Report to the President of the INFN

Il Comitato di Valutazione Internazionale (CVI)

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Introduction and General Comments

The CVI met this year from the 9th through the 11th of October at the Laboratori Nazionali di Frascati. In preparation for the meeting, INFN management provided us with the annual report of the Gruppi di Lavoro per la Valutazione (GLV), which surveyed the INFN programmes, and served as reference for our evaluation of the accomplishments of the National Scientific Commissions (CSN's), Technology Transfer group, and National Laboratories. We express our thanks to INFN central management and programme leaders for addressing our recommendations from 2016, and to LNF Director Pierluigi Campanaand his staff for their outstanding hospitality and support for the meeting. We also wish to thank INFN for explicitly addressing our recommendations, and their positive response to our requests and suggestions from last year. The meeting agenda, a list of our recommendations, and a set of requests and suggestions for next year's GLV report are attached as appendices.

This is the year of Gravitational Waves, and the highly successful turn-on of Virgo has established an essential foothold for INFN in one of the most exciting areas of all science. Integrated with the two LIGO interferometers in the US, Virgo provided the essential new information to promptly locate the region in space where two neutron stars were colliding, enabling optical and radio telescopes around the world and in space to contribute to the first-ever observation of this extraordinary phenomenon. The new field of Gravitational Wave Astronomy is now "open for business!"

We were pleased to learn that INFN has hired 73 high-quality young researchers this year (15 in theory), who under a new unusual strategy were able to choose where to accept their positions. The yield varied among institutes: those affiliated with universities largely had a successful yield, but some of the National Laboratories did not fare as well. This year's experience will form a useful basis for tuning next year's competition. We discuss this and other human-resources matters in a section below.

For yet another year the budget situation remains quite good on the short term, with a 230M€ base budget along with 30M€ International, and 30M€ for premium projects where INFN is doing very well compared to other countries. Several other "one-shots" will also be of great help: DLHC magnet R&D, Aria, RFQ for Uffizi, and the closing of IGNITOR, which could free up >12M€.

The 2016 CVI report covered Technology Transfer, Outreach and Third Mission in great detail, as well as the major management changes in the National Laboratories, particularly LNGS.

Therefore, they will not be mentioned in this year's report. However, we note that INFN continues to find technology transfer to be a challenge. This is a continuing issue not specific to INFN, but we think INFN would benefit by reaching out more proactively to other relevant entities.

Recommendation:
General 1. As we have already stressed in previous reports, INFN should improve its efforts on Technology Transfer, in collaboration with the national networks of industry organisations, to reach a larger number of enterprises and to participate in common initiatives meant to improve the R&I system.

Central Administration

During the past year public research entities have come under pressure to take on additional administrative duties, increasing the complexity of the organisation. INFN responded by appointing a highly-qualified Director General to deal with administrative affairs and to work out a programme aimed at updating administrative systems. The new director presented a well-designed plan of actions at the 2016 CVI meeting that garnered our strong support. Over the past year, actions aimed at increasing the efficiency of the administration have been executed and progress has taken place but at a lower than expected pace. Good results have been achieved in some fields, like internal accounting and procurement, and a clear organisational design of administration has been devised. However, larger projects have been impaired by both external constraints (laws and public regulations; difficulty to hire IT people), and internal resistance.

As examples of external constraints, INFN had to adapt its accounting and other procedures to several newfangled regulations introduced by national law in public administrations, like VAT split payment and new purchasing procedures, which absorb resources, and make it difficult to share solutions and software with other research institutions. For example, Public Universities – differently from INFN – have accounting systems based on asset-liability and income statements. To improve the situation INFN should make an effort together with other funding agencies to influence National regulations aiming at updating accounting systems and sharing solutions.

To overcome internal resistance, we suggest that INFN focus on smaller projects aimed at solving specific problems without increasing the bureaucratic burden, such as new organisational rules, standardisation of procedures, and streamlining of workflow. We suggest INFN should "unpack" the process of administration and organisational change, isolating a few projects that can quickly improve INFN administration. Such pilot projects should convince the research community that real improvements can be obtained, and could help overcome scientists' fears of a loss of autonomy and flexibility. Indeed, a definite goal should be to demonstrate that well-designed administrative rules and an efficient organisation could facilitate good science, which must maintain pre-eminence. Given the limited availability of human resources, and the difficulty to hire Information System people in administration, outsourcing of non-strategic activities (e.g., payroll system) should be also considered.

Recommendations:
CA-1. The re-organisation of the "Federal" INFN system should proceed with a pilot project chosen to demonstrate that scientific work can take advantage of streamlined administration.

