INFN CVI Report 2014

Conclusions of the CVI Meeting on 20 - 22 October 2014

Members of the CVI Panel:
N. Amodio, Confindustria, Italy
P. Binétruy, APC Laboratory, France
P. Drell, Stanford University, USA
A. Frey, University of Göttingen, Germany
M.N. Harakeh, KVI Groningen, Netherlands
A. J. S. Smith, Princeton University, USA
C. Spiering, DESY, Germany
E. Zaninotto, Università di Trento, Italy

Introduction

This year the CVI had its annual meeting at the INFN Laboratori Nazionali del Sud in Catania. The Committee met over three days and heard presentations covering each of the five sections of INFN. In advance of the meeting, the President had selected Nuclear Physics (CSN3) for special focus along with updates on external funding activities and the formation of a new collaboration outside of INFN for technology transfer (TIPFA). The meeting agenda is included in the appendix. At the request of the CVI, the meeting started with an overview from the President describing his vision for INFN and its future.

We would like to commend all the presenters for their very informative talks and for generating lots of interesting discussion for the CVI. In addition, we would like to commend the GLV (Gruppi di Lavoro per la Valutazione) for an unusually good report, well aligned with the goals of the meeting.

The CVI continues to be impressed with the overall science productivity of all elements of the INFN programs. By all metrics, INFN is performing at a very high level of scientific and technological excellence and compares very well with similar Institutions worldwide. Italian teams play a leading role in many international collaborations and the Italian School of Particle, Nuclear and Astro-Particle Physics is one of the best in Europe.

A decade-long trend, now quantified with multiyear data, of a flux of outstanding young talent, trained in Italy, to institutions throughout Europe and the Americas, is not abating. We are not seeing any progress to a future where a significant fraction of young Italians can have a hope of scientific careers in Italy.

The President of INFN continues to make remarkable progress in positioning INFN for a healthy and exciting future. We have seen an impressive transformation under his leadership. He is doing an outstanding job of articulating a mission for INFN that is broader and more societally relevant than in the past. He understands the challenges that INFN is facing and is not afraid to face them. He is dealing with the challenges in realistic and imaginative ways, including the diversification of INFN's portfolio, collaboration with other centers, agencies and institutions, and introducing a much more entrepreneurial culture into INFN. While much remains to be done, the progress in three years is remarkable!

INFN and its Future

A request for this CVI meeting was to hear the INFN President coherently lay out his broad vision for the future and his strategy for accomplishing it. We appreciated hearing the clear articulation of the new broader mission along with a crisp presentation of the steps the President is taking to define a new future for the institution.

Nowhere is progress more evident than in the INFN laboratory community. We can now see a future for each of the four major labs that is realistic and while challenges still exist, the clarity and frankness with which the future challenges are discussed is refreshing. With funding in place for SPES, the future of LNL in the physics with radioactive beams and in pharmaceutical radioisotope production is clear. LNS is carving a niche in nuclear physics with plans to upgrade the SC cyclotron and exploiting unique opportunities in astro-particle physics with KM3NeT, and LNGS will compete for third-generation experiments in neutrino-less double-beta decay and dark-matter detection. The future of LNF is the most uncertain at this point, but it should clarify over the next year and accelerator R&D and collaborations in space physics will certainly be key elements of the lab's future program.

As the President laid out his vision, he was able to give concrete examples of significant cultural change within the institutions that make up INFN. Researchers are approaching their work in a much more entrepreneurial fashion. Labs collaborate in ways that they didn't use to do. Significant income from external sources is supporting many programs now. Major reforms in tech transfer and patenting processes are making it easier to link research to applications in society, an increasingly important goal for INFN. An area where progress is still not clear is in the sections associated with the University community. We will look forward to hearing more about the challenges in this community in a future meeting.

INFN is defined by excellence in science. Under the President's leadership, INFN is taking a very innovative approach to mapping a future science strategy with the 'What's Next' process. While very much still in process, the concept is an interesting one. It is engaging a large fraction of the community in discussions of where the Italian community can make the most impact in a world with a light Higgs and where investments in future major facilities are limited. It will provide the input for INFN and the community to make wise decisions about how they will balance small local experiments against participation in large national and international facilities. We look forward to hearing the output from the 'What's Next' process at our next meeting.

