

The W pairs at LEP will be formed via an intermediate invisible 'virtual' Z. However the W production will still bear the stamp of this intermediate particle, providing valuable information about the coupling of a Z to a W pair, another incisive test for the Standard Model.

If the sixth quark is found at Fermilab's proton-antiproton collider, and if the precision on the W mass could attain ± 50 MeV at LEP, then the veil could at last start to be lifted from the Higgs particles, the mysterious symmetry breaking mechanism at the heart of the electroweak unification picture.

off – 1.1×10^{31} . The crews have become very skilled at optimizing conditions during each beam coast, with continual careful grooming of the beams ensuring high collision rates. This, together with improved performance at the four detectors – Aleph, Delphi, L3, and Opal – have led to average efficiency increasing to 57% from 44% in 1991, so that the luminosity delivered over a day has exceeded what could have been expected initially, says Steve Myers.

The main LEP limitations, as measured by the machine's beam current, are still the transverse coupling instabilities inherent for single beam operation, compounded

with unwelcome beam-beam interactions once electron and positron beams are in the ring together.

Some of the former is caused by the inevitable transverse impedance of the copper radiofrequency cavities used to accelerate the LEP beams. With superconducting radiofrequency cavities now being installed as part of the LEP200 programme to push the

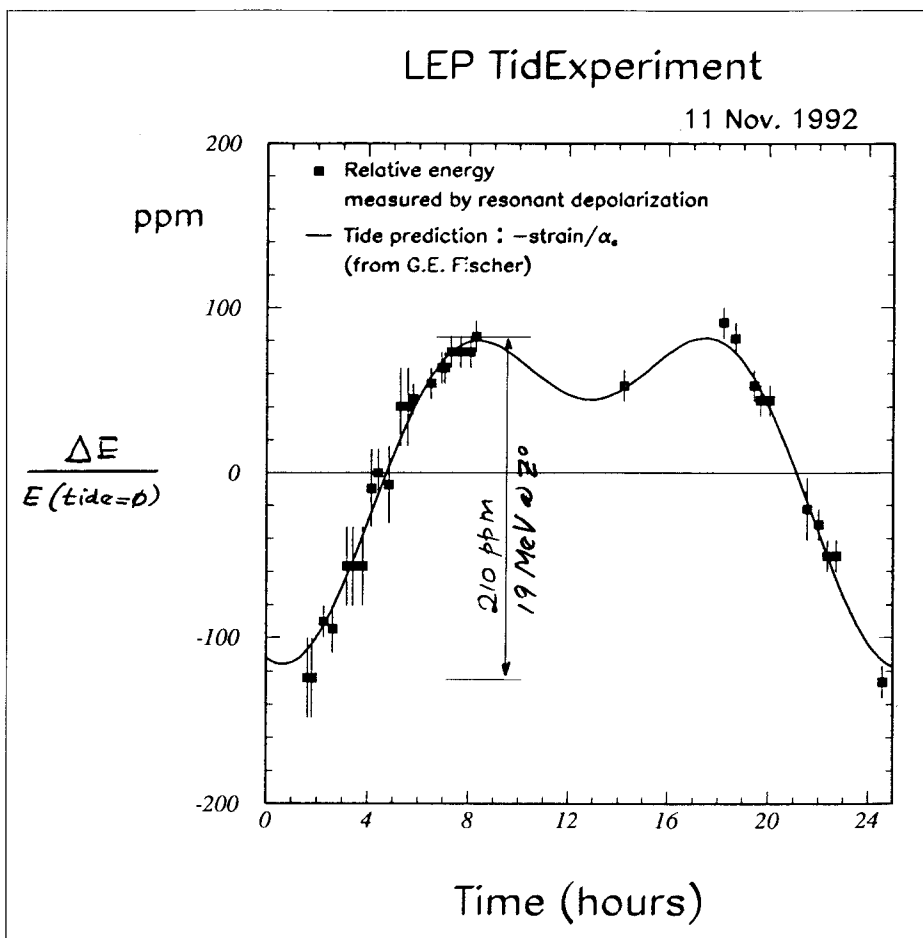
High tide at CERN. Due to the moon's gravity, the circumference of CERN's LEP electron-positron collider varies by about a millimetre over 27 kilometres. These tiny effects are amplified by LEP, producing detectable changes in the beam energy, which is measured to 20 parts in a million using polarized (spin-oriented) beams

LEP at 90°

With twice as many Z particles logged this year, the performance of CERN's LEP electron-positron collider continues to improve. Paradoxically, the improvement would have been even better had it not been for teething problems with new operating conditions which will eventually boost performance still higher.

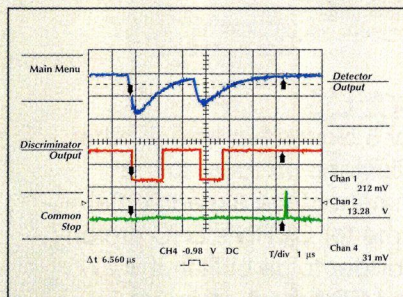
Now solidly established, these new conditions, notably the 90° (instead of the previous 60°) phase for transverse betatron oscillations, and the 'pretzel' scheme for eight bunches per beam instead of four (October, page 17), first had to be assimilated, and it took a few weeks before the LEP operating crews could add them to their full repertoire.

