

CERN/LEPC 2000-002  
LEPC 54  
11 March 2000  
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## LEP EXPERIMENTS COMMITTEE

Minutes of the 54th meeting,  
7 March 2000

### OPEN SESSION

#### 1. Status of LEP shutdown work and summary of the 2000 Chamonix workshop

S. Myers reported on the current shutdown work and on the conclusions of the Chamonix X workshop which was held in January 2000. During the shutdown, the ring quadrupoles have been realigned vertically to an rms error of below 0.1 mm. A total of 93 horizontal correctors are now powered to operate as ring dipoles in order to increase the bending length and the beam energy. Improvements to the RF system include repair of a faulty sc module (4 cavities), re-installation of 8 warm Cu cavities and new transition pieces around the 1 GHz cavities in order to reduce heating. Conditioning of the sc cavities is underway at a gradient of 7.5 MV/m (operation at 100 GeV beam energy requires 7.0 MV/m mean gradient).

Large movements of short sections of the LEP ring are expected during the 2000 run due to civil engineering work for the LHC. The estimated movements are up to 30 mm vertically and 20 mm horizontally. Preparations have been made for frequent re-alignment of the affected sections during the run, as the need arises, in order to minimise the impact of these movements on LEP performance.

At the Chamonix workshop, the main conclusion from the 1999 run was the success of operating LEP with an unprecedented system of 288 sc cavities (+ 48 Cu cavities), reliably providing up to 101 GeV beam energy. A major interruption of LEP in 1999 was caused by a water leak into a cryogenic plant which cools the ALEPH superconducting solenoid and the insertion quadrupoles. However, despite an extensive maintenance campaign during the present shutdown, no leak has been found. Another cryogenic problem resulted in a progressive reduction of cryogenic power during operation of the system which cools the superconducting cavities. This required the plants to be heated up periodically for de-icing (an 8 hr operation every 2 weeks). The same procedure may be necessary this year.

Several incremental improvements in beam energy are anticipated in 2000. They include the following: more RF cavities (0.14 GeV increase), increasing the mean gradient from 7.2 to 7.5 MV/m (1 GeV), less RF margin (a gain of 0.74 GeV is possible by allowing a maximum of only 1 klystron to trip without losing the beam, rather than the present 2 klystron margin), reduced RF frequency (0.7 GeV) and more bending length (0.2 GeV). A special GPS-based fast timing system is being installed to provide the precise timing necessary to diagnose the cause and effect of RF trips and beam loss. A better understanding of the loss mechanism is expected to result in a reduction of the frequency of these beam losses. The mini-ramp scheme should also prove effective for reaching the ultimate energies. The integrated luminosity may be further improved by a shorter turn-round time. How many of these potential improvements are realisable in practice will only be known during the run itself.

## 2. Report of the heavy flavour working group

E. Barberio presented a report on the work of the heavy-flavour working group, which includes representatives from SLD and CDF in addition to the four LEP detectors. Impressive progress was reported for a broad range of b physics, including oscillations ( $\Delta m_d = 0.476 \pm 0.016 \text{ ps}^{-1}$  and  $\Delta m_s > 14.3 \text{ ps}^{-1}$  at 95% CL), b branching ratios, lifetimes of the b mesons and baryons, and CKM matrix elements ( $V_{cb} = (40.2 \pm 1.9) \cdot 10^{-3}$  and  $V_{ub} = (4.0 + 1.2 - 1.7) \cdot 10^{-3}$ ). A global fit of the CKM matrix is underway, revealing substantial advances in the knowledge of the unitarity triangle in the  $\rho$ - $\eta$  plane. As well as drawing on a broad experimental community, the heavy flavour group is working closely with theorists to remove the theoretical limitations to interpreting the experimental results.

## 3. LEP2 physics jamboree

ALEPH	P. Dornan
DELPHI	C. Mariotti
L3	M. Grünewald
OPAL	R. McPherson

The short in the ALEPH TPC has been repaired; the culprit was a small carbon fibre.

The combined LEP value for the W mass now has an error of 49 MeV, including systematic errors. (No evidence for systematic effects due to colour reconnection has been seen in the  $WW \rightarrow 4q$  channel.) When combined with the Tevatron value, the error on the direct W mass measurement is now 38 MeV, which is the same precision as for the indirect W mass measurement from LEP and SLD. New theoretical calculations of the WW cross section are lower than the previous values by 2-3%. This was anticipated by the experimental data from LEP, which had remained systematically below the theoretical expectations. There is now excellent agreement between experiment and theory.

Lower mass limits on the SM Higgs of 103-107.7 GeV (95% CL) were reported. The lower mass limits on the lightest Higgs of minimal SUSY (h,A) are 79-92 GeV per experiment for large values of  $\tan \beta$ ; the low  $\tan \beta$  range (0.8-1.5) is excluded by all experiments. At the last LEPC meeting DELPHI reported an excess of events in the  $eeqq$  final state at  $ee$  masses near 50-56 GeV. However this has not been confirmed by the other experiments and appears to be a statistical fluctuation.

