50th MEETING OF THE LNF SCIENTIFIC Committee

During the closed session the chair welcomed Angels Ramos, new member of the committee and thanked Avraham Gal who is leaving after six years of service. He also thanked Pasquale di Nezza, who is stepping down as scientific secretary being replaced by Andrea Longhin, and Donatella Pierluigi, who will be replaced by Rita Bertelli for the logistic support to the committee. The chair excused Steinar Stapnes and Lenny Rivkin who could not attend the meeting.

This is also the first committee meeting with the new LNF director, Pierluigi Campana. The chair asks the director to renew his mandate to the SC in a document to be distributed to the committee in the coming months, well before the next SC meeting in May 2016.

The LNF director presents plans for the future of LNF beyond DAPHNE and ELI-NP. First priority is to prepare to be an excellent candidature for hosting the European facility for the plasma-based accelerator driven free electron laser that will be the follow-on of EuPRAXIA. This goes through an upgrade of SPARC_LAB both in terms of new building and of infrastructures to become a user facility.

In parallel LNF will continue to support and upgrade the BTF for experiments and test beams, and to support the services for large constructions of detector elements, also expanding to space activities if LNF staff is involved or external funds can be made available.

These plans require funding and INFN wants to invest on LNF. Part of the funding of SUPERB is now available to LNF for new programs. In parallel one may also try other sources, such as EU investment bank or regional funding. LNF could plan on funding of about 4 MU/year for several years. It is important now to prepare a plan with priorities, timelines and funding request also taking into account the operation or shutdown of SPARC_LAB during the works.

1. DAΦNE, KLOE and SIDDHARTA

1.1 DAPHNE

The overall performance of the machine has significantly improved. Since the end of September DAPHNE has delivered ~400 pb^{-1}, following the milestone plan agreed upon with KLOE. The committee is impressed by these achievements and addresses its congratulations to all people involved in the running of DAPHNE.
The instantaneous luminosity has almost reached the designed value of 2×10^{32} cm^{-2} s^{-1}. Under these conditions only a minor increase can be expected. Consolidating the machine ensures the integrated luminosity and is the first priority. The DAPHNE people have also presented their interest in working to improve the luminosity by a significant factor through the development of the crab waist scheme.
The team is undermanned and there is a lot of pressure on the people involved, limiting the possibilities for further improvements. There is a real effort made to attract young scientists, but it has not been very successful until now. On top of that, there will probably be some interference by summer 2016 between the installation and the commissioning of the ELI project, which may drain DAPHNE of human resources.

The scientific program is clear and should allow KLOE to collect 5 fb^{-1} by 2017. Beyond that, the SIDDHARTA2 option must be considered. The most obvious solution is to install SIDDHARTA2 in the KLOE intersection after definitively removing KLOE.

1.2 KLOE

DAPHNE delivered 1030 pb^{-1} of data between November 2014 and July 2015. The KLOE-2 detector has recorded 80% of this data. Since the end of September another 400 pb^{-1} have been delivered. Assuming a data taking rate of 8 pb^{-1} per day (to be compared with the best daily record of 12.7 pb^{-1}) this provides confidence in collecting about 5 fb^{-1} of data by the end of 2017.

KLOE-2 is currently fully operational and taking data with all sub-detectors. An optimization of the beam injection scheme, as well as the implementation of the new HV distribution system for the IT resulted in a safe operation of the Inner Tracker, with no observed failure during the last 1.5 months of data taking.

A significant effort has been made to understand data quality in the presence of a high level of background, which has an implication on event size and trigger rate. More than an order of magnitude increase in data volume when compared to old KLOE data volume requires an urgent reduction. A comparison of various representative signal channels with old data shows that backgrounds can be easily suppressed such that data quality is not compromised. Express analysis of the EMC information allows reducing the data volume by 60% with nearly 100% efficiency for physics. At the same time KLOE-2 has increased data storage resources to continue data taking with current data volume for significant amount of time. Further reduction would require more elaborated analysis of the various physics channels efficiency.

The KLOE-2 collaboration has presented a clear plan of milestones that culminates in preliminary measurements by the end of 2016 and the beginning of 2017 of a few key physics channels such as $e^+e^- \rightarrow e^+e^- \pi^0$ and $K_S K_L \rightarrow \pi^+\pi^-\pi^+\pi^-$. These results, based on the use of the new detectors and nearly a half of the planned data sample, should provide a solid proof of significance of the new KLOE-2 results for physics. The physics prospects of KLOE-2 will be reviewed at the dedicated physics workshop planned in spring 2016. At that point the feasibility of CPT tests with semileptonic asymmetries and of hadronic vacuum polarization measurements with Bhabha scattering should have been clarified

Urgent detector related milestones include commissioning of the new detectors, namely Inner Tracker calibration and alignment, and synchronization in time of the High Energy Taggers with the KLOE calorimeter. We have seen promising results on both activities and expect timely completion of these milestones. There is also an ongoing progress on the calibration of QCALT.

