FINAL INFN CVI Report 2013

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Introduction

This year the CVI had its annual meeting at the INFN laboratory in Frascati and the new Gran Sasso Science Institute in L'Aquila. 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 Elementary Particle Physics (CSN1) and Astro-Particle Physics (CSN2) for special focus. The CVI heard presentations on the strategic plans of the two labs most closely related to the science of CSN1 and CSN2, LNF and LNGS, as well as an in-depth presentation on the new Gran Sasso Science Institute (GSSI) in L'Aquila. We also heard a detailed follow-up presentation on the progress in setting up new programs within INFN to support Technology and Knowledge Transfer and a report on the 'Third Mission' activities of INFN. In addition, the CVI visited the Gran Sasso Laboratory. The meeting agenda is included in the appendix. We commend all the presenters and appreciate the effort put into the talks which generated lots of interesting discussion for the CVI.

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.

The President of INFN has made remarkable progress in the past year in evolving the institution to be positioned for a healthy and vigorous future in what is anticipated to be a constrained fiscal climate. The success in attracting Premiali funds is a strong indicator for the future success and viability of INFN.

We see the INFN President shaping a strategic science program and focusing precious resources where INFN can deliver the greatest impact. Priorities are being set. He is actively and successfully encouraging a more entrepreneurial culture within INFN. We applaud the actions of the President to diversify the mission of INFN with increased interaction and collaboration with other research institutes in Italy. We commend the installation of the new technical advisory board CTS. All of these steps are setting INFN on a path to deliver outstanding science for the future and for INFN infrastructure to benefit the Italian community more broadly. We commend the President for his skillfulness as he has been working carefully over the last year to develop the pieces of his plan for the future and to bring the institutions and scientists along with him toward this new vision and culture. We look forward to hearing more details of his broad vision for the future at the next meeting.

The greatest challenge INFN faces is in the development of human capital, with particular emphasis on motivating researchers (in order to promote wider internal mobility and

cooperation), and on creating new opportunities especially for young talent. New hiring laws are exacerbating an already critical problem as hiring at INFN has been severely constrained in recent years. However, as the INFN workforce ages and the missions evolve, it is essential to be able to bring in new young talent. Each country develops hiring rules that respect cultural priorities and balance the need for long-term contracts for security and stability of staff with hiring practices that will ensure equity and create opportunities for the best young talent. We understand the pressures in Italy that have led to the application of new hiring laws for public employees. However, every member of the CVI feels that the new hiring laws that are being proposed would be destructive to science.

In our opinion, there need to be specific hiring rules for public research structures within the general rules for the public sector. INFN, together with other public research centres, could work to elaborate a proposal to be discussed at a national level.

In addition, we encourage actions to improve internal mobility and to aggressively move to exploit hiring opportunities (especially for young talent) through external funding mechanisms (i.e. European programmes, competitive national programmes and partnerships with enterprises).

CSN1

The study of the fundamental particles and their interaction lies at the core of INFN's research program. Last year's discovery of the long sought Higgs Boson by the ATLAS and CMS collaborations at CERN's Large Hadron Collider has brought unprecedented attention and visibility to the field of particle physics and has culminated in this year's Nobel Prize for Higgs and Englert, with the explicit mentioning of the experiments by the Nobel Prize Committee. Italian physicists have played and continue to play a highly visible role in all LHC experiments, starting from important hardware contributions to physics data analyses of paramount importance. Italian-educated Fabiola Gianotti, former spokesperson of the ATLAS experiment, was even runner-up for the person of the year 2012 by Time Magazine.

With LHC clearly being the largest activity within CSN1 regarding budget and manpower, CSN1 pursues in addition a diverse and attractive research program covering experiments in the early R&D phase (MU2E, g-2), under construction (NA62), running (KLOE, BES-III, MEG, Compass) as well as phasing out (CDF, BaBar). CSN1 has also been very successful in securing 'premiali' funds, another sign for the high quality delivered.