Collision performance (measured by 'luminosity') continues to improve. Although in principle LEP has yet to deliver its 'design' luminosity of 1.3×10^{31} per sq cm per s at any one time, its best performance to date is not far



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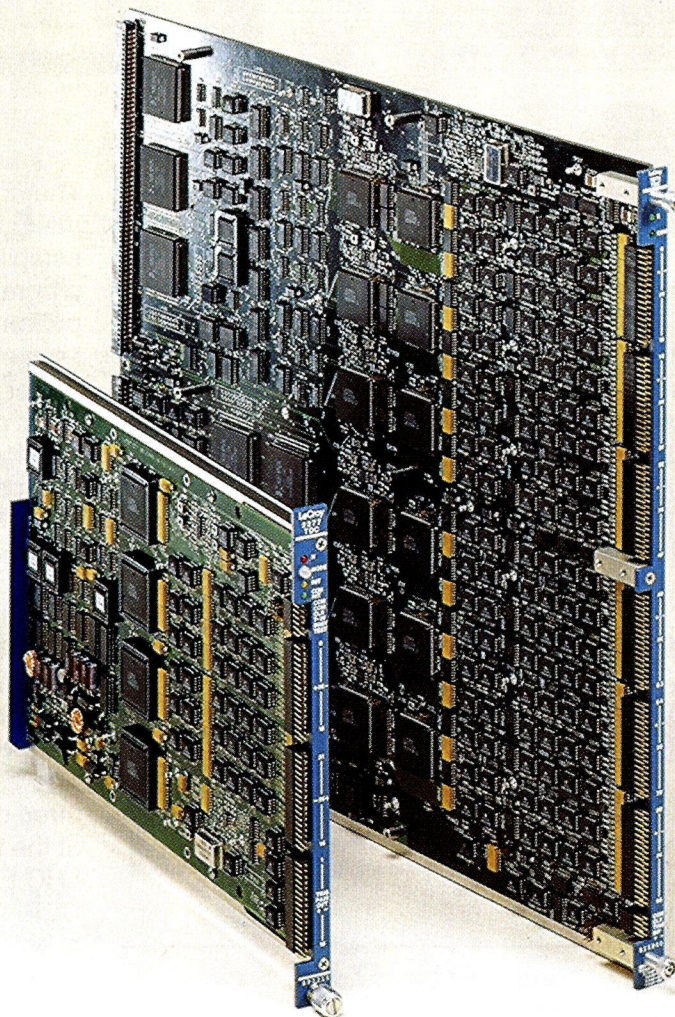


. . . since pipelining allows a trigger decision to be made up to 65.5 μs after the event of interest.

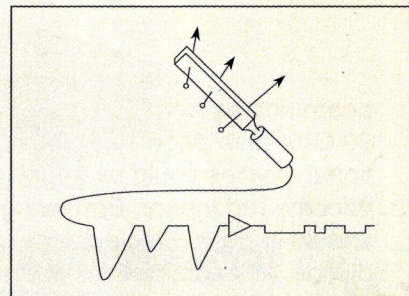
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Word (hex)	Address		Word Count	
48FF1006	Slot 9		6	
Word (hex)	Event	Chan	Time	Edge
4E0603FC	2	3	1020	-
4A070474	2	3	1140	+
4E060489	2	3	1161	-
4A07055F	2	3	1375	+
4E120369	2	9	873	-
4A130381	2	9	897	+

. . . since only hits are read out quickly (1 μs plus 150 nsec/hit in the 1876) into the 8 event buffer.

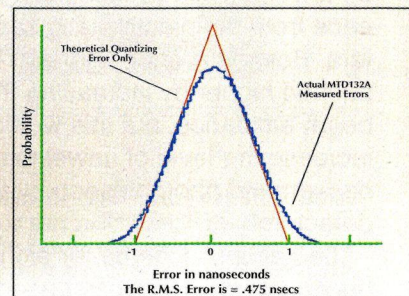


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Letters of intent

beam energy from 45 GeV towards 90 GeV (see page 1), some conventional cavities could eventually become redundant. Removing them should improve single beam conditions, at the same time liberating valuable additional klystron power for LEP200. Increasing the LEP injection energy from the current 20 GeV level delivered by the SPS should also help.

Beam-beam limitations are ascribed to insufficient beam separation as the beams get larger, to subtle differences between electron and positron behaviour, and possible orbit influence from the electrostatic separators. Beam current could also be pushed higher by increasing the beam emittance, but this would also increase the level of unwelcome background photons seen by the detectors.

The 'pretzel' scheme for eight bunch operation was first used for physics in August, but became routine in October, hopefully for the remainder of LEP's career. In principle doubling the effective electron-positron collision rate, its introduction briefly slowed the Z scoring rate as the crews had to learn new tricks, but the break-even point was soon quickly passed.

One unwelcome detail is that electron-positron differences are accentuated in pretzel mode, and additional sextupoles are being installed to compensate. Eight-bunch operation could be further optimized if it became standard right through the complicated LEP injector chain.

One disappointment this year has been the absence of polarized beams from the 90° optics. Significant polarization (spin orientation) had been seen last year (November 1991, page 12) using the old 60° optics, and opened the door to valuable precision measurements of

the beam energy. To retain this capability, a 90°/60° horizontal/vertical split could be tried, and a recent pretzel test gave encouraging results.

Thursday 5 November was another major milestone en route to the establishment of the experimental programme for CERN's LHC proton-proton collider to be built in the 27-kilometre LEP tunnel.

After initial discussions of 'Expressions of Interest' at the specially-arranged meeting at Evian-les-Bains, France, earlier this year (May, page 1), three Letters of Intent have emerged, together involving nearly 2000 physicists from research institutes all over the world. As well as these researchers listed on the documents, the plans in fact involve many additional technical specialists who work behind the scenes.

It was a historic moment as these three detector proposals were aired at the first open meeting of the new LHC Experiments Committee. CERN's main auditorium and a large overflow room receiving relayed video pictures were both packed.

The compact CMS design

