Minding the psi's and q's

from Roger Cashmore

THE European Physical Society's International Conference on High Energy Physics* was held in Geneva this year — the 25th anniversary of CERN. Much of the data presented originated from accelerators within Europe, from the CERN SPS and ISR together with a substantial contribution from the new e^+e^- storage ring PETRA at DESY.

Much of the conference was devoted to reports on the physics of both the new quarks, (charm and bottom — c,b) and the old quarks (up, down and strange — u,d,s) as well as searches for the expected quark (top — t). First the charm quark. Within the charmonium model of the $c\bar{c}$ meson states, the claimed pseudoscalar states ($^1S_0$ states), the x ($\sim$2830) and x ($\sim$3450) have long been a problem. They possessed masses, widths and M1 electromagnetic transition rates in conflict with predictions from charmonium. In the crystal ball experiment at SPEAR, an experiment particularly designed to study the electromagnetic transitions from the ψ and ψ mesons using high resolution NaI crystals, no evidence has been found for these states at the claimed mass values, although all of the other intermediate states have been observed (the $^3P_{0,1,2}$ states — the χ(3400), χ(3510) and χ(3550)). Thus the embarrassing problem of having states of the grossly wrong properties has been removed but replaced by the lesser problem of the whereabouts of these mesons, vital in the $c\bar{c}$ picture. In a separate experiment at SPEAR, using the Mark II detector, data has been taken on the D^0 and $\bar{D}^0$ mesons at the ψ'' (3772), a copious source of these particles. With the high statistics obtained the first observations of the Cabbibo suppressed $D \rightarrow \pi\pi$ and KK decays have been made which are consistent with 6 quark extensions of the GIM model of incorporating new quarks into the weak and electromagnetic gauge theories.

Until this conference evidence for charmed baryons has been scant, the only observations being in neutrino experiments and one photoproduction experiment. Three experiments from the ISR reported the observation of narrow hadronic states consistent with the earlier observations. These states have appreciable diffractive production cross sections ($\sigma.B \sim 1 \mu b$, where B is the decay mode branching fraction) while the more prominent decay mode of the lightest of these baryons, the Λ_c^+ ($\sim$2255) appears to be to $K^-p\pi^+$ although the $\Lambda^0\pi^+\pi^+\pi^-$ decay is observed. This conclusion is supported by evidence from SPEAR that the $p+\bar{p}$ yield increases more dramatically than the $\Lambda+\bar{\Lambda}$ yield in the vicinity of 5.0 GeV, the region where charmed baryon production is expected to occur.

Probably the most exciting prospect at the conference was the suggestion of a meson containing a bottom (b) quark. The b quark is expected to decay preferentially to a c quark and it has been surmised that this c quark might appear a fraction of the time within a ψ meson together with at least one 'strange' particle. A group (Indiana/Imperial College/Saclay/Southampton collaboration) studying ψ production in $\sim$150 GeV π^-p collisions at the CERN SPS looked at the $\psi K\pi$ final states and discovered an excess of events ($\sim$4 standard deviations) concentrated in a single 40 MeV bin at a mass of $\sim$5.3 GeV. From a knowledge of the Υ state, assumed to be a $b\bar{b}$ meson, the mass of a meson containing a bottom quark can be estimated and falls in this vicinity. Clearly further experimental results are eagerly awaited in the hope of confirming this exciting possibility.

Finally, an expected new quark, the t quark, has not yet been revealed in e^+e^- annihilation experiments at PETRA. Thus the mass of this quark must be greater than 13.5 GeV and means that the new accelerator must be stretched to its present limit of 16 GeV in the hope of discovering it.

Nearly all known mesons and baryons can be accommodated in models of hadrons in which mesons are qq states and baryons are qqq states, leading to the puzzle of the absence of resonances composed of greater numbers of quarks, for example qqqq or qqqqq. A few narrow structures observed in pp annihilations had been the best candidates for such states but unfortunately in a recent pp experiment at Brookhaven National Laboratory no evidence was found for the existence of one of the best of these candidates, the S(1935). Thus the puzzle remains as one of the most important questions of hadron physics.

The problem of permanently confining quarks within hadrons has apparently yet to be solved despite the tremendous amount of theoretical effort directed towards QCD (quantum chromodynamics — the theory of coloured quark and gluon interactions), a possible theory of the strong interaction. The experimental evidence for jets of particles, the remains of original quarks, was beautifully demonstrated in the new results from PETRA. However the evidence for the gluons which are essential in this picture remains tentative. Data presented on the decay of the Υ (9.45) is clearly best fitted with a model which describes its decay by way of three gluons, while in the high energy e^+e^- annihilation the evidence for a third jet (a gluon bremsstrahlung from one of the quarks) was tantalising. The existence of this effect together with a quantitative confirmation of the QCD predictions will only be obtained with the acquisition of much more data during the coming year. Results were also presented on the variation of the moments of the structure functions in deep inelastic νN and μN scattering, the 'classic' testing ground of QCD to date. Once again these were consistent with the predictions of QCD but fall short of a definitive proof, since other explanations are possible.

Results from all the high energy physics experiments studying the weak neutral current are now consistent with a value of $\sin^2\theta_w = 0.23$, the one parameter in the Weinberg-Salam model for a gauge theory of the weak and electromagnetic interactions. The only area in which there is any conflict with this value lies in atomic physics experiments studying parity violation in thallium and bismuth atoms. However here there are direct conflicts between the various experiments and a further sequence of experiments is clearly required before this situation is resolved.

There remains the unification of the weak, electromagnetic and strong interactions. The currently most popular models imply a 'desert' from the mass region of the W and Z intermediate bosons ($\sim$100 GeV) to the mass at which the various interactions have a similar strength — the grand unification mass ($\sim 10^{15}$ GeV). However A. Salam, in his summary, pointed out that this 'desert' was model-dependent and indeed other models would lead to a proliferation of particles in this region — only experiment will reveal the correct path. This represented a clear challenge to the experimental high energy physicists to understand better the properties of the particles of today and furthermore to achieve these higher energies as soon as possible with the accelerators of the future, the pp collider at CERN and, one hopes, LEP. ☐

Roger Cashmore is in the Department of Nuclear Physics, University of Oxford.

Naming names

IN a paper published in this issue of *Nature* (page 468) V. Bennett and P.J. Stenbuck describe how a red cell membrane protein is linked to the cytoskeletal spectrin through the membrane Band 2.1 protein. Bennett and Stenbuck have recently rechristened Band 2.1 protein ankyrin (Greek, anchor). But beware. The self-same protein has, by others, been rechristened nexin (Latin, to bind) and syndein (Greek, to bind). Perplexingly, the work that led to all three christenings was initiated in one laboratory, that of Professor D. Branton at Harvard.

This etymological discordance is hardly edifying. Perhaps the younger generation should devote less time to scouring dictionaries and reflect instead on other traditions. After all there was a time when the leader of an expedition could expect to have his (or even her) name enshrined in any new species discovered by juniors.

So, by way of revitalising an old tradition, I hereby propose that the names ankyrin, nexin and syndein be cast aside in favour of brantonin (from, if you must, the words branch — a subdivision — and ton — a large quantity). International Commissions on Nomenclature please note. **P.N.**

---

*Held on 27 June-4 July.

0028-0836/79/320450-01$01.00

©Macmillan Journals Ltd 1979