Minutes of the 198th Energy Calibration Meeting held on 29 August 2000

1 Q_s measurements

Anke-Susanne Muller reported on the status of the Q_s programme this year. Measurements of the longitudinal loss factor and inverse bending radius have given results close to expectation. The error on the inverse bending radius, however, is larger than had been anticipated from feasibility studies and is not sufficiently small to enable the related uncertainty on the energy measurement itself to be reduced. Repeated measurements may well help.

At the time of the meeting no actual energy measurement had been successfully performed (a first attempt was corrupted by RF trips). However, good data were successfully recorded during the evening following the meeting. A first look at these data shows the unexpected and previously unseen feature that the voltage calibration factor appears to have an energy dependence. This needs to be verified by future measurements.

In conclusion, the Q_s measurement is proceeding well but can certainly benefit from further machine time.

2 Spectrometer analysis

Esther Barbero-Soto presented an analysis of the dependence of BPM gains on current, particle type, year etc. Clear systematic dependencies are seen.

John Matheson presented an analysis of the 1999 spectrometer data. For the three good fills of Eric's analysis (6397, 6432, 6627) he obtains compatible central values. John's analysis includes a first complete look at the internal BPM consistency of these data – indeed they are significantly better than a typical measurement in 2000, but they are not perfect (the error bars as conventionally defined are ~ 15 MeV). John agrees that a card swap performed in fill 6509 leads to unusable data.

Progress! Eric Torrence realised that the RF sawtooth correction for the positron fills had been applied with the wrong sign. Correcting for this error results in a promising degree of consistency emerging for these measurements, as is shown in figure 1.

It was decided that a forthcoming RDP measurement should be exploited to include the following spectrometer tests:

- A swap of the cards of BPM 1 and 3.
- Disabling (in software) two correctors on the e^- side which are new this year.

This measurement has since occured (fill 8368, with RDP at 41, 50 and 55 GeV). The preliminary results are included in figure 2. It can be seen that it is not significantly different from the other electron fills.

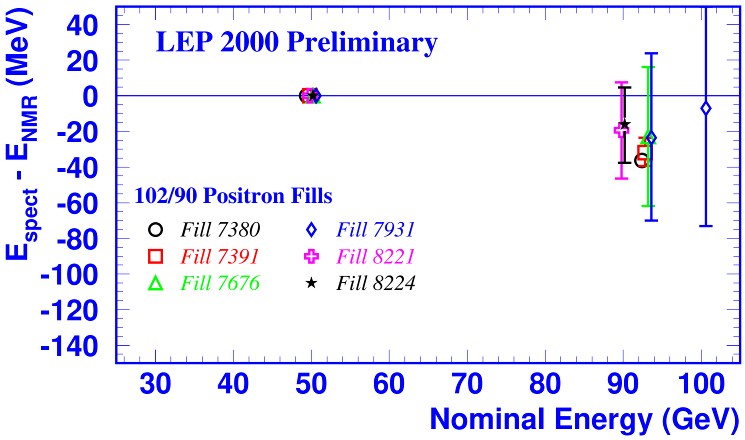

Figure 1: Eric's analysis of the year 2000 positron fills, with corrected RF sawtooth bug.

It was noted that the ambient field in the 'field-free' arm region is larger this year than last year. This may be a contributing component in the BPM inconsistency, IF it enters with the correct sign... to be checked. Plots produced by Bernd Dehning of the field as measured by the two flux-gates are appended to the minutes. Two new flux-gates are now on order to map out this field in more detail.

3 NMR and flux loop analysis

There has been work since the meeting on the NMR-RDP fits and the 2000 flux loop data.

Including the most recent fill there are now 5 RDP experiments in 2000, encompassing 12 points between 41 and 55 GeV. Fitting the NMR data to these points shows a 'banana' not dissimilar to previous years, show in figure 3.

Calculating the energy in physics with the calibration coefficients determined with the 2000 data, and comparing with the energy obtained with coefficients from a fit to the 97-99 data, gives a difference in beam energy of 8 MeV. This is somewhat larger a shift than has been seen for similar exercises in previous years. In order to ensure that it is genuine it is desirable to make another RDP calibration at 55 GeV.

A message from Pete Renton is included in the transparencies detailing the flux loop analysis. An offset (RMS) of -2 (16) MeV is seen at physics energy.

