Is the end of particle proliferation at hand?

- Only three particle families exist
- Rubbia accuses SLAC of sharp practice

London & Washington

In parallel announcements from the Stanford Linear Accelerator Center (SLAC) in California and the European Particle Physics Laboratory, CERN, in Geneva, physicists proclaimed last week that they had put a limit on the number of 'families' of elementary particles.

The two laboratories, which house the world's principal positron-electron colliders, had been engaged in an informal race to establish the new result, but CERN's director, Carlo Rubbia, has accused SLAC of using "hockey player's tactics" and of "scraping the bottom of the barrel" in making an announcement that beat CERN's by one day.

But Burton Richter, director of SLAC, says there was no contrivance in the near simultaneous declarations, and denies that his team went to any unusual lengths to "dig things out of the data" prematurely.

Both the Stanford Linear Collider (SLC) at SLAC and the Large Electron-Positron Collider (LEP) at CERN were designed as Z^0 "factories" in which electron-positron collisions would create quantities of the Z^0 particle, a crucial ingredient of particle physics for the discovery of which Rubbia won the Nobel prize in 1984.

SLC, a technically complex adaptation of an existing machine, has had some difficulties reaching its design performance (*Nature* 340, 587; 1989). LEP, by contrast, is a traditional circular synchrotron, and has come up to design specification only weeks after being switched on.

In the race to get big physics results, SLC got an early start, but LEP, by virtue of its higher beam energy, has produced more than 11,000 Z^0 particles in just 15 days, compared to 500 in 6 months of

experiments at SLC. This mass-production has an important purpose. The known elementary particles, quarks and leptons, fall into three families or generations: each family includes two quarks, a heavy lepton, (the electron, muon or tauon) and the corresponding neutrino. The third family awaits the discovery of the top quark, but otherwise the picture is complete. But there has been some doubt whether there might not be one or more undiscovered families, and the lack of a clear answer has impeded theoretical understanding.

From the rate of production of Z^0 s over a range of collision energies, it is possible to deduce the number of families: the greater the number, the more ways there are to make Z^0 s and the greater is the "width" of the Z^0 — its production rate as a function of energy.

The new data from both CERN and SLAC show conclusively that three families is all there are, but this harmonious conclusion has been marred by Rubbia's allegations about last Thursday's press announcement from SLAC. CERN announced an identical conclusion, based on a greater volume of data, the next day.

Speaking at a conference in Pisa at the weekend, Rubbia was evidently irritated at the order of the announcements, and sought to put the US group in what he regarded as its proper place. According to a report in the Italian newspaper *La Repubblica*, he said that "at best the Americans will confirm our data, coming in second place — a position they will never accept". The complaint is that SLC physicists knew of CERN's intention to announce the new LEP results last Friday and decided to scoop the Europeans by issuing the Stanford data a day earlier.

IVORY TRADE

African dissent at two-year ban

Paris

AFTER a week of debates, delegates at the seventh conference at Lausanne of the parties of the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) voted late on Monday to move the African elephant to Appendix 1 of the convention for two years. This in effect, means a blanket ban in trade in ivory from the African elephant. But nine African nations voted against the proposal, and five are to apply to enter a reservation which could mean that the ban will not apply to them.

The CITES decision has not pleased some African nations, such as Zimbabwe, who say that ivory trade is necessary for their economy and to control growing populations of elephant. Zimbabwe has developed a model practice for management of elephant culls and says that a ban will make it difficult to continue to make the policy work. But the CITES ban allows African nations to reapply for a licence to export ivory if, after two years, they can show that they have developed an effective strategy to prevent further decline in their elephant populations.

Over the past nine years, the population of elephants in Africa has declined from an estimated 1.3 million to around 600,000. According to some estimates more than 90 per cent of ivory leaving Africa is from animals killed by poachers. Peter Coles

Richter, although hesitant to respond to newspaper reports of what Rubbia had said, denied there had been any attempt to steal CERN's thunder.

SLAC, he said, has been releasing progress reports on its work, and at the beginning of August had enough data to put a preliminary limit of 3.0 ± 0.9 on the number of families, which excludes the existence of four families with a confidence level of about 70 per cent. By the beginning of September, a better limit of 2.7 ± 0.7 had been obtained, excluding four with a confidence level of 96 per cent. This was announced at a meeting of the European Physical Society in Madrid. Then two weeks ago, a paper with this conclusion was submitted to *Physical Review Letters*, a press announcement was made and copies of the paper were faxed to, among other places, CERN.

Not everyone at CERN shares Rubbia's anger. Indeed, many feel that the scramble for press publicity, which seems to be a consequence of the struggle to find money for new accelerators, in the end does a disservice to high-energy physics by provoking public quarrels. Even Rubbia confessed that the race to find the elementary structure of matter is becoming "a soap opera — like Dallas".

Roland Pease & David Lindley

SLAC's version (above) and CERN's, the latter due to appear in *Phys. Rev. Lett.* BVol. 231 (4), dated 16 November.