49th MEETING OF THE LNF SCIENTIFIC COMMITTEE

The procedure to appoint the new LNF director is well advanced and will finish by end of June. The new mandate will start on August 1st allowing for some overlap. This is the last LNF SC meeting of Umberto Dosselli and he was warmly thanked by Rolandi on behalf of the committee and by Zoccoli on behalf of INFN for the excellent job did at LNF these last four years.

The discontinuity the lab will experience with the new Director will be another opportunity to discuss the future with the INFN management. The white book on "what next at LNF" is being finalized and will be discussed at the INFN director board.

Dosselli said that the investment made in the past to consolidate DAPHNE paid off. It is much more stable now. However the machine is 20 years old and cannot be push above its limits. The lab is enhancing the capability of BTF and this can only be positive. The linac could be improved and there are contacts with SLAC for getting useful elements. The situation of KLOE should be clarified to understand whether what is left of the collaboration is able to keep the experiment running. KLOE should run until the middle of 2017. Then Siddharta should start, if it is still going to be still there in 2 years from now.

Since DAPHNE is working, other users are satisfied: BTF, which is always overbooked, has plans to move the control room and there are plans for an energy upgrade. Fortuna reminded us that the orientation of the machine advisory committee is to interrupt the extra funding for DAPHNE and move them to BTF.

SPARC_LAB has good and bad news. The plasma acceleration is proceeding well. However the laser expert (Gatti) left for one year. Since he has been offered a high-level position in Zaragoza there is a possibility that he will not come back. LNF is trying to establish an official link with the lab in Zaragoza to mitigate the problem and have experts exchange.

Zoccoli summarized the INFN funding situation. The government is discussing the budget definition: there are rumours that there will be a cut of 10 ME. The total INFN budget was 237 ME for 2015, it will be 228 ME for 2016. The management is figuring out how to deal with this without cutting research activities. Even adding the “premiali”, that should be around 20 ME, the financial situation is still 10 ME below the global threshold. The good news is that the Parliament is discussing the possibility that INFN and all the research institutions (not the Universities) will be taken out of the public administration. If this happened INFN would have much less restrictions.

1. DAΦNE, KLOE and SIDDHARTA

1.1 DAΦNE

The committee would like to congratulate the DAPHNE team on the excellent progress reported. The machine is now delivering luminosities around 10pb^{-1}/day and 771 pb^{-1} has been delivered since Nov. 2014. The DAFNE team is well on track to reach the promised intermediate goal of 1 fb^{-1} integrated luminosity by the summer of this year.

After several hardware incidents in January/February machine developments have been limited to very few aspects in favour of data taking. The consolidation investments have enabled DAFNE to reach a qualitatively new level. The uptime reached is very high for a collider.

The main points are:
The number of colliding bunches have been increased in the range 93 ÷ 103, while maintaining almost the same total current thus reducing the Touschek contribution to the background and the impact of microwave instability threshold.

A new working point has been adopted for the Main Ring electrons and extensive adiabatic collider optimisation & luminosity fine tuning have been performed. Further ideas exist and were presented to optimize/reduce background during injection and running, and also to increase luminosity further.

The personnel situation remains very difficult with four further operator departures. The fact that the consolidation efforts have decreased - at least for the time being – has allowed a more dedicated effort towards machine optimization and operation, allowing for the excellent results mentioned. However, the operation and improvement efforts rely on a large dedicated effort by the team members that is not sustainable in the longer run.

1.2 KLOE

Thanks to the recent progress in achieving stable DAPHNE operation, the delivery of ~1.5 fb^{-1} of integrated luminosity per year currently looks realistic, which ensures good prospects for KLOE in achieving some of their physics goals on the time scale of two years. The KLOE detector is currently and since more than one month taking data in stable conditions and with all sub-detectors operational.

The quality of data is however considerably compromised when compared to the previous data-taking period. In particular, the level of machine-induced background has increased by a factor of five. So a number of critical tests have to be urgently performed in order to make a critical assessment of the KLOE analyses prospects.

Studies must be performed to understand the tracking and calorimeter reconstruction efficiencies for various physics channels by determining an acceptable background level. This should allow developing a strategy for data volume reduction. Due to a considerably larger event size and higher trigger rate, the current data throughput is a factor 13 higher than in the old KLOE.

1.3 Siddharta

As has been said for long time, the collaboration can be ready after 2-3 months from the green light. Right now they are working on the upgrade of the detector. The experiment is fully funded by CSN3. From spring 2016 they will be able to use the final detector, but also now they are able to collect data with the present apparatus. The core group from LNF is quite small, but the experiment has a large international participation, including Wien, and they made financial investments in the project. They wish to obtain a starting date from the lab.

Besides, they submitted a letter of intent in Japan, but it has not been considered official yet since in the present plan for JParc will not do this kind of physics in the next two years.

1.4 Recommendations

It is important that the continued common effort between Daphne and KLOE concerning the background situation reaches a conclusion, and that a common understanding be found for stable, acceptable conditions.

After the completion of the studies on backgrounds and data volume, the KLOE collaboration should present a prioritized plan of physics analyses, e.g. new measurements in gamma-gamma physics, which can be completed in two years. This plan should include a list of milestones to be reviewed at the future SC meetings.