Obstacles to progress still exist particularly in the areas of human capital. We feel that the increased coordination of institutes and centers across Italy might offer an opportunity to collaborate on selected reforms that would benefit everyone. In the absence of an ability to change the rules, we support the use of creative strategies to get around the obstacles, e.g., by exploiting the opportunity to bring in outstanding researchers from abroad through competitive programs. This is not the ideal solution but we applaud 'doing what can be done and doing it well'.

CSN1

We are delighted to report that the CSN1 program is thriving. Results at the highest energies are pouring out from the CMS, ATLAS and LHCb experiments at CERN, important new experiments are being prepared (NA 62, BELLE-II) and ongoing experiments (MEG, COMPASS, BES-III) are being upgraded. In particular, the CERN large hadron collider continues to bring excitement and fervor to high energy physics as more understanding emerges from the 8 TeV data, and the first run at 13 TeV approaches. The ATLAS and CMS experiments reach farther into the unknown as they examine the Higgs boson for deviations from Standard Model predictions, and carry out searches for supersymmetric particles, dark matter, and other physics beyond the Standard Model. The highly successful LHCb experiment is redefining flavor physics with exquisite precision measurements of CP violation, discoveries of new mesons and baryons, and unprecedented sensitivity for rare decays of particles containing bottom and/or charm quarks. The smaller experiments LHCf and TOTEM are also beginning to produce results on hadronic physics in the forward direction.

INFN has invested heavily, and appropriately, in this truly unique opportunity at CERN for new understanding of nature, directing approximately 70% of its staff and funding to the LHC program. By any measure this investment has been an outstanding success. The science has been superb with the discovery of the Higgs particle, and as previous CVI reports have remarked, the prominence of Italian scientists in the CERN experiments has been extraordinary. This prominence continues, as Italians receive more than their share of coveted invited talks at major conferences, and are elected to leadership positions in the collaborations. For example, under spokesperson Pierluigi Campagna the LHCb collaboration has prepared a beautiful comprehensive set of “Phase I” detector upgrade projects to keep up with increasing LHC performance over the next decade, and INFN groups in ATLAS and CMS are similarly taking major responsibilities and providing leadership in their respective upgrade programs. Spokesperson Tiziano Camporesi leads CMS. And of course, we congratulate Fabiola Gianotti as she prepares to become Director-General of CERN a year from now.

With the Phase-I Upgrades to be installed during the 2018 long shutdown, all the LHC experiments should be able to operate safely and efficiently until 2022. By that time, ATLAS and CMS will have received ~300 fb^{-1} of integrated luminosity, and to make further progress, major upgrades of the accelerator and the detectors will be required. The LHC will upgrade to a High Luminosity LHC to provide 3000 fb^{-1} by 2035; ATLAS and CMS will construct a set of “Phase II” upgrades to cope with the higher rates and backgrounds. These detector projects present major scientific and financial issues for the scientific community and the funding agencies, because of the long time needed for R&D and construction, the high cost (estimated at ~ 500M CHF), and the current uncertainties in the scientific landscape. Wisely, INFN is strongly

supporting the intensive R&D program underway, but reserving judgment on the level of INFN participation and responsibility in the actual construction until results from the upcoming run appear, which hopefully will point to the most promising directions for future discoveries. We caution, however, that there is not much time before major decisions must be made: Phase-II Technical Proposals laying out conceptual designs and preliminary lists of participating scientists and institutions are due by September 2015, and the Technical Design Reports (TDR's) will be due approximately two years from now. These TDR's must specify the commitments of the various institutes and funding agencies, so INFN will need to respect this time frame if it wishes to play a major role in the High Luminosity LHC program. This situation obviously requires careful attention, and we look forward to discussions at our next meeting and beyond.

INFN has managed the 2013 cancellation of Super B exceedingly well, but nevertheless reverberations persist. On the positive side, former Super B scientists are now firmly engaged in and contributing significantly to exciting experiments (LHCb, BELLE II, MEG, and NA 62, and more). This successful transition demonstrates not only the high quality of INFN scientists, but is a tribute to the strong leadership of INFN management. NA 62 is already commissioning, and we look forward to early results at our next meeting. BELLE II and the MEG upgrade are in construction and proceeding on track. There has also been good progress in R&D for the Fermilab experiments Mu2E and g-2. The details of the CSN1 contributions will be decided upon next year and we look forward to hearing about INFN's impact on these experiments at a future meeting.