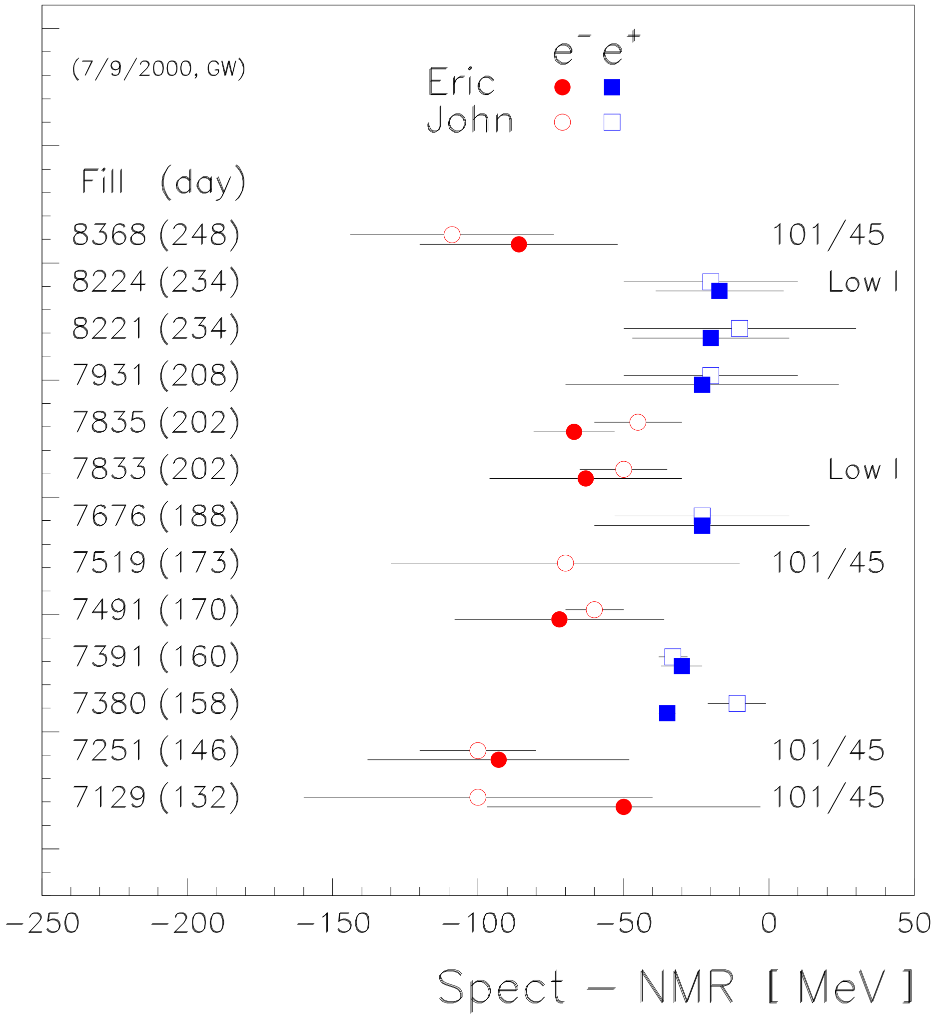

Figure 2: Plot of spectrometer-NMR for a 50–(90)93 GeV ramp. The error bars show the spread in result obtained when using different combinations of BPMs to calculate the bend angle. All fills with 102/90 optics, unless indicated otherwise.

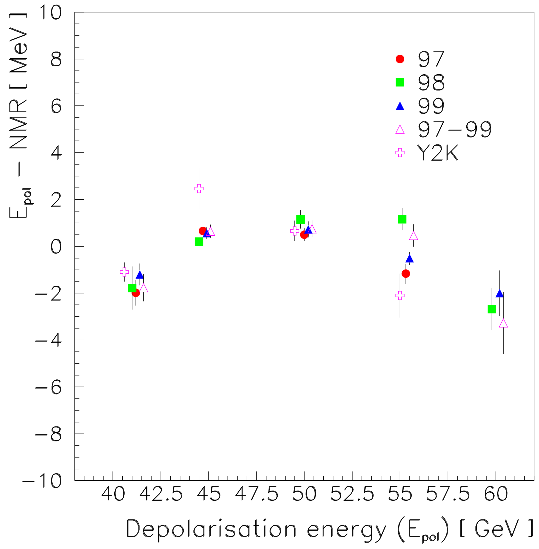

Figure 3: RDP-NMR residuals vs energy for all of LEP2.

4 LEPC

In view of the end-of run and forthcoming special LEPC meeting, it was agreed to contact the LEPC chairman and experimental spokesmen, explaining the difficulties with the ECAL this year, and pointing out that increased machine time could be used fruitfully. Subsequent to the meeting the below message was agreed and sent.

Dear LEPC chairman and spokesmen,

We wish to inform you of the status of the LEP energy calibration for m_W, and hope that you can find time to discuss the issues we raise in the meeting on Tuesday 5 September.

As you will recall the assigned error on E_{beam} at high energy is presently 20 MeV, and is set by the indirect method of magnetic extrapolation. During 1999 and 2000 we have commissioned and developed two alternative methods of calibration, the spectrometer and the synchrotron tune vs energy loss (Qs measurement). With these we can measure E_{beam} in a direct manner and with very different systematic uncertainties. Our goal has been to achieve a *watertight* measurement of E_{beam} with a 10-15 MeV error, and thus ensure that this component contributes a minor uncertainty to the final LEP W mass measurement.

Our first results with the spectrometer in 1999 were very promising. This year, however, we have encountered severe problems. Internal inconsistencies appear in the measurement of the bend angle with the Beam Position Monitors when ramping to high energy. Generous allocation of machine time has enabled us to learn more about this behaviour, and to eliminate various possible causes, but a proper understanding and solution still eludes us. We would welcome further time to continue our investigations.

Prior to 2000 the Qs measurement had returned an uncertainty of 20-25 MeV on E_{beam}. Significant contributions to this error come from imprecise knowledge of machine parameters, which can be improved by measurements with beam, and from a 'statistical' component, which will therefore reduce in size with repeated measurements. The Qs programme this year is proceeding well, but there is still scope for reducing the total error, and any further machine time this measurement receives is beneficial.

Should it be decided that LEP will indeed stop on September 30th, we believe that spending a significant period of time on energy calibration in the last few weeks of operation will benefit the W mass measurement, and thus ask that this work be given higher priority than has been possible hitherto. Alternatively, if the run is extended, we ask that you endorse continued calibration measurements in parallel with high energy operation, as has been the model so far.

We can of course supply you with more information, should you require any.
best wishes,

The LEP energy calibration group

5 Next meeting

Friday 15 September – to be confirmed.

Guy Wilkinson, 6 September 2000.