At this moment in time a longer term plan for DAPHNE/KLOE running is urgently needed, with an approved baseline schedule for the coming 2-3 years. This has to go together with a clear resource commitment (personnel in particular) to DAPHNE and KLOE, such that the DAPHNE/KLOE running period can be brought to a successful completion. In parallel, longer term plans need to be established for post-KLOE running, including SIDDHARTA.

2. Technical Division Activities

Technical Division (DTSG, Divisione Tecnica e Servizi Generali) supports LNF activities with management, operation and maintenance of the infrastructures and of the R&D activities of the laboratory. It is organized in six departments: civil works, general services, central stores and purchasing, mechanical design and construction, electric systems, vacuum and cooling. Total manpower is 38 people, 6 of which are on term contracts.

Specific tasks carried under the responsibility of DTSG in the recent past include: DAPHNE and SPARC_LAB ancillary control systems revamping, refurbishing of the BF cooling, energy saving activities, Data Center expansion, feasibility study for the visitor center. DTSG gives also specific engineering support to a number of INFN projects: CUORE, JEM-ESUO, ELI-NP, XPR, PED4PV.

In the next five years 11 people in DTSG will retire with the risk of loosing specific competences and in the coming years DTSG will not be able anymore to provide LNF current volume of core activities with the support and services supplied so far. Possible mitigation actions include optimization and redistribution of the in house existing human resources across the entire laboratory and increase outsourcing of required resources (at the expenses of loosing the capability of early intervention).

2.1 Recommendations

DTSG is performing well in spite of the difficult conditions due to the decrease of staff. Considering the retirements, there will be a big problem for maintaining the services in the near future. From the middle of 2016 there will be the possibility to hire technical staff. The total number of positions available, over the whole INFN is 35 and some 10 of them will be

for LNF. A manpower plan assuming a reasonable hiring profile should be prepared.

3. SPARC_LAB activities

The Committee is extremely pleased to see the progress on all fronts at SPARC_LAB. Following the INFN President's encouragement, SPARC_LAB made significant progress towards the plasma wakefields experiments. These experiments are expected to produce GV/m accelerating gradients while accessing a regime in which the accelerated bunch can have a small final energy spread and its incoming emittance can be preserved. The issues of emittance preservation and narrow energy spread address directly the most relevant questions in plasma-based accelerators. SPARC_LAB is currently the only laboratory that can address these issues directly. Therefore the results obtained over the last six months in terms of electron beam control are very important. The generation of a bunch train is key in order to obtain large energy gain with low energy drive bunches using multi-bunch, large transformer ratio schemes. Being able to inject a well-controlled witness bunch is also extremely important. These were demonstrated at SPARC_LAB. Progress was made with the plasma source as well as with electron beam diagnostics (CTR, Smith-Purcell, etc.). Other relevant topics such as beam-plasma matching and beam divergence control are also included in the laboratory program. Simulation capabilities were expended. These are important scientific steps taken towards the possibility of driving a FEL with a PWFA electron bunch.

In addition progress was also made with the FLAME laser that is again running at full specifications, albeit with limited personnel support. It will be instrumental in the experiments regarding external electron injection in a laser wakefield accelerator (LWFA) and in the Thomson scattering experiments. However, these experiments will probably receive lesser attention than the PWFA ones. Clear choices should be made, considering the limited resources available.

3.1 Recommendations

The PWFA research planned at SPARC_LAB would have a much greater impact with 1 GeV beam than with the current 100-200 MeV beam; it is

urgent investigating which resources and infrastructures would be needed for a beam energy upgrade of that magnitude. In particular it is mandatory to start very soon civil engineering and technological plans preparation studies. These studies include radiation -shielding issues that have long lead-time and require to be handled by laboratory services.
A significant number of machine down-time can be caused by mains and technological general services faults. Improving the reliability of the ancillaries plants should be a high priority action of the lab management

The Committee is pleased that SPARC_LAB received increased attention and priority from the laboratory support services (in particular from the accelerator division). However, the lab still suffers from a severe lack of personnel, which should at least be mitigated by hiring dedicated staff.

The Committee recommends that the SPARC_LAB should strongly pursue and support the joint European initiative in view of the realization of "THE European laboratory for plasma-driven free electron lasers ". The management should conduct a policy to favour the candidacy of LNF as a possible site to host the future European facility.

4. Pmu2e status and activities

The Mu2e experiment searches for muon-to-electron conversion in the coulomb field of a nucleus: μ^- Al $\rightarrow$ e^- Al aim at improving the sensitivity with respect to previous conversion experiment by four orders of magnitude and probe mass scales up to hundreds of TeV. The experiment has less than a ten years timeline for the completion of first phase.

INFN is involved in two main items: a) the Calorimeter system comprising design and construction of prototypes, front-end electronics, mechanics and laser system. b) Construction of prototypes for the transport solenoid. The overall INFN involvement is some 20 FTEs and LNF participates with 5+2 researcher, 3 engineers and 3 technicians.