CA-2. We propose again our recommendation from the 2016 CVI Report: "The administrative reorganisation should focus first upon 'low-hanging fruit', to realise quick improvement and remediate urgent problems and weaknesses, and thereby gain support for future actions."
CA-3 (repeated from last year). INFN should explore possibilities for collaboration with other institutions in reforming and optimising the administrations.

Human Resources

INFN is facing several issues on personnel management: First, INFN has to conform to existing norms on workers of legally protected status, which implies hiring 100 disabled people. For this purpose INFN is implementing HR solutions to accomplish this, for the most part by allocating positions among Administration, Technicians, Engineers and Researchers.

Second, a new law requires awarding permanent positions without competition to temporary contract people who have worked 3 out of the last 8 years. This seems easily achieved for technical and administrative staff, while it can be difficult to allocate permanent positions in engineering and research to people who were hired only for a time span and with expertise related to specific projects.

A third class of problems derives from INFN's competition with universities, which have the possibility, foreclosed to INFN, to directly hire ERC grant winners on permanent positions.

Fourth, following the recent internally established rule to allocate newly hired researchers according to a "free choice" competitive selection, there is a risk that peripheral laboratories and research centres will be understaffed, so it is important to consider the potentially deleterious effect on less attractive labs and centres, and ways to mitigate it.

As a final problem, gender balance is worsening, despite the articulated positive actions put in place in the past (and praised in CVI's previous reports). After a long lasting effort, actions directed to promote the presence of women in physics should be reconsidered *"ab initio."*
All this highlights the increasing importance of career management. We urge INFN to pay attention to all these issues. It seems particularly important to promote internal mobility, also making use of incentives and tools that help matching competences and needs.

Recommendations:
HR-1. INFN must monitor the new mechanisms for competitive selections and applicant choice of institutes, to identify and mitigate any negative unforeseen effects.
HR-2. INFN should consider experimenting with internal matching mechanism and use incentives to promote internal mobility.
HR-3. New approaches to gender issues should be explored, based on careful study of women's access to scientific careers.

CSN1 – Accelerator-based Particle Physics

CSN1 coordinates INFN particle physics activities at accelerators and R&D for future projects. It is a large sector with 803 assigned FTEs, a 1.6% increase compared to the previous year, the same trend being expected next year. An additional 20 FTEs work on related detector and electronics development in CSN5 or other grants. We congratulate CSN1 for attracting 28 out of the 58 new INFN experimental researchers selected in the recent hiring competition. This alleviates the tendency of increasing average age of INFN researchers observed in the previous years. About 70% of FTEs work on LHC. In addition, there is a good portfolio of experiments at LNF and various international laboratories. The scientific programme spans hadronic and flavour physics, complemented by charged lepton physics, proton structure and R&D for future applications. Most experiments are in data-taking mode. Significant progress in detector construction, upgrades and R&D towards future experiments was also achieved during last year. Some of the highlights are described below.

The integrated luminosity delivered by the LHC machine at 13 TeV in 2016 was 60% higher than anticipated, stressing somewhat the trigger and computing resources. After a successful p-Pb run and an Extended Year End Technical Stop (EYETS), a new peak luminosity record of 1.75 10^{34} cm^{-2} s^{-1} in p-p collisions was achieved in August 2017. ATLAS, CMS, and LHCb are in smooth data-taking mode, and the smaller experiments, LHCf and TOTEM, also collected valuable data. Because of the abundance of data, the experiments were able to produce new results with unprecedented sensitivity and precision; for example, ATLAS and CMS have improved the experimental precision of the Standard Model Higgs boson properties by a factor two, approaching the theoretical uncertainty. LHCb is producing many important new results in flavour physics, while LHCf and Totem are probing uncharted territory.

The LHC experiments are pursuing their ambitious upgrade plans, with ATLAS and CMS Phase-1 and LHCb upgrades well underway, pushing to keep up with the tight schedule. The R&D for High-Luminosity Phase-2 is coming to an end, and all but one or two Technical Design Reports (TDRs) are expected by end of 2017. The review of the TDRs and the “Money-Matrices” for the Phase 2 upgrades should converge by April 2018. The current total INFN contribution to HL-LHC Phase-2 upgrade Core Cost is 35 M€.

The INFN contributions to different subdetectors in each experiment are presently being discussed and will be reviewed both by CSN1 referees and by the Comitato Tecnico-Scientifico (CTS), to be finalised by the end of next year. With a core cost of 35 M€, the corresponding total cost is 50 M€ including cost of pre-prototyping, infrastructure upgrade, hired personal and an additional 20% contingency. The money is to be spent in around 9 years and does not include computing. We support the view that building prototypes is the essential next step before starting construction.

