45th MEETING OF THE LNF SCIENTIFIC COMMITTEE
FINDINGS AND RECOMMENDATIONS

The program of the open session of the SC meeting of November 20 was set up to review the status of DAΦNE and of its experimental program and summaries of other activities at LNF in particle physics (CSN1) and in technological and inter-disciplinary research (CSN5). Examining the extramural activities of the Labs, the status and plans of the NA62 and BESIII experiment were reviewed. The last item on the agenda was a colloquium given by Dr. Claudio Pellegrini on Science at LCLS and development of X-ray FELs. In the closed session of November 21 the findings of the SPARC_LAB PAB were presented. The SuperB project was discussed at the beginning of the closed session with the INFN president Prof. F. Ferroni. Few days after the meeting, the SC received a communication of the LNF director that the Minister of Research announced that the evaluated projected cost of SuperB (roughly 1 Billion Euro) could not find place in the budget of the Italian Ministry of Research. The Minister invited INFN to present one or more alternatives that could fruitfully use the 250 Millions Euro dedicated to the INFN flagship program.

1. DAΦNE, KLOE and SIDDHARTA

This section summarizes the findings about DAΦNE and its experiments with a common recommendation at the end of the section.

The committee is very pleased to see that the INFN management provides support to ensure new physics run with upgraded KLOE-2 detector and that the Board of Directors has allocated extra resources to DAΦNE in priority.

1.1 DAΦNE

L. Rolandi, J. Rossbach and S. Stapnes met members of the Accelerator Division to discuss the presentation of DAΦNE status by C. Milardi, including the programme and plans for the future DAΦNE operation and winter shutdown periods. The progress on the machine performance has been very impressive and the team should be congratulated.

During June, lowering of Vref and reversing the polarity of the clearing electrodes gave important improvements in terms of performance (lifetime increase etc.) and stability (faults removed). An earthquake, small but nearby, degraded the machine significantly introducing major operational problems and reducing the luminosity by a factor 3 or more. To recover, the summer shutdown was advanced and used to realign machine elements and address several other outstanding problems. The operation restarted Sept 19th with orbit optimization and beam based alignment, reaching the excellent result of 1.1×10^{32} cm^{-2} s^{-1} without Crab Waist (CW) sextupoles early November. After that DAΦNE reached 1.41×10^{32} cm^{-2} s^{-1} with 102 bunches in collision with CW fields at half strength. A luminosity of 4.0 pb^{-1} in 12 hours was reached. The luminosity is relatively linear with current and the specific luminosity is good. The CW operation is being phased in gradually, interleaved with optics tuning and adjustments as needed. The background is dominated by electrons, but considered acceptable, also during injection. For background optimisation, further effects/actions under study are related to scrapers, opposite side beam-position and non-linear effects. The fault situation has improved somewhat with respect to early 2012 and remedies are being planned and implemented for the main sources of failures during the winter shutdown.

A factor two higher peak luminosity is needed, and there is significantly scope for further luminosity improvements. Immediate work will focus on the optics, current increases, CW phase-in and more bunches, but could be limited by some problems to be addressed in shutdown. Longer-term improvements are therefore linked to consolidation actions in the forthcoming shutdown that is currently foreseen to last from December 16th until June 6th 2013.

The factor two improvement in peak luminosity - with respect to the present achieved figure - leads to a yearly integrated luminosity of ~2.0-2.5 fb^{-1} with 250 days at 50% overall efficiency.

The list of improvements planned during the winter shutdown covers linac components, interaction region changes (mechanical), vacuum, cryogenic, power and control systems, as well as the fluid systems and instrumentation/diagnostics. A detailed schedule, including interweaving activities with KLOE, is available.
This consolidation has a cost estimate of 1.45 MEURO, out which around 80% is secured by a combination of internal funds (400) and fresh INFN contributions (250+450). Outstanding concerns are related to completing the work needed for the cooling plant and diagnostics system.

