

CERN/LEPC 98-9  
LEPC 50  
13 November 1998

## LEP EXPERIMENTS COMMITTEE

Minutes of the 50th meeting,  
12 November 1998

### OPEN SESSION

#### 1. LEP2 performance

G. Roy reported on the performance of LEP2 during 1998. Operation at  $\sqrt{s} = 189$  GeV with 102/90 optics has been very successful. The peak performance figures are a luminosity of  $1.0 \times 10^{32} \text{ cm}^{-2} \text{ s}^{-1}$  and an integrated luminosity of  $3.4 \text{ pb}^{-1}$  per 24 hr per experiment. An injected current of 6.2 mA is routine and beam-beam tune shifts as high as 0.075 have been measured. A total integrated luminosity of  $196 \text{ pb}^{-1}$  was delivered at high energy, and  $3.2 \text{ pb}^{-1}$  was delivered at the Z for calibration data. Detector backgrounds have in general been low except for some background "storms" that have appeared in ALEPH and DELPHI. However these are now better understood and controlled.

The sc rf system has operated very reliably in 1998, causing only 12% of LEP's down-time. During the present shutdown an additional 16 sc rf cavities (assembled from spare parts) are being installed at LEP, bringing the final total to 288 sc rf cavities and 48 warm Cu cavities. In addition the LEP2 cryoplants are being upgraded from 6 to 12 kW dynamic load as part of the LHC programme. All the sc rf antenna cables in the Nb-film modules (272 cavities) are being replaced during the current shutdown. As well as curing the beam current limitation of 1998, this has the benefit of a 40% reduction in HOM impedance and, in consequence, a small reduction in the heat loading on the cryogenic system. It is expected that high energy operation of LEP in 1999 will start at a beam energy of about 96-97 GeV and then the energy will be gradually raised by increasing the sc rf gradient.

#### 2. Future LEP operation

On behalf of the Director General, who unfortunately could not be present, L. Foà clarified the situation regarding future LEP operation in the event of a major discovery. Following further discussions since the last LEPC, the possibility of re-starting LEP after an extended break for LHC civil engineering is excluded. The only viable possibility would be an extension of LEP by a few months beyond the presently-scheduled shutdown in September 2000. However, any extension of LEP would require an unambiguous and major discovery since it would delay the LHC and involve extra power costs and considerable penalties for delaying the LHC civil engineering contracts.

The Research Director took this opportunity to congratulate the LEP team on behalf of the Director General for the impressive performance of LEP this year. Since this marked their last LEPC as Director General and Research Director, he also thanked the LEPC for its vital role in the scientific direction of CERN. He emphasized the importance of the independence of CERN's experimental committees, and the scientific continuity they guaranteed for CERN through transitions in management.

#### 3. Theoretical uncertainties in the W mass reconstruction

V. Khoze summarised the status of the theoretical uncertainties in the W mass measurement due to colour reconnection and Bose-Einstein effects. These are the main systematic uncertainties in the

W mass measurement at LEP2 and together they may now exceed the statistical error. The current best estimates are about 25 MeV uncertainty from colour recombination and 20 MeV from Bose Einstein effects. The effects can only be investigated through Monte Carlo models since they depend on the effects of event selections and reconstructions. Further progress will require detailed studies with the LEP experimental data of event shape variables.

#### 4. Reports from the LEP experiments

ALEPH	E. Lançon
DELPHI	V. Ruhlmann
L3	R. Clare
OPAL	D. Plane

All experiments reported successful data taking and many new results. The EW results, including WW cross section and limits on anomalous couplings, all agree well with the standard model. After including the data collected this year, the statistical error on  $M(W)$  should be about 40 MeV from the combined LEP experiments. Each experiment has observed about 20 ZZ events corresponding to a cross section of about 0.6 pb. These events represent an irreducible background to the Higgs search near the Z mass. However preliminary Higgs mass limits of 94-95 GeV were reported, now above the Z mass and into a region of improving background. Many searches for new physics were reported but without evidence for any signals. However there were substantial improvements of up to 10 GeV in the exclusion limits for new particles. All experiments requested that LEP be operated at the highest energy in 1999 while maintaining good luminosity. Furthermore, energy changes are acceptable and should preferably take place as early as possible in the high energy run.

#### CLOSED SESSION

**Present:** R. Cashmore, J. Colas, M. Doser, L. Foà, F. Gasparini, N. Harnew, K. Hübner, P.O. Hulth, P. Janot, L. Jonsson, J. Kirkby (Secretary), K.-H. Kissler, W. Lohmann, M. Mangano, C. Matteuzzi, R. Miquel, T Müller, S. Myers, L. Pape, L. Robertson, Y. Sirois, A. Smith, P. Sphicas, M. Spiro (Chairman), R. Tenchini.

**Apologies:** D. Schaile.

##### 1. Approval of the minutes of the 49th meeting

The minutes of the 49th meeting (LEPC 98-7/LEPC 49) were approved without modification.

##### 2. Chairman's report

The Chairman joined with the LEPC in congratulating the LEP machine team for the superb performance of LEP this year.

Concerning Z calibration data, following lengthy discussions in previous LEPC meetings, the 1999 LEP schedule will include a 2.5 pb<sup>-1</sup> sample at the start and a further 0.5 pb<sup>-1</sup> sample near the end of the year.

The Chairman reported that the possibility of further sc rf cavities at LEP2 beyond the present number of 288 is completely excluded by the 18 month delivery time for new cavities.

The Director of Accelerators reported that the LEP beam energy is currently limited to a maximum of 100 GeV by the LEP INB Convention. Steps are being taken with the French authorities to relax this limitation before next summer.

