precessing—hence the name. Maglic and Macek told us that the new device would produce observable collision rates—up to 1000 per hour—with unstable particles (whose lifetimes are as short as 10^{-8} sec), in addition to low-intensity uncollimated stable-particle systems.

To produce pion–pion collisions an extremely short burst of protons (say 800 MeV) strikes a metal target, which is placed in the center of a 400-kG (pulsed) magnetic field. Pion orbits are almost circles (a few cm radius) tangential to the target. Positive pions precess in one direction, negative in the other. Because of their precession, particles in all orbits, regardless of production angle, will eventually collide. Maglic believes that the precetron would have particle momentum acceptances 10 to 50 times higher than colliding-beam devices and solid-angle acceptances 100 to 10 000 times higher. Because the collision rates are proportional to the square of the intensity, a precetron would have up to 10^{7} times the collision rate of a conventional storage ring.

After a while the pions decay into muons, which also precess, and μ–μ collisions occur, too.

Maglic is designing a model to be built at Rutgers employing low-energy electrons and positrons instead of pions. Eventually Macek and Maglic propose to use the precetron at Los Alamos for π–π collisions in the energy region of the rho meson.

A search for electromagnetically produced π–π states (spin 1) over a fairly wide mass range is already under way at the Adone electron–positron storage ring (1.5 GeV/beam) in Frascati, Italy. So precetron will have to prove itself better than an existing Goliath, although the precetron idea appears applicable to collisions of other unstable particles, too; furthermore, the π–π scattering in precetron is not restricted to spin-1 states.

How soon a precetron would be used to do physics experiments is still not clear. Detector considerations may bar its use altogether, Maglic says, but in their journal article the authors suggest possible solutions by outlining a new way of doing experiments. One serious difficulty is separating the variety of π–π and μ–μ processes, and determining energy and momenta of particles produced. Furthermore, backgrounds from pion and proton collisions with nuclei in the production target might swamp the signals coming from π–π and μ–μ processes. —GBL

Lithium-drifted Germanium Measures Gamma Polarization

A simple high-resolution method for measuring the linear polarization of nuclear gamma rays has been developed by groups in Czechoslovakia (J. Honzatko and J. Kajfosz), in Canada (Albert E. Litherland, University of Toronto, George T. Ewan, G.I. Andersson and Gilbert A. Bartholomew at Chalk River Laboratories) and at Johns Hopkins (Yung-Keun Lee, George E. Owen, J.W. Wiggins and R. Wagner). One places a single slab of lithium-drifted germanium so that the gammas strike the edge of the detector. The technique shows promise as a new tool for nuclear spectroscopy.

Compton scattering of linearly polarized gammas occurs preferentially in a plane perpendicular to the electric vector. In a lithium-drifted germanium detector most events contributing to the full-energy peak, for gammas whose energy is greater than 300keV, arise from Compton scattering followed by total absorption of the scattered photon. So if the incoming gammas hit the edge of the polarimeter the counting rate in the total absorption peak will be a maximum when the plane of the detector is perpendicular to the electric vector and a minimum when it is parallel to the electric vector. One can deduce the polarization from the change in counting rate in the total-absorption peak when the plane of the counter is rotated through 90 deg.

The Canadian group has built two such detectors; the larger one is $60 \times 35 \times 6.5$ mm. These polarization-sensitive gamma detectors have the high resolution properties of standard lithium-drifted germanium detectors and are relatively simple to use.

Spin-Flip Raman Laser Is Tunable Infrared Source

An intense laser source has been built which, by varying the applied magnetic field, is smoothly and continuously tunable in the infrared range of 10.9–13.0 microns. Other kinds of tunable sources—parametric oscillators—are available in the visible and near-infrared (but not infrared). At the APS Washington meeting late in April, Kumar Patel (Bell Labs) described the experiment. He and Earl Shaw[1] shone a 10-micron CO_2 laser onto an