Open Symposium - European Strategy Preparatory Group

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Book of abstracts

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"The QGSM Monitoring of Standard Model Baryon Spectra in High Energy Proton Collisions at LHC."

Dr. PISKUNOVA, Olga [1]

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I would like to suggest an investigation of the distributions of strongly interacting particles that are produced in high energy proton-proton collisions at LHC experiments. This study have to be important as for the Standard Physics researches as for Cosmic Ray studies.

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Fundamental Science at the European Spallation Source

Dr. ARGYRIOU, Dimitri [1]; Dr. VETTIER, Christian [1]; Dr. LINDROOS, Mats [1]; RATHSMAN, Johan [2]; CHRISTIANSEN, Peter [2]; Dr. CARLILE, Colin [1]

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The ESS project will maintain Europe's leadership in the use of neutrons for both materials sciences and for fundamental physics studies. The ESS project has been in preparation for 15 years or more, with initial operations planned for 2019. However, it will not be fully operational before 2023-2025. ESS is primarily designed for neutron scattering science, but it would also be possible to do other neutron related physics at ESS. It is even possible to share the proton driver linac of ESS with other intense proton users such as neutrino physics.

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Conclusions from the NUTURN 2012 Workshop (LNGS, 8-10 May 2012)

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In the last two years,reactor experiments corroborated in a conclusive manner previous hints supporting a very large value of $\vartheta 13$. Indeed the actual value of $\vartheta 13$ ($\sin 2\, 2\vartheta 13 \approx 0.09$) turned out to be just below the previous limits from CHOOZ. Such highly fortunate outcome is bringing us to a complete reconsideration of the strategies to assess CP violation in the leptonic sector and determine the neutrino mass pattern. The NUTURN workshop aimed at contributing to such fresh start-up, with special emphasis on the opportunities for a long-term experimental programme in Europe.

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Exploring Confinement

KRASNY, Mieczyslaw Witold [1]

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We discuss an experimental CERN programme to study the confinement of quarks and gluons.

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What if there is no Higgs?

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We discuss the next step of the LHC programme in case the Higgs is not found.

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NEXT a high-pressured Xenon-based experiments for ultimate sensitivity to a Majorana neutrino

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In this paper we describe:
1. An innovative type of Time Projection Chamber, which used high-pressure Xenon gas (HPGXe), moderate electric fields and electroluminescence amplification of the ionization charge as the basis of a 3D apparatus, capable of fully reconstructing the energy and topological signal of rare events.
2. An specific design of such HPGXe TPC, the NEXT-100 detector, that will search for $\beta\beta0\nu$ events using100−150kgofXenonenrichedintheisotope136XeN˙EXT-100hascompletedanaccelerated and very successful R period and is in construction phase. It will take data at the Canfranc Underground Laboratory (LSC) in Spain. The commissioning run is foreseen in late 2013 or early 2014.
3. Physics arguments that suggest that the HPGXe technology can be extrapolated to the next-to- next generation (e.g, a fiducial mass of 1 ton of target), which will fully explore the Majorana nature of the neutrino if the mass hierarchy is inverse.
We point out that the NEXT program may of of great interest for the European Strategy, both for technological reasons (the intrinsic interest of the innovative HPGXe detectors with EL amplification and solid state sensor readout) and its large physics potential. We point out that Xenon is the easiest and cheapest target for a future 1 ton detector and that the NEXT program can be complementary to the diode and bolometer based detectors (e.g, Gerda, Cuore), in much the same way as the Majorana and EXO experiment are considered complementary in the USA.
We thus propose that the European Strategy includes the development of a large HPGXe detector, for $\beta\beta0\nu$ (and eventually for DM searches).

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Storage Ring Electric Dipole Moment Methods: The road to the next sensitivity level of hadronic EDMs.

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Sensitive electric dipole moment (EDM) experiments can probe new physics at very high scales of order 10^3 TeV; much larger than the current reach of accelerators. The storage ring EDM method with its large statistical power could push the sensitivities of the proton EDM to the 10^-29 to 10^-30 e*cm range, several orders of magnitude better than the neutron EDM experiments. The method can be applied to deuteron and ^3He with similar sensitivities providing enough information to decipher the CP-violating source should one is found to be non-zero.

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Synergy of Particle Physics with other disciplines; the CERN CLOUD experiment

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The arguments are presented why particle physics should remain open to - or even encourage - bottom-up scientific initiatives where our accelerators or experimental and technical capabilities can make important contributions in other scientific disciplines. One such example is the CERN CLOUD experiment which seeks to answer definitively whether or not galactic cosmic rays affect clouds and climate.

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Search for GeV-scale sterile neutrinos responsible for active neutrino masses and baryon asymmetry of the Universe

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We propose a new beam-target experiment, which may lead to the discovery of new particles below the Fermi scale - right-handed partners of neutrinos. We provide a strong motivation for existence of such particles: three new neutral Majorana particles (sterile neutrinos) are associated with simultaneous solution of the problems of neutrino masses and oscillations, of baryon asymmetry of the Universe and of Dark Matter. We concentrate on the heavier pair of sterile neutrinos, responsible for the matter-antimatter asymmetry generation and for the active neutrino masses. If lighter than 2 GeV, these particles can be produced in charmed meson decays and subsequently decay into light SM particles.
The ``golden signature'' of such particles is two tracks of charged particles coming from one vertex. The searches of Majorana leptons were undertaken in the past at PS191, BEBC, CHARM, NuTeV and led to a negative result, not surprising in view of the cosmological constraints on the properties of sterile neutrinos, that were derived later on. To fully explore this sector with 400 GeV beam and 10^{20} incident protons on target (achievable at CERN SPS in the future) one needs a detector constructed from sections, each of the size and structure similar to previous detectors but with a total length of few kilometers. A smaller detector with a length of ~100 meters would allow for an exploration of considerable fraction of parameter space.

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High-energy physics in Finland Strategical outlook for Helsinki Institute of Physics

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The Canfranc Underground Laboratory (LSC)

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The Canfranc Underground Laboratory is presently the second largest in Europe. I shall briefly describe the LSC infrastructures and the ongoing research programme. I shall then describe four perspectives for the future, on the search of neutrino-less double-beta decay, for dark matter, long base line neutrino beam physics and in nuclear astrophysics. Detailed discussions are submitted separatel

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Statement of Interest and Support from the Brazilian HEP Community

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A letter of support from Brazil's RENAFAE president.
RENAFAE is a committee apointed by Brazil's Ministry of Science, Technology and Innovation, whose charge is to coordinate the funding of HEP research.

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Thermal Neutron Accelerator

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The main aim of this proposal it to reveal the secrets of the universe by accelerating neutrons. The proposal idea in its abridged version speaks about the possibility of making neutrons accelerate with help of thermal energy and magnetic energy under controlled conditions. Which is helpful in revealing the hidden secrets of the universe like dark energy and in finding Higgs Boson.

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Open Infrastructures for Scholarly Communication

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In recent years the High-Energy Physics (HEP) community has taken two important steps in developing and operating sustainable infrastructures for knowledge management and knowledge transfer: INSPIRE and Open Access/SCOAP3.

These two initiatives are presented, highlighting the potential for Knowledge and Technology Transfer of the HEP collaboration model.

