40th MEETING OF THE LNF SCIENTIFIC COMMITTEE

FINDINGS AND RECOMMENDATIONS

INTRODUCTION

The Scientific Committee welcomed Prof. Avraham Gal, from the Hebrew University of Jerusalem, who had just joined the Committee, and thanked former member W.Weise for attending the meeting in order to transfer information to A. Gal. The Director M. Calvetti as well as observers U. Dosselli and F. Ferroni could not attend the meeting.

The Director’s report was given by the Assistant to the Director V. Muccifora. As usual, the Committee discussed the status of photon science activities and of the DAΦNE experimental program. Two new proposals had been received, for a new round of experiments on kaonic atoms (SIDDHARTA 2) and for an experiment on kaon scattering, embedded in the KLOE detector (IKON). The proposals were presented in the open session and discussed in closed session. At this meeting the status of all four experiments at the LHC was discussed, following the presentations given in the open session.

1. NEWS FROM THE LABORATORY

V. Muccifora first addressed the status of LHC experiments, which are in a very active phase due to the recent startup of the LHC. The laboratory is striving to strengthen its computing facilities. The ATLAS group has infrastructure similar to that of a Tier 2, and ALICE has a Tier 3 computer farm.

SPARC and FLAME activities are strongly supported by the lab and progressing well; however the lack of manpower is significantly hurting operations.

The first priority of the Research Division remains the KLOE experiment. Its future beyond 2012 cannot be discussed until a government level decision is made about the SuperB project.

A meeting to discuss future Laboratory projects was held on June 11 (www.lnf.infn.it/11giugno). A study for an energy upgrade of DAΦNE – to at least 2 GeV in the c.m.s. – was presented. This possibility drew broad support from physicists both inside and out of the laboratory. In order to firm up the energy and the cost estimate, currently in the range of 10 M€, a prototype of a superconducting main dipole must be developed.

The SC welcomed the fact that the study for the DAΦNE upgrade is jointly authored by the DA and by the KLOE community. Of course, more technical work is needed for an in-depth discussion. The SC encourages the Laboratory to continue this study and in particular to develop the superconducting dipole prototype In general, the laboratory's projects should not be paralyzed by the absence of a decision on the SuperB project; on the contrary, good strategic thinking requires preparing for more than one outcome. The SC would like to be shown a more detailed proposal for a DAΦNE upgrade at its next meeting.

2. PHOTON SCIENCE

Prior to the SC meeting, JR communicated with the SPARC project leader M. Ferrario and with L. Palumbo, the SPARX project director. A number of scientific, technical and management issues related to these projects were covered. The findings are as follows:

2.1 SPARC

After having achieved a major milestone in 2009 by demonstrating lasing in the SASE mode, SPARC has accomplished further remarkable progress after the Oct. 2009 meeting of the SC:

- The gain of the free-electron laser operating in SASE mode was further improved by optimizing the velocity bunching, a longitudinal bunching technique developed at SPARC.
- Seeding the FEL process was demonstrated at 266 nm, using the 3rd harmonics generated in a gas cell from a 800 nm wavelength laser pulse. Also, the second harmonics at 400 nm was generated by a nonlinear crystal resulting in a much larger pulse energy and thus in larger seeding power. The observed FEL gain was very large in both cases, most likely in the saturation regime for the 400 nm seed, indicating that seeding was very efficient.
- Demonstration of the so-called afterburner mode by tuning the last undulator module to 133 nm, the 2nd harmonic when the seeded wavelength is 266 nm. Similarly, when seeding at 400 nm, 5 subsequent undulator modules could be tuned to 200 nm reaching very high radiation power (30 μJ pulse energy) plus observation of 3rd harmonics at 67 nm. This is normally clear evidence of getting into the FEL saturation regime.
- Some 100 MW of THz power was generated in a dedicated beam line, making use of velocity bunching. This THz radiation could in principle be readily offered to users. It is pointed out that there is a rapidly growing world-wide user community for THz radiation, mainly making use of the fact that this is non-ionizing radiation, see, e.g., http://tera.kture.kharkov.ua/ and http://www.lightsources.org/cms/?pid=1000680
- A novel and very promising "laser comb" technique was experimentally established, generating two electron pulses separated by a tuneable interval of approximately 1 ps.

