52nd MEETING OF THE LNF SCIENTIFIC Committee – 21-22/11/2016

The chair excused Andrey Goloutvin and Patric Muggli who could not attend the meeting.

INFN is going through the process for the definition of the 2017 budget that is composed by general baseline plus extra premium funding from the government both from the evaluation of performance and from submitted proposals. There is a maximum of four projects led by INFN plus three projects where INFN is a partner. One of the projects in priority is about SPARC_LAB. The general review process of INFN (done every three years) is being finalized and the indications are positive: this is important for the assignment of premium funding.

The plan for recruitment in 2016 was approved: 25 positions for engineers and 6 for technicians among which 4 and 1 for LNF. One of the four engineers has already been hired. LNF hopes to get also few new research positions from the current recruitment that is done without pre-allocation to the INFN structures. Staff with short-term contracts is stable to about 50 units, 50% recruited directly by INFN and 50% on special projects.

One of the main goals of this SC meeting is the definition of the DAPHNE schedule for up to 2019. This is reported in section 1.4

1. DAΦNE, KLOE, PADME and SIDDHARTA

1.1 DAPHNE

The good performance of DAPHNE has continued through the run II and into the first three months of run III, resulting in the total integrated luminosity: delivered 3.4 fb^{-1} and 2.7 fb^{-1} collected in the KLOE-2 detector. The goal of 5 fb^{-1} seems to be well within reach by the end of 2017. The performance of the accelerator is very impressive; luminosity is restored after remarkably short times. The luminosity accumulation shows

very good progress in spite of longer shutdowns due to water supply, major maintenance of the power distribution system by the main power provider, linac faults, KLOE detector downtime and other faults.

The consolidation program has continued in the background of the luminosity running, linac electronics upgrade and acquisition of key spare parts have resulted in more reliable performance.

The backgrounds are kept under control, in particular with the data taking veto system at the injection on the order of one damping time. The wiggler magnets faults represent one of the outstanding problems, but running without them has not been demonstrated and will reduce the data collection efficiency due to doubling of the damping time. Replacing the present wigglers with permanent magnets is an interesting if costly idea.

Among outstanding risks is the lack of general revision of all of the power supplies that is associated with substantial cost and the need for a long stop of the machine.

The need for scheduled time for beam studies and tuning, both in the ring and linac is becoming more urgent and the longer maintenance stops scheduled for 2017 are an important step in preparation for the detector swap and PADME running. The studies of long pulses in the linac are part of this. Studies of running with reduced wigglers/without wigglers were mentioned as ways of potentially reducing electricity costs if successful.

The plans for changeover from KLOE to SIDDHARTA seem to favour building new QUADs for the SIDDHARTA-2 run. Work is needed on the diagnostics tools and luminosity measurements for this run. The allocation of funding in 2017 for the hardware changes needed is time critical in order to keep this schedule.

1.2 KLOE

KLOE continues to produce scientific outputs on run1 data: 4 publications in 2016 including a very nice measurement of the running of α_{EM} and a Dalitz analysis of the η to three pions.

The running is going well with good efficiency and good detector performance. They have good online monitoring of data quality with

physics distributions showing that the quality of data in the trigger is fine and is not deteriorated by backgrounds.

Tracking with Inner Tracker and Drift Chamber is now operational in the official software. Progresses on the commissioning and alignment of the Inner Tracker were shown in the closed session. Some early reported problems on layer 1 have been understood, however there are still outstanding issues not understood yet and the improvement in resolution with respect to the Drift Chamber alone is a marginal 50% where a factor larger than two is expected.

Progress has been reported on the HET, however it is not clear yet if the measurement with double tagger can be done or if one should concentrate only on the single tag data. Good progress has been shown on DAQ and storage.

KLOE efficiency is around 80% and in order to reach 5/fb of recorded luminosity some 6.2/fb of delivered luminosity are needed. Di Domenico presented various models for the future luminosity delivered by DAPHNE concluding with a request to run KLOE till until summer 2018 to reach the 5/fb of recorded luminosity.

1.3 PADME

The discovery of dark matter is a real and fundamental issue that physicists face for the next year. The community has adopted a multi-experiment and multi-coverage of the whole phase space, as no hints exist to guide the searches. In this context, the PADME experiment will explore the dark photon domain at relative low energy. The experiment hopes a discovery but otherwise will bring very competitive limits constraining the future searches.

In order to achieve 10^{13} positrons on target in a six months period, the Linac has to be slightly modified and optimized for this goal. This is not a straightforward operation and it is mandatory that some machine development time is dedicated in 2017 for that, in order to anticipate any problems before the real data taking.

The main detector for PADME is the BGO calorimeter. A real progress has been achieved since the last meeting, as the necessary number of crystals is available, ready to be cut in shape and equipped with the photon read-out system. This important work has been contracted with an external company, the cutting and polishing technic is well understood, and no surprises or delays are expected. The team is designing in house a light mechanical structure, which has to support about half a ton. Some preliminary ideas exist on how to do it, and we feel confident that will be done timely.