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A realistic next-generation nucleon decay and neutrino experiment capable to probe leptonic CP violation

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Suggestion from a Taiwan physicist

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With "the Higgs" at 125 GeV, it is time to go for a 350 GeV LC as soon as possible; it can cover Higgs property measurements (including Higgs self-coupling) as well as top properties. From my perspective from the small island country of Taiwan, I would like to see this facility materialized in Asia, as Asia lacks major accelerators. Having this facility built in Asia, before one considers how to push the frontier further, will uplift the up and rising Asia. It would be wise if Japan and China could genuinely work together on this major undertaking towards a common Asian future.

North America should put the act together and go for a long baseline neutrino program for the time being, and truly build a new future to maintain its national labs. As I see it, this is the best chance, as an LC or higher energy hadron collider would face much bigger hurdles.

Europe and CERN is now in a leading position. But to fulfill all the promise of LHC, be it the high luminosity goal, or an eventual high energy upgrade, seems big enough a responsibility in terms of resource commitment. The world looks up to European HEP to proceed in a mature way.

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Dirac magnetic monopole (new arrangement of experiment)

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New approach, not applied earlier, is proposed to search for the Dirac monopole.It assumes that the monopole must be accelerated by a magnetic field. That acceleration is constant in the homogeneous and permanent magnetic field. The conclusion about the object movement nature can be drawn by measuring the time marks for equidistant registering planes.

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Swiss contribution to the Update of the European Strategy for Particle Physics

KIRCH, Klaus [1]; EREDITATO, Antonio [2]; GEHRMANN, Thomas [3]; POHL, Martin [4]; SCHNEIDER, Olivier [5]; WALLNY, Rainer [6]

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JAI input for the European Strategy

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Input for the European Strategy for Particle Physics, on the topic of Accelerator Science and Technology, by the John Adams Institute for Accelerator Science, UK (see attached pdf file for details)

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NA61/SHINE plans beyond the approved program

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This document reports on plans of the NA61/SHINE experiment at the CERN SPS beyond the approved and currently performed measurements within the ion, neutrino and cosmic-ray programs.

In particular, data taking on Pb+Pb collisions and for the Fermilab and CERN neutrino experiments is proposed as an important extension of the ion and neutrino programs.

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The Scientific Program in Particle and Nuclear Physics at the CERN injectors and its foreseable future

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A rich and diverse experimental program in Particle and Nuclear Physics is currently performed at the CERN LHC injectors (Booster, PS and SPS). The current status is presented, and it is shown that this program offers unique opportunities for at least another decade.

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Neutrinos: masses, oscillations; proton decay. A roadmap proposal by the French physicists.

Dr. DUCHESNEAU, Dominique [1]; Dr. GIULIANI, Andrea [2]; Dr. ZITO, Marco [3]; Dr. MENTION, Guillaume [3]

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IN2P3 an IRFU, the two French institutes involved in research in particle physics, nuclear physics and astroparticle, organized in 2011 and 2012 a broad study and debate in order to prepare a roadmap for 2013-2022. Starting in April 2011, 19 working groups prepared strategy documents which were submitted to community feedback. A meeting took place in April 2012 in Giens, South of France, where talks and discussions allowed finalising the recommendations proposed by the community to the Institutes' managements. Summaries of these recommendations, updated with the latest scientific results since April, are submitted as contributions to the ESPG and to the Open Symposium. This is one of these summaries. The authors are part of the group that worked on this topic. The full document (in French) is available on request from the authors.

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Statement from NuPECC regarding the LHeC and ALICE

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The Large Hadron electron Collider project, LHeC, at CERN has important implications for high-energy nuclear physics. High-energy electrons colliding with high-energy heavy ions will probe the gluon density at extremely small momentum fractions, where theory predicts gluon saturation effects. High-precision measurements of the nuclear parton distribution functions will furthermore provide a useful baseline for separating initial state effects from those produced by the quark-gluon plasma in central nucleus-nucleus collisions at the LHC.

In its 2010 Long Range plan, in the section on "Phases of Strongly Interacting Matter", NuPECC listed as its top priority "Support for a comprehensive physics programme with proton-nucleus and nucleus-nucleus collisions at several energies and upgrades of the ALICE detector". At a recent Town Meeting, the heavy ion community has re-stated this program as its top priority for the coming years. The community thus has well defined plans of experiments at the LHC that carry on at least until 2025, which is the time needed to fully exploit the potential of the accelerator and the experiments, on which the Nuclear Physics community has already made a major 20-year effort.

Support for R & D to complete a technical design report for the LHeC was also included among the recommendations in the Long Range plan, but with lower priority. From the point of view of the Heavy Ion community, the LHec could thus be seen as an interesting option in the future, if the necessary critical mass of people could be assembled. The recent proposal to use Point 2 (where the ALICE experiment is located) as the interaction region for the LHeC is not supported, if installation were to start before 2025, because it is incompatible with the top priority of the Long Range plan.

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Particle Physics at Budker INP

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The current status of the experiments at e+e- colliders VEPP-2000 and VEPP-4M is presented. The new results from SND and CMD (2E=1.0-2.0 GeV)detectors and from KEDR detector (2E=2.0-5.0 GeV) are discussed. The status of new project "Super Tau-Charm Factory" with luminosity 2*10**35 cm-2s-1 and 2E=2.0-5.0 GeV is presented.

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Searches for Permanent Electric Dipole Moments

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Input to the European Strategy for Particle Physics from the EUROnu FP7 Design Study of a High Intensity Neutrino Oscillation Facility in Europe

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As part of a FP7 Design Study, the EUROnu Consortium has undertaken conceptual designs of the three possible candidate facilities for high power neutrino oscillation facilities in Europe. Having now concluded this work, the Consortium strongly recommends the construction of a Neutrino Factory, with 10 GeV muons and a 2000 km baseline, as soon as possible.

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Nucleon Structure and QCD at High Energy. A roadmap proposal by the French physicists.

SABATIÉ, Franck [1]; D'HOSE, Nicole [1]; FERRERO, Andrea [1]; ROYON, Christophe [1]; GUIDAL, Michel [2]; VOUTIER, Eric [3]; LANSBERG, Jean-Philippe [4]; PIRE, Bernard [4]; HADJIDAKIS, Cynthia [5]; HENINO, Thierry [2]

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IN2P3 and IRFU, the two French institutes involved in research in particle physics, nuclear physics and astroparticle, organized in 2011 and 2012 a broad study and debate in order to prepare a roadmap for 2013-2022. Starting in April 2011, 19 working groups prepared strategy documents which were submitted to community feedback. A meeting took place in April 2012 in Giens, South of France, where talks and discussions allowed finalising the recommendations proposed by the community to the Institutes' managements. Summaries of these recommendations, updated with the latest scientific results since April, are submitted as contributions to the ESPG and to the Open Symposium. This is one of these summaries. The authors are part of the group that worked on this topic. The full document (in French) is available on request from the authors.

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CP violation, matter-antimatter and heavy flavours. A roadmap proposal by the French physicists.