All of these achievements are world-class and prove the excellence of the team has been formed, and that cutting-edge technology is under control at SPARC. The SC congratulates the project leader and his entire team on these impressive results.

The timing stability has been investigated and significant expertise accumulated. The timing jitter between the electron beam and the rf master clock is approximately 200 fs. This is within specifications, but insufficient for future (pump-probe) user requirements, for SPARX operation and for experiments with FLAME (e.g. plasma acceleration) which may all call for 10 fs resolution.

In parallel, impressive electron diagnostics has been established, proving the ability to determine bunch slice properties at some 70 fs resolution.

For the future, an attractive R&D program is at hand, e.g., more research on the laser comb (i.e. more than 2 pulses), studies on beam energy chirp effects, and a novel acceleration scheme using resonant excitation of plasma wake fields, applying the laser comb technique. In addition, an R&D program on timing and synchronization at the 10 fs level should be launched, most likely employing all-optical synchronization and active optical fiber length stabilization.

On the negative side, the SC is deeply concerned about the loss of almost half of the SPARC team. Six highly trained people left due to the poor outlook for positions at LNF. This is an unacceptable situation in view of the attractive R&D program for SPARC and FLAME and of the SPARX plans. It is already clear that SPARC can no longer be operated as regularly as before. There is even the danger that staffing may fall below the critical level at which operation will stop.

It is once more proposed to allocate 2-3 staff positions to the SPARC project, plus a few 3-year positions. This will not only directly help by keeping key people, but will also give a clear signal to the entire SPARC team that the FEL development is given adequate priority by LNF/INFN management.

2.2 SPARX

The advent of a formal SPARX consortium is instrumental for progress of the FEL program at LNF and should be supported as much as possible.

At this time, a proposal is being worked out towards a first stage of SPARX with 750 MeV beam energy to make use of the presently available funding of 25 M€. The SC welcomes the establishment of an international machine advisory Committee to provide advice on this challenge.

Again, it must be stressed that establishing a core team for SPARX requires the help of LNF in keeping the current SPARC team together, by supplying a few staff positions..

Establishing a strong program to attract PhD students to accelerator R&D seems to be possible and could be a key element in building up an expert team for future LNF project(s), whatever they will be. It requires, though, that an adequate number of staff personnel are available for supervision of these PhD students.

In summary, the SC points out the necessity of a clear strategy for the future of photon science at LNF. Based on this strategy, priority decisions must be made, and a plan for project organization has to be set up and made public.

2.3 FLAME

FLAME's goal is accelerator research based on extensive application of recent advances in high-power laser technology, in combination with advanced accelerator concepts. This has relevance far beyond the immediate FLAME project definition because joining laser with accelerator R&D is a key element of world wide accelerator development. It is needed in order to work with bunch structures on the micrometer scale. The Committee thus welcomes the FLAME project and strategy. Priorities are:

1. Laser-Plasma acceleration.
2. Compton backscattering, working towards a compact X-ray source.

It is noted that this is a very competitive field of research, so adequate support is needed to avoid losing momentum - and thus competitiveness - of the effort.

3. DAΦNE AND ITS PHYSICS PROGRAM

3.1 DAΦNE UPGRADES

The Committee notes with satisfaction that the success of the crab-waist and large Piwinski angle collision scheme has been recognised by publication in Physical Review Letters (PRL **104**, 174801 (2010)).

Following the comprehensive presentation in the open session, J.M. Jowett met with members of the Accelerator Division to discuss the readiness of DAΦNE for the forthcoming KLOE run and possible future options. The findings are as follows.

Preparations for KLOE run

With respect to expectations at the last meeting of the Committee, the startup of the KLOE run has been delayed. This was due to a number of factors but some procedures (notably the modifications of the DAΦNE wigglers, see below) took longer than expected. Better project planning might nevertheless have allowed some activities to be carried out in parallel. The Committee suggests that adoption of more rigorous and adaptive project planning procedures might help to avoid similar delays in future.
In the near future, it will be necessary to find a suitable period of about one month to upgrade the shielding of the DAΦNE hall.