The research within CSN1 can be grouped in several research lines. "Hadronic Physics" is exploring the energy frontier with ATLAS, CMS and the forward physics experiments LHCf and TOTEM currently taking data and with CDF at the Tevatron which continues to produce

important results after the end of data taking. After the Higgs discovery, the task is now the determination of the Higgs boson properties and interactions. While LHC dominates these measurements, the Tevatron experiments provide the best measurement of the fermionic couplings in the H -> bb channel. Other highlights come from top quark measurements and improved limits on new physics like Supersymmetry.

The second largest activity is dedicated to "Flavor Physics", an area where INFN has a tradition of excellence and expertise. The LHCb experiment has taken the lead now, while BaBar is still publishing important results.

The announcement of the cancellation of the Super-B project in the late fall of 2012 marks a branching point for CSN1 and in particular the "Flavor Physics" research line. We were pleased to see the highly skilled former Super-B scientists quickly moving to strengthen existing priority INFN projects (LHCb) and CSN1's flavor physics research program. The Italian participation in the BES-III experiment in Beijing, China, is increased as well as a new collaboration started with the Belle-II experiment in Japan, where the Italian groups have already gained significant visibility in a very short amount of time.

Kaon physics has a bright future with NA62 under construction and the upgraded KLOE experiment. We look forward to hearing about the performance of the consolidated DAFNE accelerator and KLOE at the next meeting.

The "Proton Structure" research line is focusing on parton distributions in polarized hadrons with the COMPASS experiment at CERN, currently completing its upgrade.

The "Lepton flavor violation" research line aims at investigating fundamental particle physics by relatively small, dedicated experiments. The MEG experiment at PSI will upgrade its detector to increase the sensitivity by an order of magnitude. While MEG is looking for real photons, Mu2E is searching for lepton flavor violation through virtual photons. With the R&D of the magnet technology, INFN has the opportunity to contribute to Mu2E in a highly visible and significant manner.

While some diversity next to the large efforts at LHC is necessary and healthy, as it guarantees sustained expertise in technological development and in physics analysis, both vital also in the education of young scientists, some of the smaller engagements in programs such as g-2 seem sub-threshold for INFN to have an impact. We encourage CSN1 not to diffuse its resources too broadly and focus manpower especially on a smaller number of projects where INFN can play a strong role.

With Super-B behind them, the biggest question for the future will be the level of INFN engagement in the LHC phase II upgrade, foreseen around 2022. We commend the careful

approach taken by INFN towards the phase II upgrade. Given the unfortunate manpower and funding constraints, we strongly encourage CSN1 to work with the community to develop a strategy for the future in two scenarios. One scenario should sketch out what a program with strong engagement in LHC Phase-II upgrades might look like and how such a program would be supported in CSN1. The other scenario should consider alternative options for the CSN1 program without strong participation in Phase II upgrades. The development in regards to a possible International Linear Collider hosted by Japan should be closely watched and considered in these scenarios.

LNF

Historically, LNF is the laboratory that has been most strongly aligned with CSN1. The expertise of LNF staff particularly in accelerator physics is outstanding. The DAFNE accelerator has been consolidated and will offer rich physics to the upgraded KLOE experiment. LNF also plays a vital role for future developments like test facilities for linear collider developments and for novel acceleration schemes. In terms of detector development, LNF acts as a hub, for instance for many of the LHC experiments' phase-I upgrades.

With the collapse of the Super-B project, LNF has had to regroup and rethink its future.

We heard about two potential projects that could be hosted at LNF. We recognized that some components of the IRIDE project represent important strategic opportunities for the Italian science community (broader than INFN), and LNF has infrastructure and competencies to deliver it.

We were impressed with the leadership of the new director. He is focusing LNF on its core mission in accelerator physics and is looking for ways to use the LNF infrastructure to benefit science broadly. We applaud this. The LNF director and the INFN President need to ensure that the developments at LNF are strongly linked to the overall INFN strategy for the future.

CSN2

Astroparticle physics and neutrino physics are corner stones of the INFN program and of basic research in Italy. In the last years, INFN has systematically increased the weight of these fields and has developed a clear strategy towards further strengthening them. INFN is one of the world leading players in astroparticle and neutrino physics; worldwide only the US, Japan, France and Germany have a comparable status, with China just catching up as a possible new major player. Italy's astroparticle program rests to its largest part on the unique infrastructure of the Gran Sasso Laboratory (LNGS), on the VIRGO gravitational wave detector and on the excellent astroparticle program in space.

