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1 The present programme

1.1 DAΦNE

The DAΦNE team is to be congratulated once again on a highly successful period of operation, having attained a new record luminosity, completed the delivery of 2 fb^{-1} on the ϕ resonance, and carried out the energy scan around the ϕ peak.

Besides this culmination of the KLOE run, the Accelerator Division also provided beams for synchrotron light users and the Beam Test Facility. Among a number of activities undertaken in collaboration with other laboratories, Division members recently participated in the very satisfactory commissioning of the delay loop for CTF3 at CERN and agreed to design and build the vacuum chambers for the CTF3 combiner ring. Taken together, these activities amount to a substantial and impressive programme.

A number of very interesting and valuable accelerator physics results were also obtained on DAΦNE, illustrating the potential of this small yet flexible machine as a test-bed for new ideas. Among these, the study of the bunch-length variation with negative momentum compaction is of particular value as a test of key design principles of DANAE. The compensation of the long-range beam-beam interactions also yielded very promising results.

A number of short-term upgrades are underway during the shutdown while FINUDA is prepared. The removal of the ion-clearing electrodes in order to reduce the electron ring impedance should bring a gain in luminosity. However, reconditioning may be necessary following the exposure of the chamber to air.

The Committee endorses the short-term upgrade plans.

1.2 KLOE

We acknowledge the impressive results obtained by KLOE: accurate measurements of $K_S \rightarrow 3\pi^0$ (best limit), $K_S \rightarrow \pi e \nu$ (including the charge asymmetry), $K_S \rightarrow \pi^+ \pi^-$, $K_L \rightarrow \pi l \nu$, K_L lifetime, $K_L \rightarrow \pi^+ \pi^-$ (leading to an accurate determination of $\text{Re}(\epsilon)$), $K^+ \rightarrow \mu \nu$, and crucial CPT tests ($\text{Re}(y)$ and $\text{Re}(x)$), obtained via the Bell-Steinberger relation.

We also look forward to the measurements of $K^+ \rightarrow \pi^0 l \nu$, the K^+ lifetime, and $\text{Im}(x_+)$, which are expected to be finalized very soon. Measurements of $K_S \rightarrow \gamma \gamma$ and $K_S \rightarrow 3\pi^0$ are also coming along.

Spectroscopic studies are very advanced. In the light scalar sector, $\phi \rightarrow f_0 \gamma$ has been studied to understand the model dependence and the role of the sigma (2001-02 data). Improvements are expected with the 2004-05 data.

η s are also being studied ($\eta \rightarrow 3\pi$, limits on $\eta \rightarrow \pi^+ \pi^-$).

In view of the successful completion of the data taking, the Committee endorses KLOE's requests for the needed increments of the computing resources. The Committee congratulates KLOE for the excellent performance of the offline system, which allows very effective data reduction. However, the Committee has some concern about whether the collaboration has all the human resources to fully exploit the physics potential of the available data set.

1.3 FINUDA

The Committee heard the FINUDA Status Report, where the main emphasis was on results about deeply-bound kaonic states (DBKS). An update on the missing mass analysis with the outgoing proton presented at the previous SC was shown. This has been recently submitted to Nucl. Phys. A for publication. The suggested interpretation of the observed peak at a proton momentum of ~ 510 MeV is $K^- d \rightarrow p \Sigma^-$, where the d is a constituent of the target. The invariant mass analysis $K^- pp \rightarrow \Lambda p$ (published in Phys. Rev. D) was also updated with looser cuts. Some 'non resonant' events then appear at an invariant mass lower than that for the 'signal' but the level and shape are not predicted and this weakens the observation of the 'signal' with the looser cuts.

Alessandra Filippi is now the collaboration analysis coordinator of the DBKS analysis

The current scheduling for the forthcoming run foresees good data taking by the end of September. This appears fully consistent with the planning for FINUDA installation and accelerator commissioning. The Committee recommends that FINUDA start exercising the DAQ as soon as possible, including cosmic-ray studies before the beam becomes available, in order to be fully ready by mid-September.