The new vacuum chamber was inserted in KLOE in the first week of June. Compared with the previous DAΦNE interaction region configuration, this one offers better available beam aperture, better shielding for the experiment and more flexibility in orbit and optical corrections. The latter are expected to be useful in correcting any differences between the ideal and real rotations and positions of the magnetic elements and in correcting the betatron coupling to lower levels than hitherto achieved.

As previously discussed, a number of measures have been taken to mitigate the electron-cloud problem. Despite calculations indicating that temperature rises will be acceptable, some of the stripline electrodes may overheat at high beam current and, in the worst case, may have to be removed.
Soon after the start of operation, the improvements to the feedback systems will become available and should be commissioned. At the last meeting, it was mentioned that the LNF group has obtained a new electron-cloud simulation from M. Pivi at LBNL. We strongly encourage them to use the forthcoming start-up of DAΦNE as a valuable opportunity to establish clear predictions of electron-cloud effects and then test them.
The modification of the wiggler poles is a substantial change to the basic mechanical and magnetic structure of the machine and justifies the considerable care devoted to ensuring that resultant field quality is optimal, even if it contributed to delaying the start-up. A detailed review of the alignment strategy, based on calculations by S. Bettoni at CERN, and magnetic measurements by the AD was presented to the referee. The reduction of the higher-order multipoles and better reproducibility and good-field region are expected to improve beam lifetime and facilitate operation. In addition the new field profile will give a substantial saving in power costs.
The numerous improvements made to the linac have gone well; it has been operating successfully for the BTF since March.

There remain a few potential sources of problems in DAΦNE:

1. There has not been time to remove all of the old ion-clearing electrodes from the electron ring. Some further gain in luminosity might come from removing the remainder in a future shutdown
2. In the last run, two sextupoles were removed from the arcs, for the crab-waist scheme. At the time, this was acceptable. Now, however, the sextupole component of the wigglers has changed sign, so the arc sextupoles need to be stronger to compensate it. An alternative solution might be to turn the wigglers around but this involves some risk as the distribution of synchrotron radiation would change and the absorbers might be less effective.

The Committee recommends that new sextupoles be obtained and installed as soon as possible. In any case, the effects of the wigglers and sextupoles on dynamic aperture should be properly verified.
The Committee notes that DAΦNE will continue to function as a synchrotron light source and that a new beam line is due to be set up.

The Accelerator Division's projected peak (5.5×10^{32} $cm^{-2}s^{-1}$) and integrated (0.5 fb^{-1}/month) luminosities for the new KLOE run appear feasible. The integrated luminosity goal will require improvements in operational efficiency over the last run.
Operations should restart in early July but, given the time it will take to re-establish operation of the injectors and transfer lines it is unlikely that there will be much beyond a circulating beam in DAΦNE before the August shutdown. The first useful luminosity for KLOE could reasonably be expected in October. As usual, a systematic, planned and well-staffed approach to commissioning is strongly recommended.

Future options for DAΦNE: SIDDHARTA-2

The SIDDHARTA 2 proposal included statements by the Accelerator Department that the second interaction region could be modified in order to provide collisions and that the SIDDHARTA 2 detector could be accommodated there. In this layout the machine could provide collisions to either KLOE or SIDDHARTA. By removing the low-beta quadrupoles from IR2 and implementing a suitable separation scheme, there should be negligible impact on performance for KLOE. This is plausible but the details should nevertheless be fully worked out. In the opposite direction, the situation is not as clear: the presence of the magnetic elements of the KLOE interaction region optics could mean that the luminosity provided to SIDDHARTA would be somewhat less. Again, this should be properly analysed and quantified, possibly including appropriate simulations of dynamic aperture and/or beam-beam effects.