The experiments KLOE2 (LNF), BESIII (BEPC), COMPASS (CERN) and NA62 (CERN) are taking data. KLOE2 is well on track to achieve the goal of collecting 5 fb^{-1} of data before closing in March 2018, with several analyses ongoing in the kaon and hadron sector. BESIII produces charm quark and tau lepton physics results; COMPASS studies new aspects of the proton structure; and NA62 collected a large sample of K^+ decays with the beam intensity now at 60% of nominal. BESIII and COMPASS are also preparing for an upgrade.

The g-2 experiment (FNAL) has just started data taking. BELLE2 (SuperKEKb) is ready to take data. MEG (PSI) and PADME (LNF) and Mu2e (FNAL) are moving ahead with construction. SHIP and MuONe are new proposed experiments still in the test beam phase.

We are happy to support CSN1’s plans to contribute to the update of the EU Strategy by 2019-20 and the related R&D programme on Future Accelerators (RD_FA). The activities so far include detector R&D (like the μ-RWELL detectors), high-energy beam steering with crystals (first tests were done in UA9, and INFN hosts the CRYSBEAM ERC consolidator grant) and acceleration techniques, including a new idea for a Low Emittance Muon Accelerator. INFN will contribute to the CepC and FCC CDR planned by next year.

We congratulate CSN1 for its rich and diverse programme and steady production of important results. We appreciate the effort made to develop useful indicators of the quality and volume of the INFN researchers in large international collaborations. All indicators of scientific productivity and visibility of INFN researchers are excellent and the trend is maintained across the years.

Recommendations:
CSN1-1. We encourage CSN1 to play a significant role in the preparation of the upgrade of the European Strategy for particle physics.

CSN2 – Astroparticle Physics

2017 was extremely successful and rich for CSN2, and accordingly the contributing scientists deserve appreciation and congratulations! The most spectacular success is the detection of gravitational waves, including the successful entry of Virgo on the world scene. Even thougjh Virgo's sensitivity is still behind that of LIGO, there seems to be a deficit of resources to quickly keep up. Other highlights of this year include the record limits from GERDA on neutrino-less Double Beta Decay and from XENON1T on dark matter cross sections, the demonstration of a strong extragalactic component of the cosmic ray flux at highest energies by the Pierre Auger Observatory, the detection of a multitude of sources by the MAGIC telescope, and precision measurements of solar neutrinos with Borexino indicating a high metallicity of the Sun.

An impressive, broad programme to detect low-energy photons from space is under preparation, ranging from the study of the Cosmic Microwave Background to MeV-photons with the eAstrogram satellite. This will need careful time staggering of resources. We welcome that Auger-prime is under construction and that the INFN participation in LHAASO and JEM-Euso was terminated.

KM3NeT reports a mixture of successes and problems. At the KM3NeT ARCA site in Italy the junction box has failed and the remaining 2 Detection Units (DUs) could not be read out, resulting in the need for a thorough Technical Review of the project. The plan is to deploy the 24 DUs of Phase-1/Italy until in spring 2019. A project manager from industry was hired and the fabrication and assembly of basic underwater components is outsourced to expert industry. At the ORCA site in France, after lengthy troubles with the shore cable have been solved, a first DU (assembled in Italy) was deployed and is now taking data. Finally, with the participation in T2K, SOX, DUNE, the Fermilab short baseline programme, JUNO and ORCA, there is a rich programme on neutrino-oscillation physics that reflects the great Italian traditions in this field.

In spite of problems KM3NeT will define a main pillar of astroparticle physics in Italy with high discovery potential. *INFN should continue to support the project, and the technical progress towards full deployment of Phase-1 should be carefully and continuously monitored.*

We now make several comments on the CSN2 programme. First, we urge that Virgo must keep-up as soon as possible with LIGO, to be – at least for distant objects – more than just the third antenna for better direction measurement. That will need additional resources. Second, Darkside 20 (20 ton LAr detector) has to be realised in time not to be beaten by future larger detectors. *Accordingly, DarkSide should continue with high priority* to a) have clearly the best sensitivity when it starts data taking and b) to pave the way to the >100-ton scale.

Going further, because cost of experiments at the > 100-ton scale can only be realised with argon, not xenon. The step from 50 kg to 20 tons, larger than for any previous Dark Matter technology, is a big challenge that will require careful oversight from INFN and LNGS. Third, the future of high-energy CR physics depends critically on the outcome of Auger-prime. Only 70% of the resources to equip all tanks with scintillators are secured. Although a smaller array means longer operation this should not prevent a swift construction. And finally, KM3NeT is not yet "out of the woods." The first ORCA strings will provide a better understanding of the DUs themselves. The floor components (Junction Box) at the ARCA site can be only tested there.