ARNAUD, Nicolas [1]; BECIREVIC, Damir [2]; LEES, Jean-Pierre [3]; LE GAC, Renaud [4]; Prof. NEDELEC, Patrick [5]; SCHUNE, Marie-Helene [6]; Dr. TISSERAND, Vincent [7]; Dr. T'JAMPENS, Stéphane [8]; Dr. WORMSER, Guy [9]; Dr. CHARLES, Jerome [10]; Dr. EMERY, Sandrine [11]; Dr. REBREYEND, Dominique [12]; Dr. SACQUIN, Yves [11]; Dr. STOCCHI, Achille [13]; Dr. BEN-HAIM, Eli [14]; DESCOTES-GENON, Sébastien [15]

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IN2P3 and IRFU, the two French institutes involved in research in particle physics, nuclear physics and astroparticle, organized in 2011 and 2012 a broad study and debate in order to prepare a roadmap for 2013-2022. Starting in April 2011, 19 working groups prepared strategy documents, which were submitted to community feedback. A meeting took place in April 2012 in Giens, South of France, where talks and discussions allowed finalising the recommendations proposed by the community to the Institutes' managements. Summaries of these recommendations, updated with the latest scientific results since April, are submitted as contributions to the ESPG and to the Open Symposium. This is one of these summaries. The authors are part of the group that worked on this topic. The full document (in French) is available on request from the authors.

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Search for anomalies in the neutrino sector with muon spectrometers and large LArTPC imaging detectors at CERN

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The long standing series of experimental results hinting at the hypothesis of sterile neutrinos [1] deserve in our opinion a major CERN investment to definitely clarify the underlying physics. The interest of the scientific community in this topic is almighty as proven by the existence of several projects and studies that are under development worldwide. However, only CERN may be in position to run an ultimate experiment able to investigate every possible oscillation scenario with high sensitivity.
We report here on the experimental proposal [8] currently under scrutiny by CERN committees. The experiment follows the setting up of a new neutrino beam at SPS in a short time schedule. We deem mandatory that both beam and experiment be ready by December 2015, in order to be competitive with the expected flow of neutrino physics results in the international landscape.

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Standard Model: precision measurements and electroweak symmetry breaking, roadmap elements by the French physicists

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IN2P3 and IRFU, the two French institutes involved in research in particle physics, nuclear physics and astroparticle, organized in 2011 and 2012 a broad study and debate in order to prepare a roadmap for 2013-2022. Starting in April 2011, 19 working groups prepared strategy documents which were submitted to community feedback. A meeting took place in April 2012 in Giens, South of France, where talks and discussions allowed finalising the recommendations proposed by the community to the Institutes' managements. Summaries of these recommendations, updated with the latest scientific results since April, are submitted as contributions to the ESPG and to the Open Symposium. This is one of these summaries. The authors are part of the group that worked on this topic. The full document (in French) is available on request from the authors.

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Addressing the challenges posed to HEP software due to the emergence of new CPU architectures

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A major effort to re-engineer existing HEP software is needed for the future efficient exploitation of resources being invested in computer centres used by HEP experiments. New generations of computers have started to exploit higher levels of parallelism, i.e. new CPU micro-architectures and computing systems with multiple CPUs. Significant agility will be needed to adapt, and even re-design, the algorithms and data structures of existing HEP code to fully utilize the available processing power. Evidently much work needs to be done to evaluate and select the best emerging software technologies, and to adapt our codes to new programming models that can execute efficiently in parallel on these new computing architectures. This paper discusses the motivations for a new initiative in bringing the whole HEP software community together to work on preparing our data processing applications to meet future challenges for improving software performance.

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European strategy for long-baseline neutrino-oscillation experiments; The UK perspective

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Input from the UK neutrino community to the European Strategy Preparatory Group.

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ORCA: Oscillation Research with Cosmics in the Abyss

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A Feasibility Study for a Neutrino Mass Hierarchy Measurement with the KM3NeT-Phase 1 Neutrino Telescope in the Mediterranean Sea

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NICA at JINR Dubna

Prof. MATVEEV, Victor [1]; KEKELIDZE, Vladimir [1]; KOVALENKO, Alexander [1]; LEDNICKY, Richard [1]; MESHKOV, Igor [1]; SORIN, Alexander [1]; Dr. TRUBNIKOV, Grigory [1]

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The NICA (Nuclotron-based Ion Collider fAcility) project is now under the realization stage at the Joint Institute for Nuclear Research (JINR, Dubna). The main goal of the project is an experimental study of hot and dense strongly interacting matter in heavy ion collisions at centre-of-mass energies √s_NN = 4 - 11 GeV (NN-equivalent) and the average luminosity of 10E27 cm-2 s-1 for Au(79+) in the collider mode (NICA collider). In parallel, fixed target experiments at the upgraded JINR superconducting synchrotron Nuclotron are carried out with extracted beams of various nuclei species up to Au(79+) with maximum momenta 13 GeV/c (for protons). The project also foresees a study of spin physics with extracted and colliding beams of polarized deuterons and protons at the energies up to √s = 26 GeV (for protons). The proposed program allows to search for possible signs of the phase transitions and critical phenomena as well as to shed light on the problem of nucleon spin structure. General design and construction status, physical program of the NICA complex is presented.

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Cosmology and Dark Matter. A roadmap proposal by the French physicists.

ARMENGAUD, Eric [1]; Dr. RICH, Jim [2]; Dr. AUSSEL, Hervé [3]; BERNARDEAU, Francis [4]; BRUN, Pierre [5]; Dr. FERRER RIBAS, Esther [6]; Prof. GANGA, Ken [7]; Dr. GUY, Julien [8]; Dr. MELIN, Jean-Baptiste [2]; MOULIN, Emmanuel [4]; Prof. TEYSSIER, Romain [3]; Dr. PIRES, Sandrine [3]; EALET-GROUSSET, Anne Ealet [9]; ANTILOGUS, Pierre [10]

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IN2P3 and IRFU, the two French institutes involved in research in particle physics, nuclear physics and astroparticle, organized in 2011 and 2012 a broad study and debate in order to prepare a roadmap for 2013-2022. Starting in April 2011, 19 working groups prepared strategy documents which were submitted to community feedback. A meeting took place in April 2012 in Giens, South of France, where talks and discussions allowed finalising the recommendations proposed by the community to the Institutes' managements. Summaries of these recommendations, updated with the latest scientific results since April, are submitted as contributions to the ESPG and to the Open Symposium. This is one of these summaries. The authors are part of the group that worked on this topic. The full document (in French) is available on request from the authors.

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Neutrino and Astroparticle Physics Program of JINR and Russian Institutes

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Neutrino and astroparticle physics program of JINR and Russian Institutes has been discussed recently at the Neutrino Council of the Russian Academy of Sciences.The document presents proposals for the development of the scientific facilities in Russia and plans for collaboration on the International facilities and experiments in this field worldwide.

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Particle and Astroparticle Physics in Poland

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The document contains an overview of the Polish particle and astroparticle physics with some conclusions and recommendations. After a short introduction, in Chapter 2 general information about the organizational structure, international collaboration and funding of HEP and ApP in Poland is given. Chapter 3, which is the core of the document, is dedicated to various fields of particle and astroparticle physics, arranged as proposed by the European Strategy Preparatory Group. The issues related to technology transfer and contacts with industry are described in Chapter 4, while education and outreach are the subject matter of Chapter 5. Chapter 6 contains conclusions and recommendations. The document is aimed also at the Ministry of Science and Higher Education in Poland.