Equally important is the urgent hiring of the key personnel where currently four positions are being filled, for machine operation and technical support. Further increases are needed, with high priority, to secure reliable operation (6-7 people as estimate), from recruitment of young resources, internal lab adjustments/transfers, or help from outside the laboratory, including other major accelerator laboratories.

The SC takes note that contacts have been taken to define external machine expert that can visit LNF at the start-up of DAΦNE to help in the commissioning.

1.2 KLOE

During the SC meeting A. Golutvin, and G. Colangelo met members of the Collaboration to discuss the status of the upgrades and the physics program.

As an important part of DAΦNE consolidation effort, KLOE is currently taking data in order to monitor DAΦNE operation and background conditions. These data are also useful for physics program of the Amadeus collaboration.

KLOE is well on target for preparation an upgrade. Detector upgrade includes installation of the new inner tracker (IT) and calorimeters CCALT and QCALT. The performance requirements to all new sub-detectors are driven by physics and well understood. The construction and assembly of all upgrade sub-detectors will have to be completed in the middle of February 2013. In order to meet this schedule careful monitoring is mandatory. Of particular worry is the assembly of the 4^{th} IT layer and second QCALT calorimeter. Despite good understanding of assembly procedures, for both detectors many operations and tests remain to be done in very limited time.

The installation of new sub-detectors is planned in accordance with the preparation of the DAΦNE beam pipe. Detailed schedule is currently being prepared in order to identify critical points and conflicts between various

activities. Integration is highly non-trivial given to the limited space available for the insert, which carries new detectors. This also requires careful design of cabling which remains to be demonstrated.

The physics program of KLOE-2 assumes that minimum 5 fb^{-1} should become available for physics analysis within next 2-3 years. Despite the reduced data sample their program remains viable and covers diverse areas of physics.

Meanwhile KLOE continues to provide valuable physics results based on the analysis of existing data. Since last SC meeting three new analyses have been submitted for publication and five more in the pipeline. A very important result achieved, which is almost final, is the analysis on the ratio $\pi^+\pi^-\gamma/\mu^+\mu^-\gamma$ that is important for g-2.

During the closed session discussion of the CSN1 activities it was mentioned that the computer center of KLOE is obsolete and very expensive and that they have been invited several time to migrate the system, but each time they said to be short in expert manpower.

1.3 SIDDHARTA

During the SC meeting G. Fortuna, A.Gal (Chair) and Y. Karyotakis met C. Curceanu, J. Zmeskal and other members of the Collaboration.

The SIDDHARTA-2 proponents expressed strong anxiety over getting no definite schedule for their experiment in near future, repeating arguments made already in past meetings: waiting for too long may result in diminishing the Collaboration's cohesiveness and effectiveness of operation. A definite timetable should also help to schedule and perform improvement of detector capabilities. As it stands now, they are ready to run beginning in mid 2013 upon a short commissioning period.

The SIDDHARTA-2 proponents repeated their arguments in favor of a two-point interaction installation that would allow them to run in parallel to the KLOE-2 prioritized run. They would be willing to work together with the AD to find reasonable solutions to enable it. The luminosity level reached now by DAΦNE should be sufficient for running SIDDHARTA-2.

Little time was devoted to the physics of the SIDDHARTA-2 experiment which remains as strongly motivated and recommended as expressed in past deliberations of this panel. The Collaboration reported a new evaluation of the K-hydrogen atom yields for the K_{alfa} line and for the entire K line complex in the completed SIDDHARTA-1 experiment; this should provide some constraints in simulating K- deuterium spectra where the main unknown factor are the yields. A paper on lessons gained in working with a deuterium target is under preparation for submisson to Nucl. Phys. A.

The rest of the meeting was devoted to brief reports on KLOE data-taking in the framework of the AMADEUS experiment. Preliminary (Sigma+,pi-) pair spectra from the decay of Lambda(1405) produced on carbon were shown and discussed in connection to other experiments that yield similar spectra. The possibility of identifying exotic neutron-rich hypernuclei such as Lambda- 6H and Lambda-9He by stopping K- mesons on Li and Be targets, respectively, was discussed, providing a natural continuation of the recently announced discovery of Lambda-6H by the FINUDA Collaboration. All in all this ongoing AMADEUS activity is a very promising research line.

