

meson exchange forces which make it difficult to form any bound state of two baryons other than the deuteron are expected to produce, on the other hand, a relative wealth of states which couple to the baryon-antibaryon system. Baryoniums also smooth out difficulties with the simple quark model in baryon-antibaryon reactions, where basic ideas of 'duality' seemed to break down (see June 1977 issue, page 197).

Experiments seem to show that there are two kinds of baryonium. Some states are broad, having typical hadronic decay widths of a hundred MeV or more, and are seen at 2190 and 2350 MeV in painstaking analysis of nucleon-antinucleon scattering data.

Other baryoniums have a much narrower width, usually of the order of tens of MeV, and are seen in selected channels of production experiments, such as the proton-antiproton pair in $\pi^- p \rightarrow p\bar{p}\pi^0$.

In the diquonium picture, these two kinds of baryonium are explained as being colour isomers with the same quark content but different interior colour configurations. Depending on this configuration either one or two quark pairs are formed when the colour tube connecting the diquarks snaps.

It is more difficult to produce two quark pairs than one, so the diquoniums producing two quark pairs will have a narrower decay width than those which produce just one pair. They will tend to emit mesons and change into other diquoniums.

However the diquark is only one simple example of a chromion, and whole ranges of new hadronic states could be formed from other chromions. Some narrow resonant states which have been reported could be explained as colour molecules built from two chromions, one containing three quarks and the other a quark-antiquark pair.

According to the ideas of colour

chemistry, these hadronic states are the forerunners of an infinite number of possible colour molecules. If so, this will provide fuel for many more years of experimental effort.

The solar neutrino problem

The puzzle of solar neutrinos has now been with us for some 20 years, but new technical developments afoot in the US and the USSR giving greatly improved capabilities for neutrino detection might soon resolve the problem.

It was W. Fowler and A. Cameron who first pointed out that the range of thermonuclear reactions in the sun's interior should produce an appreciable flux of neutrinos. These intense reactions provide the temperature which resists the immense gravitational forces trying to crush the sun, and the level of these reactions, as measured by neutrino fluxes, is a good thermometer for the sun's interior.

These neutrinos fly out through the sun and into space, some of them arriving on the earth. However observations so far show that the detected level of solar neutrinos is only a fraction of what is expected from theoretical estimates. If this is correct, it means that we do not understand well enough what is going on in the sun.

Solar neutrinos can be detected through a variety of neutrino-induced nuclear reactions, such as the conversion of chlorine-37 to argon-37. One of the pioneers of solar neutrino work, Ray Davis of Brookhaven, has built a neutrino detector consisting of a 100 000 gallon tank of dry-cleaning fluid (perchloroethylene) buried 5000 feet below the ground in a disused gold mine in South Dakota.

Results from this huge installation give results that are consistently less

than the predictions of various theoretical models, and moreover the results seem to be independent of the sun's position, showing that the recorded level might be due to some other source instead.

Theorists have tried to find ways out of the problem by tinkering with the parameters of the sun's interior, but these attempts appear to produce more difficulties than they remove.

One reason for the present impasse could be that the currently-used methods for neutrino detection have threshold energies which do not match well the spectra of the solar neutrinos. As a result, only the high energy tail of the neutrino spectrum is intercepted and the lower energy component of the flux remains undetected. To catch these more elusive but much more abundant neutrinos, other detection methods must be sought.

An example of such a method uses gallium-71, which is converted by neutrinos into germanium-71, but until recently it appeared difficult to extract the tiny amounts of produced germanium from the mass of gallium in the detector. However recent developments in the US now show how this can be done. All that remains is to find the money to purchase the gallium — some 15 million dollars would be required for a typical detector containing 50 tons of gallium.

In the USSR, a huge neutrino observatory in the Caucasus is now nearing completion. Among other things, this uses gallium detectors and should be able to identify solar neutrinos with much lower energies.

Asthenodynamics

In our July / August issue (page 246), we intimated that someone might come up with a name to describe the new unification of our description of the weak and electromagnetic interactions.

People and things

'Broken Symmetry' — the latest sculpture from Bob Wilson which stands over the Pine Street entrance of Fermilab. The Hi-rise building is visible in the background. The sculpture uses steel deck plate from the USS Princeton, stands 16 m high and weighs 21 tons.

(Photo Fermilab)



As a result of theoretical developments which have become known as the Weinberg-Salam model, the weak and electromagnetic interactions can now be understood by a single picture. In a way this parallels the developments in the last century when theoretical developments culminating in Maxwell's equations achieved a synthesis of electricity and magnetism, giving birth to the word electromagnetism.

No new word analogous to electromagnetism seems to be in common parlance among physicists to describe this newest unification. Many people still talk of the Weinberg-Salam or the 'standard' model. However Salam himself uses the term 'electro-weak' fairly freely.

Another possibility that has been suggested is pointed out by one of our readers in Edinburgh University, who regrets that physicists don't resort to Greek for new nomenclature in the way they used to. The background of classical education which produced such elegant words as hadron, meson, lepton or baryon has now given place to a new candour, with homespun names like parton, gluon, colour and flavour.

The suggestion is for the new electro-weak phenomena to be given the name 'asthenodynamics', or the 'asthenic force'. The Greek adjective 'asthenis' has the virtue of meaning 'not strong', rather than merely weak. In this way it can be used logically to describe all phenomena not associated with the strong force.

The root of the word 'sthen' means strong, and the α prefix denotes 'not', as in asymmetric. This gives us quantum asthenodynamics (QAD) as the field theory of the forces to be distinguished from those attributed to quantum chromodynamics (QCD) and strong interactions.

EPS and Trends in Physics

The 4th General Conference of the European Physical Society was held at York in the UK from 25-29 September. Organized in collaboration with the British Institute of Physics, it attracted 700 participants from Europe and overseas to the modern campus of York University.

Under the wide-ranging theme of 'Trends in Physics' the great diversity of present-day physics research was evident as a full programme of plenary sessions, specialized Seminars and posters attempted to cover the spectrum of modern optics, surface physics, phase transitions, nuclear astrophysics, hot plasma, heavy ions, synchrotron radiation and quarks.

In addition to the quark sessions, high energy physics came into prominence during the opening address of Professor A. Zichichi, Presi-

dent of the Society, at the General Assembly. He pointed out that in 1978 (the 10th anniversary year of the EPS), we can look back 100 years to the formulation of Maxwell's equations that unified electricity and magnetism and we can also see the new unification of electromagnetic and weak interactions as the model of Salam and Weinberg comes to fruition.

The laser and synchrotron radiation, two remarkable new tools now at the disposal of the experimental physicist, dominated the proceedings. Their almost ideal experimental characteristics have resulted in an increasing trend towards all forms of spectroscopy. A widening interdisciplinarity, with physics bridging the gap between such diverse disciplines as biology, ecology, medicine and telecommunications, was also noticeable.

Discussions on the role of education in popularizing science, on physics in the developing nations and on the