The LNF management is supporting KLOE-2 with some new positions: one young postdoc for the Inner Tracker reconstruction, one senior post-doc for run coordination/data taking, and one senior post-doc to help on the software upgrade and one fellow (INFN position for foreigners).

1.3 Siddharta

The SIDDHARTA2 collaboration has a very solid physics case. The measurement of the kaonic hydrogen X ray in the SIDDHARTA1 experiment was a milestone in the field of low energy hadron physics. The long awaited measurement in deuterium by SIDDHARTA2 should have a similar impact. This experiment might be performed in J-PARC, but not before 3 years time from now, and certainly not with the energy resolution and intensity that could be achieved with DAPHNE. After all the investment made, we believe that LNF cannot afford losing the credit of having settled the details of the Kbar N low-energy interaction. With the new Silicon Drift Detectors, SIDDHARTA2 should already be able to operate, with DAPHNE, in the second half of 2016. Several international institutions have contributed financially and are also bringing valuable expertise to the team. The present performance of DAPHNE should be good enough to guarantee the running of SIDDHARTA2, which needs to be given a realistic starting date. They also need to have contact persons in DAPHNE (physicist and engineer) to start planning the details of the installation and of the manpower necessary to finalize and run the experiment.

1.4 Recommendations

We consider the development of the crab waist scheme important and we encourage pursuing this research that has an international impact. However the priority of DAPHNE should be the steady delivery of luminosity to KLOE. We encourage the development of automatic operation procedures for the machine, making the operation simpler and less manpower demanding.

We encourage once more the development of a technical plan for installing SIDDHARTA2 after the present run of KLOE, as well as an evaluation of the resources needed for SIDDHARTA2 installation and its running.

We recommend the KLOE Collaboration to re-analyze possible strategies to reduce the gap between delivered and recorded luminosity.

We also recommend that the KLOE-2 collaboration publicizes its current status and plans to groups active in this domain of physics, which may express an interest in joining KLOE-2.

We expect to see, at the next SC meeting, results on full commissioning of the new KLOE sub-detectors and their exploitation in data analysis.

2. SPARC_LAB activities

SPARC_LAB has again shown significant progress since the last meeting. Most noticeably:

- Development of a 1-10Hz capillary plasma source for PWFA experiments with the possibility of “designing” the plasma profile with flow simulations and 3D printing of the capillary chamber. This can allow for matching of the beam to the plasma focusing force of the plasma wakefield accelerator (PWFA) and potentially leading to emittance preservation, one of the holy grails of plasma-based accelerators.
- Measurement of the bunch coherent transition radiation spectrum even at low charge, allowing for bunch profile retrieval.
- Improvement of the quality of the FLAME laser pulse, as well as excellent time synchronization with the electron bunch. This is

crucial for external injection of electrons in a laser wakefield accelerator (LWFA).

- Electro-optic measurements of electron bunches to determine accelerating electric field enhancement at the edge of a shaped target. This will help understanding and potentially improving laser-driven proton emission from solid targets.
- Use of electron-beam-produced THz radiation to measure the nonlinear response of topological insulators. This was performed with and for external users. This is an excellent step showing that SPARC_LAB already produces radiation (THz X- and gamma-rays later) that is interesting for users' applications.
- Improvement of the laser transport line and plans to redesign and improve the Compton scattering experiment. In particular, this should fix the low photon energy yield previously observed. The new Compton scattering line will be designed for broad tunability of the photons energy.
- The SPARC_LAB team has also published a significant number of papers and has made a very strong show at the recent European Advanced Accelerator Concept workshop they co-organized.

The committee is pleased to see that the technical support from the laboratory (Accelerator Division) has increased over the years. This fact was strongly acknowledged by the SPARC_LAB team. The Committee is pleased to see that activities as those of SPARC_LAB and ELI-NP attract a new generation to the laboratory. This should be taken as a sign for the laboratory to consider for its future.

In the current laboratory situation SPARC_LAB is perceived as the major research direction for the mid- and long-term future. SPARC_LAB has a very strong reputation in accelerator and FEL physics. It now has a plasma source and a powerful laser that will soon enable the team to also make its marks in the field of plasma-based particle accelerators (PWFA and LWFA). SPARC_LAB is very active and has leading positions in the EuPRAXIA design study recently approved at the European level. This places the SPARC_LAB and LNF in a very good and very strong position to become the laboratory that will host the European facility for the plasma-based accelerator (PWFA of LWFA) driven free electron laser that is expected to be the follow-on of the European EuPRAXIA project.

