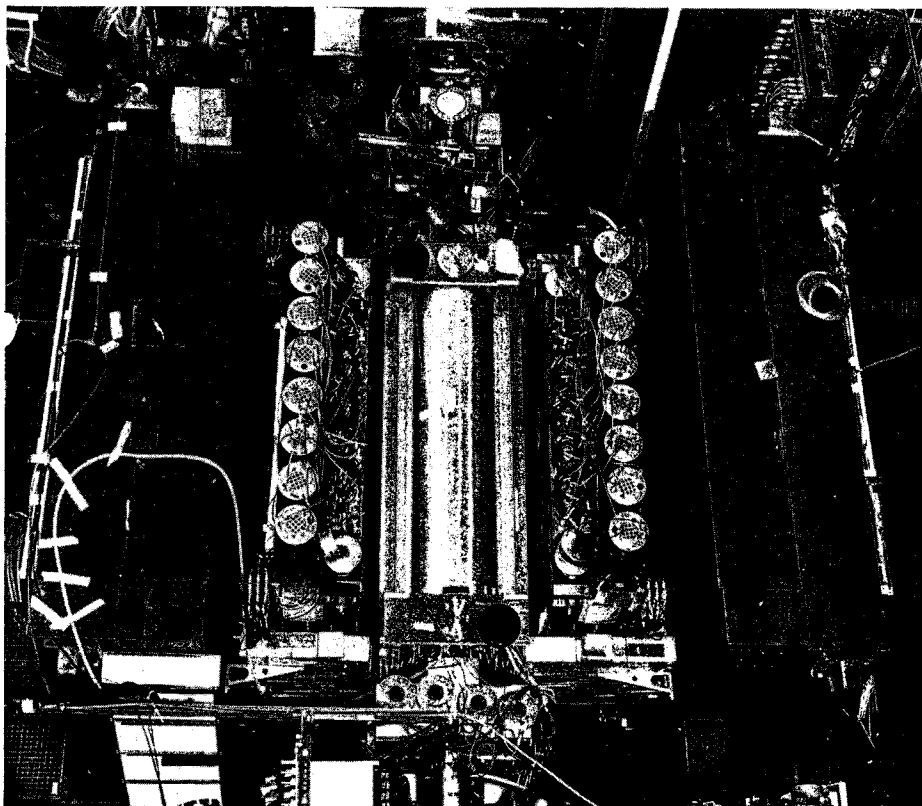


The DESY/Heidelberg experiment installed in the southern intersection region of the DORIS electron-positron storage rings. The cylinder in the centre contains drift chambers and scintillation hodoscopes. On both sides of it, rows of sodium iodide and lead glass counters for energy determination and iron walls for muon filtering are visible. The positron beam is entering from the top of the photograph.

(Photo DESY)



with the stored beams. According to schedule, PLUTO was taken out of the area in February and work is now being carried out to improve the detector and its data handling system.

At the northern intersection region the double arm spectrometer, DASP, has been looking for the decays of the new particles. Its nonmagnetic inner detector has a high detection efficiency and good angular resolution for gamma rays of more than 100 MeV. It was therefore used to study neutral decays. No peak was found in $e^+e^- \rightarrow \gamma\gamma$ at 3.1 GeV which supports the spin $J = 1$ assignment to the particle. Upper limits for the decay into two gammas, gamma and neutral pion, η_c and gamma can be derived from the data (reported in Physics Letters). η_c is a hypothetical heavy particle of mass greater than 2.6 GeV decaying into two gammas. Several events have been observed which are consistent with the decay.

The decays of the new particles into muon and hadron pairs have been investigated with the two magnetic arms of DASP. Covering a solid angle of 0.9 steradian they offer good momentum and time-of-flight resolution and good particle separation. Electrons and muons are separated from each other and from hadrons by shower and range counters. Pions and kaons can be separated up to 1.7 GeV/c, kaons and protons up to 3 GeV/c. The angular distribution of muon pairs at 3.1 GeV is consistent with a $J = 1$ particle. There is no significant forward-backward asymmetry and no pion pairs were found at 3.1 GeV. This is strong evidence for isospin $I = 0$. Also, no kaon pairs were seen but the decay into proton and antiproton has been observed.

Inclusive particle distributions were measured by triggering on a charged particle in one of the magnetic arms in coincidence with a charged particle

or photon in the inner detector. The kaon/pion and proton/pion ratios are rising with increasing momentum.

The cascade decay of the 3.7 GeV resonance was studied by looking at muon pairs with an invariant mass of 3.1 GeV/c². In about half of the cases the muons were accompanied by two charged pions. Also events with two neutral pions and events with charged tracks and/or photons have been observed which cannot be classified as $\pi^+\pi^-$ or $\pi^0\pi^0$.

At 4.1 GeV some data has been taken and is awaiting analysis. In the near future the DASP team will concentrate on details of the 3.7 GeV particle. The inner detector will be completed in order to get a better photon efficiency at low energies.