The INFN program is presently organized in six research topics:

1) Neutrino physics
2) Rare processes
3) Cosmic particle detection from ground and underwater
4) Cosmic particle detection from space
5) Gravitational wave detectors
6) Fundamental processes

Line 1 (neutrino physics) has provided a wealth of new, important data during the last two years.

a) BOREXINO has measured for the first time neutrinos from the solar *pep* process and has constrained fluxes from other solar processes. These measurements are relevant for our understanding of the transition from vacuum to matter oscillations in the Sun.

b) The T2K experiment in Japan released new and more precise data on the mixing angle θ_{13}, one year after the first data on its non-zero value have been obtained by T2K and three reactor experiments.

c) ICARUS constrained the parameter space for possible sterile neutrinos with the help of neutrinos sent from CERN to LNGS ("CNGS program").

d) The OPERA experiment has detected a third ν_τ candidate and is looking forward to analyzing the last third of experimental data.

e) The LVD detection continues its mission as a monitor for galactic supernovae.

By now, the CNGS programs (OPERA and ICARUS) have been completed. The T2K experiment continues data taking and may possibly reach some sensitivity to measure CP violation. BOREXINO continues solar and geo-neutrino measurements, while BOREXINO-SOX is being prepared, with the goal of testing the sterile neutrino hypothesis using a Cr source (2015/16). We congratulate M. Pallavicini for winning an ERC grant for SOX.

Future options to continue oscillation physics are the JUNO experiment in China, and the US-based LBNE project. The European neutrino community is presently looking to CERN to take the lead on future neutrino projects, either through supporting LBNE or by making a significant contribution to neutrino activity in Europe. The role of INFN in LBNE can be determined only in this context.

We also mention R&D on the HOLMES project which aims to measure the electron neutrino mass via ^{163}Ho electron capture with sub-eV sensitivity. We congratulate S. Ragazzi for winning

an ERC grant for this novel technology and look forward to hearing about first performance results in 2014.

Line 2 (rare processes): These experiments are hosted exclusively by LNGS and form a program unique in the world. At present there are the dark matter experiments DAMA-LIBRA and XENON-100 (CRESST has no Italian participation) and the $0\nu\beta\beta$ experiment GERDA, which very recently has released record limits on the mass of Majorana neutrinos. GERDA is being upgraded and will be flanked by a second $0\nu\beta\beta$ experiment CUORE, with an INFN lead role.

LUCIFER (Low-background Underground Cryogenic Installation For Elusive Rates) 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. We congratulate F. Ferroni and A. Giuliani for winning an ERC grant to develop a demonstrator for this technique.

XENON-100 will be replaced by XENON-1T and flanked by the depleted argon experiment DARK-SIDE (now being commissioned as a 50 kg prototype).

This suite of experiments defines a solid program until 2017/18. What comes after those years cannot be decided 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 at 14 TeV does not find SUSY particles, the momentum for WIMP dark matter searches 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 recommends to INFN to strengthen its role in XENON and DARK-SIDE. We believe that the LNGS and CSN2 management could play a stronger coordinating role for the rare-process program.

Line 3 (Cosmic particle detection from ground and underwater): At present, INFN is a partner in ARGO, Auger, MAGIC, Antares and KM3NeT. The ARGO and Antares activities are being phased out. In the long term, ground-based gamma astronomy (now within MAGIC) will be performed in the framework of CTA. Terminating the INFN participation in older projects gives the freedom to start new, more attractive ones. All these decisions appear to be very reasonable.

The panel also supports the work towards a Phase-I of KM3NeT and is satisfied to hear about the deployment of a first full tower at the Capo Passero site. The fact that the new director of

LNS has taken direct responsibility of the project and the fact that for the first time real money is available have dramatically improved the situation. 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 much firmer scientific ground than in 2012. 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 secured in the very near future.

For next autumn, the panel looks forward to hearing about the deployment of additional towers and, in particular, on the medium-term perspective to deploy, in addition to towers, the first strings.

