

Thinking cLEARly

A welcome appearance at the recent workshop at Villars in Switzerland to look at the future research programme at CERN's LEAR Low Energy Antiproton Ring was I.S. Shapiro of Moscow (right), seen here with O. Dalvarov of the Lebedev Institute.

The smallest ring at CERN is also one of its big successes. The 80 metre LEAR Low Energy Antiproton Ring which came into action in 1982 has provided invaluable research material for several hundred physicists.

(The world's only other antiproton factory, at Fermilab in the US, is concentrating on high energy goals, preferring to sit on the low energy sidelines and watch LEAR with interest.)

Whilst the initial programme at LEAR, concentrating on annihilation, search for narrow states etc., is now complete, attention is turning to a second generation of experiments with a slightly shifted emphasis. These new studies now extend to basic symmetries, hadron spectroscopy and comparisons of particle and antiparticle behaviour (see December 1986 issue, page 11). The detectors are taking shape in the old PS South Hall and will later be joined by internal target experiments such as JETSET (see May issue, page 21).

However LEAR's success promises a rosy future, and with this in mind, close to 250 researchers gathered at Villars-sur-Ollon in the Swiss Alps for the fourth in a series of LEAR workshops. Following Karlsruhe in 1979, Erice in 1982, and Tignes in 1985, this one was arranged, in collaboration with CERN, by several Swiss Universities under the overall responsibility of Ernst Heer and Catherine Leluc (Geneva).

The meeting reviewed LEAR's achievements so far. Although the idea of 'baryonium' – exotic quark combinations once expected in proton-antiproton annihilation – has now been put on the back burner, LEAR experiments have removed some of the mystery from annihilation and are poised



to probe deeper. An interesting debate was between I.S. Shapiro of Moscow who underlined the very short short range character of annihilation and quark modelists who on the contrary believe it extends over a range of one fermi.

Another hotly debated topic was that of the 'rho parameter' connected with the structure of the proton-antiproton scattering. Two collaborations (PS 172 and PS 173) see an oscillatory behaviour at low energy which is in agreement with antiprotonic atom experiments at LEAR but which is not accounted for by the theoretical models.

Likewise valuable new insights on annihilation could come from the role played by spin. Results from the use of polarized (spin oriented) targets were given by PS 172 (SING collaboration), while W. Haeberli and A. Penzo looked further ahead to the prospect of polarized antiproton beams, using spin 'splitters' or 'filters'. A Test Storage Ring is being built at Hei-

delberg to test, with protons, the latter possibility.

Several hot topics in theory have an immediate bearing on present or potential LEAR physics. R. Petronzio described how supercomputer lattice gauge calculations now hint at where the long-awaited 'glueballs' might be found. S. Brodsky reviewed the quark field theory aspects of proton-antiproton collisions, while C. Dover and J. Rafelski discussed different aspects of the interaction of antiprotons with nuclei.

K. Kleinknecht gave the news of hints from the NA 31 CP violation experiment at CERN that one of particle physics long-standing mysteries (upsetting the combined CP particle/antiparticle and left/right symmetry in the decays of neutral kaons) might be starting to crack (see November issue, page 20). C. Jarlskog and A.J. Buras gave the theoretical update on these topics which are expected to become one of the principal lines of interest at LEAR. L. Montanet gave

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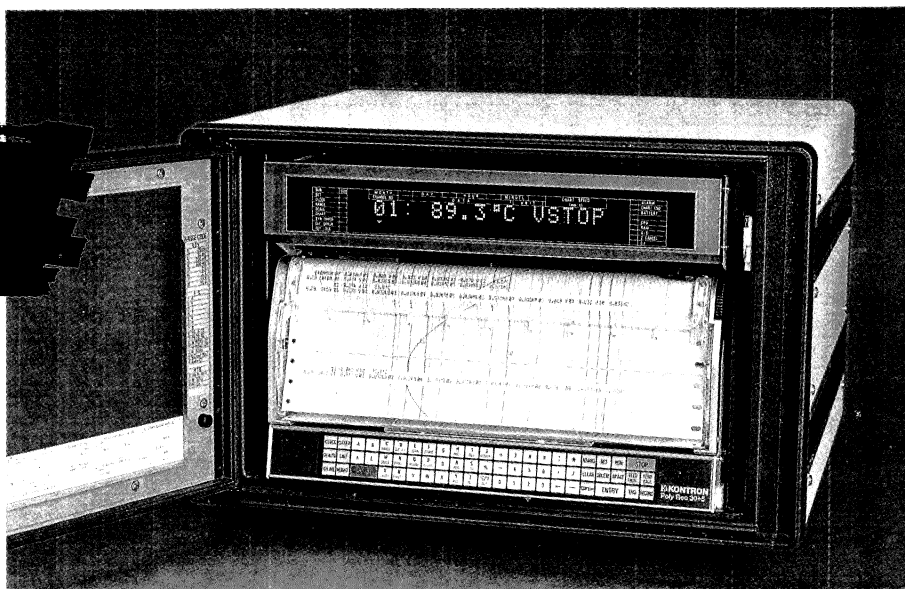
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the status of preparation of experiment PS 195 while N. Hammann suggested that CP violation could be looked at in hyperon decays.

