PARTICLE PHYSICS WITHOUT ACCELERATORS

Pions, muons, positrons, neutrons, and strange particles were found without the use of accelerators. More recently, most developments in elementary particle physics depended upon these expensive artificial aids. Science changes quickly. A time may come when accelerators no longer dominate our field: not yet, but perhaps sooner than some may think.

Important discoveries await the next generation of accelerators. QCD and the electroweak theory need further confirmation. We need to know how b quarks decay. The weak interaction intermediaries must be seen to be believed. The top quark (or the perversions needed by topless theories) lurks just out of range. Higgs may wait to be found. There could well be a fourth family of quarks and leptons. There may even be unanticipated surprises. We need the new machines.

On the other hand, we have for the first time an apparently correct theory of elementary particle physics. It may be, in a sense, phenomenologically complete. It suggests the possibility that there are no more surprises at higher energies, at least at energies that are remotely accessible. Indeed, PETRA and ISR have produced no surprises, even at energies many times greater than were previously studied. The same may be true for PEP, ISABELLE, and the TEVATRON. Theorists do expect novel high-energy phenomena, but only at absurdly inaccessible energies. Proton decay, if it is found, will reinforce belief in the great desert extending from 100 GeV to the unification mass of $10^{14}$ GeV. Perhaps the desert is a blessing in disguise. Ever larger and more costly machines conflict with dwindling finances and energy reserves. All frontiers come to an end.

You may like this scenario or not; it may be true or false. But, it is neither impossible, implausible, nor unlikely. And, do not despair nor prematurely lament the death of particle physics. We have a ways to go to reach the desert, with exotic fauna along the way, and even the desolation of a desert can be interesting. The end of the high-energy frontier in no way implies the end of particle physics. There are many ways to skin a cat. In

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this talk I will indicate several exciting lines of research that are well
away from the high-energy frontier. Important results, perhaps even extraor-
dinary surprises, may await us. But, there is danger on the way.

The passive frontier of which I shall speak has suffered years of benign
neglect. It needs money and manpower, and it must compete for this with the
accelerator establishment. There is no labor union of physicists who work at
accelerators, but sometimes it seems that there is. It has been argued that
plans for accelerator construction must depend on the "needs" of the working
force: several thousands of dedicated high-energy experimenters. This is
nonsense. Future accelerators must be built in accordance with scientific,
not demographic, priorities. The new machines are not labor-intensive, and
must not be forced to be so. Not all high energy physicists can be accommo-
dated at the new machines. The high-energy physicist has no guaranteed right
to work at an accelerator, he has not that kind of job security. He must
respond to the challenge of the passive frontier.

1. CP PHENOMENOLOGY

Here is a small but important enterprise: the search for the electric
dipole moment of the neutron. The theorist is confident that the effect does
not vanish, but it has not yet been found. One line of thought requires a
dipole moment of order $10^{-24}$ cm. In another, it is expected to be a million
times smaller. Which view is correct, if either, will soon be determined by
experiment. It is a result of the greatest theoretical interest. In a
similar vein is a precision study of the CP violation in K decay. It is
essential to know whether or not there are measurable departures from the
superweak model. Both of these examples are in the way of loose ends that
have been passed over in the push to higher energies. No great surprises
await us here, just important and basic physics. There are many other such
eamples. In this lecture, we are out for bigger game.

2. NEW KINDS OF STABLE MATTER

It has been suggested that there exists a very strong but unobserved
interaction that sets the scale of weak interaction effects. Associated
with these new forces are new particles with masses between 100 GeV and
100 TeV. (In these technicolor scenarios, the lower reaches of the desert
are made to bloom.) Some of these particles may be reasonably stable, so that
the particles or their effects may be seen today.

With lifetimes shorter than $10^{10}$ years, the heavy particles will have
already in large measure decayed. Relic high energy neutrinos or photons
would be their only spoor. With longer lifetimes, we might see them decaying