However, the impact on LNF of the loss of Super B remains a serious concern. In spite of major recent efforts the DAFNE e^+e^- collider has failed to achieve the levels of luminosity, reliability and "factory-mode" efficiency needed for the KLOE experiment to make progress. As a result the future of the DAFNE/KLOE program, and thereby the future direction of LNF, are at stake. This issue is of major concern to CSN1, and to INFN more broadly. We strongly support INFN's plan to make a decision by June 2015, the outcome of which will likely be a major subject for discussion at our next meeting.

Finally, we were most pleased to learn about the innovative 'What's Next' exercise, which attracted 700 scientists for open discussions and brainstorming toward a future CSN1 program under realistic budget assumptions. The goal is to produce a world-class program with a healthy balance between LHC activities and experiments at other accelerators in Europe, the US and Asia. A report is expected within the next few months, and we look forward to reviewing the recommended strategy and scenarios at future meetings.

CSN2

Astro-particle physics is a field where INFN has historically played an extraordinary role. INFN belongs to the world leading players in astro-particle and neutrino physics; only the US, Japan, France and Germany have a comparable status, with China just beginning to catch up as a new major player. We encourage the growing collaboration with China in this field.

In the last years, INFN has systematically increased the weight of astro-particle and neutrino physics and has developed a strategy towards further strengthening them. The amount of funding by sources external to INFN (about 55% in 2014) is impressive. The activities rest dominantly on three very strong pillars: the Gran Sasso Laboratory and its broad program, the VIRGO gravitational wave detector and the astro-particle program in space. KM3NeT could become a fourth key component.

In what follows, we give comments on each of the six research topics in CSN2:

Line 1 (Neutrino Physics)

BOREXINO has succeeded in making the first *direct* measurement of the primary solar process. This result by far exceeds the original expectations about the capabilities for background rejection. We congratulate the BOREXINO collaboration on this impressive result.

INFN has joined the JUNO experiment in China, with the primary goal of determining the neutrino mass hierarchy, but with an additional goal of measuring supernova and geo-neutrinos and searching for proton decay. INFN participates via high-level expertise on scintillators and purification, with comparatively low investment cost from INFN. The Committee supports this decision. Participation in Short Baseline ICARUS has been approved. R&D towards a possible participation in LBNF and Nessie is continuing and R&D on the HOLMES project which aims to measure the electron neutrino mass via ^{163}Ho electron capture with sub-eV sensitivity is ongoing.

We repeat our comment from last year that CERN is expected to take the lead on future neutrino projects, either through supporting LBNF or by making a significant contribution to neutrino activity in Europe. INFN's exact role in SBL ICARUS, LBNF and Nessie can be determined only in this context. We would have to get more detailed information on the Holmes project in 2015.

Line 2 (Rare Processes):

These experiments exclusively are hosted by LNGS and form a program unique in the world. DarkSide has successfully completed a technical run with natural argon and is working towards a physics run in 2015. CRESST has gotten the initial background processes under control and is

now providing record limits at low WIMP masses. The long existing small INFN participation was officially approved this year, in accordance with our recommendation from last year. An important step was the commissioning of the large CUORE cryostat in 2014.

The $0\nu\beta\beta$ experiment GERDA will start its second phase in 2015, with an increased amount of germanium. A second $0\nu\beta\beta$ experiment in LNGS is CUORE, with an INFN lead role. CUORE-0 started data taking in 2013, with first results expected in 2015. XENON1t is under construction. LUCIFER is a new attempt for $0\nu\beta\beta$, aiming to suppress background by simultaneous bolometric measurement of the heat and of the scintillation light produced by a particle. R&D is ongoing. Important input for $0\nu\beta\beta$ experiments is expected from the LUNA MV project.

This suite of experiments defines a solid program until 2017/18. What comes after those years cannot be fixed at this moment but options include CUORE+ with enriched Te isotopes, multi-ton dark matter detectors (xenon and argon) and a detector with cryogenic crystals. Choices between these options will depend on the demonstration of background suppression in the upcoming stages and on the international competition.

If LHC-14 does not find SUSY particles the momentum for WIMP dark matter search may be somewhat reduced. However, the goal to push the sensitivity to the point where solar neutrinos dominate the background – at least with one technology – is appropriate for the long-term R&D program.

