

## Summary of a Meeting on Beam Energy Measurements at JINR Dubna from 30.05. to 01.06.2006

Present :

O. Brokov, V. Duginov, N. Morozov, V. Romanov.

E. Syresin, B.Zalikhonov (DLNP JINR Dubna)

R. Makarov (MSU, Moscow)

B. Maiheu, A. Liapine (University College London)

K. Hiller, H.J. Schreiber, M. Viti (DESY)

V. Nikoghossian (Yerevan)

N. Muchnoi (BINP, Novosibirsk)

The meeting covered the following topics:

- End Station A (ESA) activities at SLAC
- Synchrotron radiation for the beam energy measurement
- Compton backscattering (CBS) for the beam energy measurement
- Resonance absorption method for the beam energy measurement
- The use of electric field of the electron bunches for the beam energy measurement

The topic on **End Station A** activities at SLAC started with a talk of A. Lyapin on the BPM based spectrometer as expected for the ILC. This talk was followed by three talks from Dubna (N. Morozov, V. Romanov, and O. Brovko) on the magnet activities for the test bench. Some details on magnet activities in Dubna and plans for ESA are given in Appendix A. B. Maiheu gave a status report on the ESA test run in April 2006 and A. Lyapine reported on the BPM development at UCL. It has been agreed that Dubna performs simulation studies of the SPEAR magnets for ESA, participates in the test runs in July and will be involved in the B-field measurements. It is intended to provide the equipment of the vibrating wire technique for B-field measurements at SLAC in 2007. DESY takes part in the test runs at SLAC and the B-field measurements. Analyzing the data from the April run is welcome. UCL will analyze the data from the April run, install a further BPM triplet and performs simulations on the ESA beam optics. On May 31 there was a telephone conference with SLAC (M.Woods), and a summary is given in Appendix B.

The **synchrotron radiation** topic started with a talk from K. Hiller on GEANT3 simulations, followed by R. Makarov using GEANT4. E. Syresin reported on some open points based on Makarov's simulation and on further activities. J. Schreiber summarized the situation of the present draft for a publication and what is worthwhile to do within the next two years. It is agreed to finalize the paper in summer of 2006. R&D for the gas detector with the Ni plates and tests are expected from the Dubna group within the next years. The Si-detector cannot be covered

by the collaboration; other groups are very welcome to account for this topic. The simulation studies (with GEANT3 and GEANT4) will be continued by Dubna and DESY including the detector.

The basic idea of the **Compton backscattering** (CBS) and its possible application for the ILC was presented by J. Schreiber. N. Muchnoi reported on recent measurements of the beam energy based on this method at BNPI, Novosibirsk, followed by J. Schreiber with a talk on the latest results from simulation of CBS for the ILC. BNPI (Novosibirsk) is interested to join this study and is very welcome. A detailed report on CBS application for ILC beam energy measurement is expected in one year.

V. Nikogossian talked about the feasibility of the measurement of the electron energy by the method of **resonance absorption** of photons in a magnetic field. He suggested to perform a 'proof of principle experiment' at the Yerevan accelerator. Detailed informations on this proposal are expected at the next meeting.

E. Syresin and B. Zalikhanov reported on the use of the **electric field** of the ILC bunches for the beam energy measurement. The idea of this method was presented, but its technical realization needs more investigations.

The YerPHI invites the collaboration to next meeting in Armenia for the second half of October. The invitation was accepted, but further details have to be discussed in accordance with the expected test measurements at SLAC in fall of 2006.

The presentations of the meeting and the summary are accessible on the web-page

<http://www-zeuthen.desy.de/main/html/aktuelles/workshops.html>

We thank Bino Maiheu for writing the Appendicies.

