43nd MEETING OF THE LNF SCIENTIFIC COMMITTEE
FINDINGS AND RECOMMENDATIONS

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INTRODUCTION

The program of open session of the SC meeting of 19 January was set up to review the status of DAΦNE and of its experimental program, as well as the status and planning of SuperB and of the photon science initiatives at LNF. Examining as well the extramural activities of the Labs, the status and plans of the four major experiments at the LHC was reviewed.
In the closed session of 20 January INFN president F. Ferroni, Cabibbo Laboratory director R. Petronzio, LNF director U. Dosselli as well as the former and the new directors of the Accelerator Division, P. Raimondi and A. Ghigo, gave the Committee inputs on the DAΦNE and SuperB programs. The discussion of the reciprocal constraints deriving from these two programs was the main focus of the closed session.
In this meeting the new Committee members Y. Karyotakis, L. Rivkin and S. Stapnes were welcomed, as well as observers F. Bedeschi, M. Taiuti, M. Carpinelli and F. Cervelli from CSN1, CSN3, CSN5 and the NTA Committee. V. Vercesi also participated in the meetings and kindly refereed for the LHC experiments. Former members J. Jowett and J. Zinn-Justin also participated in this meeting and were thanked for their excellent services.

1. INTERACTIONS WITH THE MANAGEMENT OF INFN, CABIBBO LAB AND LNF

F. Ferroni asked of the Scientific Committee for advice regarding the DAΦNE program, which over the last year has run into considerable delays. He suggested that the SC hear the perspective of the new AD director A. Ghigo about DAΦNE , and said that he would circulate the SC's F&R document to the INFN Board of Directors. In addition, he stressed that he sees the Accelerator Division (AD) as the core activity of the Laboratories, and announced the intention of opening an accelerator physics school with a few INFN-funded positions at the LNF.

In the discussion that followed Ferroni's statements it was clarified that the SC is now expected to give feedback about the SuperB plans, especially for what concerns their interaction with the DAΦNE plans.

Following up on his open session presentation on the status of SuperB, R. Petronzio pointed out that later in the year the SuperB faces two crucial milestones, the cost review and the hiring of staff. He expressed a strong concern about ramping up the number of engineers and saw an incompatibility between the latter need and the continued running of DAΦNE, because of the need for experienced physicist and engineering staff in order to get the SuperB Technical Design report (TDR) completed. He was reassured of the support of the new government for the Project and restated that the urgent issue is manpower, not funding. Without an almost immediate injection of manpower the project is at risk.

The numbers of AD staff and their dedication, as well as the immediate needs of the SuperB project were briefly discussed and are given further down in this section. The need for a detailed timeline of staff to be hired for SuperB, and what part of it would have to come from the LNF was stressed. There was also discussion of the possible benefits for SuperB of running DAΦNE, both to learn more about the crab-waist scheme and as training grounds for SuperB staff.

U. Dosselli gave a short report about the status of the LNF, focussing on the recent changes in the AD. Following the decision of P. Raimondi to leave the LNF, he appointed A. Ghigo as the new AD director, entrusting him with the mission of recovering the synergy between the different AD activities. Regarding DAΦNE operations, he restated his earlier position that 2-3 years of running KLOE and then SIDDHARTA could be foreseen, but that the recent problems with the machine make it necessary to reconsider this plan.

The problems highlighted by the previous three speakers were discussed further with P. Raimondi and A. Ghigo.

A rough count of the current AD personnel breakdown by projects was given. Out of about 90 persons, 40 FTEs are currently devoted to DAΦNE operations, of which 5-6 are physicists, the others being engineers or technicians. About half of these resources could be used for SuperB, which currently has only 5 or so persons working on it, whereas about 50 would be needed at this time. About 23 FTEs are working for SPARC_LAB, the remaining FTEs being support personnel (for cryo, vacuum etc.).

Even if about half of the DAΦNE personnel– those who could be useful for this purpose–were devoted to SuperB, at least 20 additional people must be hired for the TDR. Ghigo and Raimondi did not think it would be possible to hire as many within the year. As to the time needed to complete the TDR, at least two years seemed necessary, counting from the time of having 50% of the needed personnel available.