The CVI Panel had recommended to INFN to extend its prominent role in DAMA-LIBRA, CUORE and GERDA to all promising experiments in this category, e.g., also to XENON, CRESST and DARK-SIDE. We acknowledge the recent formalization of INFNs role in CRESST.

The LNGS and CSN2 management should take a more coordinating and architectural role for the rare-process program. Playing a significant driving role in developing a coherent strategy for key experiments in this field, and a broader direct participation in the experiments, needs some increase of the number of INFN staff members at the site.

Additionally we repeat our recommendation from last year, that – if the science evolves favorably, Dark Matter experiments could be a major element of the INFN program in the future and INFN should try to capture a leadership position in that science.

Line 3 (Cosmic Particle Detection from Ground and Underwater):

At present, INFN is a partner in Auger, MAGIC and KM3NeT. The INFN role in the Auger upgrade is under discussion. In the long term, ground-based gamma astronomy will be performed in the

framework of CTA, with INFN's role to be determined. The discussed participation in the Chinese air shower project LHHASO would continue the proven cooperation with China within a much more powerful project.

On the extreme high-energy frontier, JEM-EUSO aims to achieve one of the main original goals of Auger: to find point sources of cosmic rays. JEM-EUSO was conceived as a detector on the ISS observing cosmic-ray showers in the Earth atmosphere. Italy is playing traditionally an important role in this project. JEM-EUSO is managed by ASI, with a participation of INFN on the 5% level. At present, it is open as on which carrier and at which time such a detector would fly. Much motivation (or de-motivation!) could come from the Auger upgrade: a positive momentum could result if there would be a large proton contribution at highest energies, or a de-motivation if the particles are mostly heavy nuclei and the possibility for source identification would be very low. Physics-wise, we therefore give a high priority to the Auger upgrade (a 10 M$ effort).

The Committee was impressed by the work towards a Phase-I of KM3NeT. Our expectation from last year to hear about the deployment of additional towers was not met in October, but meanwhile the first fully equipped tower is successfully deployed and commissioned – without any obvious problems. We congratulate the KM3NeT collaboration on this important step. Also, three of the DOMs for the strings are under in-situ test and show excellent performance.

We acknowledge that KM3NeT is understood to be a key project of LNS and that the director of LNS has taken direct responsibility for it. From a physics point of view, the discovery of extraterrestrial neutrinos with IceCube proves that one can identify cosmic neutrinos with a cubic-kilometer detector. This puts KM3NeT on a firm scientific ground. At the moment, it seems that KM3NeT may fail to get continued European support. We emphasize, however, that the successful realization of Phase-I as a demonstrator project is a sine qua non for any long-term perspective. Therefore, Phase-I should be pursued, irrespective of the obvious risk that the 200 M€ for the full project could not be acquired, and Phase-1.5 (requiring 50-60 M€ in addition to Phase-1) be prepared. With 3-4 times the sensitivity of ANTARES, KM3NeT Phase-1 can deliver already important results, e.g. constraining the interpretation of the IceCube hot spot as a point-source, precision measurement of down-going muons and the charm contribution and thereby constraining the charm contribution to the IceCube diffuse neutrino signal – to mention just 2 obvious issues.

Line 4 (Cosmic Particle Detection from Space):

In this field, INFN has a particularly impressive record. From Agile to the overwhelming success of Fermi, and from Pamela to AMS-02, all with strong Italian leadership and participation, the Italian satellite community is to be congratulated for their successes.

Fermi and AMS-02, together with small-scale participation in the Chinese missions DAMPE (dark matter search with electrons and photons) define the mid-term future. In the longer term, Italian physicists look for a possibility to continue the Fermi program. There are two options. HERD is a Chinese initiative with the goal to reach the tenfold sensitivity with respect to Fermi. Italy has a strong interest both on calorimetry and the tracking system. Gamma-400 is a Russian mission with similar goals, but with a lower momentum – the project exists since more than a decade, with good formal but slow technical progress compared to the Chinese sprint. It has been approved by ROSCOSMOS for launch in 2020. INFN would like to build the tracker (financed to the largest part by Russia) and contribute to operation cost.

The Panel also heard about R&D on the projects LSPE (Study of CMB by detecting polarized photons) and COSMO_WNEXT (dark energy study). It also noticed that there are discussions to make LNF the INFN space lab, to support Svalbard operations through LNF and about a corresponding agreement with ASI in progress.