Line 4 (Cosmic particle detection from space): In this field, INFN has a particularly impressive record. With the gamma-ray mission Agile, Italy heralded the overwhelming success of Fermi, also the latter with strong Italian participation. With Pamela, Italy has led space-born measurements of cosmic-rays until Pamela was surpassed recently by AMS-02. AMS-02 has also very strong Italian participation. In 2013 it has released data of unprecedented accuracy. The panel congratulates the satellite community on these successes.

Fermi and AMS-02, together with small-scale participation in two Chinese missions 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, a Chinese initiative, and Gamma-400, a Russian mission. On the high-energy frontier, the JEM-EUSO aims to achieve one of the main original goals of the Pierre Auger Observatory: to find point sources of cosmic rays. JEM-EUSO will be a detector on the ISS observing cosmic-ray showers in the Earth atmosphere. Italy is playing traditionally an important role in this very large collaboration. JEM-EUSO is managed by the Italian space agency ASI, with a participation of INFN at the 5% level.

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. At the next meeting, the panel would like to hear 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 bar-detectors and of VIRGO/VIRGO+, and with preparatory work on LISA, Italy has a very strong record in this field. 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 (E.T.).

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.

Line 6 (Fundamental processes): This is a series of small experiments, in space, underground or in surface laboratories. They search for exotic particles or effects, for instance axions with the PVLAS experiment, or the so-called "frame dragging" with the LARES satellite, led by ASI, or tests of General Relativity with the Gyro-laser project in Gran Sasso, or parity violation in chiral molecules with the SUPREMO experiment.

General Comments on CSN2: CSN2 presented an impressive picture of their program choices for the mid-term and long-term future. With four 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 are pleased to see how a clear strategy is being defined for this research area which holds great potential for INFN future scientific leadership. We note that with such a clear articulation of the strategy, it is much easier to get people to engage with the future rather than cling to the past. The CVI noted that the division into 6 research lines with priorities for each line may be too granular. The strategy could be further optimized if several of the research lines were combined as appropriate so the 1 or 2 top priorities can be more clearly distinguished.

LNGS

The future of LNGS is complex. LNGS offers a unique infrastructure for the science of rare processes in particle and astroparticle physics. We were particularly excited about the possibilities for neutrino-less double-beta decay and the LUNA MV project.

INFN should consider increasing participation in key experiments that capitalize on the LNGS infrastructure and aspire to play a significant driving role in developing a coherent strategy for key experiments in these fields. With the LNGS infrastructure, and some rebuilding of the strength of the staff at the LNGS site, INFN has the opportunity to be a world leader in several very important areas of science.

GSSI

The Committee had several of its sessions at the Gran Sasso Science Institute (GSSI) and could visit the facilities, just before GSSI receives its first students. We were very impressed with how quickly the program has been assembled.

This program is very ambitious since it aims at attracting 120 students in 3 years. The first call for applications had an amazing success for a new entity, with 552 applications for 35 positions. This shows that some serious action was undertaken in order to bring the program to the attention of prospective students. This first step is an important one for the full success of the enterprise.

The Committee heard a presentation on each of the three programs by the three coordinators: astroparticle physics, mathematics and computer science, and urban planning. Our expertise only allows us to comment on the astroparticle physics program, which appears to offer a rich variety of courses. Ensuring that all the students get appropriate mentorship and thesis supervision will be critical. The Committee believes that the vicinity of the Gran Sasso laboratory, with its many Italian and international teams, is a vital element of success for the astroparticle physics component.

The Committee welcomes the desire expressed by the GSSI management to have some students whose studies are linked to some industrial engagement. It will be important to develop from the initiation of the institute, broad and strong collaborations with enterprises at a regional and national level to be successful.

The Committee wishes good success to the GSSI enterprise which has been managed until now in an exemplary manner.

CSN3

The progress made in all four lines of research within CSN3 is gratifying. The scientific production rate has increased in comparison to last year. This progress, however, is disturbed by a worrying development in the recruitment policy which makes it difficult for the groups to attract and appoint scientists, especially young researchers, in vacant permanent positions. This erratic policy in fact applies to all INFN sections and will surely be detrimental to the scientific progress in the coming few years if not corrected in time.

