Upward and Onward with Storage Rings

The Germans' new positron-electron ring accelerator will extend one of the most surprising new chapters of particle physics.

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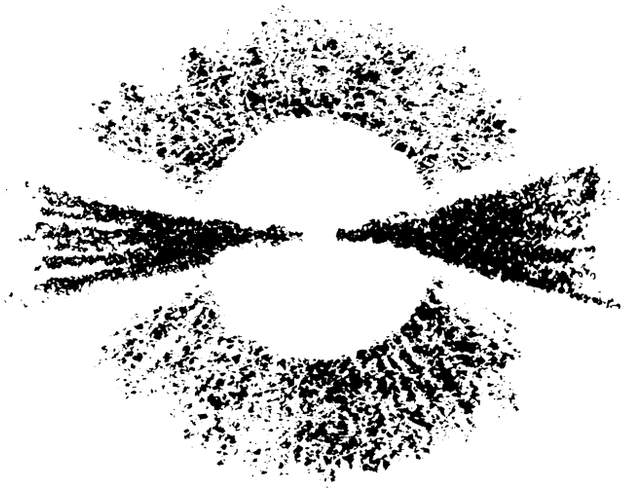

CERN Courier

An impression of what happens in electron-positron annihilation by the Italian painter Renzo Vespignani.

The collision and annihilation of electrons and positrons is one of the hottest forms of experiment in physics today, and promises to be one of the longest running. For more than a year now, three such experiments have been running (in Palo Alto, Calif., Hamburg, West Germany, and Frascati, Italy) in devices called storage rings, which build up and collide counterrotating beams of the two kinds of particle. After the annihilation of matter and antimatter that occurs in the collision, ultraheavy, oddly behaving new particles appear along with other unusual phenomena. Week by week and month by month, as the energy of the electron and positron beams is gradually raised, a seemingly endless succession of discoveries is reported.

The whole thing has greatly excited both experimental and theoretical physicists. They want it to continue, but in the present machines the parade will come to an end when energies about 7 billion electron-volts (7 GeV) are reached. Naturally, physicists have planned and begged for a second generation of e-p storage rings with an energy range up to about 20 GeV.

It now appears that at least two of these will come into being, one in the United States and one in Europe. Funds to begin the apparatus called PEP (because it will be able to collide positrons, electrons and protons with one another) are part of the U.S. government's fiscal 1977 budget proposal. PEP is a joint project of the Stanford Linear Accelerator Center and the Lawrence Berkeley Laboratory. Meanwhile, near Hamburg, construction has begun on what may turn out to be the sole European entry in this second generation. A similar Italian proposal is apparently dying of unbenign neglect by the Italian bureaucracy. The British government has given a definite no to the Rutherford Laboratory's proposal.

The new German machine will be called PETRA (Positron Electron Tandem Ring Accelerator). It represents the next step in the escalation of a laboratory that began as the Deutsches Elektronen-Synchrotron (DESY, pronounced "daisy") and later added a storage ring called DORIS. Now there will be PETRA, which will provide electron and positron beams at energies between 5 and 19 GeV per beam.

(Although Goethe ended his *Faust* with the line: *Das ewig Weibliche zieht uns hinan*, acronyms and nonacronyms that spell feminine names are not solely a German peculiarity. Italian physicists have ADA; the French have Alice; the British had NINA, and Americans are now proposing ISABELLE.)

With an extremely tight construction schedule, the Germans expect PETRA to deliver her first particle beams by 1979. If all goes well and too much political grandstanding does not interfere, PEP should be ready shortly after. On the time scale on which big-physics experiments are planned and assembled it is by no means too early to begin thinking about experiments for the new generation.

A conference to discuss what should be done at PETRA gathered recently at Frascati. It included 200 physicists from all over Europe and some from the United States, Japan and Israel. Its international flavor, as the CERN Courier points out in reviewing the meeting, reflects the "degree of integration which has been achieved in the high energy physics community." That integration comes about largely because of CERN, an internationally funded and operated laboratory. But PETRA will be strictly a German national accelerator, and the almost reflexive way in which DESY joined the Italian Istituto Nazionale di Fisica Nucleare to organize an international conference to talk about what to do with it indicates how deeply the influence of CERN has been assimilated as well as the expense of this sort of operation.

To quote CERN Courier again, PETRA will move "into an unpredictable range of physics." Theorists are not without ideas about what will be found, but theorists' predictions have so often been wrong before that the experimentalists were not stampeded. Apparently there was very little of the "I would like to look for so and so and so" at the meeting. Nobody seems willing to stake much on what "so and so and so" is likely to be in this especially surprising branch of physics.

Basically there is only one experiment that can be done at a colliding beam facility: surround the collision points with an array of detectors and record everything that happens. The colliding beams essentially stop each other cold, and the products of their interaction can come off in any direction. The difference in experiments is what kinds of detectors a given group uses and in what order and configuration they pile them.

The most nerve-twisting question is whether to submit a design based on available detectors of known capability or to take a gamble on the development of new varieties, which may be able to find rarer or more delicate phenomena than present ones. Space and experimental time are both severely limited, and it could be a losing game to wait on the development of new detectors only to find, by the time they were ready, that all the available places were taken and one had to wait another five years to get an elbow in. Trying to decide whether the greater advantage is being first in line or whether it is promising new and exotic detection techniques may be keeping some European physicists awake nights. Helwig Schopper, director of the DESY Laboratory, announced that proposals for the first generation of experiments should be in by the end of July. In September DESY will hold a workshop on the PETRA program, and decisions about the first experiments to go in are expected in October. When Germans do something, they don't fool around. □