1.4 SIDDHARTA

The preparation of the SIDDHARTA-2 experiment is on schedule. The team claims that the detector can be ready by summer 2017.

Progress has been done for increasing the background rejection and efficiency in data taking. This should allow a more efficient run compared to the previous SIDDHARTA run that was done with large dead time excluding from data taking the DAPHNE injection time.

The new set up has improved substantially in order to increase the signal to background ratio. A technical report, issued last August, describes the main changes with respect to the old SIDDHARTA setup. Some of the new elements have already been built and tested. The main improvements are: i) the placement of the kaon monitor just below the kaon entrance window to the target cell, ii) the implementation of new SDD-chips with on-board preamplifier (CUBE), and iii) the development of a veto counter, given by an external scintillators array, to tag the events of kaons being absorbed by the gas or by the solid materials. The performance of this new setup was simulated with GEANT4 , giving a signal-to-background ratio of 1:3, which represents a large improvement over the 1:100 ratio of the previous experiment. According to the simulations, with the planned setup improvements and with an integrated luminosity of about 800 pb-1, Siddharta-2 will be able to perform the first X-ray measurement of kaonic-deuterium with a similar precision of their kaonic hydrogen measurement.

1.4 DAPHNE SCHEDULE

The SC discussed the schedule of DAPHNE for 2018 and 2019 in order to accommodate the end of the KLOE run, the first run of PADME and the run of SIDDHARTA2. The integrated luminosity needs are

- 5/fb for the completion of the KLOE2 program
- 10^13 positrons for PADME for the first run for the search for dark photon
- 0.8/fb for the SIDDARTA2 for the first measurement of kaonic deuterium

DAPHNE is performing very well delivering more than 200/pb per month to KLOE. Extending the approved run of KLOE from end of 2017 to end of March 2018 and giving KLOE priority until this date gives a good probability to reach the goal of 5/fb on tape.

Moving the start of PADME to April 1st 2018 gives three extra months contingency to schedule of PADME that has to complete the installation by end of 2017.

The SIDDHARTA2 apparatus will be at LNF before the end of 2017 ready to be installed. The roll-out of KLOE and the installation of the SIDDHARTA2 experiment can be done in 4 months starting on April 1st 2018 and be completed before the August stop. During these four months PADME can take data.

In September and October the priority will be to DAPHNE and SIDDHARTA2 start-up including engineering run for SIDDHARTA2. PADME can take data parasitically.

In November and December PADME will have priority and will complete the data taking with 10^13 positrons.

The luminosity run of SIDDHARTA2 will start in January 2019 and will continue to end of July.

1.5 Recommendations

The SC congratulates the DAPHNE team on the excellent work behind the very good performance of the accelerator.

The SC recommends again as the first priority for DAPHNE the consolidation of the machine and the maximization of the integrated luminosity.

The SC recommends that funds for the preparation of the changeover from KLOE to SIDDHARTA are made available early in 2017.

The SC congratulates the KLOE-2 Collaboration for the progress done on the online monitoring, in understanding the new detectors and for the nice papers produced.

The SC recommends that the KLOE-2 Collaboration concentrates efforts on solving all calibration problems (especially those of the IT) in short time and starts soon the reprocessing of RUN-II and RUN-III datasets.

The SC, after discussion with the chair of CNS1, expects that CNS1 schedules soon a status report on the KLOE-2 calibration and that some SC members will be invited to this presentation.

The SC congratulates the PADME team for the progress done and believes that the experiment has a real physics potential at a very modest cost. The SC recommends that LNF monitors closely the experiment's progress, schedule and milestones as it is important for PADME to be ready to take data at the end of the KLOE run, foreseen by April 2018.

The SC notices that the size of the PADME Collaboration is small compared to the effort needed to build and run the experiment and encourages the spokespersons and the LNF Director to look for new collaborators.

The SC congratulates the SIDDHARTA Collaboration for the progress shown on the apparatus design that will substantially improve the signal to background ratio in data taking.

The SC expects that the SIDDHARTA Collaboration discuss with the LNF director a plan for personnel that will ensure a stable data taking during 2019. The SC expects this plan be presented at the November 2017 meeting.

The SC expects that the SIDDHARTA detector will be operational at LNF by the end of 2017.