In the closed session discussion it was iterated that SIDDHARTA-2 is an important part of the DAΦNE program, which doesn't have competitors and it could run for one year after the end of the KLOE program, or earlier depending on the DAΦNE/KLOE luminosity performance.

Concerning the installation on IP2, it was reminded that it is known that DAΦNE cannot run with collisions in IP1 and IP2 simultaneously. Colliding in IP2 implies that the beams have to be separated in IP1. No figure exists of the DAΦNE performance in this condition, but it can be estimated on a six months timescale.

1.4 Recommendations

The SC recommends that LNF continue to put as first priority of the Laboratory the physics program of DAΦNE.

The consolidation programme of DAΦNE during the shutdown and improvement in personnel situation for machine operation should be given the highest priority and support in the coming 8 months. The first seem well prepared (noting the concerns for the cooling and diagnostics systems), the latter is still insufficiently addressed while should be addressed in priority also using resources presently allocated to other programs.

The upgrade schedule of KLOE looks very tight. The SC recommends close monitoring of the upgrade activities as well as timely support (especially from mechanical workshop) if required. The quality of new upgraded detector should not be compromised.

The SC recommends KLOE to follow up on the request of migration of the computer center providing a resource-loaded schedule where the missing manpower is clearly identified.

The SC recommends producing a study of the luminosity and background in IP2 when separating the beams in IP1 and an estimation of the time needed for replacing the beam-pipe and installing SIDDHARTA in IP2 and an estimation of the running time of SIDDHARTA in IP2.

The SC recommends that the soon after the DAΦNE start-up attention is put to produce an assessment of the achievable level of luminosity and an official schedule including the running of the two experiments. The goal is to have the schedule six months after the start-up.

2. SPARC_Lab

P. Mugli, and J. Rossbach (SPARC_LAB PAC), and L. Rolandi and U. Dosselli met with members of the SPARC_LAB and discussed the SPARC-Lab status and plans.

During the past 6 months, the major activity on the accelerator side was devoted to technical studies on using hollow core crystal fibers for a novel FEL seeding arrangement and to a novel method, based on speckle analysis, to determine the transverse coherence of the FEL photon beam. These are once more world-class contributions to FEL science and technology indicating the excellence of the team and the state of the art of the SPARC FEL installation.

Preparations are made to test the novel C-band rf accelerating sections (2x1.4m) at the side of the S-Band system to make tests possible without the need to remove the operating S-band system. A new 1.4cm-period undulator of DELTA type will be installed during spring 2013. It will allow tests on staged FEL seeding down to 66 nm. Finally, in collaboration with BNL, a corrugated beam pipe is considered for installation at SPARC which could open a way to modify an energy chirp inside a very short electron bunch in a passive and well defined way.

Very important progress was reported in terms of the synchronization. Based on a new optical master oscillator laser, synchronization between the laser oscillator and the rf system was demonstrated with a residual noise level of only 50 fs. This is a key prerequisite for many FEL issues and in particular for the plasma wake-field acceleration experiments with external injection of an electron bunch. It is now mandatory to apply this technology to the full accelerator system and to the FLAME timing, and to keep this expertize in the team.
FLAME has reported an electron acceleration of 7GV/m over 8 cm, i.e. a beam energy of some 600 MeV in the self-injection mode. To this end, laser transport into a long capillary had to be managed. While this is encouraging, it also indicates that FLAME isn't any more on the laser forefront. Other labs like Berkeley have much more powerful laser systems. The conclusion is that experiments with FLAME deserve high priority as the scientific lifetime of such devices is rather short.