3.2 KLOE 2 INSTALLATION AND STARTUP PLANS

The KLOE referees (T. Akesson, G. D'Ambrosio, M. Cavalli-Sforza) met with the KLOE team on 24 June. The conclusions are as follows.

The KLOE-2 program consists of two phases: Step-0 and Step-1. Step-0 is essentially the original KLOE experiment plus two gamma taggers: the High Energy Tagger, HET, and the Low Energy Tagger, LET. In addition the DAQ and data processing get the necessary improvements. Step-1 in addition has three new detector systems: An Inner Tracker, a forward calorimeter CCALT and a calorimeter around the new quadrupoles QCALT.

Step-0 is expected to last one year, and starts now with a three month commissioning phase. During the year that will be devoted to step-0, the preparations for step-1 - the main motivation of KLOE 2 – will be completed.

Roll-in of the detector started in January 2010, the magnet was cooled down in May and the experiment is now closed. The situation with dead channels and available spares looks fine.

The referees did not detect any show-stoppers. As expected from the last meeting, it was decided to place the Front End Electronics for the LET in an accessible position, rather then on the detector. The final scintillators for the HET are not ready, but the insertion-mechanics is there, and some measurements will be done with a temporary scintillator.

The collaboration now faces the task of understanding the new environment of the machine and of the detector, and to get physics without major delays. Some of the milestones are to integrate the HET and LET reconstruction software, to understand the calibration strategy and to have the full MC available.

Internally to the collaboration, the transition of from KLOE to KLOE 2 has taken shape by deciding that publications using previous KLOE data, but whose analyses are just starting, will be authored by the KLOE 2 collaboration. The referees welcome this development that will further strengthen the collaboration's analysis work.

An extensive paper on the KLOE 2 physics is under preparation. A few bench-mark processes, to be investigated at startup, have been agreed upon.

Turning to staffing matters, KLOE 2 stated that they need 4-5 positions for certain crucial support-functions; the Laboratory management should to discuss this with the collaboration. They also stressed the importance of Laboratory support for infrastructure (cooling, UPS, ...) and support to the logistics of the collaboration, like office space for collaborators coming from outside the Rome-area.
In general, KLOE 2 re-iterates the importance that the priority of the KLOE 2 program be maintained – a position which the collaboration believes is well-understood by colleagues in the Laboratory at large.

A change in the layout of the Inner Tracker being built for step 1 was recently decided. The outermost of five layers was eliminated, for space reasons. This downscoping should not affect the precision of the measurement of the vertex. The development of the inner tracker is well advanced and without remaining critical issues. Layer-1 is expected to be ready for testing in December.

The collaboration is concerned about the integration of the interaction region, in particular of the inner tracker services with the components under control of the machine and the insertion mechanics. It is crucial that the necessary preparations start after the 2010 summer vacations. The KLOE collaboration and the Accelerator Division,, and in particular so-called SIM-group, should closely coordinate their activities. In the view of the referees, it may be worthwhile to build a mock-up, to check the compatibility of the different components including the services, and to demonstrate the step-by-step feasibility of the assembly of the interaction region. The full understanding of this must be ready by spring.

3.3 KLOE DATA ANALYSIS

G. Venanzoni gave a report on the KLOE measurements performed to determine the hadronic contribution to $(g-2)_\mu$. This is important to establish the SM prediction for $(g-2)_\mu$ and to compare with the experimental results from BNL E821.
Four aspects of this issue were reviewed:

- The KLOE publication, in 2008, of the hadronic cross section at the ϕ peak, $\sigma(e^+e^- \to \pi^+ \pi^- \gamma)$, with the photon emitted at small angle
- The KLOE publication, in 2009, of the hadronic off-peak cross section, $\sigma(e^+e^- \to \pi^+ \pi^- \gamma)$, with the photon detected at large angle
- The new measurement of $\sigma(e^+e^- \to \pi^+ \pi^- (\gamma))$, normalized by the measurement of the cross-section $\sigma(e^+e^- \to \mu^+ \mu^- (\gamma))$

- The relevance of possible KLOE 2 measurements of the hadronic cross sections around 2 GeV

