Minutes of the 106th Energy Calibration Meeting held on 27 September 1996

1 Progress with understanding temperature coefficients

Enrico Bravin presented new results using the LEP dipole in the ISR tunnel which give information on the temperature behaviour.

The first investigation was the effect of temperature on the "initial field" when the magnet is ramped after degaussing. Each 30 minutes, the magnet goes through a degauss cycle and is then ramped to a steady value. The temperature is slowly varied between 22 and 30 deg, by modulating the cooling water temperature. Observations:

- The initial field is strongly correlated with temperature. The temperature coefficient is measured to be 6.4E-5 /deg.
- The magnetic field rises during the 30 minutes after setting
- An empirical correction for the temperature gradient within the magnet (estimated by the difference in temperature between the cooling water in and out) improves the description of the initial temperature.

This investigation was followed by long term tests, where the magnet current was kept constant while the temperature varied (with only occasional degauss cycles, indicated by vertical lines on the plots). A model to describe the field as a function of temperature was derived, taking into account the initial field as above, which depends on the initial core temperature and the input water temperature, and in addition the maximum and minimum temperatures reached by the magnet since the last degauss. (A future test is needed to observe whether it is temperature since degauss or temperature since ramping that is more relevant.) A total of 5 temperature coefficients are therefore needed.

A first look at the NMR data for initial field in a fill compared with temperature was also shown. These include a correction for the gradual drift of field for NMR4 during the year, and show coefficients of around 3–4 MeV/deg (i.e. around 8E-4/deg). The effect in octant 3 (i.e. for NMR4) could be due to the evolution of humidity through the year.

The degauss/initial field measurements should be similar to the temperature coefficient measuremnt in 1991 which was obtained using the flux loop to find the ring temperature coefficient (measured to be 10E-5/deg). The lab measurement from 1992 where the magnet was heated and then the coil inserted would give rise to a completely different temperature distribution within the magnet (value measured 12E-5/deg). The observed complications of the temperature behaviour indicate that this measurement is much less relevant to the real situation in the tunnel.

After discussion, the following tests were thought to be useful:

- Resolve question of whether temperature since ramp or temperature since degauss is most relevant
- Attempt to mimic the temperature behaviour in the tunnel as closely as possible
- Apply the more detailed model that has been evolved to data from the tunnel

2 1996 Status - memo to experiments

The following memo was sent to the experiments after the meeting, to summarise the 1996 situation
From: The LEP Energy Working Group
To: The LEP Experiments and the LEP Electroweak Working Group

Status of the LEP energy calibration for 1996

The LEP Energy working group discussed the status of the 1996 energy measurement in its meeting on Friday 27 September. The preliminary beam energy released for the summer conferences was:

Ebeam = 80.65 +- 0.1 GeV

Subsequent polarisation measurements around 45 GeV, together with an extrapolation based on flux loop or NMR data, yield a consistent value of Ebeam for the high energy data. However the single preliminary polarisation measurement at 50 GeV shows a discrepancy with the NMR and flux loop measurements of 30 MeV. With a naive linear extrapolation this would imply a correction of around 180 MeV (Ebeam) at 80 GeV. The polarisation measurement at 50 GeV was not entirely without ambiguity, so at this stage the flux loop and NMR extrapolation is thought to be more reliable. The 50 GeV polarisation calibration should be repeated during the next running period in order to understand this discrepancy. This is not only needed for the W mass measurement using 1996 data, but more importantly to understand how to make a precise energy calibration in the future.

The energy group therefore recommends:

1) To continue to use the preliminary number Ebeam=80.65 +- 0.1 GeV at this stage

2) To perform an end of fill polarisation MD during the Z running at the beginning of the next running period (to allow calibration of the next data, and in addition to check the effect of correctors which at present lead to a large error in the Z width from 93-95 scan data)

3) To repeat the polarisation measurement at 50 GeV (with experimental solenoids turned off) at the end of the running period using the 90/60 optics (on Sunday 3 November)

3 Further details of status of analyses

The NMR data has been added to the dst's on hpplus.

Joerg Wenninger plans to make further cross checks of the consistency between NMR's and flux loop during the cold checkout at the start of the next running period. At present the NMR and flux loop predictions agree to 10 MeV at 80.5 GeV for the most plausible choice of normalisation procedure, with a spread of 30 MeV for different procedures.

The RF model requires further measurements of the alignment of cavities to resolve one of the largest systematic uncertainties. So far the position of one SC cavity has been measured using a pair of Cu cavities at IP6 and a pair at IP2 as reference, with a 2.5mm shift in position betwen the two measurements. This will be investigated while the new SC cavities are being phased in.

The requests for polarisation measurements are summarised in the memo above. The end of fill MD during the Z running should also allow a check of whether polarisation data are consistent with a saturation effect in the dipole model. This will partly be a spin off from trying different corrector settings and returning to the original setting in between. If necessary an extra couple of hours MD to check the saturuation behaviour could be taken. A polarisation MD to investigate the "quiet period" between midnight and 5am will not be requested in addition.

Enrico noted that the recording of the absolute current on the beam pipe will be commissioned in the next running period.

4 Next Meeting

The next meeting will be at 15:00 on Friday 11 October in the pavillon. Note that we return to the usual post-scheduling meeting time. This meeting should include a discussion of the draft paper on 1993–1995 calibration.

Pippa Wells, 1 October 1996.