The Committee regrets that FINUDA did not comply with the request from SC31 for a complete and concrete layout of the physics goals for the run, in particular the definition of a clear strategy concerning DBKS studies. The Committee therefore reiterates this request, in view of the recommendations for the planning of the 2007 DAΦNE run to be taken at the next meeting. The Committee requests a written document, to be made available by end of October, containing a properly worked-out proposal for physics studies to be carried out with the new data, including analysis strategies and physics goals to be achieved with different amounts of integrated luminosity, supported by corresponding MC simulations of the anticipated results.

1.4 SIDDHARTA

The Committee was pleased to hear in discussions with Carlo Guaraldo that the preparations are proceeding well and according to plan, in a manner consistent with the scheduled time frame. The experiment confirmed its readiness for a physics run in early 2007.

2 The future programme

2.1 The physics case

The physics programme outlined in the three EoIs and LoIs submitted (KLOE2, AMADEUS and DANTE) is very important, solid, and compelling. It will offer unique opportunities for new and improved SM measurements in the sectors of flavour and of strong interactions, as well as for the exploration of the limits of the SM and of its foundations. Higher-statistics running at the ϕ peak will improve the knowledge of kaons, possibly exposing anomalies consistent with the presence of new physics, and will probe with unmatched sensitivity possible violations of CPT and decoherence phenomena in Quantum Mechanics. No other facility worldwide, either existing or planned, would be able to carry out this part of the physics programme, which the Committee strongly supports. AMADEUS also appears to be an ideal experiment to explore and study in detail the physics of possible deeply-bound kaonic states using the high kaon statistics available.

The access to higher collision energies promised by DANAE will open complementary possibilities, most notably the measurement of $R(e^+e^-)$ at the 1% level or better, the exploration of $\gamma\gamma$ reactions and the associated opportunities for scalar meson studies, and the measurement of proton and neutron time-like form factors. The measurement of R would lead to a determination of $\alpha_{EM}(M_Z)$ with the accuracy necessary to match the precision of future electroweak data from the ILC. While a comparable accuracy may also emerge in the future from other experiments (e.g. BES, VEPP2000, or the Super-B factory), the relevance and difficulty of the measurement are such that performing it at DANAE is highly desirable. The opportunity to perform this measurement by itself justifies the effort to increase the DAΦNE beam energy.

2.2 Accelerator R&D

2.2.1 DANAE Letter of Intent

The Committee takes note of the DANAE Letter of Intent. This document is an evolution of the DAΦNE-2 proposal that was presented at the last meeting and represents significant progress towards a Technical Design Report. Changes in the collider parameter list, notably the beam-beam parameters, have allayed most of the concerns about extreme parameter values expressed at the last meeting. The layout is also better adapted to the existing building.

Given its close relationship to the present DAΦNE, with which it shares some components, and where critical tests of some key design principles can and have been carried out, the DANAE design can now be regarded as well founded at its present stage. However, further work remains to be done to further flesh out the details and to ensure that the required values of all performance parameters can be attained simultaneously. The DANAE team and their collaborators are well equipped to carry out the necessary simulation studies.

The superconducting wigglers contribute significantly to the cost and operational complexity of DANAE, the more so as they must be constructed with great care. However, it is difficult to see how the required performance could be attained without them. Besides increasing the radiation damping to a useful level, they provide important flexibility in adjusting emittance and other beam parameters. Therefore it is important to pursue design studies, particularly on the problem of absorbing the synchrotron radiation power (there may be some common ground here with recent studies for the CLIC damping rings).

The Committee reiterates its remark at the last meeting that additional staff and a rejuvenation of the Accelerator Division will be essential, particularly if the DANAE project goes ahead. To

attract talented young physicists and engineers, the laboratory will need to ensure that the accelerator programme offers a mix of challenging and innovative opportunities.