Options for continuing the very successful satellite program depend to a large degree on contributions from foreign partners and the availability of launch vehicles, but also on the funding situation in Italy. The Panel repeats the request from last year to hear at the next meeting a more detailed discussion of the options, the strategy to define priorities and milestones for decisions in Italy and by foreign partners. We encourage the growing collaboration with China in this field.

Line 5 (Gravitational Wave Detectors):

With the operation of 3 bar-detectors, VIRGO and VIRGO+, and with preparatory work on LISA, Italy has a very strong record in this field. The bar detectors AURIGA and ROG are being closed. Advanced VIRGO is planned to start operation in 2015/16. The very tight approach of building advanced VIRGO with much smaller resources seems to be successful: the project is on time and within the new cost schedule. The activities of the next 2-3 years must have one main goal: to start the operation of advanced VIRGO and to be among the “harvesters” when the first gravitational waves will be detected on Earth. Only a success of the advanced GW detectors LIGO and VIRGO will lay a firm ground for a large follow-up project like the Einstein Telescope.

After the ups and downs of LISA, the main focus in space is to get LISA-Pathfinder launched and to provide a (partial) proof of principle for full LISA. The Panel is pleased to hear that a concrete date for the launch has been defined (July 15, 2015).

Line 6 (Fundamental Processes):

This is a series of small experiments, in space, underground or in surface laboratories: atomic physics for gravity measurements (Magia, Micra), quantum gravity or variable fundamental

constants (Humor, Supremo), axion search (PVLAS), atomic physics for quantum simulation of field theories (FISh), search for the Lense-Thirring effect (G-GranSasso), test of equivalence principle on ground (GGG). Some of these experiments are running, some just approved, some (like FISh) are a result of the 'What's Next' effort. The impression of a fragmented program is inherent and unavoidable in a line attempting to cover many innovative ideas in small scale experiments. Room for new ideas and small experiments must be kept open, but care has to be taken that some "strategic discipline" is kept.

General Comments on CSN2:

CSN2 has a rich variety of projects and program choices for the mid-term and long-term future. With the ERC grants and the PON funding for KM3NeT Phase-I, and with additional money from the space agency and FP7 and other sources, external funding for CSN2 exceeds the internal funding. The publication rate is steadily increasing.

We feel the program could be articulated more strategically. Astro-particle physics cannot be reduced to a very few dominant projects (as the LHC experiments in CSN1). This leads to a certain "natural" fragmentation in the program. However, this cannot be an excuse to avoid thinking about convergences and prioritization wherever possible. At this meeting we were a bit concerned that perhaps the community of researchers in CSN2 does not have ownership of an overall strategy for the program. We suggest that INFN considers initiating a community process where the Italian astro-particle community is asked to chart a strategy for their future and claim ownership in some significant areas of investigation. This might help avoid what appears to be a too strong fragmentation in the program and ensure major Italian impact in several significant efforts.

CSN3

There continues to be a healthy national and international program in nuclear physics at INFN. This is pursued at major international facilities, particularly JLAB, which has undergone an upgrade and delivered its first 12 GeV electron beam in 2013, and ALICE@LHC, where an intensive experimental campaign was rounded off before the start of a long shutdown (~ 2 years) of LHC in the middle of February 2013. The upgrades of these two facilities and the installation of new detectors at MAMI@Mainz and ELSA@Bonn open new opportunities for research in the fields of Quarks and Hadron Dynamics and Phase Transitions in Hadronic Matter.

CSN3 groups have activities at all four INFN facilities: LNL, LNS, LNGS, and LNF. The CVI was extremely pleased to see that SPES@LNL will be a reality for the future. The Nuclear Structure and Nuclear Dynamics line of research will benefit strongly from the exotic beams that will be delivered by SPES when it is completed and running. In that respect, the CVI is pleased to see that the advanced AGATA detector array, with a strong contribution from INFN, is shared between the three major European facilities delivering radioactive ion beams, i.e. LNL, GSI and GANIL, and is supposed to be back at LNL when SPES is completed.