Dubna, June 01, 2006

V.Duginov and H.J. Schreiber

## Appendix A: issues on magnet activities in Dubna

Nikolay Morozov introduced his magnetic simulation work using the TOSCA program. He is comparing simulation results from this program and the MAFIA program. Initial results show that TOSCA is not so optimistic about magnetic field uniformity as MAFIA. Nikolay showed us around a test stand as well which can be used for performing fieldmaps. It uses a high accuracy linear encoder ( $\sim \mu\text{m}$ ) and consists of a massive table of about 5 m in length. Hardware and readout software are close to being finished. He reported as well on a test measurement for a technique using a vibrating wire to measure  $\oint B \cdot dl$  with an accuracy of 0.1 G · cm. Some more mechanical and hard/software details were given by Viktor Romanov and Oleg Brovsko. Discussion with Nikolay Morozov and Sergei Kostromin:

- The price to manufacture an eventual magnet for the spectrometer at Dubna would be on

the order of k\$30 for a 1.5 m long magnet without instrumentation. Roughly the price scales as \$10/kg of iron, Nikolay informed us. The total design and manufacturing takes on the order of a year, with roughly 3 months design phase and acquirement of the raw materials and 9 months of manufacturing.

- Nikolay provides us with a huge archive of internal notes in electronic form about magnet design and magnetic measurements in general.
- Nikolay proposes a combination of NMR probes for measuring the total dipole field as they can only operate in limited gradient fields and have a relative accuracy of  $10^{-5}$ , and Hall probes to measure the edge fields with an accuracy of  $10^{-4}$ . He proposed to complement this measurements with a system based on induction coils. A detailed description of this method is found in the internal notes he provided us with.
- Sergei Kostromin's work basically involves simulation and tracking of particle bunches through the chicane. He is adapting a Mathematica-based code which is used for cyclotron calculations. So he is now working on changing the coordinate system to cartesian coordinates. This code does an integration of the full equations of motion, without any approximations or simplifications. His code is also able to use a real field map as measured or as simulated from TOSCA by Nikolay. It will be good to compare and cross check results with work done in the UK.

## Appendix B: summary of the phone conference with SLAC

The following main items were discussed during the phone conference :

- Mike Woods provided a timescale for the magnet work at SLAC. The old H-type magnets which are available at SLAC will undergo refurbishment. Where the pole faces need to be machined, the water cooling and the electric connections need to be hooked up and checked together with the coils themselves. This will be done mid to late September. The mapping of the field can start after that, so in October and will be done by Michele Viti (DESY), Sergei Kostromin and Viktor Romanov (Dubna), assisted by people from the workshop at SLAC. The installation of the magnets in the end station will occur in December, so a first testrun with beam can be performed in January of next year.
- The magnets are approximately 45 inches long with a 10 inch wide pole face. The idea is to run them at 1 kG and a dispersion of 5 mm. We want to have the integrated field stabilized using a feedback system at the  $10^{-3}$  level and monitor the field using NMR probes at the  $10^{-4}$  level.
- The technical drawings of these magnets, provided by Ray Arnolds, were passed on to Nikolay Morozov, who will implement an initial simulation using TOSCA in order to find out an optimal placement for the probes. After the refurbishment this simulation will have to be refined.
- As to equipment we will need to acquire
  - **NMR probes** for the dipole field.
  - **Flux Coils** for monitoring of the stray field.

Dubna has equipment available for long term stability measurements, temperature/current stabilisation etc. People at SLAC will look into what is needed and come up with a list.

- An issue brought up by H.Juergen Schreiber about whether or not it makes sense to measure the field inside the beampipe. As the idea for the end station tests is to investigate relative stability of the energy measurement and only to a lesser extent have an absolute measurement, this is probably not important. TOSCA simulations from Nikolay Morozov can estimate eventual effects.
- Sergei Kostromin and Viktor Duginov will come to SLAC join for the July testrun. We need to make sure that the invitations from SLAC for Sergei Kostromin and Viktor Romanov reach Dubna two months before the test measurements in October are planned.
- The question arose whether it is possible to measure 0 integrated field. Dubna experts will bring a flux-gate magnetometer to SLAC and investigate this option during the mapping of the field. A vibrating wire technique can also be used for this but this setup is only available next year. It can however be moved to SLAC.
- For a next phone conference, an alterative conferencing system would be preferred.