Regarding improving the performance of DAΦNE, A. Ghigo thought that in April it would be possible to judge what luminosity could be achieved. He was reasonably optimistic about the chances of success, using the currently available manpower.

2. ELECTRON COLLIDERS, STATUS AND RECOMMENDATIONS

The inputs by the SC's accelerator specialists are given in this section, previous to the conclusions and the recommendations of the Committee.

L. Rivkin and J.M. Jowett met members of the Accelerator Division to discuss the presentation of DAFNE status by P. Raimondi and expected future developments in the division.

2.1 DAΦNE STATUS

The commissioning time during November – December 2011 saw a quick rise of the peak luminosity to the level of the best values achieved during the KLOE-1 run, corresponding to an integrated luminosity of 2 to 3 fb^{-1} per year. Several very interesting results obtained during this commissioning period pointed out possible future improvements in luminosity performance.

Further squeezing of the beam transverse size was successfully demonstrated and the vertical beta function at the IP was reduced to 8.5 mm.

Studies of the coupling correction schemes resulted in a very small vertical beam size down to 3 µm RMS. This corresponds to a coupling value of 0.14%, significantly lower than the best results during the KLOE-1 run that were at the 0.2% – 0.3% level.

The sources of vertical beam orbit oscillations in the interaction region quadrupoles were identified. Measures to improve the orbit stability have been successfully implemented, resulting in a reduction by a factor of three of the peak-to-peak oscillations.

Detailed measurements of the influence of the clearing electrodes on the transverse beam size and the horizontal tune-shift and instability growth rates were performed, giving a detailed quantitative picture of the effectiveness of this countermeasure for the electron cloud suppression.

The low-current gain of a factor of three in specific luminosity as compared to the KLOE-1 run has been realised. However the fall of the specific luminosity with current requires further study and optimisation. Measurements indicate that it is related to total rather than single-bunch current.

These results are consistent with the expectation that a peak luminosity comparable to that previously achieved in the SIDDHARTA run is within reach, given continuing systematic optimisation and tuning of the machine. It currently falls short of this goal by a factor 3.

DAΦNE's age is showing up

The new KLOE-2 interaction region installation work was completed and complemented by additional repairs and hardware fixes during an unscheduled shutdown in June – September 2011.
In its last report the Committee recommended to use that shutdown to inspect, repair and refurbish the machines. This time was indeed used to give the machine a general overhaul in many areas, including injection system work, in particular gun, linac and positron ring septum work. But the job is not finished by far, partly due to the lack of resources and partly due to the difficulties encountered.

Much work was done on the linac refurbishment, both repairing and replacing failed components as well as on preventive maintenance in an effort to improve the reliability and up-time.

Many improvements were made to the magnets in the ring. In the process, substantial electric power consumption optimisation was obtained resulting in an overall impressive energy and electricity cost reduction.

Several hardware problems resulted in an overall downtime on the order of 50%. This may be a further manifestation of the "bath tub" effect in this 15 year- old machine. A seemingly endless string of new failures has engaged staff in continuous repair and replacement actions. During these repairs new problems came to light, extending further the downtime needed to fix them. An analysis of the problems encountered has to be urgently performed in view of defining the necessary preventive maintenance measures.
In parallel, a risks analysis and an estimate of the probability that the integrated luminosity goals required by physics could be met in the time frame compatible with the physics programme should be performed as soon as possible.
The Committee notes that the strength of the Accelerator Division is being reduced, particularly because of retirement and departure of high-level experienced staff.

2.2 SUPERB

The present status of the design and detailed planning were presented in the open session by M. Biagini and R. Petronzio. The overlap with the LNF plans and projects is important and thus this committee has to comment on this. This concerns not only the Accelerator Division but also the technical support services. The examination of the strategic impact of the SuperB on the laboratory is long overdue. The mandate of this committee has been correspondingly extended.

The Committee reiterates the need for an in-depth technical review of the concept by appropriate international experts. Our present perception is of a high level of technical risk associated with the luminosity and polarization performance. Furthermore we would like to express our concern with the project's ability to ramp-up in time, to be able to complete and evaluate the TDR, to go ahead with the resource-loaded schedule formulation. The project needs engineers and experienced staff.