## CLOSED SESSION

**Present:** R. Cashmore, J. Colas, M. Delfino, F. Gasparini, N. Harnew, K. Hübner, P.O. Hulth, P. Igo-Kemenes, P. Janot, L. Jonsson, J. Kirkby (secretary), W. Lohmann, M. Mangano, C. Matteuzzi, R. Miquel, S. Myers, L. Pape, D. Schaile, Y. Sirois, A. Smith, M. Spiro (chairman), R. Tenchini.

**Apologies:** M. Doser, T Müller

### 1. Approval of the minutes of the 53rd meeting

The minutes of the 53rd meeting (LEPC 99-9/LEPC 53) were approved without modification.

### 2. Chairman's report

The chairman welcomed the chairmen of the Higgs (P. Igo-Kemenes) and SUSY (L. Pape) working groups to the meeting (see item 4). The dates for the "LEP Fest" are now fixed for 10-11 October 2000. The LEP Fest will be preceded by a special reception for politicians and the

press on the afternoon of 9 October . The LEP Fest will include talks on the LEP machine and detectors, and on the physics from the final run. There will also be talks to celebrate the contributions of LEP to physics during the last 12 years. An organising committee chaired by the research director for collider physics has been set up, and input is welcome. A web page will shortly be announced where people can obtain more information and complete an informal registration form if they plan to attend.

### 3. Discussion on the LEP machine report

The committee was pleased to hear the schemes to increase the energy of LEP a little further. The improvements may add 1-3 GeV to the beam energy beyond 100 GeV. The aim of the machine team will be to try to reach the peak energy as quickly as possible since the performance of the sc cavities is highest early in the run. However worries were expressed about the anticipated tunnel movements which will now occur during the run rather than in the downtime as previously scheduled. Although the effects on LEP performance are unknown, the committee appreciated the preparations that are in place to rapidly re-survey and adjust the affected ring components when any movement or deterioration is observed.

De-icing of the cryogenic plants will be necessary during run, requiring 8h every 2 weeks; this time can also be profitably used for pulsed processing of sc cavities and Z calibration data if required. It was reported that the possibility of operating LEP with 2x2 bunches rather than the present 4x4 was discussed at Chamonix but rejected for reasons that included poor injection characteristics and uncertainty in any possible overall gain of integrated luminosity. The committee was pleased to hear the progress with the beam energy calibration. There are now 3 methods of comparable precision—NMR extrapolation (20 MeV precision), spectrometer (15 MeV), and  $Q_s$  vs. RF voltage (20 MeV)—which will allow important cross-checks to be made.

### 4. Discussion on the reports from the heavy flavour working group and the LEP experiments

The committee was impressed by the quality of the b physics results reported by the heavy flavour working group. It also admires the wide collaboration of the group, which includes theorists and experimentalists from LEP, SLC and the Tevatron. The range and quality of the b results from LEP has proved to be far beyond what was originally foreseen, such as, for example, the contributions of LEP to the CKM matrix elements.

The committee congratulated the LEP experiments for their impressive physics results presented in the jamboree, reflecting the excellent operation of LEP in 1999. Important progress was noted in calculating the higher order corrections to the WW cross section, which has resolved the previous discrepancy between theory and experiment. Brief status reports were presented in the closed session from the chairmen of the Higgs and SUSY working groups. The combined SM Higgs lower mass limit is now 107.9 GeV (95% CL). An on-going analysis in the SUSY working group of the combined supersymmetric  $\tau$  channel ( $\tau^+\tau^- + \text{missing energy final state}$ ) appears to show poor agreement with background expectations. The committee looks forward to hearing the latest developments on this and other physics at the July LEPC meeting.

### 5. Report from the LEP coordinator and strategy for the 2000 energy schedule

The LEP coordinator reported on the proposed strategy for LEP operation in 2000, after consultations with the LEP machine team and experiments. The machine will start with RF work during the day and Z calibration data during the night. The planned Z calibration data comprises  $2.5 \text{ pb}^{-1}$  at the start of the run and  $0.5 \text{ pb}^{-1}$  near the end.

For high energy running, the first priority is to optimise the machine for the SM Higgs since this has the highest discovery potential. This implies running at a total energy of at least 200 GeV—and higher as the run progresses. If, for some reason, the maximum energy of the ring falls below 200 GeV during the run then the priority is either a) machine development to cure the 200 GeV limitation and push the energy even higher, b) machine development to improve the calibration of the beam energy, or c) switch LEP off to save energy if the repair takes longer. Any days lost will be used to argue for extending the run into the two-week LEP reserve in September. In the event of new scientific or technical developments, this energy strategy can be revised by the research director in consultation with the appropriate parties. The energy strategy will, in any case, be reviewed at the July LEPC meeting and re-optimised for the remainder of the run.

## **6. Next LEPC meeting**

The date of the next meeting of the LEPC is **Thursday, 20 July**. The primary purpose of this meeting is to look at the combined search results from the run in progress. This will allow decisions to be made on the optimum energy strategy for the rest of the run and on any possible extension of LEP. In addition to presentations from the search working groups (Higgs and SUSY), the open session will include a machine report and short reports from each of the four experiments.

J. Kirkby