The KLOE 2008 publication used 2002 data, with an integrated luminosity of 240 pb^{-1}, corresponding to 3.1 million $e^+e^- \to \pi^+ \pi^- \gamma$ events, with the two-pion invariant mass squared in the range 0.35-0.95 GeV^2. This analysis, together with the 2009 KLOE publication (using 2006 of-peak data) resulted in agreement with other experiments, SND and CMD-2, and strengthened and consolidated the 3.4σ disagreement with the SM prediction for the anomalous magnetic of the muon. The 2009 publication is particularly interesting because it extends the two-pion mass range investigated in the 2008 publication by probing previously unexplored low values of the two-pion invariant mass squared down to 0.1 GeV^2.

The measurement of $\sigma(e^+e^- \to \pi^+ \pi^- (\gamma))$ normalized to the measurement of $\sigma(e^+e^- \to \mu^+ \mu^- (\gamma))$ are being done with the same set of data used for KLOE 2008 analysis. Results are expected soon.

In the c.m.s. energy region above the ϕ peak KLOE 2 can again play a crucial role in establishing a possible failure of the SM in predicting $(g-2)_\mu$. To further narrow down the (dominant) error on hadronic vacuum polarization one needs to accurate measurements of the cross section $\sigma(e^+e^- \to \text{hadrons})$ at scales substantially larger than the dimuon mass.

An energy scan reaching 2 GeV in the c.m.s. would be extremely valuable for several reasons – to quote one, the direct measurement of the hadronic cross section would avoid the systematics associated to the calculation of the radiator function used to analyze the results obtained by the radiative return technique. It should also be pointed out that there results would be unique, because it will not be possible for the BES collider to obtain them.

In summary, the SC congratulates the KLOE collaboration on the excellent work on this important subject supports the KLOE 2 program to improve the measurements of the hadronic cross section with an energy scan above the ϕ peak.

3.4 SIDDHARTA

(The following three sections are based on the discussions and exchanges during the 40th LNF SC meeting of Committee members F. Linde, L. Fayard, A. Gal, and J. Zinn-Justin, together with former member W. Weise with SIDDHARTA and AMADEUS physicists.)

The Committee congratulates the SIDDHARTA team for the results achieved in the latest data-taking campaign and acknowledges the attention the collaboration paid to the recommendations of the LNF SC - notably, the detailed reporting of the run statistics and data taking conditions as well as the successful exploratory helium-3 run.

A major achievement was the precise calibration (to the level of a few eV) of the 144 independent Silicon Drift Detectors (SDDs) using copper and titanium X-ray calibration runs to equalize the response of all SDDs. The slightly worse precision for hydrogen data as compared to helium are due to the poorer running conditions during the hydrogen runs (notably the high DAΦNE related backgrounds).

Regarding the analyses of the helium-4, hydrogen, deuterium and helium-3 data samples:

- The first ever measurements of kaonic helium-4 and helium-3 of transitions to p-states using gas targets should be published in the months to come and well before the next meeting of the LNF scientific Committee. The near zero shifts are in line with expectations since p-states (as opposed to s-states) hardly probe the nuclear interior in these atoms.

- The kaonic hydrogen results require some more work, but the collaboration still expects to complete this analysis before the next meeting of the LNF Scientific Committee. The preliminary result is such that the apparent discrepancy (1-2 sigma) between the previously reported KEK and DEAR (SIDDHARTA's predecessor) measurements gets resolved i.e. the new much more precise SIDDHARTA measurement agrees within about 1 sigma with both earlier results. The new measurement also agrees well with the most precise theoretical predictions. The Committee urges the collaboration to perform a very thorough error analysis.
- Because of limited statistics – only about 100 pb^{-1} of useful deuterium data were obtained in 2009 – and poor signal/background ratio a measurement of the kaonic deuterium transitions cannot be obtained with the data in hand. The collaboration does not make any claim for a signal, but contemplates publishing the kaonic deuterium data as an exploratory study.

The Committee was pleased to learn that SIDDHARTA succeeded in attracting four PhD students from the Rome area.