Several highlights were reported by CSN3 groups, and were published in high-impact journals. For example, the determination of the neutron-skin thickness of ^{208}Pb from coherent pion production in electron scattering at MAMI provides a novel method to determine the neutron-skin thickness, which yields results in agreement with other methods in use at present. Further, the analysis of ALICE data for Pb-Pb collisions confirmed that a hot, low-viscosity matter, is produced. On the other hand, p-Pb collision data provided evidence of collective effects in the long rapidity range correlations (ridge effect), the origin of which is not yet fully understood. A highlight that resulted from the AGATA campaign at LNL is the resolution of the isospin splitting and nature of the pygmy dipole resonance (PDR) in ^{208}Pb and ^{124}Sn nuclei, a topic of much current interest.

At LNS the MAGNEX spectrometer was used to study in an exploratory measurement the double-charge-exchange reaction ^{11}B(^{18}O,^{18}Ne)^{11}Li in order to demonstrate the capability to measure nuclear processes connected with the nuclear matrix element of double-beta decay. Experimentally it was possible to resolve the ground-state to ground-state transition, but a full understanding of the process requires studies at different bombarding energies and good theoretical support.

In the line of research “Nuclear Astrophysics and Interdisciplinary Research”, it was for the first time possible to measure the ^{19}F(p,α)^{16}O reaction in the Gamow window (< 500 keV) with the Trojan Horse Method using the reaction ^{19}F(d,αn)^{16}O at 50 MeV at ASFIN@LNS. The ^{2}H(α,γ)^{6}Li reaction was measured at LUNA3@LNGS at Big-Bang energies. The results confirm the ^{6}Li abundance prediction of the standard Big-Bang nucleosynthesis theory.

The CVI is pleased to see the very interesting results obtained by the different research lines of CSN3 and congratulates the groups on maintaining the high publication rate. The CVI also applauds the efforts regarding the gender issue, where females are well represented in CSN3 at all levels.

LNS

The entire Committee was impressed with the tour of LNS and hearing about the vision for the future from the director. LNS has a broad program of interesting science and technology and a vibrant sense of future opportunity. The CVI was also impressed by how the lab presents itself as modern and forward looking. We greatly enjoyed interaction with the young, enthusiastic and dedicated staff.

The disparate missions of the laboratory seem to be integrating seamlessly which is a tribute to the leadership of the director. The parts of the lab are not in competition but rather seem to support each other for the common good.

The upgrade and modernization of the tandem has been going on with a new tube having been installed, and the Pelletron to replace the belt expected to arrive before December 2014. The SC Cyclotron is the workhorse of the lab, supporting programs in hadron therapy, nuclear physics, and looking forward to supporting programs being highlighted in the 'What's Next' exercise. Unfortunately, the SC Cyclotron was down for most of 2014 because of breakdown of the helium liquefier. Steps have now been taken to revamp the liquefier by Air Liquide Company. The SC Cyclotron upgrade, which is needed for addressing some interesting physics questions like double-beta decay matrix elements, is intriguing and seems of appropriate size. A scientific and technical review will be needed to justify the level of resources before INFN can invest in this relatively expensive upgrade. KM3NeT will need a steady hand moving forward but substantial progress is being made. The first string has been successfully deployed in water at Capo Passero. The deployment of the other strings will continue by the end of 2014 and in 2015. LNS is playing a significant role in the success of the endeavor.

LNS's modest but successful proton therapy program for treatment of eye melanoma serves as a good example of how a nuclear physics lab tends to societal needs. LNS organizes as well successful outreach activities that are very well attended by the public.

The CVI was pleased to see that LNS is also involved in development and construction of parts of the accelerator facility for the ESFRI research infrastructure ESS (European Spallation Source) and is collaborating on the proposal to demonstrate the clinical applicability of laser-driven proton beams al beam lines of another ESFRI research infrastructure ELI (Extreme Light Infrastructure).

LNS faces challenges but the staff are aware of them and are addressing them. Having watched the lab evolve over the last several years, the CVI can see that strong leadership has played a defining role in changing the future of the lab and we are impressed.