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A case for a very large circular electron-positron collider

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We explore the physics case for building a facility for high energy physics based around a very large circular tunnel which, in the first instance, would house a high-luminosity electron-positron collider with 300 GeV CMenergy.
This facility would be able to make a detailed study of the weak sector, in particular the measurement of the properties of light Higgs bosons in and beyond the standard model. At a later date, one could imagine upgrading the energy to study the top threshold and possibly the Higgs self couplingor installing an O(100) TeV pp collider in the same ring, giving access to possible physics beyond the standard model at a very high energy scale.

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Large-system Engineering

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To explore the frontiers of knowledge, future experiments will require improved detectors with higher performances and innovative functions. The challenge for the engineering field is the capacity to integrate innovative technologies and to monitor numerous intertwined parameters.

This paper gives a prospective study aiming to prepare the future phase of experiment conception. Some orientations for engineering tools and methodologies for the design and construction of large instruments are proposed.

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Excellence in Detectors and Instrumentation Technologies: Network Project

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Today HEP projects are extraordinary complex and require long term investment for the conception and construction phases. Students entering the world of Fundamental Physics after these phases will rarely have the opportunity to make a detector functioning, debug it, understand its fundamental properties, features and limits.

To contain the decline of experience and expertise in instrumentation among young experimentalists, it is very important to sponsored regular Instrumentation Schools that cover the extremely advanced detectors techniques used in HEP experiments.

This contribution describes a European Network Project of Schools of Excellence in Instrumentation to be submitted to the European Commission within the EU Framework Programme for Research and Innovation: Horizon2020.

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JINR Activity in Future Linear Colliders

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JINR in collaboration with member states research centers and industry is actively participating in R works on future linear colliders including ILC and CLIC, relevant physics and engineering. The status of this activity and plans for the future are presented.

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TIARA contribution to the European Strategy for Particle Physics

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Strategy for Experimental Particle Physics to 2040: University of Liverpool

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FRENCH MEMORANDUM ON A FAST TRACK SCENARIO FOR BUILDING A GLOBAL LC

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Contribution of the Spanish network for Future Linear Colliders to the Update of the European Strategy for Particle Physics

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The Spanish community involved in R activities for future linear colliders has been working very hard during the last 6 years on the different aspects related to ILC/CLIC Linear Colliders projects and is well prepared to make an important contribution to the construction and operation of the ILC. The status of this activity and plans for the future , as well as the physics case for future linear colliders are presented.

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Conclusions of the Town Meeting: Relativistic Heavy Ion Collision

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On Friday 29 June 2012, a town meeting was held at CERN to collect input on the section of relativistic heavy ion collisions in the update of the European Strategy for Particle Physics. The meeting featured short presentations of existing and planned future heavy ion experiments at the CERN LHC, the Brookhaven RHIC, the CERN SPS, the FAIR facility in Darmstadt and the JINR in Dubna. In addition, the meeting provided a forum in which individual scientists and groups could contribute with short comments and statements. The meeting counted 237 registered participants that covered all experimental and theoretical activities in the field. The meeting concluded with an open 2-hour discussion of the priorities in the field. The following text summarizes the consensus view of the scientific community on the priorities of the field, as expressed by the participants of the town meeting.

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NICA at JINR Dubna

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The NICA (Nuclotron-based Ion Collider fAcility) project is now under the realization stage at the Joint Institute for Nuclear Research (JINR, Dubna). The main goal of the project is an experimental study of hot and dense strongly interacting matter in heavy ion collisions at centre-of-mass energies √s_NN = 4 - 11 GeV (NN-equivalent) and the average luminosity of 10E27 cm-2 s-1 for Au(79+) in the collider mode (NICA collider). In parallel, fixed target experiments at the upgraded JINR superconducting synchrotron Nuclotron are carried out with extracted beams of various nuclei species up to Au(79+) with maximum momenta 13 GeV/c (for protons). The project also foresees a study of spin physics with extracted and colliding beams of polarized deuterons and protons at the energies up to √s = 26 GeV (for protons). The proposed program allows to search for possible signs of the phase transitions and critical phenomena as well as to shed light on the problem of nucleon spin structure. General design and construction status, physical program of the NICA complex is presented.

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ApPEC/ASPERA Scientific Advisory Commitee (SAC) Recommendations

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We revisit the ApPEC/ASPERA roadmap recommendations, published in November 2011, focusing on those fields which are of relevance for particle physics. This text constitutes therefore the ApPEC/ASPERA input to the European Strategy for Particle Physics. The recommendations take into account recent extraordinary scientific developments, such as the measurement of a surprisingly large third neutrino mixing angle θ13 and the discovery of a particle compatible with the long sought Higgs boson predicted by the Standard Model, but they are not a rewriting of the November 2011 roadmap, nor a change of the order of priorities.

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CERN IT & WLCG Input to the European Strategy for Particle Physics Update (Computing)

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This document provides input on Computing and Software from the WLCG collaboration and the CERN IT department.

59

UK input to European Particle Physics Strategy Update

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We provide here a short UK perspective for consideration by the CERN Council Strategy Group as it prepares an update to the European particle physics strategy.

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COMPASS planned measurements in the next five years and longer term perspectives on the study of the nucleon structure

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In this document for the the European Strategy Preparatory Group, we outline the planned measurements for the next years and sketch the longer term perspectives on the study of the nucleon structure for the DVCS/DVMP, SIDIS and DY programs.

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The SuperB Computing Model

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The R activities aiming at the design of the computing model for the SuperB experiment attack some of the most challenging issues in scientific computing. They are outlined in this document and their relevance for High Energy Physics computing is discussed.

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AIDA contribution to European Strategy on Infrastructure for detector R&D

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63

Advanced technologies for components of future accelerators

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New technologies are required to achieve the multi-TeV energies of the future e+/e- linear colliders, build compact x-ray FEL, neutrino facilities and other foreseen linear accelerators and storage rings. However, a mandatory condition to achieve these energies is the generation of high-frequency high-power RF and achieving practical accelerating gradients well above 120 MeV/m. Reaching these gradients require extensive and systematic effort in new materials, advanced diagnostics and related techniques. In addition to the highly demanding high-energy applications, accelerators play a key role and we expect they will certainly continue playing a key role also in many applications. More than 15,000 accelerators (value estimated in 2000) are in use around the world and this number is still growing. More than 97% of these accelerators are used for different industrial and commercial applications and as an example, electron linacs for radiotherapy represent one third of all the existing accelerators.
We propose here to start a coordinated R of key components of all next generation of accelerators: superconducting RF cavities and magnets. Among the other key developments absolutely necessary in the coming years, we need to consider new magnets with improved performance and a better stability. Regarding magnets will be particularly important improve performance of superconducting magnets, key components of the future colliders of post LHC era. The use of magnets and many other superconducting components in future high-energy accelerators has to take into account of irradiation values never reached so far.
We propose also to explore in a more systematic way damage effects induced by radiation of the new generation of high temperature superconductors (HTSC) in the presence of a high fluence of proton and gamma radiation but also of more exotic particles such as pions copiously produced today in many factories.