3.6 SIDDHARTA 2 PROPOSAL

The aim of SIDDHARTA was to measure kaonic hydrogen and deuterium X-rays in order to explore the K^--proton and K^--neutron interactions near threshold and to make contact with QCD-based chiral approaches to low energy K^--nucleon physics. As already discussed, the latter goal was not reached.

The prime motivation for the SIDDHARTA collaboration to propose a continuation experiment, SIDDHARTA-2, is to measure the kaonic deuterium X-rays. In addition to kaonic deuterium, SIDDHARTA-2 also aims to study transitions to the s-states in helium-3 and -4 (as opposed to the previously measured transitions to p-states) as well as transitions in kaonic (and even sigmonic) atoms with higher mass numbers. The goal would be to provide theorists with a minimal, yet comprehensive set of measurements with common systematic uncertainties to explore the nuclear in-medium interactions of K^- mesons. This topic is currently under intense theoretical discussion. It will be explored in J-PARC in the coming years, but mostly by in-flight experiments. Frascati through SIDDHARTA-2 specializing in selected kaonic atoms can contribute uniquely to this frontline topic. In addition, SIDDHARTA-2 could in principle (depending on the accuracy of necessary theoretical, QED, corrections) improve the measurement of the charged kaon mass using kaonic lead transitions.

Assuming approval of the implementation of a collisions point at IR2, the collaboration proposes to install the SIDDHARTA-2 setup on DAΦNE just after this change in the machine's layout, at the time of the shutdown to install step 1 of KLOE 2. This would take place at the end of 2011 – beginning of 2012. Subsequently, the collaboration would like to take data for typically 2-3 months per year, alternating with KLOE 2 until 2014. They foresee a continuous upgrade of the setup, starting with a much improved trigger and shielding configuration giving much better signal-to-background, later instrumenting the region below the IP, possibly adding Si-PIN diodes to the already used SDDs, etc.

The LNF Scientific Committee endorses the scientific relevance of the SIDDHARTA-2 proposal, in particular the measurement of kaonic deuterium. This measurement will be feasible after the proposed improvements of the original SIDDHARTA setup, with a factor of two higher yield per pb^{-1} and at least a factor of 10 improvement in the signal-to-background ratio.

However, before the Committee can recommend Siddharta2 for approval, the following points need to be addressed in more detail:

- *Impact of the new DAΦNE interaction point:*
  Performance: is the expected luminosity for SIDDHARTA-2 as in KLOE 2 or is it significantly lower?

Schedule: does the installation work (DAΦNE machine and SIDDHARTA-2 experiment) fit in the 2-3 months time presently foreseen for KLOE2-upgrade? Does the laboratory have the manpower to carry out these tasks concurrently to the KLOE 2 step 1 installation?
Running: is it true that the switch from KLOE 2 to SIDDHARTA-2 running and vice-versa can be made in one day without retuning of DAΦNE machine parameters?

- *Optimal layout of the Siddharta2 setup.*
  In view of statistics it is important to maximize the number of detected kaonic atom radiative transitions per pb^{-1}. The Committee notes that SIDDHARTA-2 plans to also equip the downwards hemisphere. Nevertheless, the SC urges the SIDDHARTA-2 collaboration to investigate if the yield can be increased further, thereby possibly increasing the cost of the set-up but eventually allowing a reduction of the running time and hence significant savings in DAΦNE operation cost.

While these issues are clarified, SIDDHARTA-2 can already present its (hardware) funding request to INFN's CSN3 which, in case of a positive evaluation, may grant the request *"sub-iudice"*.

3.6 AMADEUS

Analysis of previous KLOE data

Most of recent efforts went into getting the KLOE Monte Carlo simulation chain to simulate exactly the events which the KLOE collaboration treated hitherto as background: capture of kaons in the drift chamber gas (and wall) . This turned out to be very cumbersome, however the latest results look very promising, as the simulated distributions appear to reproduce the measured distributions. Acceptance corrected distributions are now within reach. To limit the acceptance corrections, momentum cuts on e.g. protons and deuterons where relaxed using in addition other measurements such as those from the calorimeter, wherever possible. The various analyses were also extended to include the full KLOE data sample. The Committee looks forward to receive the first (draft) publication(s) by its next meeting. At that time the Committee also would like to see some real event displays to see in the raw data itself the tracks of all relevant particles: incoming kaons and decay products of the hypothetical deeply bound kaonic nuclear states.