The present design effort relies heavily on the expertise and original ideas coming from the LNF Accelerator Division. However additional resources are requested by the SuperB project and supplying them may make it impossible to pursue the DAΦNE programme. It is also not clear that even this level of commitment on the part of the laboratory would be sufficient to launch the SuperB project activity at an adequate level.

External commitments to the project should be clarified in order to enable a proper cost-benefit and added value analysis of these contributions.

Despite the above considerations, we recognise that continued operation of DAΦNE could be of significant benefit to SuperB in that:

- the demonstration of the crab-waist concept should be completed in an interaction region configuration incorporating a detector solenoid and this may lead to adaptations of the design concept. Similar remarks apply to other items such as feedback system, clearing electrodes, etc.
- there are few places left in the world where the new staff to be recruited for SuperB can gain useful operational experience with a high luminosity e^+e^- collider.

2.3 CONCLUSIONS AND RECOMMENDATIONS

Based on the information acquired in this and previous meetings, the SC discerns certain trends that allow it to make short-term recommendations for the DAΦNE and SuperB programs.

DAΦNE

Considering the inputs from the new AD director, but also the large past and recent investments into DAΦNE and KLOE, it seems worthwhile to put additional effort into DAΦNE in order to reach stable operation and luminosities compatible with its experimental program. The plans for DAPHNE running for KLOE and possibly SIDDHARTA are scientifically well motivated. Over the coming months it will be possible to make firmer predictions about luminosities and up-time of the DAΦNE machine, and to judge whether the scientific programs of these experiments can be carried out on a reasonable timescale.

About three months were claimed to be needed to judge about the chances of success of this effort. In view of the fact that commissioning of KLOE with the solenoid field is not completed, this time estimate may be somewhat short. As stated in the next section, at least $4fb^{-1}$/year are required to carry out the KLOE program within two or three years.

Clearly, for this effort to succeed, the human resources currently devoted to DAΦNE/KLOE cannot be taken away. The SC believes that in the current situation of the SuperB organization the resources that would temporarily be still devoted to DAΦNE will not hurt the timing of the SuperB project.

SuperB

The SuperB project has been reviewed and has presented its plans at several occasions in international committees, for example by ECFA in 2008 and in the CERN Strategy Session of Council in 2009 and 2010 (see for instance, : *ECFA/08/257, 28 November 2008).*

Several areas of the project have evolved positively since then; the national funding prospects, the siting and the possible involvement by the community as witnessed in the Elba workshop of June 2011.

However, detailed plans and schedules, and the main follow-up points identified in these reviews/reports, remains serious concerns in the view of the Committee.

A detailed TDR needs to be produced and reviewed at the appropriate level, particularly insofar as the luminosities to be reached and the polarization scheme are concerned, because these performance aspects are crucial in view of the inevitable delay of SuperB with respect to the Japanese facility. There is an urgent need for a detailed resource-loaded plan with all partners identified and with formal commitments, an analysis of the scope and schedule resulting from such an exercise, and the plans to obtain the overall resources needed to complete and operate the facility. The committee observes that without such detailed plans it is difficult to monitor progress and judge the realism in scope and schedule of the entire project.

With respect to the LNF program it is mandatory and urgent to have a detailed plan for the personnel of the SuperB projects in the TDR phase, including the LNF personnel contributions in the accelerator and general services area, and a timeline for their involvement. It is also a crucial input towards producing a realistic resources plan for the entire LNF program in the coming years as the SuperB project involvement will be substantial and should have high priority.

However the Committee notes that the leaders of the SuperB organization were not identified at the time of its meeting and that, until such crucial personnel is at work, additional personnel may not be used at full efficiency. In addition, the LNF (and INFN at large) should face the fact that operation of the SuperB will inevitably begin a few years after the Japanese facility. These facts go hand-in-hand with the concerns identified above and are an element in recommending not to divert to the SuperB TDR resources that may not be fully used until the proper leadership and plans are in place.

