HIGH-ENERGY ACCELERATOR

Flexibility for CERN

The machines that physicists use to accelerate elementary particles have usually been designed to fairly rigid specifications. The maximum energy determines the physical size of the machine, the number and design of the accelerating waveguides, the magnets that will be needed to bend and focus the beam, and the size of the power supply that makes it go. Once the design is set, so is the energy range.

But with money for new machines ever scarcer, physicists are learning how to design machines with a built-in flexibility.

The trend started with the United States National Accelerator Laboratory, whose proton synchrotron is designed to operate first at 200 billion electron volts (GeV) and later be boosted to 400. Physicists of the European consortium CERN have now begun consideration of a plan, which could go to 2 million GeV, in successive stages, all built around a single machine.

The CERN physicists are running somewhat scared. For five years they have been talking about building a 300-GeV synchrotron, and their governments have been negotiating about it.

A meeting of cabinet ministers was supposed to be held in January to select a site so that construction could begin this year. German intransigence over site selection (SN: 12/27, p. 593) has caused indefinite postponement of the meeting.

The negotiation difficulties have in part reflected a general cooling of enthusiasm for high-energy physics. The CERN physicists thus realize that anything they can sell their governments now will be the cornerstone of high-energy physics research in Europe through to the end of the century.

The CERN people are therefore constrained to demonstrate how much can be bought in one package.

There are two ways to design energy flexibility into an accelerator: leaving out magnets, or leaving out power. The National Accelerator Laboratory has chosen the missing-power scheme. It will build a ring big enough for 400 GeV and with all the magnets in place, but with only half the power supply. This will operate at 200 GeV. Later the power supply will be doubled to operate at 400 GeV.

The CERN designers prefer the missing-magnet scheme, since it gives them greater flexibility in taking advantage of future improvements in magnet technology. They would build a ring large enough for 500 GeV, but with only half the magnets in place. This would operate at 250 GeV.

For their second stage, they would have two choices. They could add conventional magnets to bring the energy up to 500 GeV. Or, if the technology of superconducting magnets (SN: 3/28, p. 313) had made them feasible for accelerator application by that time, superconducting magnets could be added.

If the second alternative were taken, the conventional magnets would be shut off, and the machine run at 500 GeV, by running the superconducting magnets at twice the field strength of the original magnets. This, then, would open the possibility of yet a third stage in which the original conventional magnets would be replaced by superconducting magnets to run the machine at 1,000 GeV.

Finally, addition of a storage ring to stage one could give colliding beams with an effect equal to particles from an accelerator of 125,000 GeV, while a storage ring at stage three would yield 2 million GeV.

The CERN physicists are not ignoring the prevailing fear that nothing will ever get done. The climate notwithstanding, they are making a try. Says a spokesman: "Let us hope that it won't be very long before we move from the present extreme position, where all the magnets are missing." □

DETERGENTS

NTA in for phosphates

Environmentalists insist that detergent companies remove phosphates from their products; they say phosphates, a major component of detergents, are primarily responsible for eutrophication of Lake Erie, the Potomac River and many other lakes and streams.

Detergent manufacturers have argued not only that detergents are not the major source of phosphorus, but that nutrients other than phosphorus—such as nitrates—are equally guilty. They have maintained that there is currently no adequate replacement for phosphates and that the right approach to the eutrophication problem is to build tertiary sewage treatment plants to remove all the nutrients from wastes.

Evidence pointing to detergents as a major contributor, however, is accumulating. Most of the other nutrients that contribute to algae bloom are biologically available in bodies of water (blue-green algae, for example, fix nitrogen from the air, then make this element available to other organisms when the algae die) and phosphorus therefore is the limiting factor: Add phosphorus and plant growth accelerates; reduce or remove it and plant growth diminishes.

Without admitting they are responsible for eutrophication, and without abandoning their plea for tertiary treatment, detergent manufacturers appear to be yielding. They are considering the substitution of nitrilotriacetate (NTA) for at least part of the phosphates used as builders, or sequestering agents, in their products. "Let's say there has been a change of emphasis," says William A. Geoghegan of Washington, D.C., attorney for the Soap and Detergent Association.

At least one company has announced actual plans: Proctor and Gamble Co., credited with 47 percent of the detergent market in the United States, plans to substitute NTA for 25 percent of the phosphates in about a third of its products by next month. The company's aim is 25 to 40 percent substitution of NTA in all of its products within 30 months, and an eventual phosphate reduction of 50 percent.

Proctor and Gamble began some time ago to use small amounts of NTA in two of its products, Gain and Cheer, primarily to gain experience.

The test was apparently based on a belief that increasing concern over the environment would eventually necessitate reduction or removal of phosphates from detergents. With the House Government Operations Committee early in April asking for virtual elimination of phosphates by 1972, and with J. J. Greene, Resources Minister of Canada, making a similar request recently, it appears Proctor and Gamble may be one up on other manufacturers in an action that either public opinion or legislation may require. In this light, Geoghegan's statement could be interpreted as an indication the other manufacturers will soon follow the Proctor and Gamble lead.

The NTA is a better builder than phosphates. As well as being a sequestering agent for the calcium and magnesium ions that cause water hardness, NTA also chelates, or immobilizes, heavy metal ions, such as those of copper, iron and manganese, and prevents staining of clothes by these substances.

Although NTA has been used in small amounts in North America, and more extensively in Sweden, without any apparent environmental damage, there is some concern in both the United States and Canada that this very ability to chelate the heavy metal ions may be an environmental hazard; the NTA may take up the heavy metals from sediments and make them available in toxic amounts to organisms. Canadian and United States water pollution agencies have begun an urgent program to measure these possible effects of large quantities of NTA. "We think it's safe," says James Bruce, acting director of the Canada Center for Inland Waters in Burlington, Ont., "but we want to be absolutely certain." □