4.1 Recommendations

The committee takes note that Mu2E has been extensively reviewed by CSN1, which has approved the experiment and defined in early June 2015 a ceiling to the total CSN1 commitment. At the request of CSN1 the Mu2E experiment will be reviewed, starting this fall, by the Technical/Scientific

Committee (CTS) of INFN, that will give a final recommendation by Spring 2016.

5. Bes III status and activities

The INFN participation has increased with time and is currently about 20 FTEs. LNF participation is about 4 FTEs including 4 researches, one senior associate based at IHEP and 1 senior guest. BESIII has the world largest data set of J/ψ ψ(2S) and ψ(3770) and will run for at least 8 more years.

INFN groups are involved in a number of analyses including di-baryons, J/ψ and ψ' exclusive decays, J/ψ line shape scan for the measurement of the electromagnetic and strong decay amplitude phase, baryons and hyperons cross sections at threshold, measurement of Collins asymmetry in inclusive production of pion pairs.

INFN groups, with a leading role of LNF based on the KLOE experience, have the leadership of the upgrade of the inner tracker based on a cylindrical gem. The installation is foreseen for 2018.

5.1 Recommendations

The committee is pleased to see progress on the CGEM project and on the involvement in analyses.

The committee takes note of the importance of the INFN participation to BES III in the framework of the Executive Program for Scientific and Technological Cooperation between Italy and China. INFN established a protocol for exchanging students, similar to the CERN simil-fellow mainly meant for allowing Italian young physicists to stay at IHEP for long periods.

6. Belle-II status and activities

The first physics run of SuperKEKb is foreseen at end of 2018 and target luminosity in 2022. The presence of the Frascati group in Belle-II stimulated also the revival of the long-standing collaboration between LNF and KEK on machine physics with mutual benefit. INFN contribution to Belle-II is of about 32 FTEs including 60 people from 9 institutions.

The involvement of LNF is of 4 FTEs with 7 researchers. The group contributes to the upgrade of the forward electromagnetic calorimeter and is involved in all aspects of the studies, which will be key for the decision on the upgrade of the calorimeter.

6.1 Recommendations

The committee takes note that the LNF participation to BELLE-II should be seen in the context of the large Italian participation including also contributions to silicon vertex detector and PID. Studies are in progress to understand the need for the forward calorimeter upgrade. A decision will be made by Belle in the first half of 2016. In preparation for that decision the LNF group should prepare a contingency plan in case this upgrade is canceled.

7. Computing Service

The computing service has 9 staff of which 4 on term contracts. The responsibilities of the service include the network infrastructure of the laboratory, the storage infrastructure and OS virtualization. They provide a set of essential basic services to LNF and also to the whole INFN. The latter include Authentication and Authorization Infrastructure (redundant with CNAF), INFN WWW, Computing resources for Enterprise Resource Planning (including disaster recovery with CNAF). They support computing in big experiments (KLOE, ATLAS).

7.1 Recommendations

The committee takes note that the service runs smoothly and tries to fulfil the requests of the experiments and the users. LNF hosts the national web portal and the central administration, so the efficiency must be high. Possible help will come from a recently signed collaboration agreement with INAF for cooperation on computing. One of the last hired permanent positions was an engineer for computing.

8. The PADME experiment proposal

PADME aims to search for the Dark Photon A' using positron on target collision at the BTF. Searching for missing mass in $e^+e^- \rightarrow \gamma A'$, $A' \rightarrow \chi\chi$ the

mass region is limited by beam energy: with 550 MeV e+ beam the region $m_{A'} < 22$ MeV can be explored. The photon energy and angle are measured by a 30 cm diameter highly segmented forward calorimeter. The experiment is sensitive to coupling square smaller than 10^{-6} that is beyond the present limits. Searching for $A' \rightarrow e^+e^-$ using a spectrometer also improves on existing limits.

A proto collaboration including LNF, Rome1, Lecce and Sofia has been formed. The experiment could be ready to take data in less than 2 years after approval.

7.1 Recommendations

The committee takes note that CSN1 will complete the review of the proposal during the summer and will then recommend a funding plan by early October. The committee is pleased to see that this interesting proposal is coming close to the approval phase. The Committee recommends that a decision on the funds needed to upgrade the BTF to 1 GeV is taken soon.

9. JLab12 status and activities

LNF is involved in the CLAS12 RICH project that has the goal of providing a 4σ π/K/p separation for momenta between 3 and 8 GeV. This detector was not present in the first design of the CLAS12 spectrometer. The construction is done in collaboration with JLAB. The INFN groups that participate to the projects are Ba, Fe, Ge, LNF, ISS/Roma1. The LNF group involvement includes R&D and prototyping, selection of the photon detectors, design of the module, test of the mirrors and the construction of the mechanical structure. Thanks to extra funds from MIUR LNF and Ferrara will build two modules instead of one. The installation of the detector is foreseen in June 2017.

7.1 Recommendations

The committee takes note that the activity is progressing efficiently and smoothly and is pleased to learn that – thanks also to this effort in JLAB - DOI acknowledged INFN as the largest external collaboration in US.

10. Next Meeting

50th SC 23-24/11/15.