3. EXPERIMENTS AT DAΦNE

3.1 KLOE DATA ANALYSIS

In parallel with the running experiment, the collaboration analyses the old KLOE data.
During 2012, they expect the following analyses would be finalized:

$\gamma\gamma \rightarrow \eta$ at 1 GeV
$\Phi \rightarrow e^+e^-\eta$ decay form factors
$\eta \rightarrow \pi^+\pi^-\gamma$ decay
$K_s \rightarrow 3\pi^0$
and the ratio of $\sigma(\pi\pi)/\sigma(\mu\mu)$ with radiative returns at 1 GeV.

In terms of manpower they have 6 PhD students and one diploma student in Poland and Sweden analyzing the data. They have 4 PhD students in Rome. The collaboration asks for help from the management in recruiting young people.

3.2 KLOE 2

The referees (T. Akesson, M. Cavalli-Sforza, G. Colangelo, S. Stapnes) discussed with KLOE-2 the future of the experiment, in view of the performance of DAΦNE.
When KLOE-2 was approved the assumption was that it would operate in two steps: Step-0 accumulating 3-5 fb^{-1} while the upgrade detectors were fabricated, and Step-1 with upgraded detector getting 20 fb^{-1}, requiring about 20 pb^{-1}/day.
Step-0 will be over by late spring and then KLOE-2 would have collected around 1 fb^{-1} if DAΦNE's best performance up to now (~6.5 pb^{-1}/day) is maintained. In general DAΦNE delivers an average of about 4 pb^{-1}/day, due to short beam lifetime and 50% downtime. There is about half a year remaining before the shutdown, and KLOE-2 is prepared to continue data-taking during this period.

By late spring KLOE-2 would be ready to install the new detector systems, and by then the collaboration will have spent about 50 man-years and 2 M€ on the Step-1 upgrade. To profit from it they need DAΦNE to reach 12 pb^{-1}/day. This is not a very ambitious goal, for it corresponds to the performance of DAΦNE during 2008/9.
The collaboration will hold a general meeting 26-28 March and will then take stock of where it is, and its outlook for the future.
The physics potential of KLOE-2, step-1, has increased since it has been shown that with 5 fb^{-1} the width of the π^0 can be determined with a 1% statistical uncertainty via the reaction e^+e^- $e^+e^-\pi^0$. This would provide an input to the understanding of results on the muon's g-2 .

3.3 SIDDHARTA DATA ANALYSIS

The referees of SIDDHARTA and of AMADEUS (A. Gal, Y. Karyotakis, F. Linde, J.Zinn-Justin) as well as the CSN3 chair M.Taiuti jointly met with the SIDDHARTA and AMADEUS representatives.

During the June 2011 LNF SC meeting the SIDDHARTA collaboration reported on the completion of the atomic K^- hydrogen 1s level shift and width measurement analysis in arXiv:1105.3090 (nucl-ex), submitted for publication. This report has been published since then:
- A new measurement of kaonic hydrogen X-rays, SIDDHARTA Collaboration, M. Bazzi et al., Phys. Lett. B 704 (2011) 113.

A more detailed report,
- Kaonic hydrogen X-ray measurement in SIDDHARTA, SIDDHARTA Collaboration, M. Bazzi et al., arXiv:1201.4635,

has been accepted for publication in Nucl. Phys. A (2012).
Other publications by SIDDHARTA, excluding conference reports, concern measurements of the atomic 2p level shift in He isotopes:
- First measurement of kaonic helium-3 X-rays, SIDDHARTA Collaboration, M. Bazzi et al., Phys. Lett. B 697 (2011) 199.
- Kaonic helium-4 X-ray measurement in SIDDHARTA, SIDDHARTA Collaboration, M. Bazzi et al., Phys. Lett. B 681 (2009) 310.

3.4 THE SIDDHARTHA 2 PROPOSAL

The SIDDHARTA 2 collaboration reported progress exactly in line with the promises made in the previous meeting of the Scientific Committee. The anticipated funding from the agencies (INFN, Vienna, etc.) was secured; the various hardware components (cryo-cooler, SDD electronics, target cell, scintillator+SiPM readout) showed excellent progress; the aimed-for SIDDHARTA 2 setup improvements (in yield and in signal-to-background) compared to the SIDDHARTA experiments remain unchanged and are feasible. SIDDHARTA 2 readiness also remains unchanged: they could start as early as October 2012.