The experiment of the DESY/Heidelberg group replaced PLUTO at the southern intersection point. Their apparatus aims to identify charged particles, to measure energies of positrons, electrons and gammas and to separate hadrons from leptons. To detect charged particles, an inner detector consisting of cylindrical drift chambers and scintillation hodoscopes is installed around the crossing point of the circulating beams covering about 85 % of 4π . The energy measurements are performed with sodium iodide and lead glass counters surrounding the inner detector. In addition, drift chambers are installed behind 60 cm of iron to identify muons. Data has been taken at total energies of 3.1 and 4.1 GeV and the group hopes soon to get information on inclusive gamma and neutral pion spectra and will look for gamma transitions.

Gordon Conference

A conference on 'High Energy Hadronic Interactions' will be held at Meriden, New Hampshire, USA from

18-22 August. It will be of the 'Gordon' type and has nine subjects — A theoretical introduction (H. Harari), An experimental overview (G. Giacomelli), The new particles (G. Goldhaber), Diffractive phenomena — experimental (M. Derrick), Diffractive phenomena — theoretical (M. Jacob), Single particle distributions (H. Sens), Correlations among produced particles (C. Quigg), Phenomena at large transverse momentum (L. Di Lella), A look forward (S. Wojcicki). Further information may be obtained from J. Lach at the FermiLab.

RUTHERFORD

More light on accelerators

The possibility of using the light from high power lasers to accelerate charged particles was recently put forward by K. Mizuno, S. Ono and O. Shimoe (see *Nature* 17 January, page 184). With the high electromagnetic fields available with modern lasers, the tantalizing figure of 1 GeV/m was quoted as a potential rate of acceleration, leading to speculation on book-shelf accelerators being just around the corner. At the Rutherford Laboratory, the well-known accelerator theoretician J.D. Lawson has taken a look at this problem (Rutherford Lab. lecture notes RL-75-043) and, unhappily, he concludes that things are not quite so bright as they might first appear.

The idea seems to have been considered first by another Japanese physicist, K. Shimoda in 1962 and has been taken up several times since. Basically, it attempts to use the inverse of the effect seen in an experiment by E.M. Purcell and S.J. Smith in 1953. They fired 300 keV electrons along the surface of a diffraction grating (at right angles to the grating lines) and observed that light was emerging at

angles calculable from the usual grating formula. This must decelerate the electrons since they are giving off energy. If we can send light back at the grating in the right way, perhaps we can accelerate particles along its surface?

Lawson first considered using a plane light wave and worked from there to set up appropriate conditions for acceleration. Maxwell's equations obviously impose limitations and a plane wave cannot accelerate particles in its direction of motion because its electric field is perpendicular to that direction. Tilting the wave through an angle overcomes this obvious restriction but accentuates the problem that the wave would be travelling faster than the particle and therefore could not consistently make the particle feel the accelerating field. A dielectric medium would slow the wave down and the associated light wave at its surface could then have the desired properties — some electric field pointing in a direction to accelerate the particles and keeping pace with the particles.

Unfortunately, there is also an unwanted electric field at right angles to the good direction and the ratio of this to the useful field increases with the energy of the particles. Very high energies could be ruled out. Using a diffraction grating rather than a dielectric slab doesn't improve the situation, its effect can be analysed as a combination of plane waves and waves of the type described above.

Bringing two gratings or dielectric slabs very close together and accelerating particles between them would make it possible to escape from the impasse since their accelerating fields would add while, on the symmetry plane, the unwanted transverse fields would cancel out. Away from the symmetry plane the transverse fields increase rapidly and would push the particles sideways out of the beam.

To keep the sideways effect smaller than the forward accelerating effect, the gratings or slabs would have to be very close together. (Similar conclusions were reached by A. Lohmann in an unpublished IBM note as long ago as 1962.)

Lawson concludes that a miniature linac of tiny bore might be feasible with accelerating fields of about 200 MeV/m for pulses less than 1 μ s long. With a high brightness electron microscope as source, it might yield a few nA of current.

'Non-synchronous' acceleration (where the charged particles get one sudden enormous boost in energy at a sharp laser focus rather than a consecutive series of energy nudges as laser light is applied along the length of a linac) might still be interesting but it is not clear how it could be used to make a useful accelerator. Nevertheless, the subject of particle acceleration using light is a very enticing one and worthy of serious attention.

WESTFIELD COLLEGE

WES-POP

Stimulated by the success of AIX-POP, the science popularization exercise carried out during the particle physics Conference at Aix-en-Provence in 1973, Westfield College London took up the challenge of communicating the fascination of science in their own 'Carnival of Science — WES-POP'. The Carnival was initiated by E. Leader, who led the preparations with particular help from V. Bull, C. Cooke and M. Green.

A provocative publicity campaign preceded the Carnival day and the whole event was arranged to be light-hearted and yet to convey scientific principles. Participation of the visitors was encouraged with exhibits such as