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Imaging and Imagination, how to exploit semiconductor technology for particle physics

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Main Points
Semiconductor technology can be exploited to achieve innovation in visualization and analysis for particle physics experiments. Memory chips as well as recent CMOS imager chips present similarities to particle detectors. Fine-grained, sub-micron position measurements with sub-ns timing precision could become possible in a relatively large fiducial volume. Miniaturization of functional blocks allows in-situ integration of information processing. This can lead to alternatives
for trigger generation. Related developments in chip power management and micromechanics also present opportunities. Contacts with the nanoelectronics world have to be cultivated, even if practical and economical accessibility of the most advanced technologies proves difficult.

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Neutrino Physics in Finland

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Strategic outlook of the Finnish Neutrino Physics community
from the Universities of Jyväskylä, Oulu and Helsinki

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R Activities in Electronics for future HEP Experiments

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Future HEP experiments will require better impact parameter resolution, higher channel count, better hermeticity, lower tracker mass, better timing resolution, higher trigger and data readout rates, more flexible data processing together with very harsh environmental running conditions, including high magnetic and radiation fields.
In the last 25 years microelectronics technologies have been key enabling technologies for designing and building detectors with increasing capabilities and performance. Today, very deep-submicron technologies (65 nm and below) open new possibilities for meeting the future experiments requirements. However these technologies are both complex and expensive and their qualification for our environment (radiation) and their effective use in the community will require a very substantial investment in money and manpower.
Emerging hybrid and interconnect technologies (small pitch bump bonding, Through Silicon Via and 3D assembly for instance) can enable the construction of new low mass high-density detectors. Although our requirements in terms of density and performance are not very different from those of commercial applications (as typically found in portable devices), the access to these technologies and the adaptation to our specific needs (reliability and radiation hardness, size, etc.) require a solid development program.
Powering the front-end electronics of the new detectors requires the development of innovative techniques because of our specific environmental conditions. The on-going R effort on the subject is to be continued.
The need of low power, low mass, high speed and radiation hard optical links for reading out and controlling the detectors calls for a robust R effort to break the limits of existing concepts and to explore emerging technologies, such as silicon photonics.
Maintaining and increasing the support and services for key activities such as radiation hardness (key issue for both the experiments and the accelerators), high reliability design and access to microelectronics technologies is essential for guaranteeing good engineering practices and efficient use of resources. Collaborative efforts with other scientific and industrial partners in very deep sub micron CMOS design help to maintain and enhance the ability of the HEP community to harness the technology for future physics experiments and such activities should be encouraged.
The cost of the readout and control electronics of current HEP experiments represents about 25% of the total experiment cost. This is not going to decrease in the future and such a level of funding deserves a corresponding substantial investment in R activities.

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Computing : A contribution from the French community

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Since several years, IN2P3 and IRFU are on the cutting edge of the technology in the area of the processing of very large date volume. Pushed by the particle physics needs, both IN2P3 and IRFU have deployed tools and have acquired computing resources that are useful to all the scientific domains, especially astroparticles, nuclear and hadronic physics and multidisciplinary research. Our community is now facing several challenges in the computing field which will have deep implications.

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SuperB Physics Programme

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This document summarises the highlights of the SuperB physics programme. The potential benefits to understanding new physics and the standard model through the study of B, D, and tau decays, along with precision electroweak and conventional and exotic spectroscopy measurements are discussed. Finally the use of these results in the context of the bigger picture of understanding how new physics can behave is summarised.

69

The Physics Case for an e+e- Linear Collider

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This document presents an overview of the physics potential of a future electron-positron linear collider. It represents a common input from the CLIC and ILC communities.

70

LENA - Low Energy Neutrino Astronomy

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Proposal for a liquid scintillator neutrino detector lcoated at a European deep underground laboratory at Pyhäsalmi, Finland.

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Opportunities Offered by the SuperB Detector Development

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The R activities aimed at optimizing the design of the detector for the SuperB experi- ment tackle some of the most challenging issues in detector development and scientific computing. They are summarized in this note and the potential impact on the High Energy Physics community is discussed.

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Covering letter & summary, International Linear Collider submissions to Open Symposium

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The International Linear Collider is a mature project utilising superconducting radiofrequency acceleration to produce electron-positron collisions. It produces excellent experimental conditions and is flexible in its energy reach from the Z0 peak to beyond 1 TeV. It can be readily staged in several steps to reach this maximum energy. Its physics programme is exciting, well founded and complementary to that of the Large Hadron Collider. There are two large and enthusiastic groups of physicists organised in the ILD and SiD proto-collaborations who are eager to do experimentation at the ILC. The delivery of the Technical Design Report at the end of 2012 will document that the ILC could be built immediately. This document summarises the ILC case and references more detailed documents submitted to this process.

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Summary of the International Linear Collider Technical Design Report

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The ILC TDR will be completed by the end of 2012. This document summarises the design of the ILC at a high level, including the overall layout, the main subcomponents, the parameters at a variety of energies, the two site-dependent designs and an outline of various upgrade possibilities.

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A new CERN long baseline conventional neutrino beam (CN2PY) aimed at a deep underground research infrastructure for large scale detectors at Pyhasalmi: an opportunity for Particle and Astroparticle Neutrino and Grand Unification Physics

Prof. RUBBIA, Andre [1]; LAGUNA/LAGUNA-LBNO FP7 CONSORTIA AND LBNO PROTO-COLLABORATION, The [2]

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Considering the overall state of neutrino physics, and all proposed projects worldwide, we conclude that to stay at the frontier of neutrino physics and astroparticle physics, Europe has to build a next generation neutrino facility at a deep underground location with an appropriately long baseline distance from CERN.
Several years of investigations made possible by the LAGUNA and LAGUNA-LBNO Design Studies, indicate that the Pyhasalmi mine in Finland (2300 km from CERN) can host such a research infrastructure.
We are calling on CERN to endorse the creation of the LAGUNA laboratory at Pyhasalmi by inserting it in the European Roadmap, and by preparing an engineering design of a new long baseline conventional neutrino beam (CN2PY) aimed at that facility. CERN should support the development of a full experimental proposal by the end of 2014, in a collaborative effort with neutrino physicists.

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ILC Project Implementation Planning I: Introduction, Governance and Funding

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The Project Implementation of the ILC is summarised in three parts. The ILC is a unique endeavour in particle physics; fully international from the outset, it currently has no “host laboratory” to provide infrastructure and support. The realisation of this project therefore presents unique challenges in scientific, technical and political arenas. This document presents a workable and efficient scheme to structure the project so that it can be effectively managed and so that it provides the requisite accountability to funding authorities. It suggests both general principles and outlines a specific model for ILC governance as well as summarising possible funding models.

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ILC Project Implementation Planning II: Management, Siting & Host responsibilities, In-kind Contributions.

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The management structure proposed for the ILC Laboratory is outlined, together with considerations on deciding a site and host and a variety of models for managing likely in-kind contributions to the ILC construction project.

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ILC Project Implementation Planning III: Industrialisation, Schedule & Future R&D

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The industrialisation of a major international project such as the ILC is a complex and difficult undertaking essential to provide cost-effective production of large-volume components. The major item studied here is the industrialisation of the superconducting RF cavities and cryomodules. An outline of the construction schedule is given followed by R topics that could usefully be carried on after the completion of the TDR and before project construction begins to optimise construction and contain costs.

78

The ILD Detector Concept for the ILC

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The ILC detector concept is outlined, including a description of the detector components, their performance and the overall status of the project.