Recommendations:
CSN2-1. INFN should strongly support a further upgrade of Virgo, with the goal to quickly approach a similar sensitivity to that of the LIGO antennas.

CSN3 – Nuclear Physics

Over the past year, CSN3 has continued to make progress in all its lines of research. In particular, the sector **Quarks and Hadron Physics** is strongly involved in the JLAB activities, contributing to building equipment for and commissioning the upgraded CEBAF facility at JLAB. Experiments with the upgraded 12 GeV facility are planned in the spring of 2018, and ground-breaking results are expected in understanding the structure of the nucleon and a few other topics in the regime of non-perturbative QCD. Meanwhile, the Collaboration has been busy analysing data taken in measurements using electromagnetic probes at different energies at MAMI (Mainz), ELSA (Bonn), JLab (USA) as well as in the experiments KAONNIS at LNF (Frascati) and ULYSSES at KEK (Japan). Furthermore, together with colleagues in CSN1 the collaboration is participating in a feasibility study of an electron-ion collider to be constructed in the next decade at JLAB or Brookhaven.

The section studying **Phase Transition in Hadronic Matter** had an intensive year of data analysis finishing the analysis and publishing the data from ALICE of Run-1 and starting the analysis of Run-2 for Pb-Pb collisions at 5.02 TeV, *p*-Pb collisions at 8 TeV and *p*-*p* collisions at 13 TeV. Many papers have been published and many contributions (talks and posters) were presented at the Quark Matter conference in February 2017. Interestingly, the ALICE programme is now facing competition from other LHC experiments (ATLAS, CMS and LHCb), which have become interested in heavy-ion physics, putting pressure to publish results soon.

To pursue its nuclear structure studies, in particular gamma-ray spectroscopy, at national and international research facilities the **Nuclear Structure and Reaction Dynamics** section formed a collaboration around experiment GAMMA, involving about 50 physicists and 20 engineers from 6 INFN units. The experiments involve the use of Ge detector arrays coupled to complementary scintillation detectors such as BaF_2 and $LaBr_3$. We endorse this coherent concentration of efforts and the efficient pooling of experimental resources, which make Italian groups internationally visible and influential. Interesting results have been obtained on the spectroscopy and nuclear structure of neutron-rich and neutron-deficient nuclei, and in particular with the AGATA campaign at GANIL. Progress has also been made in research programmes at LNS and LNL (see sections on LNL and LNS).

The **Nuclear Astrophysics and Interdisciplinary Research** section has made progress in preparation of the LUNA-MV (LUNA3) facility. We were pleased to see that CSN3 addressed the questions raised in last year's meeting regarding LUNA3 satisfactorily by involving external groups, in some cases new ones, in the research programme. A workshop was organised to bring all interested international scientists together to form a collaboration, resulting in plans by INFN to formalise the collaboration via an MoU. Furthermore an important letter of intent has been submitted by M. Wiescher of Notre Dame University. We also note that exciting results were obtained by n_TOF and **AEGIS** collaborations. The first measured the $^{7}Be(n,\alpha)$ reaction in the energy region of 0.02-10 keV, which is crucial for the cosmological lithium problem, and the second deduced the antiproton-to-electron mass ratio with a precision of 10^{-9} from the spectroscopy of anti-protonic helium atoms. These results appeared in Phys. Rev. Lett. (Editor's Suggestion) and in Science, respectively. The FTE's working in this section more than doubled in the course of a few years whereas the other sections either remained constant or decreased slightly.

During the presentation it was mentioned that the Foot (nuclear fragmentation) Experiment, which aims at nuclear physics applications in radioprotection and measuring nuclear fragmentation for particle therapy, has been approved and financed. On the other hand, the novel PANDORA experimental programme, a joint activity of CSN3 and CSN5 that advocates the use of plasmas in study of nuclear astrophysics processes among others, awaits results from CSN5 experiments before embarking on full investigation of beta-decay rates in plasmas that simulate nuclear decay rates in stellar conditions.

We note with satisfaction the CSN3 successes on different fronts for all four pillars and congratulate CSN3 on awards, important positions taken by its members in national and international organisations, success in obtaining European (including ERC grants) and national funding and the high productivity, e.g., many publications in high-impact journals, and visibility through invited talks.

Recommendation:
CSN3-1. CSN3 scientists should work together with other European groups and funding agencies to realise the 1π solid angle configuration of the AGATA detector array.