However, in order to be ready to compete with other possible laboratories (DESY, Cilex-Apollon, etc.) strong investment must be made very soon both in terms of support for the upgrade of SPARC_LAB and in term of strengthening of the scientific staff by hiring new, top of the crop and enthusiastic scientists. In order to be able to capture this unique opportunity at the European or even World level, the laboratory must be ready, in a three to five years period, to be one of the top laboratories in the world in plasma-based accelerator research, both in terms of infrastructure (electron beam at the GeV energy level, high-intensity laser, diagnostics, etc.) and in term of scientific expertise and staff. This requires a significant shift of the laboratory resources towards SPARC_LAB. New resources must come not only for manpower, but also for students and personnel politics of hiring, maintenance budget and programs, users access and visibility.

2.1 Recommendations

The SC encourages the SPARC_LAB team to quickly make headways in plasma-based acceleration. This effort should be strongly supported by the laboratory.

The SC encourages the SPARC_LAB team and the laboratory to make concrete plans for the future of the SPARC_LAB. This may require prioritization in the SPARC_LAB activities.

The SC encourages the SPARC_LAB team to make a list of milestones that they consider as required to maximize the readiness of the laboratory to be the host of a European facility

The SC encourages the laboratory management to make preparation for the SPARC_LAB upgrade and for the new building that must have the scale and infrastructure to be able to welcome a European-class facility.

The SC invites LNF management to consider strengthening the committee with an additional person expert in the fields related to SPARC_LAB and to hosting intermediate (video) meeting of a restricted SC about SPARC_LAB since it is in a timely phase and may become a major lab activity.

3. Status of ELI

ELI-NP is a very challenging project aiming at very high x-ray photon fluxes and narrow bandwidths. LNF is the main contractor and is responsible for the final result. At present the project is in the phase one acceptance process and procurement for phase two has already started. A great effort has been put to meet all the requirements and to be able to provide the requested hardware in due time and with the outstanding quality requirements needed for such a challenging project.

However the building was not delivered at the end of March (technical date) nor at the end of October (contractual date). And the delivery date is not yet known. This delay poses a number of problems for scheduling the involvement of LNF technicians and engineers for the phase one integration and installation and for LNF physicist and engineers for the commissioning phase.

3.1 Recommendations

The SC congratulates the LNF AD for the timely and successful delivery of the ELI phase one and recommends minimizing the impact of the delays in the delivery of the ELI building by negotiating a schedule for installation, integration and commissioning in Magurele that also takes into account the need of laboratory the in-house activities.

4. NA62 status and activities

During 2015 the experiment took data with all detectors installed and active. The Kaon and Pion tracking systems were included in the trigger. The first L1 trigger algorithms have been tested. The Large Angle Veto and the Small Angle Photon Veto perform to specifications. The LNF group has been active in the commissioning of the L1 Trigger. The experiment will collect data again starting April 2016. The LNF group is also involved in a study of the reaction KL →π0**νν** at the SPS aiming to produce a document of the experiment setup, acceptance estimates and background studies by February 2016.

4.1 Recommendations

The SC takes note of the success of the NA62 installation and first physics run and acknowledges the large contribution of the LNF group to the experiment. The SC looks forward to the first results of the 2015 data analysis.

5. LHC experiments upgrades @ LNF

The four LHC experiments have upgrade plans involving LNF resources mainly targeting installation in LS2 (2018).

- ALICE: LNF gives large contribution to the R&D and prototyping of parts of the new Inner Tracking System and to the assembly and test of a fraction of the staves.

- ATLAS: LNF is involved in the muon spectrometer upgrade with the design and construction of the New Small Wheels (NSM): they are building and assembling the drift panels for SM1. The LNF group is also involved in the trigger upgrade with fast tracks reconstructions: they contribute to the associative memories chip (AM06) design and test.

- CMS: LNF is involved in the upgrade of the muon system contributing to GEM 1/1 chamber design. They are also involved in the R&D for the GE2/1 that is foreseen for LS3.

- LHCb: LNF is involved in the upgrade of the muon detector producing 30 MWPC of large dimensions and their readout electronics.

The plans for these constructions involve a large fraction of LNF resources.

5.1 Recommendations

The SC takes note of large involvement of LNF in the LHC upgrades.

The SC recommends the construction schedules to be regularly monitored to verify the compatibility of the use of the resources with other activities planned by the Laboratory.

6. Next Meetings

51th SC 23-24/5/16
52th SC 21-22/11/16