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The SiD concept for the ILC

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The SiD detector concept is outlined, including a description of the detector components, their performance and the status of the "push-pull" concept.

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ILC Detector R: its impact

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The impact of the R for ILC detectors on areas outside ILC and indeed outside particle physics is very real. This report draws attention to the significant positive impact the ILC detector R has had on the field of particle physics and beyond and points to the value of sustained support for basic research and development for instrumentation.

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EUROPEAN STRATEGY FOR ACCELERATOR BASED NEUTRINO PHYSICS

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Massive neutrinos reveal physics beyond the Standard Model, which could have deep consequences for our understanding of the Universe. Their study should therefore receive the highest level of priority in the European Strategy. Among the many neutrino questions that experiments in different physics domains can answer, the discovery and study of leptonic CP violation and precision studies of the transitions between neutrino flavours require high intensity, high precision, long baseline accelerator neutrino experiments. The community of European neutrino physicists involved in oscillation experiments works on ongoing accelerator based experiments from CERN (CNGS), but also in Japan (T2K), the USA (MINOS), using reactors (Double Chooz) or natural sources (ANTARES, ICECUBE, km3, LVD) and has taken a leading role in detector and accelerator studies towards powerful future long baseline facilities. It is strong enough to support a major neutrino long baseline project in Europe, and has an ambitious, competitive and coherent vision to propose.

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Proposal to use a high intensity neutrino beam from the ESS proton linac for measurements of neutrino CP violation and mass hierarchy

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It is proposed to complement the ESS proton linac with equipment that would enable the production - concurrently with the production of the planned ESS beam used for neutron production - of a 5 MW beam of ca 10^23 2.5 GeV protons per year in microsecond short pulses to produce a neutrino Super Beam, and to install a megaton underground water Cherenkov detector in a mine to detect νe appearance in the produced νμ beam. Results are presented of preliminary calculations of with which sensitivity measurements of neutrino CP violation and Mass Hierarchy could be made and of the neutrino base line distance at which optimal sensitivity would be obtained. The results indicate that, with 8 years of data taking with an antineutrino beam and 2 years with a neutrino beam and a base line distance of around 400 km, CP violation could be discovered at 5σ (3σ) confidence level in 48 % (73%) of the total CP violation angular range at and that, with the same base line distance, the neutrino Mass Hierarchy could be determined at 3σ level over most of the total CP violation angular range. There are several underground mines with a depth of more than 1000 m, which could be used for the creation of the underground site for the neutrino detector and which are situated within or near the optimal base line range.

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Beyond the standard model. Contribution by the French physicists

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IN2P3 and IRFU, the two French institutes involved in research in particle physics, nuclear physics and astroparticle, organized in 2011 and 2012 a broad study and debate in order to prepare a roadmap for 2013-2022. Starting in April 2011, 19 working groups prepared strategy documents which were submitted to community feedback. A meeting took place in April 2012 in Giens, South of France, where talks and discussions allowed finalising the recommendations proposed by the community to the Institutes' managements. Summaries of these recommendations, updated with the latest scientific results since April, are submitted as contributions to the ESPG and to the Open Symposium. This is one of these summaries. The authors are part of the group that worked on this topic. The full document (in French) is available on request from the authors.

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Opportunities for Collaboration at Fermilab: Input to the European Strategy for Particle Physics, 2012

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The purpose of this letter is to describe the major opportunities for collaboration between European institutions and Fermilab over the next two decades. Fermilab is developing a leading program at the intensity frontier, where the currency is not the highest energy but the greatest flux of particles. Fermilab will provide the international particle physics community with the most powerful facilities for the study of neutrinos with accelerators in both long- and short-baseline configurations. Fermilab facilities will give the world's researchers their best opportunity to study the rare processes of kaons and muons that are sensitive to mass scales well beyond the direct reach of the Large Hadron Collider. The large flux of particles available from Fermilab accelerators will also allow the greatest reach in the study of the neutron electric dipole moment, the muon electric dipole moment and the electron dipole moment through the production and measurement of copious amounts of rare isotopes. The intensity frontier program is an important and necessary addition to the world's particle physics program, complementary to and independent of the discoveries made at the LHC.

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Input of Nikhef to the European Particle Physics Strategy Discussion 2012

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This document describes the input of Nikhef, the National Institute for Subatomic Physics in the Netherlands, to the European Particle Physics Strategy Discussion 2012.
The input is given in the form of eight statements summarizing the view of Nikhef on the future of the LHC programme, a linear e+e- collider, accelerator research and development, a long baseline neutrino oscillation facility, the organization of European contributions to large accelerator facilities outside Europe, the roadmap for astroparticle physics, detector R, and grid computing.
It is the opinion of Nikhef that the highest priorities should be set on the exploitation of the full LHC programme, including a high luminosity upgrade after 2022, and on the rapid construction of a linear e+e- collider with a centre-of-mass energy around 250-350 GeV.

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The Hyper-Kamiokande Experiment

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We propose the Hyper-Kamiokande (Hyper-K) experiment as a next generation neutrino and nucleon decay experiment with an underground one Megaton water Cherenkov detector. The Hyper-K detector serves as a far detector of a long baseline neutrino oscillation experiment for the J-PARC neutrino beam and is capable of observing proton decays, atmospheric and solar neutrinos, and neutrinos from other astrophysical origins.

We would like to discuss Hyper-K as a global project and make an international strategy in order to contribute to the world-wide effort to make a strong neutrino physics program.

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TIMING TRACKERS FOR HIGH LUMINOSITY HADRON COLLIDERS

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The understanding of the Higgs properties, the measurements of triple and quartic boson-boson coupling, the study of the Higgs self coupling, and the search of new particles are strong Physics cases, pushing for a LHC upgrade both in energy and luminosity.

New concepts of on-line triggers must be developed in order to cope with the expected presence of hundreds pp collisions per bunch-crossing. The use of a time coincidence window between hits of the same sub-detector or of different sub-detectors much narrower than accelerator clock can strongly increase the rejection of fake coincidences.

Tracking layers with sub-nanosecond time resolution can meet the requirements.
Resistive Plate Chambers and Diamond Detectors are two important example of candidate detectors for "timing trackers".
New front-end electronic technologies must be made available to the European high-energy research community such as SiGe BiCMOS chips and Vertical Integration Mixed technology in order to build timing trackers for high luminosity colliders.

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COMET and PRISM - Search for muon to electron Conversion in Japan

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Charged lepton flavor violation (CLFV) has yet to be observed and is known to be sensitive to new physics beyond the Standard Model (SM). The J-PARC E21 experiment is an experiment to search for a CLFV process of neutrinoless muon-to-electron conversion (mu-e conversion) in a muonic atom at a single-event sensitivity of 3x10^{-17} at the Japanese Proton Accelerator Research Complex (J-PARC). This experiment is called COherent Muon to Electron Transition (COMET).
In the long-term future, significant improvements to aim at a single event sensitivity of mu-e conversion of about 2x10^{-19} should be considered. For this ultimate mu-e conversion search, the PRISM (Phase Rotated Intense Slow Muon source) project is being developed in collaboration with the UK and Japan groups.
The physics case made by the staging approach of the COMET experiment and the PRISM experiment is extremely strong. At present, the COMET collaboration includes researchers from the UK and other European countries. We are hoping that the European Strategy for Particle Physics must provide for European contributions to the realization of the COMET and PRISM.

