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LEP SPECTROMETER PROJECT

Summary Notes of the 22^{nd} meeting held on December 10, 1998

Present: C. Bovet, D. Cornuet, B. Dehning, R. Genand, M. Hildreth, N. Hilleret, W. Kalbreier, J. Montes, G. Mugnai, A. Müller, Y. Muttoni, S. Myers (chairman), J. Poole, J. Palacios, F. Roncarolo, M. Sassowsky, E. Torrence, J. Wenninger, W. Weterings

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Comments to Summary Notes of previous meeting - Bernd noted that it should be emphasised that the the "gating"mode of running the BOM electronics will probably be essential in determining some of the systematics of the measurement, and that more emphasis should be placed on them.

Orbit Matching between the Spectrometer and LEP BOMs - J. Wenninger showed some studies he has made using the LEP BOMs to extrapolate the measured orbit to the Spectrometer BOMs to look at correlations, resolutions, etc. He does this by fitting a betatron oscillation plus an energy offset term through the LEP orbit on either side of the spectrometer. Technically, he actually fits the *difference* between a "reference" orbit and other orbits later in a fill, to avoid unkind dependences on errors in the optics description. He has done this for one of the physics fills (5237, 1st October) where the Spectrometer BOMs were running in the higher-resolution "ungated" mode. Fitting the average e^+e^- orbit over 15 LEP BOMs gives 10 an average error on the predicted position at the spectrometer of about 10 μm in the horizontal plane, and $\sim 5\mu$m in the vertical. He sees a clear correlation of the predicted position with the measured one on the second Spectrometer BOM station (LSP2), with the residuals being consistent with the accuracy of the LEP prediction, i.e. 10 μm. He extracts a calibration coefficient of 1.71 μm/mV, which is very similar to numbers obtained by E. Torrence. Similar agreement is seen in the vertical plane. On the first BOM station (LSP1), good correlation of the beam orbit motion is seen, but there is also a drift of approximately 30 μm relative to the LEP BOMs over a 4 hour period. The BOM data from LSP3 is not available because this station gives no reading when running in ungated mode; the e^+ and e^- signals effectively cancel. Joerg has made his orbit-fitting program easily usable; it is expected that this will be extremely useful next year in calibrating the spectrometer installation and watching drifts.

More Discussion of BOM Electronics Performance - M. Hildreth showed data from the last Polarisation MD fill of the year (5337, 19th October), where the BOMs were run ungated at 65 GeV beam energy. Since there was only one beam in LEP, the pickup at LSP3 has an orbit measurement, so a triplet residual can be formed to measure the BOM resolution, albeit at a somewhat lower energy. When this is done, a value of 0.8 μm is found, over a time period of about 5 hours. There is evidence for a drift of 0.1 μm per hour somewhere in the system, as a clear trend can be seen in the residuals. This can be compared with the resolutions of 5 to 7 μm that we have seen in the "gated" data, which is far away from the resolution of 100 - 200 nm seen by BERGOZ on their simulator of the BOM setup. We still do not understand the differences between the testbench measurements and what is measured, either gated or ungated, in the tunnel. We have the BERGOZ simulator, and measurements are

planned. Meetings are planned next week to discuss the situation with BERGOZ. We would, however, like to have the possibility of measuring both beams simultaneously, as this will probably be crucial to establishing some of the systematic errors. We will press BERGOZ to provide this.

Progress on the 1999 Mechanical Design - Y. Muttoni gave an overview of the design and fabrication of the elements for the 1999 installation. The following items have are all in the workshop, to be completed the 21st of January: the stone blocks for the support, the absorbers, the pickups, the pickup and absorber supports, and the stone blocks for the quadrupole chamber support. Still left to be finalised are the designs for new cooling around the pickups, adjustable supports for the wire sensors and their fixation, lead shielding around the wire sensors, and a new "heat shielding" box cover for the pickups. A smaller group will meet to discuss the design changes. The design of the lead shielding for the new cooling station has been "outsourced" and drawings are expected shortly.

One issue that was raised was whether or not the installation of the MBI would interfere mechanically with the pickups and absorbers, which are foreseen to be installed in the LEP tunnel earlier than the MBI. W. Weteringswill investigate.

First Results from the Mapping in the ISR - D. Cornuet showed some of the first measurements made with the MBI dipole in the ISR. Primarily, his presentation concentrated on the potential effects of slightly-magnetic components in the mapping arm and its supports. The stationary reference NMR placed near the pole face of the dipole can see a change in the magnetic field it measures due to the passing of the hall probe supports, the support arms for the mapping arm, and some magnetic elements in the mapping NMR. Of these, by far the largest effect is due to the mapping NMR, which overlaps with one of the support arms longitudinally (see attached plots), which changes the local field by 8×10^{-4}. Once the elements have passed, however, the local field returns to its previous value within the NMR precision, which also implies that the field mapping will not encounter problems, because there will be another set of reference NMRs at the other "end" of the dipole. Didier estimated that the residual effect on the local field from one pass of the probe should be 0.2×10^{-6}, based on a test made with a large piece of steel. Since the MBI is degaussed after a couple of maps at different energies, this effect should not be a problem. In any case, more tests will be made.

Installation of Reference NMRs in MBI - G. Mugnai gave a report on the progress in finding suitable locations in the MBI to install the reference NMR probes. The overall goal in placing the probes is that they sit in a local field with a gradient less than 10 milli-Gauss/mm, which is a relative error of 1×10^{-5}. The main problem encountered so far is that, due to the way the laminations are stacked into "packets", the uniformity of the magnetic field near the lower pole face is not very good. The main effect of this is that the Type II NMRs have trouble locking at low (45 GeV) field. To counter this effect, two sets of reference probes will installed, one set of Type I and one set of Type II probes. This may have the added benefit that we may not need to change the probes during the year; since the high range of the Type I probes is at polarisation energy, and the high range of the Type II probes is at physics energy, the degradation of the signal quality at the low range of the NMRs due to synchrotron radiation will have little effect. The probes themselves will sit 3.5 mm from the pole face, which is higher than they have been in the past. This means that the vacuum pipe will have to be placed off-centre in the dipole. It is an open question whether it is optimal

for the beam to pass through the centre of the magnet, and hence, off-centre in the vacuum chamber, or centred on the vacuum chamber.

Overview of the Mapping Analysis Software - J. Palacios showed the first results from his analysis of the one map of the dipole that has been made so far, mainly as an overview of the features of his analysis program. His software takes the data files produced by the DAQ in the ISR tunnel and makes an analysis ntuple as well as several diagnostic plots. He showed the consistency of the NMR and Hall probes during the first map. The Hall probes and the NMRs show the same overall structure in the field, which varies (relatively) by 10^{-3} over the length of the dipole, but the Hall probes seem to drift around by quite a bit, with relative changes of 2.5×10^{-4}. This is bigger than expected, and is under investigation. A selection of plots from Juan's code is included.

AOB - S. Myers mentioned that Germany had given $500,000$ DM to the spectrometer project. We've already spent this, but it will help CERN cover the total cost of the project.

The next meeting will be on Thursday, 14th January, 1999.

M. Hildreth