CSN4 – Theory

INFN continues to provide strong support for theoretical physics, preserving a legacy in Italian theoretical nuclear physics that began almost a century ago. The CSN4 remains a vibrant, active enterprise covering a broad spectrum of theoretical physics that is the envy of other European countries. This strong positive conclusion is supported also by bibliometric data. INFN deserves great credit for the way it has steadily supported theoretical physics over the years. In this field the Italian school has long been one of the best in the world and it is important to foster this excellence. Every indicator this year testifies that this is the case: number of researchers, funding, number of publications and impact factor.

The composition of the CSN4 collaborators is as follows: INFN Staff (11%), University Staff (49%), PhD students (20%) and Post-docs (18%). The research covers six different lines of scientific enquiry: String and Field Theory, Particle Phenomenology, Hadronic and Nuclear Physics, Mathematical Methods, Astroparticle Physics and Cosmology, and Statistical and Applied Field Theory. However, the field of theoretical physics continues to evolve and the composition and weight of the various scientific lines is evolving accordingly. It will be important to monitor whether these lines of enquiry are well-matched with the updated goals of the INFN.

Post-doctoral fellowships ensure the future of the field, so we are pleased to note that INFN provided 15 post-doctoral fellowships which started in 2016 and 14 in 2017. The positions offered by INFN command a healthy number of applicants, and in many cases lead to future employment in High Energy Physics (HEP). Post-docs are funded by the INFN as just described, and also through the University system by various methods. Using the statistics presented above, the number of post-docs per member of University staff would seem to be about 1/3, which seems low by the standards of some other countries.

We are concerned that the Theory group at LNF is very small, and, we were told, lacks coherence. A strong theory group would contribute to the intellectual atmosphere at the laboratory, so addressing this issue will be increasingly important as the active experimentation in HEP decreases at LNF.

Recommendation:
CSN4-1. In association with the Lab director, the INFN should plan for the success of the LNF theory group.

CSN5 – Technological and Interdisciplinary Research

CSN5 operates with a clear mission: to fund and monitor advanced technological research for INFN "core" experimental activities; to promote the application of instruments, methods and techniques developed for fundamental physics to other fields; and to coordinate researchers from different scientific areas, thus strengthening the link of INFN with University and other national research institutes (CNR, IIT, ASI, INAF, INGV, INRIM).
Since 2013 CNS5 has adopted a specific funding method, "Calls of proposals", to support projects of excellence from young researchers in the framework of the INFN R&D technological activity. We support this new funding scheme and underline its good capability to gain external funds.

CSN5 leadership pays great attention to resources: gain, attract and use. We congratulate them for the great activity and good results, and appreciate the attention paid to define strong links with other scientific committees, the academic world, and other scientific institutions, and to support work on items of great common interest.

We welcome CNS5's determination to improve further through a clear future action plan, which strengthens the (already effective) collaboration with the other National Scientific

Committees and The National Committee for Technology Transfer. The plan further improves the use of the “calls” as an instrument for scientific policy, and identifies a set of strategic items for INFN: Scouting within INFN and the other Scientific Boards, and fostering an even stronger involvement of CSN5 in European projects. We encourage CSN5 to proceed with this approach and to operate in order to fulfil the future action plan

Recommendation:
CNS5 – 1 CSN5 should carefully monitor and evaluate the effects and effectiveness of the "Call for Proposals" method.

Laboratori Nazionali di Frascati (LNF)

LNF is the largest and oldest INFN National Laboratory with more than 60 years of experience in the development, construction and operation of particle accelerators, and the design and construction of experiments for particle, nuclear and astroparticle physics. We were pleased to see the progress in the development and implementation of a sound and attractive plan for the future of the laboratory, as we requested last year. A Conceptual Design Report for a new on-site facility called EuPRAXIA@SPARC_LAB has been presented to the INFN board of directors; the completion of the DAFNE collider programme following the plan outlined last year is well underway; and there are many ongoing detector construction activities in the laboratory facilities. The laboratory facilities for detector R&D and detector construction are being currently exploited with LHC detectors Phase-1 upgrades and satellite experiments. The detailed planning for LHC Phase-2 construction is ongoing.

We now take note of some of the highlights.

1. DAFNE. The completion of the scientific programme of DAFNE, an e^+e^- collider unique in Europe running mainly at the Phi-meson centre-of-mass energy, is progressing well. DAFNE reached the milestone of 2.0 fb^{-1} delivered during Run 3 from September 2016 to July 2017. The KLOE2 experiment has collected so far a total of 4.0 fb^{-1} of good data and should achieve the goal of 5 fb^{-1} of acquired data by the time it closes in March 2018. PADME, an experiment to search for Dark Photons, is under construction, while Siddharta2, which will study exotic kaonic atoms is being upgraded. PADME will run in 2018 and Siddharta2 in 2019, concluding the DAFNE collider programme. The upgrade work of the DAFNE Beam Test Facility (BTF) in order to deliver beam to PADME in parallel to the many other users of the BTF facility is well under way. We note that a study group started working on a possible future for DAFNE that should match the requirements of other initiatives at the laboratory.