2.2.2 DAΦNE Upgrade

The Committee heard an outline of the new “crabbed-waist” concept and how it could lead to a substantial luminosity gain if implemented in the present DAΦNE, possibly for the SIDDHARTA run in 2007. If this is successful, the DANAE project might be adapted to exploit the concept in its extended energy range. Another option might be to continue to operate DAΦNE in this mode to provide a phase of higher luminosity at the ϕ resonance, postponing the upgrade of the magnet system for higher energy.

However, it is clear that the short-bunch scheme used to boost luminosity in DANAE, as described in the LOI, and the long bunches used by the crabbed-waist scheme cannot be used simultaneously. We suggest that both options be kept open for as long as resources and the DANAE schedule allow. Other ideas such as the strong RF focusing should receive some consideration on the same basis.

At present, there is little documentation available and it would be premature to evaluate the crabbed-waist idea in detail. The Committee strongly encourages P. Raimondi and collaborators to produce not only a technical report defining the possible implementation in DAΦNE but also a scientific paper exposing the principle for discussion in the accelerator community. The former document is needed rapidly for planning and implementation within the LNF. Rapid evaluation and testing of the idea at DAΦNE may be important also in view of potential applications to other colliders.

Nevertheless, as presented to the Committee, the idea is elegant and appears very promising, potentially opening up a new high performance regime for e^+e^- colliders. The fact that the beam-beam simulations of leading independent experts in other labs are reported to confirm the results is a strong further argument in favour of according it a high priority in the R&D plans of the laboratory.

Provided that the essential DANAE design activities are sustained in the meantime, there appears to be little risk that implementing the test in DAΦNE in 2007 would delay the DANAE project.

Finally, we remark that this is a good example of work on innovative ideas that should help to make the laboratory more attractive to young researchers.

2.3 The experiments

2.3.1 KLOE2

The Committee was impressed by the Expression of Interest presented by the KLOE2 collaboration. The KLOE2 physics programme is based on an integrated luminosity of 50 fb^{-1} or more to be collected at the ϕ peak, and a smaller additional sample to be collected during a scan in the energy region between 1 and ~ 2.5 GeV. This increase in luminosity and energy will open new prospects relative to the goals achievable by KLOE with the present data sample. These include reaching *significant* sensitivities in the studies of entangled neutral kaons, measurements of rare K_S decays, tests of lepton universality in leptonic charged-K decays, and more accurate probes of the η/η' system. At energies above the ϕ peak, KLOE2 plans to measure the total cross section, achieving an accuracy better than 1%, and to explore the physics of $\gamma\gamma$ collisions and scalar mesons.

The required detector upgrades are a minor additional investment compared to the cost of KLOE. They include a vertex detector, an increase in the EM calorimeter granularity, and very forward electron taggers required for the $\gamma\gamma$ studies. Upgrades or replacements in the trigger/DAQ must also be decided upon and implemented. The Committee is satisfied with the overall assessment of needs and options presented in the EoI, and encourages the collaboration to continue its preparatory work.

2.3.2 AMADEUS

The presentation of the AMADEUS project in the open session was well received. As an exploratory prerequisite, a search for possible deeply-bound antikaon-nuclear cluster events formed in interactions with the helium of the KLOE drift chamber during KLOE running is being prepared. The Committee was impressed by the excellent coordination between subgroups of DEAR/SIDDHARTA and KLOE members in pursuing this dedicated search, which has been preceded by detailed Monte Carlo simulations. At the present stage of discussions concerning antikaon-nuclear bound systems, it is clearly of prime importance to get independent confirmation of the previously reported signals from KEK experiments, and of the indications from the FINUDA data. Further developments will strongly rely upon a complete analysis of the decay channels, with special emphasis on K^- absorption on nucleon pairs leading to hyperon-nucleon final states. The Committee looks forward to a report on the analysis of the KLOE drift chamber data.

The Committee was also very pleased with the MC studies performed on the neutron detection efficiency of the KLOE calorimeter, and looks forward to the results of the planned test-beam measurements, as well as to an update on the AMADEUS project, at the next meeting.