Regretfully the statistically very promising (about 2 eV uncertainty) preliminary result on a measurement of the Λ mass will not be published. This is because the systematic uncertainty cannot be reduced to much less than 10 eV, despite a rigorous study of the systematics using charged kaon decays.

The Committee was pleased to hear that a PhD student recently joined the KLOE data analysis effort and encourages further strengthening of the analysis manpower which currently in the view of the Committee critically relies on a single (extremely productive!) person.

AMADEUS schedule

Following discussions with people from KLOE and also partially because of the SIDDHARTA-2 proposal, AMADEUS has decided to drop its goal to already start the AMADEUS experiment in between KLOE 2 upgrades. Instead AMADEUS foresees now to start running after the completion of KLOE 2 in 2014. This leaves ample time for the optimal design of the AMADEUS setup (fibres, photo-detectors, TPC, etc.) and avoids multiple insertions and extractions of the KLOE/AMADEUS beam pipe.

A key issue in the future joint operation of the KLOE 2 detector is the participation of AMADEUS people in the running of KLOE 2 now. This is to gain experience in operating the KLOE2 detector as well as to foster the KLOE 2-AMADEUS collaboration. A healthy number of AMADEUS physicists, engineers and technicians are getting acquainted with and/or contribute to the KLOE 2 experiment already. An objective figure-of-merit will be to see which percentage of KLOE 2 shifts were taken by people from AMADEUS.

The AMADEUS goal is 10% and the Committee asks the AMADEUS collaboration to keep track of this indicator in order present it in its future meetings.

3.7 IKON PROPOSAL

The Committee received a proposal to systematically study the scattering of charged and neutral kaons on proton and deuteron targets at DAΦNE, replacing the KLOE 2 inner tracker with a vertex detector designed for this purpose. Due to the low momenta of the kaons from ϕ decays, the proposal's focus is on the low energy region, where as the authors show data are typically from experiments of many years ago and measurements are not precise. The open session presentation was given by A. Filippi.
The proposal was reviewed by A. Gal and J. Zinn-Justin; in addition, comments were contributed by W.Weise. A review of the experimental aspects of the proposal was not deemed necessary at this stage.

While the proposed physics program was found interesting, there was a generally shared view that more detailed theoretical justifications for the proposed program of measurements and the aimed for precision are lacking and should be given.
On the other hand, the main problem with the proposal at this time is the apparent lack of coordination with other kaon-nucleus physics efforts. Considering the priority of KLOE 2 within the DAΦNE program until 2013, the uncertainties on the operation of the accelerator after that date, its running costs and the cost of a new tracker it does not appear realistic to consider two separate kaon-nucleus experiments running in sequence on DAΦNE. The AMADEUS proposal is at a more advanced stage of planning, and states an interest in doing a scattering experiment – as opposed to their already proposed kaon absorption experiment –at a second stage.

The Committee advises the IKON team to further develop the physics case, and to interact with both the KLOE and AMADEUS teams in order to advance a common program.

4. EXPERIMENTS AT THE LHC

The Laboratory has given very important and visible contributions to the construction of all four major detectors of the LHC. The LNF had a major role in the construction, installation and operation of the muon chamber systems of three of the four detectors, putting to good use the excellent technical facilities of the Laboratories.
In the recently begun phase of the experiments, in which physics analysis activities have become most visible, the strength of the LNF analysis teams (with the possible exception of ALICE) does not appear to match the contributions to construction, and may not allow to profit from the past commitments as much as the Lab deserves.
Several reasons for this insufficient analysis effort were pointed at in the discussion, the most important ones being the small number of postdocs in the Lab (only three new posts per year) and the difficulty in attracting graduate students. It was remarked that analyzing these complex experiments requires well-organized and significant human resources. Collaboration with external groups, which in fact is already present, is encouraged.