2. The plan to host EuPRAXIA@SPARC_LAB, a new challenging and attractive facility for laboratory accelerator experts, adapted to the size of the laboratory and capable of getting external funds, is moving forward with the conceptual design report submitted to the INFN board of directors in July 2017. LNF participates in the H2020 Design Study EuPRAXIA led by DESY, and is willing to build a European facility hosting the first Free Electron Laser (FEL) driven by a plasma-based accelerator. Such a project paves the road for the next generation of compact electron accelerators needed in High Energy Physics and in Applied Physics. EuPRAXIA will apply for

inclusion of the facility in the ESFRI road map (in 2019) and will start a preparatory phase (2020-22) when the site will be decided. To make a very strong and attractive proposal for Frascati as a site, LNF proposes to start building a new facility on the premises of the laboratory, allowing SPARC_LAB to continue the acceleration R&D work in parallel. The project includes a 12 GHz X-band state-of-the-art Linac capable of injecting a high-quality beam into a plasma cell, accelerating the beam to 1-2 GeV. The Linac will also be able to run alone as a Free Electron Laser (FEL), reducing the risk to the project in case of difficulties with plasma acceleration. The undulator lasers at 3 nm lie in the “water window” of great interest to study biological samples. The choice of X-band is a top-class R&D for future compact accelerators. LNF can profit from various synergies, as it has a collaboration agreement with CERN that sees EuPRAXIA as a 0.5% step towards CLIC, and also participates in the H2020 X-band technology project “Compact Light,” led by ELETTRA. The total cost of the hardware for the project is 75 M€ (without VAT): 23 M€ for the buildings, 26 M€ for a first phase of the Linac, plasma cell and undulator and 17 M€ for an upgrade. LNF can count on 50 M€ from INFN and remaining funds from the former SuperB project, but will have to look for financial support from the EU, the Regione Lazzio, the Science ministry and international collaborators. ESFRI endorsement would be essential to obtain that support. Considering the long time needed for construction tenders and for administrative authorisations, it is mandatory to start the project as soon as possible (within 2017). The project is complex but LNF together with its partners, in particular CERN and ELETTRA, should have the know-how to build, commission and operate such a user-facility. Though a large turn-over of 50-60 people is expected in the lab in the next five years, young people are being trained in the current facilities SPARC_LAB, DAFNE and ELI-NP.

3. Some interesting plans for outreach at the LNF are under way, with a former storage area refurbished as a 200 m^2 visitor centre that will host by 2018 an exhibition on accelerators, detectors and their impact on society. A longer-term 2000 m^2 science centre is under study in collaboration with the architecture department of the University of Sassari.

In conclusion, very good progress has been observed on many fronts during last year. We support the proposal to put forward the candidature of Frascati as host of a future European facility for new advanced technologies in particle acceleration. It is a very interesting and well-balanced project, and LNF should have the capacity to carry it through. The time window to profit from the opportunity is now and requires fast action. There should also be room for the role of LNF as a detector hub, and we encourage the laboratory to continue with the study group working on a possible future for DAFNE.

Recommendation:
LNF-1. The construction of the infrastructure for the EuPRAXIA@SPARC_LAB facility should start soon, with high priority.

Laboratori Nazionale del Sud (LNS)

The KM3NeT experiment, a major activity of LNS, is discussed in section CSN2 above, and some of the LNS nuclear physics activities are covered in the CSN3 section.

LNS science is focused on its two operating accelerators: a Tandem Van de Graaff with a maximum terminal voltage of 15 MV, and a K800 Superconducting Cyclotron (SC). The two accelerators accelerate heavy-ion beams in a very wide range of mass and energy allowing studies of nuclear structure, nuclear reactions and nuclear astrophysics, as well as applications of nuclear physics techniques in particle therapy, cultural heritage and other multidisciplinary activities.

Nuclear reaction and structure studies performed with radioactive ^{16}C and ^{10}Be beams using the fragment detector array CHIMERA in coincidence with the large-acceptance gamma detector array MEDEA demonstrated the excitation and decay of new possible cluster states in both nuclei. Furthermore, important progress was made with the NUMEN project to measure the 2β-decay nuclear matrix element. The collaboration, which has been increasing in size in the last year, demonstrated the feasibility of measuring the double-charge-exchange reactions, (^{18}O,^{18}Ne) and (^{20}Ne,^{20}O) at zero degrees with the MAGNEX spectrometer. NUMEN, following our earlier recommendations, has established strong collaborations with theory groups (both experts in reaction mechanism and nuclear structure). Recently, the group organised the international "Conference on Neutrino and Nuclear Physics (CNNP2017)" in Catania on 15-21 October 2017. This conference was very heavily attended (over 200 participants), indicating the strong worldwide interest in this topic.