Handling low energy antiprotons has always been a challenge for machine specialists and special sessions looked into LEAR's future requirements. The advent of beam cooling has opened up precision studies with a wide range of beams (including ions), and the meeting heard news from projects in Europe, the US and Japan.

I. Meshkov of Novosibirsk reviewed the latest developments in electron cooling, and Ishiro Katayama of Osaka reported on a new idea using a thin internal target in lieu of a gas jet in a cooling ring.

J. Peoples gave a status of the Fermilab antiproton source and of the experiment under construction to continue, using the debuncher ring, the charmonium spectroscopy initiated by a gas-jet target experiment during the last days of CERN's Intersecting Storage Rings.

Another big push at LEAR is for lower energies for measurements of static properties of the antiproton. The antiproton is thought to be the mirror image of the proton but if high precision measurements revealed even tiny differences this would have drastic consequences.

Whereas the design energy of LEAR foresaw going down to 5 MeV kinetic energy, M. de Saint-Simon described a mass spectrometer experiment that calls for 200 keV antiprotons. H. Poth of Karlsruhe outlined ideas to manufacture atoms of antihydrogen by combining antiprotons and positrons with the help of a laser and electron cooling. While antiparticles are standard fare at particle physics laboratories, neutral antimatter has yet to be synthesized.

For the long term future, several scenarios are conceivable. One candidate receiving increased attention is the SUPERLEAR project for a modest 120 metre ring of superconducting magnets to collide

proton and antiproton beams in the energy range 1.5-10 GeV. This would fill the gap between CERN's two existing antiproton rings – LEAR and the SPS synchrotron, while the LEAR ring could confine its attention to the low energy frontier. SUPERLEAR, concentrating on colliding beams or gas jet target studies and with no external beams would open the door to the precision spectroscopy of heavy quark states. In view of its modest dimensions it would also be the world's first machine to use curved superconducting magnets.

On the final evening Carlo Rubbia talked about the long term future of CERN. Whilst the views of the committee he chairs are well known as regards the very high energy frontier (see September 1986 issue, page 17, and this issue, page 1) he gave a personal view on why a broad and balanced programme is also a must for the continued well-being of CERN.

Around the Laboratories

CERN Letting them sulphur

For several weeks during September and October, the CERN accelerators handled sulphur 32 ions, with the SPS synchrotron reaching 6400 GeV (6.4 TeV, 200 GeV per nucleon) surpassing CERN's previous world energy record of 3.2 TeV set last year with oxygen 16 ions at 200 GeV per nucleon.

The heavier ions provide increased energy densities to extend

the physics insights into the behaviour of 'hot' nuclear matter, and in particular to look for signs of the long-awaited 'quark-gluon plasma', when quarks and gluons will finally gain enough energy to break loose from their conventional confinement in nucleons.

To provide the heavier particles, the ion source feeding the CERN accelerator chain (Linac 1/Booster/PS proton synchrotron/SPS) has been fitted with a new Electron Cyclotron Resonance (ECR) source built by R. Geller at Grenoble and

installed by GSI Darmstadt and CERN.

Similar in design to the oxygen 16 source used last year, it operates with a 15 GHz ionizing radio-frequency field to boost the yield of highly charged ions such as sulphur 32 (12+) by a factor of about 20 compared to the 10 GHz oxygen 16 source. Even so, sulphur 32 is present only as a five per cent 'contamination' of the oxygen 16 supply. But this is enough to get on with and is a step towards a 20/30 GHz source being con-