The “Quarks and Hadron Dynamics” line of research is presently being pursued in the regime of non-perturbative QCD in several European (ELSA@Bonn, MAMI@Mainz, DAPHNE@LNF and COSY@Jülich) and international (JLAB in USA and KEK in Japan) laboratories. At JLAB, the investigation of the 3-dimensional structure of the nucleon through determination of the Transverse Momentum Distribution functions (TMDs) forms one of the main pillars of the research program. The upgrade of JLAB will allow these studies at very small x and large 4-momentum transfer. The Italian groups are participating in this upgrade in projects for which they have the technical expertise. Several other interesting research projects are also being pursued at different labs for which data analysis is in progress. An interesting highlight of last

year is the measurement of the spin-dependent cross section of proton-proton scattering which was found to be in excellent agreement with theoretical predictions. This is promising for the ultimate goal of producing polarized anti-proton beams.

In preparation for possible participation in the PANDA experiment, the INFN groups are now participating in two technical development programs for construction of parts of the PANDA detector. The CVI is concerned that there did not seem to be a clear scientific program for the PANDA efforts. There needs to be a well-thought-out and coherent plan for INFN participation in PANDA in light of significant concerns regarding when FAIR will be completed. The CVI thinks INFN management should consider any commitment to significant participation in this experiment as part of the overall strategy of participating in FAIR.

The "Phase Transitions in Nuclear Matter" line of research had a very successful year at the LHC resulting in many highly cited papers. During 2012, p-p data were collected at 8 TeV, and p-Pb at 5.02 TeV. The ALICE Collaboration will upgrade the detector by improving the vertexing capability to meet the requirements of a higher luminosity after the planned 2018 shutdown. INFN will contribute to the construction of the outer layer of the inner tracking system (ITS) upgrade which will facilitate new measurements on heavy-flavor production in heavy-ion collisions.

In addition to INFN National Laboratories LNL and LNS, physicists of the "Nuclear Structure and Reaction Dynamics" line of research performed experiments mainly with radioactive beams at European (GANIL, GSI, and Orsay) and international (MSU, Argonne and RIKEN) laboratories. The data obtained with AGATA and other ancillary equipment at GSI during 2012 and part of those obtained at LNL in 2011 are still being analyzed with very interesting results emerging on nuclear structure concerning among others particle-phonon coupling.

In 2011, the CVI noted that both LNS and LNL are working to define their strategic futures in the face of challenging budgets. In particular, although LNL received the full budget to complete the α phase of the SPES project, it lacked the resources to finish the SPES β phase, which is essential for providing the accelerated radioactive beams to the experiments. This phase requires an estimated budget of about 27 M€. An amount of 5.6 M€ was secured in 2011 within the framework of the Premium projects. More than 20 M€ were still needed for the years 2014 and 2015 to complete this phase. The CVI proposed possible courses to follow. The CVI was pleased to hear that a solution for a large part of the funding shortfall at SPES may be forthcoming. The CVI strongly supports the plan for 14 M€ of unspent SuperB funds to be applied to SPES β phase. This will have positive influence on the community. It is therefore very gratifying to see the scientific community starting to organize around the new facility and develop strategies for the science case. The CVI is also pleased to see groups coordinating with the scientific steering committee the need for instrumentation for SPES. In particular, the

prototyping activity toward the instrumentation of the future SPES is progressing in regards the photon detector (AGATA), charge-particle detector (FAZIA) and neutron detector (NEDA). This is very encouraging. The CVI would like to hear the science strategy for SPES at the next meeting, and also hear how the beam lines will be completed with equipment to carry out the science.

Within the "Nuclear Astrophysics and Interdisciplinary Research" line of research, the LUNA Collaboration analyzed the $^{17}O(p, \gamma)^{18}F$ reaction data obtained during 2011 with two different experimental techniques that were found to be in excellent agreement. LUNA's scientific program is very broad and addresses several important questions in astrophysics including solar neutrinos, age of globular cluster, light-nuclei nucleosynthesis and Big-Bang nucleosynthesis, He burning and stellar evolution, and s-process nucleosynthesis. Therefore, the CVI is very enthusiastic about the short-term plans to install the LUNA MV accelerator at LNGS which will allow to address the scientifically rich LUNA program in the very near future. The CVI also acknowledges the progress made by both the ERNA and n-TOF collaborations. The ERNA collaboration presented very high-precision data on the helium-burning reaction $^{4}He + ^{12}C$ in inverse kinematics. The n_TOF collaboration performed (n, γ) measurements relevant both for astrophysics and reactor applications.