ELIMED (ELI-Beamlines MEDical and multidisciplinary applications) is progressing satisfactorily. It involves the design and development of a transport beam line for the next generation of laser-driven beams as well as of diagnostic and dosimetric devices to measure the dose and characterise the laser-driven beams. The beam line will be installed at the ELI-Beamlines facility in Prague by March 2018. Another innovative topic of research is connected with PANDORA**,** an interesting project for measuring beta-decay rates in plasmas, simulating decay in stellar conditions (This has been discussed in CSN3 section).

In order to fulfil the needs of different research programmes at LNS, and in particular NUMEN, the SC has to be upgraded for higher beam intensity. Studies for the major upgrade of SC have been done. The tender for the new cryostat for the SC is running. CVI would like to repeat the recommendation of last year.

Recommendation:
LNS-1. INFN should help LNS implement its plans to upgrade the K800 superconducting cyclotron.

Laboratory Nazionale del Legnaro (LNL)

LNL exploits a set of accelerators: the TANDEM-ALPI-PIAVE complex (TAP), comprising a 15 MV Tandem accelerator and two superconducting LINACs (ALPI and PIAVE), two small electrostatic accelerators, CN and AN2000, and a cyclotron that has been delivered to LNL recently. The latter is a dual-exit high-current cyclotron that will deliver proton beams of energies between 35 MeV and 70 MeV. It will be the driver of the SPES project that will produce neutron-rich ions by ISOL technique through bombardment of a UCx target using one of the exits. The second exit will be used for radioisotope production for medical purposes and neutrons for material studies. Following commissioning in 2016, the final acceptance tests were successfully completed in June 2017.

We acknowledge the efforts of LNL and CSN3 to enthuse the nuclear physics community about the prospects of the fundamental physics research programmes with SPES, and it is encouraging that the community is presently active in defining SPES physics with strong interest from many European groups. In March 2017, the CSN3 meeting was dedicated to SPES physics, in particular in the fields of nuclear physics and nuclear astrophysics for studying nuclear structure and properties of exotic nuclei as well as nuclear processes relevant for stellar evolution. All representatives of the experiments that had submitted LoI's attended the meeting, generating great enthusiasm for the programmes to be pursued at the facility. From the submitted LoIs a 3 to 4 year research programme at SPES is assured. The decision to start physics programmes in 2019 with 1^+ non-post-accelerated radioactive ion beams is wise and could help start the nuclear astrophysics programme and other topics in 2020. We are pleased to hear that the first-day physics programmes have now been financed.

Following the recommendation of the CVI after it learned of the 2-year delay of SPES during its meeting in 2016, the LNL Director took proper actions to mitigate this problem. The SPES project was reorganised and a project board was created that reports to the director. It was also decided to start the physics programmes with non-post-accelerated beams already in 2019 (see above). We are pleased by these actions, which hopefully will ensure that the SPES project will now progress smoothly under the new project management. It is also encouraging that commissioning of the cyclotron and training of LNL staff to run it have progressed well. It is now planned to complete reacceleration of radioactive beams in 2021 using ALPI to reach 10-11 MeV/u.

We support the plan in which fundamental physics now stands first on the mission of the lab, with advanced technologies and applications as other important pillars. The applications are diverse and important including production of radioisotopes for nuclear medicine in late 2018 (LARAMED), radiobiology and dosimetry, surface technology and environmental research. We also endorse LNL's involvement in and important contributions to accelerator technology (IFMIF (RFQ), ESS (DTL) and MUNES (RFQ) projects), which is an important pillar for INFN institutes.

Recommendation:
LNL-1. LNL management should define a set of milestones that should be achieved at regular intervals. Regular project reviews and INFN's new project management systems should be used to ensure the successful progress of the project.

CVI Meeting at LNF, October 15-17, 2017

Agenda as of October 11, 2017

All presentations –unless otherwise indicated- are assumed to be 15', followed by 45' discussion.