2.3.3 DANTE

The Committee considers the measurement of the form factors and their phases a very desirable element of the future physics programme of DANAE, as underscored by the large international participation in the DANTE LoI. The Committee welcomes the addendum to the DANTE LoI, where new details on the physics programme are presented and the requirements to perform the form factor measurements with an upgraded KLOE detector are discussed. The necessary vertex detector appears to be well matched by what is being proposed in the KLOE2 EoI. Likewise, the studies by AMADEUS presented above indicate that KLOE appears well fit to match the required neutron detection efficiency. The geometry of the KLOE2 detector makes it conceivable to incorporate the carbon polarimeter necessary for the study of the form-factor phases. Discussions during the meeting, however, made it clear that operations with the polarimeter installed would strongly impact KLOE2 performance, and simultaneous data taking at high energy for both the form-factor and total cross-section measurements is impossible. The Committee takes note of the DANTE interest in participating in the full physics programme at high energy, including the study of $\gamma\gamma$ collisions and the measurement of the total cross section. The Committee encourages the DANTE collaboration to strengthen its contacts with KLOE2, with the aim of actively participating in the planning and implementation of the detector upgrades relevant to the high-energy runs as a first step toward establishing the conditions for a run dedicated to the form-factor measurements.

2.4 Conclusions

The Committee is convinced that a strong physics case has been put forward in the present EoIs and LoIs, and strongly endorses the laboratory proposal to pursue the required R&D for the DAΦNE and DANAE upgrades. The ongoing and planned R&D efforts underline the high international profile of the LNF accelerator programme, with the potential of leading to breakthrough developments of great impact on the future of accelerator-based HEP worldwide.

The Committee considers peer review and experimental test of the crabbed-waist optics as the greatest priorities, and urges the Accelerator Division to promptly produce the technical documentation required to proceed with planning and acquisition of the hardware needed for the experiment. The Committee strongly recommends that this experiment be performed at the earliest possible opportunity in 2007, with installation of the IR starting during the first major shutdown.

Work on DANAE should continue where necessary (i) to evaluate the potential integration of the crabbed-waist optics into the DANAE upgrade programme (including the energy upgrade), (ii) to validate the design of critical systems such as the superconducting wigglers and feedback, and (iii) to resolve the outstanding questions of beam physics related to performance.

The Committee recognizes that the KLOE2 upgrade is an indispensable component of the physics programme, and that the KLOE2 physics goals are sufficiently strong and complete to justify the efforts for the accelerator upgrade in both luminosity and energy.

The Committee is very pleased with the ongoing efforts by the AMADEUS and DANTE collaborations to study the integration of their detector requirements within the KLOE2 design, as requested in the SC31 recommendations, and encourages them to continue working in this direction. The Committee recognizes nevertheless that a more complete integration at the level of the collaborations is required for these joint efforts to materialize. This includes contributions to the development, construction, and maintenance of hardware and software, as well as the readiness to assume responsibility for the detector operations and offline efforts. The Committee encourages steps in this direction, and calls on the laboratory management to closely monitor and facilitate this process.

3 Other issues

3.1 Synchrotron light programmes

The Committee welcomes the institution of a Scientific Committee for the synchrotron light programme (SLSC). This will better coordinate the rich activity of the laboratory in this sector, and provide the necessary expertise to guide the future intensification of these efforts. The Committee observes that the increase in dedicated DAΦNE running time may interfere with the anticipated new phase of high-luminosity particle-physics experiments, and recommends that the SLSC chairman be invited to future SC meetings when the strategic planning of the laboratory in this direction will be discussed.

3.2 Gravitational wave searches

The Committee takes note of the interesting results that have emerged so far from the study of coincidences between the Nautilus antenna, located at LNF, and the Explorer antenna, hosted at CERN. The Committee looks forward to the implementation of additional coincidences in the context of worldwide activity to extract conclusive evidence for gravitational wave signals, and commends the efforts by the INFN groups to lead these efforts.