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Particle Physics at High Energies but Low Luminosities

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While standard s-channel physics indicates that extremely high luminosities will be needed at TeV and beyond energy scales, there are physics questions which can be probed with lower luminosities. Since achieving high luminosities with realistic power consumption could be technologically much more difficult than achieving high energies, it is important that the physics case for a high energy but low luminosity (or single beam) accelerator be investigated. We have listed a number of physics topics in this note to indicate that such physics topics exist, and hope that this will lead to further investigations of physics topics that would rely primarily on energy and not on luminosity.

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Input for European Strategy for Particle Physics from IFIN-HH, Romania

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The Horia Hulubei National Institute of Physics and Nuclear
Engineering (IFIN-HH) participation in the frame of LHC programme is shortly described.

93

The CERN Theory Unit and the future of European High Energy Physics

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An Accelerator Science Perspective on Experimental Particle Physics to 2040

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A document on behalf of the leadership of the Cockcroft Institute, UK submitted for consideration to the European Strategy in Pareticle Physics, 2012

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The fourth generation, linac-ring type colliders, preons and so on

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After a brief review of our contributions to the 2006 European PP Strategy, recent comments on several topics are present. First of all, it is emphasized that only the simplest version of the fourth chiral generation, namely, minimal SM4 (mSM4) with only one Higgs doublet is in some tension with the recent LHC data on the Higgs boson search. This tension, which follows from the relative strengths of the H --> 4l and Higgs --> γγ channels, can be naturally resolved if there is a mechanism to enhance the H-->γγ width (although any charged and heavy particle could enhance the H-γ-γ loop, 2HDM can be given as an example).

We then emphasize the possible role of the linac-ring type colliders, especially LHeC (QCD Exploder) and TAC super charm factory. The QCD Explorer will give opportunity to enlighten the origin of the 98.5% portion of the visible universe's mass. Especially the γ-nucleus option seems to be very promising for QCD studies. The TAC super charm factory may provide opportunity to investigate the charm physics with statistics well above that of the dedicated runs at Super-B factories.

Finally, it is argued that the history of particle physics (and, more generally, the history of the investigation of the fundamental ingredients of the matter), a large number of "fundamental" particles, an inflation of observable free parameters, and, especially, the mixing of "fundamental" fermions favor the idea of a new set of fundamental particles at a deeper level. These new particles can be formulated with the preonic or even pre-preonic models.

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The LHCb Upgrade

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The primary goal of the LHCb experiment at the LHC is to search for new physics beyond the Standard Model. Results obtained from data collected in the last three years show that the detector is robust and functioning well. A limit of 1–2/fb of data per nominal year cannot be overcome without upgrading the detector to read out at 40MHz, which will allow the experiment to collect 5/fb per year. A highly flexible software-based triggering strategy will lead to increased trigger efficiencies, especially in decays to hadronic final states. It will also be possible to change triggers to explore different physics as LHC discoveries point to the most interesting channels. The physics scope extends beyond that of flavour, and includes searches for Majorana neutrinos, exotic Higgs decays and precision electroweak measurements. The proposed detector changes are discussed for the upgrade of LHCb to be ready in 2019 for the further exploration of new phenomena in the forward region of proton-proton collisions at the LHC.

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Input from CPAN on behalf of the Spanish community

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This document summarizes the general views of the Spanish scientific community concerning the update of the European Strategy for Particle Physics.

99

CLIC e+e- Linear Collider Studies

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This document provides input from the CLIC e+e- linear collider studies to the update process of the European Strategy for Particle Physics. It is submitted on behalf of the CLIC/CTF3 collaboration and the CLIC physics and detector study.

101

Prospective Studies for LEP3 with the CMS Detector

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On July 4, 2012, the discovery of a new boson, with mass around 125 GeV/c2 and with properties compatible with those of a standard-model Higgs boson, was announced at CERN. In this context, a high-luminosity electron-positron collider ring, operating in the LHC tunnel at a centre-of-mass energy of 240 GeV and called LEP3, becomes an attractive opportunity both from financial and scientific point of views. The performance and the suitability of the CMS detector are evaluated, with emphasis on an accurate measurement of the Higgs boson properties. The precision expected for the Higgs boson couplings is found to be better than that predicted by Linear Collider studies.

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A New Search for the Decay mu->eee

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A letter of intent to search for the lepton flavor violating decay process μ ⟶ eee with a sensitivity of B(μ ⟶ eee) < 10-16 at 95% CL was recently submitted to PSI by the Mu3e collaboration. The physics motivation and the technological challenges of such an experiment, together with the importance of the installation of a new high intensity muon source are discussed.

103

R Paths of Pixel Detectors for Vertex Tracking and Radiation Imaging

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This report reviews current trends in the R of semiconductor pixellated sensors for vertex tracking and radiation imaging. It identifies requirements of future HEP experiments at colliders, needed technological breakthroughs and highlights the relation to radiation detection and imaging applications in other fields of science.

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Implications of LHCb measurements and future prospects

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During 2011 the LHCb experiment at CERN collected 1.0 fb−1 of sqrt{s} = 7 TeV pp collisions. Due to the large heavy quark production cross-sections, these data provide unprecedented samples of heavy flavoured hadrons. The first results from LHCb have made a significant impact on the flavour physics landscape and have definitively proved the concept of a dedicated experiment in the forward region at a hadron collider. This document, which is a summary of a more detailed article, discusses the implications of these first measurements on classes of extensions to the Standard Model, bearing in mind the interplay with the results of searches for on-shell production of new particles at ATLAS and CMS. The physics potential of an upgrade to the LHCb detector, which would allow more than an order of magnitude
more data to be collected, is emphasised.

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Fundamental physics at low energies -- The quest for axions and other new light particles

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Embedding the Standard Model into more fundamental theories often predicts low mass and very weakly interacting particles, so-called WISPs (Weakly Interacting Slim Particles), such as the axion. A number of small-scale experiments at the intensity/precision frontier -- for example "light shining through a wall", haloscopes and helioscopes -- are actively searching for these elusive particles, complementing searches for physics beyond the Standard Model at accelerators.
A plausible next generation of experiments includes scaled-up versions of the existing techniques as well as innovative concepts, together covering a huge unexplored parameter space.
A WISP discovery would have a tremendous impact on our understanding of fundamental physics, astrophysics and may shed light upon the mysteries of Dark Matter and Dark Energy.

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The future of Monte Carlo Event Generators

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In this brief submission to the European Strategy Group for Particle Physics, we argue that continuing a strategy of European co-ordination and funding of general purpose Monte Carlo event generator development is vital to keeping pace with the increasing precision and breadth needed to fully exploit the experimental data.

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Imperial College London HEP Group Submission to the ESPG

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This document contains some comments on priorities for a European Particle Physics Strategy in the coming decade from the Imperial College London High Energy Physics group.

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nuSTORM: input to the update of the European Strategy for Particle Physics

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The nuSTORM facility has been designed to deliver beams of electron and muon neutrinos from the decay of a stored muon beam with a central momentum of 3.8 GeV and a momentum spread of 10%. The facility will serve a number of near detectors situated at which the electron-neutrino and muon-neutrino cross sections will be measured with a percent-level precision. A detector located at a distance of ~2000m will be capable of making sensitive searches for sterile neutrinos.