LNL

We had a brief report on LNL and this was also a much improved situation over several years ago. We were very pleased to hear the plan to successfully execute the alpha, beta and gamma phases of SPES at LNL. The research and development of the different phases have been completed. The construction phase of SPES at LNL has already started with the driver cyclotron, now being constructed by BEST Cyclotron Systems, expected to arrive in March 2015. SPES is the cornerstone for the future of the lab with a clear and very interesting program of physics driven by radioactive beams. The interest of the European nuclear physics community is demonstrated by the large number of letters of intent, and the pledged installation of large detection systems at SPES upon completion of the project. Furthermore, the public/private partnership to produce radio pharmaceuticals is exactly the right path forward. This is a win-win endeavor for everyone, i.e. science and society. LNL is also actively involved in other projects of societal importance including the monitoring of environmental radioactivity by means of gamma spectroscopy using an aircraft with modern technologies. Again the leadership of the laboratory deserves praise for resolving what has been a very difficult situation a few years ago into something that now points towards success.

CSN4

The CVI congratulates the theory section of INFN for its continued success and for staying at the forefront of the developments in the various fields of theoretical physics. Both the number of FTEs and the budget are rather stable, which allows a good continuity in funding. CSN4 has a rather sophisticated procedure for budget distribution, which involves a renormalization procedure that takes into account productivity but also an evaluation by two external referees. The CVI finds this procedure well adapted to the type of funding necessary in theoretical physics.

There was notable success in attracting external funding, especially with ERC grants, which is yet another sign of the excellence of the community. This allowed for new postdoc positions, which is very good news for sustaining a renewal of generations (assuming that some permanent positions follow). All in all, substantial resources are devoted to the training of young researchers.

Regarding PhD applications, it is very important that steps be taken in order to align the schedule of acceptance with the rest of Europe, in the context of a growing competition between the European countries for attracting the best students. The excellence of the Italian community is an obvious advantage, but delays in the hiring procedure may deprive the Italian teams of the best candidates.

The Zefiro cluster remains the main infrastructure for the CSN4 community, it seems to satisfy the present needs adequately.

CSN4 is also conducting activities with the other groups, such as CSN3 and CSN5. The theory community was also actively engaged in the 'What's Next' exercise, which is very encouraging for the future.

The activities at the Galileo Galilei Institute in Florence have expanded, with the new Ph.D. schools. The CVI gives its full support to this new development, which offers the stimulating atmosphere of the centre to a new and younger generation.

CSN5

The CVI has been impressed by the strategic orientation taken by the CSN5 in the last three years and the progress made towards a set of activities focused on its mission inside INFN, i.e. coordinate, fund and monitor advanced technological research for INFN "core" experimental activities and promote the application of instruments, methods and techniques developed for fundamental physics to other fields. There has been a substantial 'defragmentation' of the program so that significant resources are now targeted to a much smaller number of projects with potential for impact. Activities are now concentrated on the development of radiation detectors, of particle accelerators, which absorbs an increasing amount of budget and human resources, and of electronic and software development. Moreover, room is given to interdisciplinary applications. The increasing number of FTE per experiment is a good indicator of the defragmentation strategy. According to bibliometric indexes this seems also a rewarding strategy. At the same time, the effort for balancing external (55% over the last three years) and internal funding has been successful.

The CVI would like also to praise the initiative to give grants, on a competitive base, to young researchers. The very enthusiastic response to the grants for young researchers program highlights a latent desire in the system for independence and initiative that should be encouraged. The disappointing response to the larger grant program should be examined and the program reconsidered to make it more attractive.

The CVI has also appreciated the clear view CSN5 has on the need to balance 'top down' strategically focused and 'bottom up' calls for proposals. Research and technology development plans can gain from the collaboration with other scientific boards, as well as with the Technology Transfer Committee. It might be beneficial, moreover, to have an external portfolio review sometime in the future to ensure that the program is optimally accomplishing the goals of INFN. We would like to hear on this point in the next CVI meeting.

TIFPA

CVI looks with interest to the creation of TIPFA , an organization with the goal to bring FBK, APSS, Trento University and INFN even closer together in order to combine basic science with R&D programs and to facilitate easy application of scientific results to the benefit of the broader community. It could be a positive experiment to reach some of the strategic goals already underlined by the CVI. It will be important to focus on this new center not only as a way to maximize direct support by the local government to consolidate traditional scientific research lines of INFN in Trento, but also as an opportunity to reinforce the collaboration with external collaborations more broadly and to focus on the application of scientific results into new strategic activities of industrial interest. In order to be able to evaluate the added value of the TIFPA center, CVI suggests a more detailed definition of the vision chosen to drive the success of TIFPA and strongly encourages a clear effort to develop metrics to track success in order to guide the program; especially important in early years. The bundling of expertise in virtual laboratories focused on activities with high relevance for science as well as industrial applications seems very promising, for instance, in the development of Silicon PMTs.