### 3. Discussion on the LEP machine report

The committee was highly impressed by the operation of LEP in 1998. Many performance records for the machine have been broken, including a delivered luminosity of  $200 \text{ pb}^{-1}$  which exceeds this year's goal by one third. Despite its size and complexity, the sc rf system is performing highly reliably. The repair of the antenna cables offers an improved luminosity/energy margin at the highest energy. An average accelerating gradient without beam of 6.8 MV/m has been achieved for the entire Nb/Cu sc rf system. This gradient provides enough accelerating voltage to reach 100 GeV per beam, but with no safety margin; after a systematic improvement programme during the shutdown it is hoped to reach an average of 7.0 MV/m to allow stable operation at 100 GeV.

The committee appreciated the concerted effort of the LEP machine team to reduce the luminosity spread among the four experiments. At the time of the September meeting the range of delivered luminosities was  $\pm 7\%$ , and it has now been improved to  $\pm 5\%$ . The committee stressed that priority should be given on maximizing the luminosity at LEP summed over all four interaction regions, and acknowledged the continued efforts of the LEP team to bring the weaker interaction regions up to the same level as the best. The committee was pleased to hear that the detector backgrounds had largely remained low despite the high beam energy and the consequent steep increase in synchrotron radiation. The experiments are indebted to the LEP machine team for the great success of the collimation and masking scheme.

### 4. Discussion on the physics and experimental reports

The committee thanked the experiments for presenting their preliminary results at 189 GeV and complimented them on the high quality of the results, especially considering the short time available since the end of data taking. The committee noted the comments raised in the open session on the possible need to improve and extend some of the Monte Carlo generators. It encourages further communication between the experiments to expose such problems and find solutions, perhaps within the framework of a small workshop. The need was stressed to maintain a diversity of generators to reflect the theoretical uncertainties. Concerning the working group results, the committee supports the approach that seems to have developed in which the combined results from the *previous* year are available for the winter conferences (Moriond, La Thuile, etc.), and some preliminary combined results from the *current* year are available for the summer conferences (Rochester, Lepton Photon, etc.).

Following the requests of the experiments in the open session, the committee recommends that the goal in 1999 be to operate LEP at the highest energy consistent with maintaining a high integrated luminosity. This implies a gradual increase of LEP energy during the early part of the year, at a rate to be decided by the LEP machine team. If things go well, it is hoped to reach a total energy of 200 GeV well before the end of the year.

The committee discussed the possible extension of LEP beyond the scheduled shutdown date in September 2000. A decision to extend LEP would require rapid feedback from the experiments - possibly including the combined results from all four. After an extensive discussion it was decided that a LEPC meeting will be held in the second half of July 2000 at which the experiments will be invited to present the results from their latest data. Exceptionally at the same meeting, the working groups will be invited to present the combined results of the latest data from the four experiments. This will require that the experiments release their new results to the working groups a sufficient time - about one or two weeks - in advance of the LEPC meeting. The July date for this special meeting is chosen for two reasons. Firstly it is the latest possible date that a decision to extend LEP could be taken (this remains to be confirmed), thereby allowing the maximum input from the final LEP data. Secondly, depending on the results presented, it allows for a possible decision to operate LEP in a high failure-risk mode during the final weeks to squeeze out the ultimate energy.

## 5. Report from the LEP Coordinator

The LEP Coordinator reported on LEP2 operation during 1998 and the status of the beam energy calibration. LEP performance since the last LEPC in September had exceeded expectations, and on average  $15 \text{ pb}^{-1}/\text{week}$  had been achieved rather than the estimated  $10 \text{ pb}^{-1}/\text{week}$ . The LEP2 luminosity above WW threshold now comprises  $23.4 \text{ pb}^{-1}$  at 161-172 GeV (1996),  $73.8 \text{ pb}^{-1}$  at 181-184 GeV (1997) and  $196.4 \text{ pb}^{-1}$  at 189 GeV (1998), totaling  $293.6 \text{ nb}^{-1}$ . This leaves about  $200 \text{ pb}^{-1}$  in 1999-2000 to reach the original LEP2 aim of  $500 \text{ pb}^{-1}$  per experiment above WW threshold.

Concerning the beam energy calibration, the required  $1 \mu\text{m}$  measurement precision had been achieved with the beam orbit monitors of the precision beam spectrometer. The remaining parts of the spectrometer - including a steel dipole whose field is mapped to  $10^{-4}$  precision - are presently being installed at LEP and the full system will be operational when beam returns in 1999. Considerable progress has also been achieved by the energy working group in understanding the flux loop/NMR measurements. Beam polarisation has been achieved at a new record energy of 60 GeV. The increased lever arm provided by this measurement will help in studying and reducing the uncertainties associated with the presumed linearity of the NMR extrapolation technique.

The draft schedule for LEP in 1999 is to start physics on 10 May and stop on 25 October. The number of days for LEP operations is about 160. The final date is limited by power costs; the two weeks immediately following the scheduled stop are kept in reserve in case of an unforeseen interruption of LEP operation earlier in the year.

## 6. Any other business

At the close of the meeting, the Research Director warmly thanked the outgoing LEP Coordinator, Paris Sphicas, for his excellent work and welcomed the new LEP Coordinator, Patrick Janot, who will start on 1 February 1999.

## 7. Next LEPC meeting

In order to avoid a conflict with an ECFA meeting, the date of the next meeting of the LEPC is **Wednesday 24 March**. The tentative dates for the LEPC in the remainder of 1999 are

7 - 8 September  
9 - 10 November.

Jasper Kirkby