CSN4

The Italian theoretical physics program remains among the best in the world. It is very strong both quantitatively (989 FTE) and qualitatively, as testified by the number of publications and impact factors. The difficulties in hiring young theorists remain very worrying. Neighboring countries are exploiting the hiring difficulties in INFN to their own benefit and INFN's detriment.

The Committee was very pleased to see that the convergence towards a smaller number of larger groups, a consolidation that had been started last year and which the Committee fully supported in its report last year, was actively pursued: the number of "Initiative Specifiche" has significantly decreased from 50 to 39, as well as the number of local groups, from 220 to 170. In a similar spirit of convergence, the Committee praises the upgrade of the CSN4 cluster "zefiro" which serves the computing needs of some 16 research groups.

Funding which remained stable in 2013 is wisely distributed on the basis of FTEs "renormalized" according to productivity and the results of an external evaluation. The rules to attribute postdoctoral positions and the schedule followed which allows the groups to advertise the positions one year in advance is a model to be followed by other institutions in Europe.

The research topics covered by CSN4 are harmoniously distributed among the various fields covered by INFN, from the more formal to the more phenomenological approach. The Committee notes the very thoughtful cross disciplinary applied field theory program. Both the

reorganization and the cross disciplinary program in CSN4 may be models that could be adopted in other CSN committees as appropriate.

A noteworthy infrastructure for the theory community is the Galilleo Galilei Institute in Florence which has succeeded through a careful choice of its programs during its 7 years of existence, to become one of the major institutions in the world hosting long-term workshops. The full support to this institution should be continued, since this is a precious window of the Italian theory community to the world.

CSN5

The CVI was extremely pleased to see the efforts made within CSN5 to make the program more strategic and focused. The impact of a smaller number of more focused R&D efforts may take some time to be visible but we believe this is the right approach to get the most value for limited funds. The approach of having a fraction of the portfolio with strategic focus while allowing opportunities for breakthrough new ideas is a good one. The initial areas of focus on accelerator technologies and detector R&D seem appropriate. We will look forward to observing how these programs evolve.

We applaud the actions taken to encourage younger researchers to propose projects to CSN5 and the more strategic funding approach. We were also impressed by the spin-offs resulting from INFN research units. We recognize this is a work in progress and it will take some time for a more entrepreneurial culture to develop around the detector and accelerator R&D programs. The communication between CSN5 and the other sections seems to have substantially increased which we applaud.

Much of the R&D in CSN5 is having a worldwide impact. Particularly impressive is some of the accelerator R&D on 2-color strategies which are being adopted at other labs, having been demonstrated at SPARC_LAB, the magnet development for the Mu2e experiment at FNAL, and the REDSOX detector work for astrophysical applications.

Once the infrastructure is in place, INFN needs to link CSN5 to the knowledge and technology transfer efforts and to the diversification of the laboratory programs. The challenges are multifold. It is easy for this effort to become diffuse with no focus or strategy and this would fail to benefit INFN in the long term. We look forward to a briefing next time that articulates an overall strategy and shows how the various contributing pieces fit together. We would also like to hear about the Trento Center and its role.

Third Mission Activities

Third Mission refers to the whole set of activities aimed at improving knowledge exchange between research institutions and society, with a goal of making research institutions real partners of the host community. Under this heading there are Technological Transfer activities, as well as support to scientific education and activities aimed at increasing the awareness of the role of science in society.

To highlight INFN's recent focus in this area, this year the CVI was extensively briefed on the third mission activities, including both the field of Technological Transfer and of activities supporting education and science in society.

Third Mission Activities--Knowledge and Technology Transfer

The Europe 2020 growth strategy for the coming decade aims for "smart, sustainable and inclusive growth". This clearly calls for a new approach to technology transfer underlining the importance of collaboration in research and innovation carried out at a national and European level.