Brief reviews of each team's work follow.

4.1 ALICE

The LNF activities in ALICE were presented by P. Di Nezza. The Laboratory's work on ALICE started in 2007 and spans both construction and analysis aspects. The group consists of 12 people (11.5 FTEs).

The effort in building and installing the modules of the electromagnetic calorimeter (EM), in collaboration with France and the USA, was significant and very successful. It is essentially concluded, with only certain technical support activities remaining to be performed – namely, building tools to construct modules of an extension of the EM calorimeter to be used in the trigger and helping with their initial use.
The group also took part in the detector software development and the integration of the EM calorimeter in the High Level Trigger.
The choice of physics subjects in the analysis of LHC data is related to the use of the E.M calorimeter: the group is studying jet reconstruction, developing and comparing different algorithms in view of their application to the Pb-Pb collisions starting at the end of 2010. The group is also active in the operation of the detector.
The participation in ALICE is globally well organized and coherent. The group seems to be very well integrated in the collaboration, and its activities are well balanced: a large effort in hardware construction is being followed by a significant commitment in the analysis of the data, as shown by the fact that about one-half of the group is engaged in data analysis.

4.2 ATLAS

The work of the ATLAS group was presented by Claudio Gatti.
The LNF contribution to ATLAS consisted in the construction of an important fraction of the muon chambers system. These instruments were installed in the ATLAS cavern some time ago.
The group is composed of 26 people, most of whom were involved in the construction stage. The group actively participated in the collection and analysis of cosmic ray data taken to test the muon chambers after their installation.
A significant effort is also going in computing activities, setting up the local facilities.

The analysis work is in consonance with the hardware expertise of the group: physicists in the group are studying $Z \rightarrow \mu^+\mu^-$ and $W \rightarrow \mu\nu$ to calibrate the detector and later on to look for $H \rightarrow ZZ$ and $H \rightarrow WW$. The effort in these analyses does not seem in proportion to the large investment in hardware construction. One very active physicist is working almost permanently at CERN, and at LNF the activity is carried out by a very small number of young physicists.
A positive aspect of the work of the LNF team is their active collaboration with other Italian groups that are also working on muon chambers and physics related to muons.

4.3 CMS

The contribution of the LNF to CMS was presented by Davide Piccolo.
During the construction and commissioning phase this relatively small group had important responsibilities, in particular in the Resistive Plate Chambers (RPC), a detector system spanning both Barrel and Endcaps which provides the muon trigger. The group had a critical role in building the gas gain monitoring system and in the operation of the detector.
The group also contributed to studies of the RPC performance, working on more than one year's worth of cosmic rays data and on the first collision data. They are also preparing the RPC upgrades for super-LHC.
The group has a cluster of computers at the level of a Tier 3, around which analysis work is currently being organized.
A subset of the group recently got involved in the analysis of the first data, focussing on muon reconstruction and at physics with dimuons, $J/\psi \rightarrow \mu\mu$ and specially $Z \rightarrow \mu\mu$. This analysis team is

small but well integrated into CMS. We encourage them to increase the group's implication in analysis activities.

4.4 LHCB

The LNF contribution to LHCb was presented by Matteo Palutan.
The group gave an outstanding contribution to the construction of the muon chambers: 30% of the whole muon detector of LHCb was built in Frascati.
The group also contributed to the readout electronics, to the installation of the muon detector, to the development of the control system and to the commissioning.
The analysis group is currently small but wants to grow in order to strengthen its contribution to the physics analyses.
They have computed the muon hardware efficiency maps and they are now contributing to the validation of the muon identification algorithms using $J/\psi \rightarrow \mu\mu$. The development of a tag-and-probe method to measure the muon finding efficiency is in progress; the misidentified fraction has been measured.
The group is now planning to participate in the measurement of the J/ψ cross section and later to the search for $B_S \rightarrow \mu\mu$. We encourage their efforts to increase the strength of their analysis team.