======================15/10 Sunday=========================

CVI meets with INFN President F. Ferroni at business dinner (place and time to be set)

======================16/10 Monday=======================

08:45 F.Ferroni/S.Smith: *brief introduction and charge to CVI*

09:15 B. Quarta: *Update on AC* (12' presentation, 18' discussion)

09:45 N. Pastrone: *Report from CSN1*
[All CSN talks should begin with response to CVI recommendations, if any]

10:45 coffee break

11:15 P. Campana: *LNF Status and Perspectives for the Future*

12:15 M. Pallavicini: *Report from CSN2*

13:15 Lunch, CVI in closed session

14:30 V. Bonvicini: *Report from CSN5*

15:30 A. Zoccoli *Status and Perspective of INFN scientific Computing* (15'+30' discussion)

16:15 Coffee break (short-15')

16:30 *Tour of selected LNF Infrastructures (CVI only)*
(SPARC/FLAME, Micromegas construction site, SCF_LAB Lab. Space Qualification)

17:45 CVI Closed Session until 19.15

20:30 Dinner CVI+GE+Labs Directors

=================== 17/10===========================

9.00 M. Taiuti: *Report from CSN3*

10.00 A. Lerda: *Report from CSN4*

11:00 coffee break

11.30 D. Bettoni: *LNL*

12.30 G. Cuttone: *LNS*

13.30 lunch break; *CVI in Closed Session*

15.00 R. Saban: T*echnical Coordination of the National Labs: a status report*

16.00 Break; *CVI in executive session*

17.30 Closeout with INFN: management, heads of the CSN's, etc.

18.00 Adjourn

Appendix II. Recommendations

***General 1*.** As we have already stressed in previous reports, INFN should work, communicate and work on Technology Transfer in collaboration with the national networks of industry organisations, to reach a larger number of enterprises and to participate in common initiatives meant to improve the R&I system.

CA-1. The re-organisation of the "Federal" INFN system should proceed with a pilot project chosen to demonstrate that scientific work can take advantage of streamlined administration.
CA-2. We propose again our recommendation from the 2016 CVI Report: "The administrative reorganisation should focus first upon 'low-hanging fruit', to realise quick improvement and remediate urgent problems and weaknesses, and thereby gain support for future actions."
CA-3 (repeated from last year). INFN should explore possibilities for collaboration with other institutions in reforming and optimising the administrations

CSN1-1. INFN should make sure now that the infrastructure and other resources required will be available for constructing the Phase-2 upgrades to CMS and ATLAS, since formal TDR commitments will be taken in 2017. This should be done in close contact with other relevant CSNs and laboratories.
CSN1-2. Increase efficiency by pursuing useful synergies with the other INFN CSNs, National Laboratories, in concert with the new Technical Coordination office.

HR-1. INFN must monitor the new mechanisms for competitive selections and applicant choice of institutes, to identify and mitigate any negative unforeseen effects.
***HR-2*.** INFN should consider experimenting with internal matching mechanism and use incentives to promote internal mobility.
HR-3. New approaches to gender issues should be explored, based on careful study of women's access to scientific careers.

CSN1-1. We encourage CSN1 to play a significant role in the preparation of the upgrade of the European Strategy for particle physics.

CSN2-1. INFN should strongly support a further upgrade of Virgo, with the goal to quickly approach a similar sensitivity to that of the LIGO antennas.

CSN3-1. CSN3 scientists should work together with other European groups and funding agencies to realise the 1π solid angle configuration of the AGATA detector array.

CSN4-1. In association with the Lab director, the INFN should plan for the success of the LNF theory group.

CNS5 – 1. CSN5 should carefully monitor and evaluate the effects and effectiveness of the "Call for Proposals" method.

<u>LNF-1.</u> The construction of the infrastructure for the EuPRAXIA@SPARC_LAB facility should start soon, with high priority.

<u>LNS-1.</u> INFN should help LNS implement its plans to upgrade the K800 superconducting cyclotron.

<u>LNL-1.</u> LNL management should define a set of milestones that should be achieved at regular intervals. Regular project reviews and INFN's new project management systems should be used to ensure the successful progress of the project.

Appendix III: Requests and suggestions for next year's report.

1. As was done this year, please document INFN's response to our recommendations.
2. It would be very helpful to have a section in the GLV report on Human Resources Strategies, both at central level (hiring, promotion, mobility) and at the level of the CSNs (incentives, distribution of funds...).
3. (Repeat of last year) We suggest that INFN conduct a "competitive assessment" of its more risky or questionable experiments. The exercise should be aimed at ranking these experiments with competitive ones, both to assess the chances of winning the race, given the resources and steps already done by competitors, and to look for complementarities.
4. Sections in the GLV report from the four National Laboratories and TIFPA are most valuable to us in our evaluations. For next year the following would be particularly useful:
   i) Updates on the progress of the major projects of each laboratory, and status reports on strategic plans, programme priorities, and their integration with the programmes and priorities of the CSN's.
   ii) Presentations on LNGS and LNF programmes, operations, and future plans.
   iii) Presentations from the other laboratories and TIFPA as time permits.