The INFN strategy to build the infrastructure of technology transfer as their first step is the right one, but it needs from the start to operate with a clear action program that identifies potential partners, targets and tools.

We were impressed with the significant activity that was accomplished during the past year to plan KTT services which include: creating procedures to manage intellectual property, efforts to engage personnel to participate in joint projects, organizing and training local TT representatives, and utilizing technical tools to develop the web site, and to map the technical and research infrastructures.

Once the infrastructure is in place, INFN needs to develop a strategy to improve collaboration with enterprises in two main areas: engaging industry to help develop innovative instrumentation for use in INFN activities and identifying projects that stem from industry needs with potential future applications for product development. To explore opportunities of joint programming in the private sector and technology domains, INFN needs to build strong collaboration relationships with the network of Italian enterprises (i.e. The Innovation Network of Confindustria)

On the eve of Horizon 2020 launch, particular attention should be paid to reinforce and improve the success rate in the competition for European programs. To this end it might be useful to dedicate a specialised sub-unit of the TT system to support the projects' definition and writing. To better explore opportunities linked to industrial applications, INFN could participate

in activity promoted by enterprise organizations (i.e. Confindustria) to work on common R&I projects.

The success of the KTT mission is directly linked to a new cultural approach that should be embraced and incorporated throughout INFN. In the next year, we look forward to a briefing that articulates the long term vision for the program and implementation plan.

Third Mission Activities—Education and Science in Society

With respect to activities supporting education and science and society, the CVI is impressed at the level to which consciousness of the importance of these activities has spread within INFN. INFN has encouraged, on an individual basis, scientists to take initiative both to promote science in society and to offer support to the scientific education in schools. We were very pleased to hear not only about the blossoming of a large number of initiatives (like guided tours to laboratories, exhibitions, scientific fairs, stages and seminars, support to schools for running experiments), but also of the unexpected response of the community, that testifies against the common tenet of low interest for science in Italy. We are enthusiastic about the strategy being employed. We were stunned to hear that INFN, through its outreach programs, is able to touch 0.1% of the Italian population! This is an achievement to be proud of!

The focus on the Third Mission is new, and we share a very positive view of the blossoming of many initiatives aimed at popularizing science and increasing the awareness in society of what physics is accomplishing. We wonder whether, once this first effort on individual basis has been consolidated, Third Mission activities could be centrally supported with a few professionals with expertise in science popularization, and the introduction of some formal gateways aimed at recording and filtering emerging proposals and benchmark on best practices.

Summary

The CVI is very impressed with the remarkable progress that INFN has made in the past year. There is a much clearer path to the future. The strategy is sound and the leadership is strong. Much work remains to both clearly articulate and execute the strategy, but the pieces are coming together. We are also very gratified with how responsive INFN has been to the suggestions of the CVI. We will work hard to ensure that our advice is as thoughtful and sound as possible.

We would like to thank LNF, LNGS, GSSI, 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)

Frascati and L'Aquila September 30 - October 2, 2013

Monday, September 30 -- LNF

12.30	LNF CVI meeting with INFN GE
13:30	Lunch at LNF
14.30	F. Bedeschi: CSN1 (particle physics)
15.30	M. Taiuti: CNS3 (nuclear)
16.30	U. Dosselli: Overview of LNF
17:30	Transfer to L'Aquila
20:00	Dinner at L'Aquila, CVI only

Tuesday, October 1 – GSSI & LNGS

9:30	E.Coccia: GSSI activities
10.30	Tour of GSSI
11.30	Transfer to LNGS
12.00	R. Battiston: CSN2 (astroparticle)
13:00	Lunch
14:00	S. Ragazzi: Overview of LNGS
15:00	CVI Executive Session
16.00	Tour of LNGS
20:00	Dinner at L'Aquila with CVI + GE

Wednesday, October 2 – GSSI

9:00	A. Lerda CSN4 (Theory)
10:00	M. Carpinelli CSN5
11:00	S. Falciano: Technology Transfer
12:00	G. Chiarelli: INFN III Mission A few numbers, preliminary evaluation strategies
13:00	Lunch CVI only
14:00-16:00	CVI Closed Session & Close out with the President