It was also mentioned that SIDDHARTA 2 could be installed at the KLOE interaction point if that would be more desirable (implying as it does moderate cost savings in interaction point layout) - i.e. the DAΦNE machine group and/or INFN management can decide at which interaction point SIDDHARTA 2 should be installed.

The real unknowns appear to be DAΦNE performance and KLOE's running plans. SIDDHARTA 2 will accept any eight-month slot in the period 2012-2015 to primarily take data on Kaonic deuterium (Kd). The measurement of the width and shift requires about 600 pb^{-1} i.e. a few months of data-taking at 200-300 pb^{-1}/month, assuming a typical 60% efficiency (primarily due to high background conditions during injection). There are no peak luminosity requirements. Before starting the Kd run a few weeks of commissioning will be required, using helium targets. In addition the SIDDHARTA 2 experiment must be installed and dismantled, which brings the total time needed to the mentioned eight months.

3.5 AMADEUS

A new, very interesting analysis of old KLOE data was shown.

The AMADEUS group studies the $\Lambda(1405)$ excited hyperon, formed in K^-p interactions in helium-4 and decaying by $\Lambda(1405) \rightarrow (\Sigma^0 + \pi^0)$, in which decay the final state has no I=1 component, hence it cannot arise from $\Sigma(1385)$ that often dominates over and distorts $\Lambda(1405)$ decay spectra. The final state $(\Sigma^0 + \pi^0)$ is identified by its e.m. decay to $(\Lambda + 3\gamma)$, with a subsequent $\Lambda \rightarrow (p + \pi^-)$ weak decay The invariant mass spectra of the $\Lambda(1405)$ studied in this way exhibit a double hump structure, a lower one and the broader of the two is centred around 1390 MeV, whereas the upper one is centred around 1430 MeV. This is in line with recent theoretical expectations [see the recent review by W. Weise, Nucl. Phys. A 835 (2010) 51] that the (anti-K-N — $\pi^-\Sigma$) I=0 system gives rise to *two* S-matrix poles that are loosely identified with the $\Lambda(1405)$, this object being a quasi-bound state in the anti-K-N upper channel, and a scattering resonance in the π-Σ lower channel. These results are still preliminary and require more statistics and analysis before becoming conclusive and making a physics impact.

In view of the disappointing DAΦNE machine performance and the interference with SuperB plans the AMADEUS running prospects were not discussed. However the collaboration pointed out that by just adding a degrader between the DAΦNE beam pipe and the KLOE2 central drift chamber the K^- capture rate would be boosted by two orders of magnitude. In other words. a week of data-taking would more than double the KLOE-1 data sample used to date! Perhaps this should be considered at some time if KLOE-2 keeps on taking data at DAΦNE.
It is worth pinting out that the AMADEUS team covers an impressive 22% of the KLOE shifts.

AMADEUS hardware studies are proceeding well and are also applicable elsewhere (FOPI @ GSI).

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4. LHC EXPERIMENTS

LNF had a very significant role in the construction, installation and operation of several subsystems of the four major LHC detectors. Relevant contributions were given in particular to the muon chamber systems of ATLAS, CMS and LHCb, and to the electromagnetic calorimeter of ALICE, profiting from the outstanding technical facilities of the Laboratories. This translates now into a strong participation of LNF researchers in several responsibility roles for detector operation and monitoring.
The excellent performance of the accelerator has pushed data analysis to front stage sooner than expected. The LNF groups are committed to this trend, in order to match the construction efforts with an active presence in the physics analysis.
This is not always easy for teams in a Laboratory, which cannot profit directly from the work of students, unlike other INFN Units that are hosted in Universities. Hence, more effort must be put in building

collaborations, both with nearby Physics Departments and with external groups.
While the past situation has improved for almost all teams, it would definitely help the process if ad-hoc measures could be taken, such as creating LNF post-doctoral Fellowships. Collaboration with theorists is also encouraged, to promote cultural diversity within the Laboratory.
Despite the fact that the LHC experiments are already planning upgrade activities, it is recommended that LNF groups keep their main commitment to physics analyses.
A brief review of each team's work follows.

