
Simon van der Meer retires

CERN's big Auditorium was packed on Friday 23 November for a 'Simon van der Meer Feest' to mark the formal retirement of the gifted Dutch accelerator physicist who has made so many valuable contributions to his field and to CERN's success.

It is no accident that CERN's two most important scientific discoveries – that of the W and Z particles (the carriers of the weak force) in 1983, and the neutral current of the weak interaction ten years earlier – were both made possible by ingenious van der Meer inventions enabling unruly particles to be fashioned into strong beams.

His idea and subsequent development of stochastic cooling made CERN's antiproton project possible and opened the way for the W/Z discovery, for which he and Carlo Rubbia, now CERN's Director General, were awarded the 1984 Nobel Prize for Physics.

An earlier invention, the 'magnetic horn', focuses parent charged particles before they decay, boosting the intensity of resulting neutrinos and greatly increasing their physics potential, so that rare processes like neutral currents become easier to spot.

Feest chairman Ugo Amaldi introduced the proceedings by recalling the first time the antiproton scheme based on van der Meer's stochastic cooling was described in public at CERN, in a 1976 seminar by Carlo Rubbia subtitled 'just one of those unthinkable ideas'! At the retirement event, Carlo Rubbia was on hand with an elegant personal explanation of stochastic cooling.

Particle accelerators work in

phase space – a combination of ordinary space and momentum – and their working domain, or acceptance, is defined by a phase volume. Secondary particles, such as antiprotons, produced when a primary beam hits a target, are spread out over a wide phase volume, and handling them efficiently means compressing this volume.

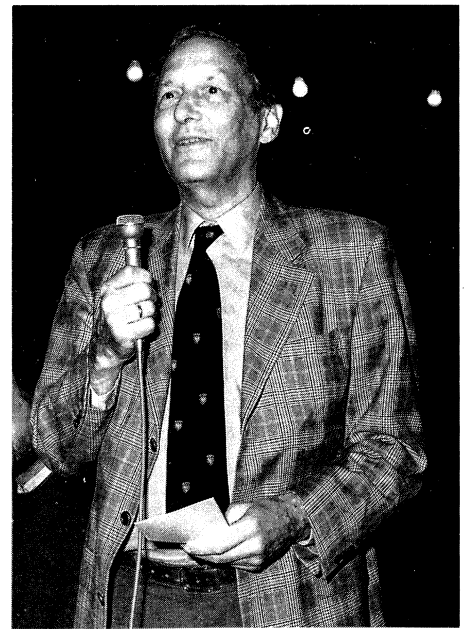
It is a fact of life (Liouville's theorem) that phase volume cannot be compressed using ordinary conserved forces. The electric and magnetic fields used in accelerators merely distort the phase volume, and to change the density calls for something else.

While others looked at schemes based on foils and eventually collisions with collinear beams (called 'smart foils' by Rubbia) which turned out to be better suited to lower energy projects, Simon van der Meer's genius led to a radically different approach. High energy particles circulating in a storage ring are monitored by pickups, and appropriate signals are fed to kickers diametrically opposite to catch the same particles as they pass and give them a small nudge. In this way a wide statistical spread can be successively damped and a more orderly, or 'cooler', beam built up.

Despite initial appearances, Liouville's theorem is still OK - the empty phase space around each particle is preserved, but these individual phase spaces get rearranged. The stochastic cooling idea, both elegant and practical, exploits this emptiness of accelerators' phase space, pushing sparse particles together and empty regions outwards.

After Carlo Rubbia's tribute, Jack Steinberger turned to van der Meer's magnetic horn brainchild.

Simon van der Meer – ingenious accelerator ideas.



These fearsome-looking devices compress charged kaons and pions into a cone so that their resultant neutrinos, otherwise uncontrollable, are confined in a narrow beam.

Steinberger underlined the physics implications. As well as its neutral current triumph, CERN's early neutrino beam programme showed that the deep interior of the nucleon as seen by neutrinos was the same as that seen at Stanford in high energy electron studies, and went on to enable the tiny 'parton' constituents seen by these beams to be identified with the quarks of the static nucleon picture. Later came the precision high energy work at the SPS, which is still continuing.

Van der Meer has even a third claim to fame, described at the Feest by Giuseppe Cocconi. At CERN's Intersecting Storage Rings (closed in 1984) van der Meer developed a precision method for vital measurements of the machine's luminosity by determining the vertical distance between two beams. This exploited the ISR's remarkable

precision and ability to maintain stable conditions, and quickly led to the early precision determinations of the proton-proton reaction rate (cross-section) in the new energy range opened up by this pioneer machine.

In conclusion, Giorgio Brianti sketched van der Meer's remarkable 35-year career at CERN, paying tribute to his remarkable insight and inventiveness. 'If there was a problem, then Simon could find us a solution'.

With characteristic modesty, van der Meer has shunned publicity after his Nobel triumph, preferring to work quietly on fresh challenges. Fortunately for CERN and for particle physics as a whole, he will continue to tinker with these problems, hopefully for a long time to come.

VIEWPOINT

Mind over matter – the intellectual content of experimental physics

According to my experience, the most brilliant physics students at any university want to become theoreticians, and this on both sides of the Atlantic ocean. It is rare that a person of the intellectual power of, say, a Gell-Mann or a Cabibbo decides to embark on a career in experimental physics.

It is obvious that this fact entails a serious loss for physics, since physics is primarily a natural science. I have often asked myself about the reasons for this regrettable situation; once these are established, perhaps remedies could be suggested.

I have come up with two reasons. The first is the style in which physics is taught essentially everywhere. There are two models, A and B, both of which fail to convey to the students the intellectual content of important experiments.

In model A, the student is told that some great genius, identified by name, predicted a remarkable dependence $y(x)$ of one observable upon another. That dependence was then subsequently brilliantly confirmed by experiment – by some unspecified person.

In model B, one presents an observed dependence $y(x)$ that constituted at its time a great puzzle. Again a great genius (name given) came along and presented a theory which fitted the observations perfectly.

In either model, the intellectual accomplishment of the experimentalist is generally not conveyed to the students. I shall illustrate this by two examples: (1) in Okun's masterful book 'Leptons and Quarks', experiments are rarely described – although the authors are given – their results are merely quoted, as 'one finds....'; (2) I once gave a course 'Great Experiments in Modern Physics' at MIT. It was attended by young students

Val Telegdi – mind over matter



and senior theorists. Many of the latter learned for the first time how Willis Lamb had actually determined 'his' shift, how many brilliant insights he had had to have to achieve his goals. Quite a few people concluded correctly that there was as much intellectual content in the Lamb experiment as in the quantum electrodynamics explanation of it. (This example is marred by the fact Lamb was actually an accomplished theorist!).

A second, altogether different reason derives from what I might call the 'theory of the father image': in practice, all our physics courses are theoretical, whether the title of the course says so or not. The theorists teaching theory mostly know what they are talking about, and the experimentalists frequently do not. So the student (who though he may himself not understand the subject, still infallibly catches the lack of understanding of the lecturer!) says to himself: 'I do not want to become like him (insert name of experimentalist) but like him (insert name of theorist)'.

What can we do to remedy this situation? Two things: first, we must postpone the difference in training of future experimentalists and theorists as far as possible. The difference is one of technique and not one of intellectual competence. Second, we must teach courses in which brilliant experiments of great significance are analysed in some detail. There is no shortage of candidate material!

Val Telegdi

(This essay, supplemented by an analysis of several interesting and incisive experiments, is published as a CERN 'Yellow Report', CERN 90-09.)