No top quark at PETRA's top energy

The most widely accepted theory of particle physics proposes that nearly all subatomic particles are built of various combinations of fundamental objects called quarks. Quarks ought to come in six varieties or "flavors," as they are whimsically called. Experimental evidence for the existence of five of the desired six flavors is in hand. The five are known as: up, down, strange, charm and b (usually called bottom, but sometimes beauty). The sixth flavor, t (usually "top," but sometimes "truth"), has been the subject of an ardent search.

In a recent series of experiments the search for the t quark has reached a new high in energy, which happens also to be the maximum energy available in the type of apparatus used for hunting and studying new quark flavors. But the results are negative — no t was found. The work was done by 63 physicists working with the particle detector called Mark-J attached to the PETRA storage ring at the Deutsches Elektronen-Synchrotron (DESY) Laboratory in Hamburg. The participants come from six institutions in West Germany, the United States, Spain, the Netherlands and the People's Republic of China. Their report appears in the March 14 PHYSICAL REVIEW LETTERS.

Searches of this kind have usually been done in a storage ring that accelerates a beam of electrons and a beam of positrons and collides them with each other head-on. In the collisions electrons and positrons annihilate each other, producing blobs of energy that can turn themselves into anything the total energy and the conservation laws of physics allow. As the energies of these experiments have been raised, from time to time evidence of a new quark flavor has turned up.

PETRA is one of the two most energetic electron-positron colliding beam machines in the world. (The sister machine is PEP at Stanford University in California.) Over the last couple of years a series of runs at gradually increasing energy had looked for the top flavor up to a ceiling of 36.72 billion electron-volts (36.72 GeV). Results were negative.

If top were to show up, it might be in one of two ways: as "hidden top" or as "open top." Hidden top, also called toponium, would be a particle that consisted of a top quark and its antimatter opposite, the antitop antiquark, bound together. It is called hidden, because many of the properties of the top quark would be canceled or masked by equal and opposite properties of the antitop. Open top would be a top quark bound to a quark or quarks of some other flavor. In this case the particular properties of the top quark would be more likely to be visible.

Certain theorists had adduced reasons to believe that there was an energy threshold for the production of open top around 38 GeV. Technical adjustments raised PETRA's maximum energy to 38.63 GeV, and at the end of 1982 a run to energies as high as 38.54 GeV was made. The results are still negative, and the open top threshold remains open.

The same experiment produced another important datum. Despairing of the discovery of top, some theorists had suggested theories with only five quark flavors. The number six comes from symmetry principles that physicists believe are expressed in these structures. But if necessary, one can tinker with the symmetry and reduce the number to five. Such a five-flavor theory demands that the bottom quark decay radioactively in a particular way that changes its flavor. The experiment looked for instances of such decay and found none. The report concludes that these five-flavor theories are ruled out.

So it seems to be onward and upward after the top quark. An electron-positron apparatus that will go to a maximum of about 100 GeV is under construction on the French-Swiss border near Geneva as part of the CERN laboratory. It seems likely to be the scene of the next major step in the search. *—D. E. Thomsen*

Icarus could be Einstein's downfall

Many people have tried to make a theory of gravity that would replace Albert Einstein's general relativity. Some of them have even known what they were doing. Certain of these theories turned out to be observationally indistinguishable from Einstein's. In cases where they were distinguishable, evidence has usually favored Einstein. The theory that is distinguishable from Einstein's and now seems possibly to represent a necessary correction to it is that of John William Moffatt of the University of Toronto.

Moffatt's theory came into prominence with the recent discovery that the sun appears to be oblate (SN: 4/17/82, p. 260). One of the secondary effects of the sun's gravity is to cause the orbits of the planets to precess. That is, as centuries pass, the long axes of the elliptical orbits swing around like the hand of a clock. This phenomenon is usually called precession of perihelion. It was a discrepancy between the Newtonian prediction and observations of the precession of Mercury's perihelion that first made Einstein's theory look better than Newton's.

That is, it does if the sun is a perfect sphere. If the sun is oblate, that adds a certain factor to the Einsteinian predictions, and they no longer match observation. Moffatt's theory can take account of solar oblateness and yield accurate predictions.

Now Moffatt proposes a further test. In the March 7 PHYSICAL REVIEW LETTERS he suggests using the perihelion precession of the asteroid Icarus. An Einsteinian prediction for Icarus's precession figuring in solar oblateness is 10.18 seconds of arc per century. Moffatt's prediction is 10.0, closer to the observed 9.5. A better determination of the motion of Icarus might be able to solve the question, Moffatt asserts. Combining Mercury and Icarus data gives a discrepancy of about 2¼ standard deviations between the two theories, he says, and that should be enough of a statistical base for scientists to tell which is better.

—D. E. Thomsen

EPA investigations and a resignation

Staff investigators from five House subcommittees are now searching through thousands of pages of newly released documents and preparing for forthcoming, wide-ranging hearings on Environmental Protection Agency activities. Last week, President Ronald Reagan agreed to surrender control of all the EPA documents requested by the subcommittees.

An Energy and Commerce subcommittee is focusing on allegations that grants for cleaning up five hazardous waste sites were delayed for political reasons. A second subcommittee is examining the lack of progress in cleaning up 15 New Jersey dumpsites. A Public Works subcommittee is looking into conflict-of-interest allegations involving former EPA assistant administrator Rita M. Lavelle, while a Government Operations subcommittee is examining similar allegations involving other former EPA employees. A Science and Technology subcommittee is investigating the use of agency "hit lists," which commented on the political leanings and attitudes of scientists on EPA advisory boards. Some scientists subsequently lost their positions.

After weeks of controversy (SN: 2/26/83, p. 132), Anne M. Burford last week resigned as administrator of EPA. In her letter to President Reagan, Burford wrote, "It is now clear that my resignation is essential to termination of the controversy and confusion generated by the outstanding dispute over Congressional access to certain EPA documentary materials." President Reagan accepted the resignation "with deep regret," and named the agency's deputy director, John W. Hernandez, as acting administrator.

At a news conference, Burford said, "I resigned because I felt that I had become the issue." She complained that "we shouldn't conduct government by allegation . . . if there's been any wrongdoing at the Environmental Protection Agency, it ought to be investigated, and people should be either punished or not."

—I. Peterson