2. SPARC_LAB activities

The committee applauds the progress that has been achieved at SPARC and is also evidenced in a strong list of publications. The SPARC team keeps exploiting the unique capabilities at SPARC, for example by using the available short and high brilliance electron bunches plus a TDS for investigating the accelerator physics of plasma lenses. The results show new and important insights into wakefields and emittance growth from plasma lens devices. A thorough planning for recovery from the FLAME fire and the C band klystron damage has been worked out. The committee is worried to see that companies of high reputation did not reveal possible hardware improvements before a damaging event. The committee applauds the efforts from the SPARC team to use the downtime for pushing laser upgrades faster than originally planned. The detailed planning for 2017 scientific work at SPARC is success-oriented, setting ambitious goals and motivating fast progress in work by the involved experts. The committee supports this planning. The team is congratulated for the progress on EUSPARC. The extension of the available space for EUSPARC will maximize the physics reach of EUSPARC and is strongly endorsed.
Maximum resources on a fast recovery for the C band klystron and the FLAME laser should be made available. One should check any ways to accelerate repair work. One should review the acceptance criteria for high power equipment to include professional interlock systems. The milestone of a “plasma-driven FEL” for May 2017 should be rephrased to be a little bit more general and allow for a proper testing and R&D phase before this goal is met. Strong theory and simulation efforts should be continued to systematically compare the measurements with plasma lenses to the expectation and theoretical understanding. The conceptual design report for the EUSPARC facility at the LNF site should be advanced as fast as possible, taking the longer version as the baseline and continuing the strong connection to EuPRAXIA work. The scientific case for novel

accelerator goals at EUSPARC should be clarified in more detail, especially concerning the maximum allowed beam energy: multi-GeV as state of the art or restrict to 1 GeV? Is R&D on staging towards high beam energy (HEP) possible or not? The RF choice for EUSPARC should be analyzed in terms of achievable performance, required implementation time and the required schedule for EUSPARC realization. What are the feasibility milestones to be reached, before a EUSPARC project can be approved for the C band or the X band option?

2.1 Recommendations

The committee expects that the Milestone for a "plasma-driven FEL" by May 2017 is reformulated in more general terms.

The conceptual design report for the EUSPARC should take the longer version as baseline.

The scientific case for novel accelerator goals at EUSPARC should be clarified in more detail.

The committee would like to see a set of feasibility milestones before EUSPARC con be approved for the C band or the X band option.

3. BTF

BTF continues to be a successful story for LNF. During 2016, 28 weeks of beam were delivered, to be compared to 38 week requested in two calls. The test performed at BTF resulted in 26 scientific papers produced in 2016 of which 4 co-authored by the BTF staff. This is a large improvement in the scientific accounting compared to previous years.

The upgrade of the BTF includes a second beam line, a consolidation of the LINAC, an extension of the pulse width, a refurbishment of the control and timing system and new telescope with high resolution. The details of the line have been worked out taking into account the limited space and the

simulations have been re-checked. Radiation studies have been performed and a preliminary project of the civil engineering exists.

In 2017 there will be a call covering operations from February to July and probably no user operation in September December.

3.1 Recommendations

The SC congratulates the BTF staff for the very successful operation of the facility and for the efficiency in improving the scientific output accounting. The SC reiterates the recommendation of a smooth funding plan for the upgrades compatible with the schedule of PADME.

4. DAPHNE-L

Five beam lines extracted from DAPHNE provide photons in the range from meV to KeV for various applications mainly in material science studies. In this laboratory new detectors and optics can be tested using SR light and conventional sources. In 2015 about 50 experimental teams had access to the facility. Eleven papers have been reported as scientific output of the tests performed at the facility.

The facility participates to the CALIPSO Eu program (ending in 2015) and contributed to the submission of the CALIPSO-plus and Open Sesame Eu projects.

The group is involved in WG4 of EuroCirCol project. The latter activity, in collaboration with CERN, is a Key Enabling Technology to address the mitigation of the huge heat load from SR in FCC-hh. The possibility of a dedicated SR beam line at LNF fully dedicated to irradiate long pipes is under study.

4.1 Recommendations

The SC congratulates the group for the interesting activities reported.

The SC recommends an optimization of the organization of the access to the facility for external users and of the accounting of the scientific output

of the experiments conducted at the facility. The organization of the BTF is a good model to emulate. The web site https://web.infn.it/Dafne_Light/ should be kept up-to-date especially on "access" and on "publications".

The SC recommends that plans for the possible use of the facility beyond 2019 are prepared well in advance.

5. NA62

The NA62 LNF group has the full responsibility of the Large Angle Veto and Small Angle Veto detectors. They are also involved in the Level1 Trigger and in the general running of the experiment.
The experiment is taking data, the goal is a 10% measurement of the BR $K^+ \rightarrow \pi^+\nu\nu$ by the end of 2018. SM sensitivity (10^{-10}) should be reached with the data collected in 2016.
The detector performs well and specifically the LAV and SAV detectors efficiency have been measured and found in or better than specifications.

The LNF group is also involved in extending the scientific goal of the present data taking with exotic searches including Hidden Sector searches and in the proposal for the measurement of the branching ratio $K_L \rightarrow \pi^0\nu\nu$.

5.1 Recommendations

The SC congratulates NA62 and the LNF group for the good performance of the detector and looks forward to the presentation of the results of the analyses of the data collected in 2016.

6. Next Meetings

53rd SC 9-10 May 2017
54th SC 14-15 November 2017