The various aspects of interaction of the accelerator with the FLAME laser are the other focus of activities of the SPARC_LAB team. First Thomson backscattering

tests are scheduled for June 2013, having installed and aligned almost the complete electron and photon beam lines during 2012.

A number of experiments have been presented to the SPARC_LAB PAB, some already under progress, others proposed.

The scope of SPARC_LAB was discussed with the lab director. Due to the limited resources, SPARC_LAB should not be considered a full-fledged user facility but a test facility open to external groups. Two of such collaborations are already successfully running. To attract more, a Technical Design Report and an improved website will be prepared, which is highly welcomed. In terms of the rather substantial collaboration with ELI the pros and cons for LNF did not entirely become clear to the PAB.

As it was stressed previously, SPARC_LAB represents a very exciting and attractive environment for the next generation 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 once more 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 we are pleased to hear that the University La Sapienza has launched a PhD education program exclusively for accelerator physics.

2.1 SC with respect to SPARC_LAB PAB

SPARC_LAB is an activity that can receive proposals from external users. LNF select and prioritize the requests with the advice of the SPARC_LAB PAB. The LNF SC has a larger mandate and has to look at the SPARC_LAB in the general context of the other activities of the laboratory. In the future we will keep the same format of the present meeting: the SPARC_LAB PAB will meet the day before the SC and there will be a report and discussion about SPARC_LAB in the SC closed session.

2.2 Recommendations

In view of the limited resources the PAB recommends to focus on experiments of high scientific value, which can hardly be done at other places. This certainly includes experiments that need both a high-quality electron bunch and a high power laser, such as Thomson backscattering and laser plasma acceleration with external electron injection. The PAB proposes to define a priority list for the experiments.

The PAB invites a detailed presentation on ELI for the next meeting to enable an in-depth discussion.

3. Summary of particle physics activities (CSN1) at LNF

The particle physics activities at LNF comprise 11 experiments of different size, plus a new activity on the g-2 experiment at FNAL. KLOE is the largest group, about 23% of the FTEs of LNF "gruppo 1", and is the only group with the experiment in the Laboratory. R&D activity is very intense, including the upgrade of the LHC experiments, and construction activity for KLOE and NA62 is ongoing.

Some groups with extramural activities, such as ATLAS , LHCb and NA62, have the size and the visibility that one expects for the participation of a national laboratory to an external experiment, with large impact on the infrastructure of the laboratory. This however is not the case for other activities (accounting for about 30% of the FTEs), although some could grow into more solid participations in the future. There are also some special cases like UA9 that is among the CSN1 activities, but, in practice, is an accelerator R&D project and is consistent with the core business of the lab and BESIII that is a small but not invisible participation and has the interesting role to improve the INFN-China relationship.

At the time INFN is investing on DAΦNE to ensure new physics run with upgraded KLOE-2 detector, it is also important to secure the human resources devoted to the experiment for the commissioning, the run and the analysis of the new data. The SC is worried that the hemorrhage of people leaving KLOE for other activities could geopardize the investments done on DAΦNE.

3.2 Recommendation

The SC invites a presentation from KLOE of consequences of possible shortage of human resources for the commissioning, run and analyses of the KLOE-2 due to researchers migrating to different experiments.

The SC recommends the LNF management to tune the assignment of resources to CSN1 LNF groups privileging a) the internal core activities and b) the large and visible extramural activities, which have an impact on the local LNF infrastructures. The goal of this request is to reduce to a minimum the Laboratory participation in small and less visible extramural activities with little return on the Laboratory.

4. Summary of Technological and inter-disciplinary research (CSN5) at LNF

The technological and inter-disciplinary research at LNF includes a majority of projects related to new acceleration techniques and R&D on detectors for various applications. LNF scientists address fundamental questions for the future accelerators and also DAΦNE. As an example we are mentioning few of them.

- Their participation to the CTF3 project at CERN is very important and visible. Many important pieces, the RF deflector, the septum chamber etc., for this machine have been produced by LNF.