ALICE

The LNF activities in ALICE were presented by P. Di Nezza.
The group consists of 12 people and has significantly contributed to the building and installation of the modules of the electromagnetic calorimeter, in collaboration with France and USA, and to the development of the related High Level Trigger software. The construction work finished in 2011 and the performance of the calorimeter is as expected. Some upgrade activity is foreseen for the forward extension of the calorimeter (DCAL), but will be confined to tooling and to sharing of expertise.
The group is actively involved in the study of jet reconstruction using the calorimeter, in the detailed analysis of the fluctuations of the event background in Pb-Pb collisions (which may shed more light on the jet-quenching phenomenon) and in polarized physics in p-p collisions. It remains also very active in the operation of the detector.

The team takes part in ALICE activities in a well-organized way: there is also close collaboration with foreign institutions for the analysis, in particular, but not only, for the development of Monte Carlo simulations. About half of the group is engaged in physics studies and their impact is also reflected in the authorship of some important publications.

ATLAS

The work of the ATLAS group was presented by M. Testa.
After the successful construction and installation of an important part of the muon chamber system, the group (composed f 20 people) participated in the cosmic ray data taking, which allowed for a detailed testing and calibration of the overall muon system.
A significant effort has also been put in computing activities, resulting in the recent creation of a local GRID Tier-2 node.
Thanks also to the presence of one physicist working almost permanently at CERN, the LNF group is very well connected to the muon performance studies and contributes to the definition of several ingredients (efficiency, resolution) for many physics analyses, which have generated publications (e.g., the muon inclusive cross-section). Recently, the team's contributions to the study of E_T^{miss} resolution in the presence of the high LHC pile-up are also having a major impact on the related analyses.
About six researchers are analyzing physics channels that are important for Higgs searches, in particular the decays of W and Z bosons into muons. The group is productively collaborating with other Italian teams on these issues. We would like to encourage maintaining a strong participation in these analysis, to fully harvest what was sowed with the previous huge construction effort. This will also have to be balanced with new involvements in upgrade activities, related to the trigger and the muon systems.

CMS
The contribution of LNF to CMS was presented by D. Piccolo.
This relatively small group (three researchers) has very actively participated in the construction phase of the Resistive Plate Chambers (RPC), by building the gas gain monitoring system and contributing to the operation of the detector in both the cosmic rays and proton collision data taking periods.
This has been recognized by the CMS Collaboration, giving responsibility roles to members of the team in the Run Coordination and in the RPC Detector Performance Group. There is also some interest in RPC upgrades for the future of LHC at higher luminosity (a conference will take place at LNF in 2012).

A subset of the team is collaborating with other Italian groups in the study of muonic decays of the Z boson and would like to become involved in single top analysis. We strongly encourage the group to increase their implication in analysis activities.

LHCb

The LNF contribution to LHCb was presented by B. Sciascia.

The group (today 11 people) strongly contributed to the muon detector: 30% of the chambers were built at the LNF together with the readout electronics. After installation and commissioning, the team is playing a crucial role in the operation and maintenance of the detector, and in the offline muon efficiency monitor. Concerning muon identification, the group has contributed to measuring acceptance and efficiency and to determining the misidentified fraction. Several responsibility roles come along with this work, including the Spokeperson of the Collaboration, a recognition of the group's and of the INFN's efforts.

The group has increased its participation to physics analysis (now about six people), focusing in particular on the studies of $B_{(d,s)} \rightarrow \mu\mu$ decays, a possible window on New Physics, and is fully integrated with the rest of the working group on Rare Decays.

The group also expressed interest in the future LHCb upgrade (together with other Italian groups), in both the muon system and in new detectors for the central tracker.

5. SPARC_LAB

During the SC meeting, J. Rossbach met with M. Carpinelli, F. Cervelli, M. Ferrario, A. Ghigo, and L. Gizzi to discuss SPARC, SPARX and FLAME issues. A number of scientific, technical and management issues related to these projects were covered. The findings are as follows:

During the past 6 months, the major activity at SPARC was devoted to installation of the electron beam line for the interaction of the electron beam with the FLAME laser beam.