The CVI sees this new joint initiative as having potential for both national and international impact. Thus, it will be vital to attract funding and excellent people in an international contest.

The CVI is looking forward to hearing about the TIFPA activities once it will be fully operational.

Fondi Esterni

INFN established Fondi Esterni in 2102 as a unit dedicated to the promotion, co-ordination and support of fund-raising activities, in response to the decreasing availability of national research funds, and the increasing importance of both European and Regional ones. To face this challenge, the unit has started a clear hub-spoke model, where the hub is responsible for strategic actions, top level support and the interaction with INFN headquarters; and spokes scout, support and manage local actions. This approach is aimed at matching between the opportunities offered by European funding calls, programs at National and regional levels and private funders, and the existing expertise within INFN.

A training program has also been put in place to increase the community awareness on the potentialities of fund raising, and to drive the cultural change needed to acquire a proactive approach to research funding. Other important steps have been made towards the harmonization of administrative procedures, and the improvement of management and reporting skills. A set of tools is now available to research units for disseminating information, retrieving documentation and helping with administration and reporting.

The CVI appreciated the important effort made by the unit and the clear strategic view it has. Results of this remarkable effort are, however, still discontinuous, particularly on the European side. After the encouraging success in FP7 calls, there are areas of competition (particularly the innovative training network and ERC starting grants) where the INFN performance has been disappointing. This could be partly due to the new strategic goals stated by Horizon 2020, aimed at eliminating the distinction between research and innovation and focused on the societal and competitive impact of research. Moreover, the evaluation procedures and criteria are changing with each funding call and the expectations of the European Commission for documentation and execution of projects is strict.

The Unit for external funds is now setting actions to cope with the new framework, and we encourage it to continue to be responsive to the external market. A proper map of competences internal to INFN, and a map from competences to the calls can help research units to maximize their impact. Moreover, to give an answer to the request of societal and competitive impact, and of an interdisciplinary approach, it is necessary to establish a network of co-operation wider than the community of INFN. Universities can bridge with other scientific fields, as well as a tighter contact with the Technology Transfer Office can be useful. A particular attention must be dedicated to ERC grants. We note that causes of disappointing results may run very deep in the Italian system. We encourage INFN to approach this problem strategically by identifying promising researchers early in their career and supporting them to be competitive for these highly prestigious programs whether they have gone abroad or not. It is possible that these programs can be used as a way to attract some of these outstanding young researchers back to Italy. We hope to hear on the actions taken in this direction in the next CVI meeting.

Summary

The CVI continues to be impressed with the remarkable progress that INFN is making. There is a much clearer path to the future. The strategy is sound and the leadership is strong. There is a clearly articulated strategy and the focus now must be on execution. We continue to be very gratified with how responsive INFN has been to the suggestions of the CVI.

For future meetings we suggest that the CVI could benefit from some accelerator expertise among its membership. We would also appreciate clear responses to previous reports as the first item of business in all presentations.

We would like to thank LNS, the members of the executive board and the chair-persons of the scientific sections for organizing a very successful meeting and extending such warm hospitality to us.

Appendix---CVI Meeting Agenda

Meeting of the INFN International Evaluation Committee (CVI)

LNS Catania October 20 – 22, 2014

Monday, October 20

12.30	CVI meeting with INFN GE
13:30	Lunch at LNF
14.30	F. Ferroni: INFN and its future
16:00	Break
16.30	M. Pallavicini: CNS2
17.30	M. Taiuti: CSN3
20:00	Dinner with CVI only

Tuesday, October 21

9:30	G. Cuttone: LNS activities
10.30	Tour of LNS Facilities
13:00	Lunch
14:00	CVI Executive Session
15:00	G. Fiorentini: LNL
16:00	F. Bedeschi: CSN1
17.00	Break
17:30	A. Lerda: CSN4
20:30	Dinner with CVI + GE

Wednesday, October 22

9:30	G. Fortuna: TIFPA
10:30	M. Carpinelli: CSN5
11:30	Break
12:00	V. Vercesi: Fondi Esterni
13:00	Lunch
13:00-15:00	CVI Closed Session & Close out with the President