- The e-cloud effect is a limitation of many accelerators and the study of coating materials for the beam pipe is essential to mitigate the problem. The team has set up an international level laboratory on material science relevant to the cloud effect and their impact is well internationally recognised.

The expertise developed by LNF is applied to other domains, as the important R&D on laser-based Geometrodynamics applied to Galileo.
The committee is impressed by the variety of the projects but could not get a complete picture of the total number of FTEs involved. We understand that the research on this domain is a bottom up process, however it is not clear which is the global strategy pursued. Many of the projects concern approximately one FTE and it is difficult to judge the scientific impact. Also the evaluation and follow up processes for all the projects have to be enhanced.

4.1 Recommendations

The SC recommends that the LNF management, together with all involved people, define the common goals and the appropriate follow up process for each project.

The SC invites a new presentation of the summary of LNF CSN5 activities at the next meeting addressing some of the questions asked by the committee and showing the correlation between the LNF CNS5 activities and the needs of the Laboratory.

5. NA62

The LNF group plays a central role in all aspects of the construction and installation of the Large Angle photon Veto (LAV) of the NA62 experiment. The group is involved in design, testing, assembly and installation of the detector; in design, production and testing of the electronics and has a leading role in the software development. The stations are built in LNF with large involvement of the structures of the laboratory. Nine out of 12 modules are already installed in the experiment at CERN.

The group has participated to the technical run 2012 and is fully committed to the continuation of the activity that will start data taking in 2014.

5.1 Recommendation

The SC takes note that the group is making good use of the structures of the Laboratory in order to contribute to an important experiment capable add new constraints the CKM matrix.

6. BESIII

The LNF group (together with PG and TO) participates to BESIII since 2009. Participation now formalized in a framework of a larger IHEP-INFN collaboration signed in 2012. They contributed with the analysis of J/ψ and ψ' to pp/nn and with a Zero Degree calorimetric Detector (ZDD) installed in 2011. They are preaparing an upgrade of the ZDD with a thin layer of scintillator strips and they propose an upgrade of the inner drift chamber of BES with Cylindrical GEM technology.

6.1 Recommendations

The SC takes note that the group is making good contribution to BES also in synergy with other hardware activities of the Laboratory. The SC notices that the size of this contribution is quite limited and configures more as the participation of a "Sezione" than as the participation of a Laboratory. See also the recommendation section 3.2.

7. From Previous Meetings

7.1 NAUTILUS Recommendations_SC_44

The SC recommends guaranteeing the run of NAUTILUS until VIRGO will restart after its upgrade, in spite of the limited sensitivity of the NAUTILUS detector compared to the interferometers.

SC_45: Nautilus will be kept running.

7.2 Theory Group Recommendations_SC_44

The SC recommends defining a clear strategy for the Theory Group of LNF. A working group with representatives from the Theory Group, the Lab management and theorists from nearby universities should be formed with the mandate to define and state this strategy for the medium/long term.

An effort should be made to increase the number of young people in the group: establishing collaborations/official agreements with nearby universities and possibly finding ways to finance more postdoc positions.

SC_45:Dosselli states that the preparation of the panel to review and to define the strategy is ongoing. It was decided to go up to 5 postdoc positions (a fraction of which will go to the theory group) reducing the money for foreign visitors.

7.3 Space Research at the SCF_LAB Recommendations_SC_44

The SC takes note that the group is making good use of existing infrastructures (eg. clean rooms) giving added value to the Laboratory also with external contracts.

7.4 PANDA Recommendation_SC_44

The SC acknowledges the good work done on the SST and is impressed by the very light design. The SC recommends that the participation of INFN to PANDA and to its funding is clarified before the start of the construction at LNF and takes note that

CSN3 has a new scientific committee to better understand the scientific position of PANDA.

SC_45: The report of this new scientific committee was positive endorsing the participation of the Italian community to the project. However the funding (5MEu) situation is not clarified. Dosselli states that LNF will start the construction work on PANDA when the situation will be clear. R&D will continue.