Regarding the FLAME laser, it is important to note that with 220 TW peak power, FLAME has practically achieved its design value. Also, the results on pulse length and wave front quality are within specs. The next experiment on plasma-wakefield acceleration, now making use of maximum laser power, is slightly delayed and now scheduled for the spring of 2012.

So far, there were mainly three photon-science oriented projects run by LNF: SPARC, SPARX and FLAME. They were related to each other, but not fully coupled. The INFN management has now made the important decision to combine these three activities into one major new scientific lab called SPARC_LAB, which is supposed to become a flagship activity of the LNF, joining SPARC and FLAME. While the SPARX project is essentially abandoned, SPARC_LAB also includes some aspects and components of the SPARX R&D, e.g. the C-band accelerator components. Due to this concentration of forces, the entire field of photon science activities at LNF will gain much in terms of consistency and credibility, since it is now based on a strategic decision and commitment of INFN. The SC welcomes this development and understands that SPARC_LAB will be a core mission of LNF for many years to come.

The SPARC_LAB team's human resources presently consist of approximately 20 FTEs, distributed over 40-50 individuals. Some eight out of these 15 FTEs are presently paid from SPARX funds which will be finished soon. These positions need to be funded differently. This could be managed partially through synergy effects from collaboration with ELI, but certainly about 4 positions will have to come from LNF resources.

The SPARC_LAB team received considerable funds to prepare a scenario and proposal for establishing a collaboration with ELI. In view of the competence and mission of the SPARC_LAB team, this is very adequate and will extend the possibilities and visibility of the LNF photon science activities. This is very much supported by the SC. It should be clear though, as said before, that this step will mean additional obligations which will absorb most of the additional funds obtained from ELI.

For SPARC_LAB to become a user facility adequate LNF resources need to be allocated to guarantee technical reliability and manpower continuity. This means, for instance, adequate spare part management and permanent (or at least long lasting) positions for core team members. Presently, the position for an expert on synchronization needs particular attention.

In order to become a user facility, the mission and the technical possibilities should be written up in a consistent way such that it becomes visible to potential users, to students, and to the public. This requires writing a Technical Design Report (TDR) describing resource plans and schedules, beyond the scientific mission and technical infrastructure. This is also necessary for the LNF management to adequately plan resources. Also, a potential second stage, e.g. an energy upgrade or construction of an experimental hall for users, should be discussed with the LNF management and eventually planned and budgeted.

SPARC_LAB represents a very exciting and attractive environment for the next generation of photon scientists as it covers cutting edge technologies from various fields such as lasers technology, accelerator physics, plasma science, RF technology, and digital controls. It is thus suggested to define a strong education program as an integrated part of the SPARC_LAB, in collaboration with one or more university faculties. In this context the SC is very pleased to acknowledge that the INFN president has initiated a fellowship program for 6-8 PhD students on accelerator physics.

The hardware inventory of SPARC_LAB is up-to-date but it is acting in a very competitive field. It is thus mandatory to keep the momentum of this activity; otherwise the investment made will become unattractive soon. This requires proper support by LNF.

For adequate scientific use of SPARC_LAB two important issues should not be underestimated: numerical simulations and femtosecond-level synchronization.

Regarding numerical simulations, SPARC_LAB (i.e. the former FLAME group) is well equipped with experts and computing power through a strong network with some ten Italian institutes. This field does not necessarily need that its major resources be located in Frascati, but there must remain at least some core expertise on site for the definition and interpretation of experiments. For the rest of this collaboration, LNF should assist in securing reliable perspectives for its Italian key players. SPARC_LAB is also an excellent format for seeking further collaboration with other players in the field.

Regarding synchronization, the present status has remained unchanged in recent years. The SPARC beam timing jitter is about 150 fs (rms) with respect to the master oscillator, while the FLAME laser jitter is at the 60-70 fs level (rms). While this performance might be sufficient for early experiments, it is definitely insufficient for achieving progress and for retaining competitiveness. What is needed is a timing jitter smaller that the FLAME laser pulse length, i.e. below the 10 fs level, for instance for probing the plasma with an injected electron bunch at adequate resolution. The SC points out that this is absolutely essential for the progress and success of SPARC_LAB. Thus the SC invites the SPARC_LAB team to formulate a master plan describing the road map of how to achieve this goal.