The physics case for the facility is compelling. The facility can be implemented today for a modest cost and is well within the capabilities of the major HEP proton-accelerator laboratories. In addition, by delivering a first-rate physics programme using neutrinos produced in the decay of muons confined within a storage ring, nuSTORM will herald a new technique for particle physics, paving the way for the detailed studies of the properties of the neutrino that can be carried out at the Neutrino Factory.

Therefore, the case is made that the European Strategy for Particle Physics must provide for European contributions to the realisation of the nuSTORM facility.

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Higgs/top factory and Planck physics

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We argue that if the LHC confirms that the properties of the recently discovered boson with the mass 124-126 GeV coincide with those of the Higgs boson of the Standard Model, and finds nothing else, a next step in high energy experimental physics should be the construction of an electron-positron or muon collider with a center of mass energy 200+200 GeV (Higgs and t-quark factory). This would be decisive for setting up the question about the necessity for a new energy scale besides the two ones already known - the Fermi and the Planck scales. In addition, this will allow to study in detail the properties of the two heaviest particles of the Standard Model, potentially most sensitive to any types on new physics.

110

On the Prospect and Vision of Ultra-High Gradient Plasma Accelerators for High Energy Physics

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Assessment from the European Network on Novel Accelerators on the promise for High Energy Physics of ultra-high gradient acceleration techniques based on plasmas. The status of achievements is summarized and visions and a possible roadmap for very compact high energy colliders are discussed.

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Particle accelerators

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Executive summary of the strategy document by the French accelerator engineers and physicists

112

Implications of LHC results for TeV-scale physics: Exotics

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Exotics refer, in the context of this document, to all new physics that is not directly related to electroweak symmetry breaking, nor to flavor and that has not an important component of missing energy. The number of models that fall in this category is too large to be covered in this kind of document so we have decided to classify implications of new physics according to the relevant types of new particles, namely new bosons, new fermions and other exotics. We have tried to motivate the presence of these new particles, to report on the current (or expected after the end of the 2012 run) bounds and to discuss the implications for future colliders in terms of this kind of new physics. The main conclusions are that discoveries with LHC8 are possible and well motivated but, if no discovery is produced, any further discovery with LHC14 will most likely require an upgrade in energy or luminosity or a LC for a precise determination of the properties of the new particles. We include a small appendix on issues related to boosted techniques in searches for high scale new physics in current and future colliders.

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Statement by the German Committee for Particle Physics (KET)

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Statement by the German Committee for Particle Physics on the European Strategy for Particle Physics. The Committee for Particle Physics (Komitee für Elementarteilchenphysik, KET) is the elected representation of the community of German particle physicists at universities, DESY, and CERN.

114

Scalable CaloTracker (SCT) proposal for universal particle detector from zero till practically infinite energies

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After discovery of Higgs-boson the particle physicist community should turn its attention for new challenges which could be directed toward ultra high energies. The hope in new accelerator technologies is greatly enhanced by invention of the laser driven plasma wake field methods which can produce beams with PeV (1015 eV) energy at some future time. For comparison on the expected time scale, one can mention that LHC was conceived in 1984 and will reach full energy hopefully in 2014. It is an interesting question what type of detector system would be applicable in this energy range for fixed target and collider arrangements.

Here we should like to present a new concept which is radically different from the present onion shell design (vertex pixel, tracker, EM-calorimeter, hadron calorimeter and muon detector). This new system would have a completely homogenous structure built from standard elements in a scalable way serving at the same time as very fine resolution TRACKER and a full absorption CALORIMETER with full 4 coverage for both charged and neutral particles with the usual exception of penetrating neutrinos. Though one is not expecting accelerators with PeV beams before 2050, one can test the SCT (Scalable CaloTracker) detector principle at lower energies due to its modular scalable structure. The key element is a massively parallel information system which can process the complete shower development on track-by-track base on adaptive granulation levels.

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Instrumentation & Detection. Contribution from the French engineers and physicists

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Executive summary of a strategy document on Instrumentation & Detection

116

Theoretical physics in France (particle physics, nuclear physics, astroparticle physics and cosmology)

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Status and recommendations, summary of a longer document elaborated by the theory community, (in French) available on request from the authors.

117

A Fixed-Target ExpeRiment at the LHC: AFTER @ LHC

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We discuss the possibility of the conception of a multi-purpose fixed-target experiment with the proton or lead ion LHC beams extracted by bent a crystal. This mature extraction technique offers an ideal way to obtain a clean and very collimated high-energy beam, without altering at all the performance of the LHC. As simple as it seems, the multi-TeV LHC beams allow for the most energetic fixed-target experiment ever performed.

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High-energy universe, gravitational waves, multi-messangers

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IN2P3 and IRFU, the two French institutes involved in research in particle physics, nuclear physics and astroparticle, organized in 2011 and 2012 a broad study and debate in order to prepare a roadmap for 2013-2022. Starting in April 2011, 19 working groups prepared strategy documents which were submitted to community feedback. A meeting took place in April 2012 in Giens, South of France, where talks and discussions allowed finalising the recommendations proposed by the community to the Institutes' managements. Summaries of these recommendations, updated with the latest scientific results since April, are submitted as contributions to the ESPG and to the Open Symposium. This is one of these summaries. The authors are part of the group that worked on this topic. The full document (in French) is available on request from the authors.

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COMPASS Plans and Perspectives for Physics with Hadron Beams

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The Belle II experiment at SuperKEKB

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The Belle detector at the KEKB electron-positron collider has collected approximately 800 million Y(4S) events in its decade of operation. Many of the existing measurements have statistical uncertainties still higher than their systematics. More statistics would then bring a substantial improvement in the accuracy. However further increase of the luminosity at the same rate as now would not lead to significant reduction of uncertainties. The Japanese national accelerator laboratory KEK group has therefore started tu build Super-KEKB, an upgrade of KEKB to increase the luminosity by two orders of magnitude during a four-year shutdown, with an ultimate goal of 8E35/cm2/s luminosity. To exploit the increased luminosity, an upgrade of the Belle detector is under construction by new international collaboration Belle II. The document presents physics motivation, basic methods of the accelerator upgrade, as well as key improvements of the detector.

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Future Strategy of Japanese High Energy Physics Community

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Attached in this document is the final report of the subcommittee on future projects of high energy physics, submitted in February and approved in March, which summarizes the future strategy of the Japanese high energy physics community.

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The Belle II experiment at SuperKEKB: Importance for the European Particle Physics Institutions

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The Belle detector at the KEKB electron-positron collider has collected approximately 800 million Y(4S) events in its decade of operation. Many of the existing measurements have statistical uncertainties still higher than their systematics.
More statistics would then bring a substantial improvement in the accuracy.
However further increase of the luminosity at the same rate as now would not lead to significant reduction of uncertainties.
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To exploit the increased luminosity, an upgrade of the Belle detector is under construction by new international collaboration Belle II. The document presents physics motivation, basic methods of the accelerator upgrade, as well as key improvements of the detector.
The experiment will be performed in Japan, but about 40% of the members come from the European institutions. This document presents the participation of them, and also the synergies with other European projects.

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Quark-gluon plasma. Input from the French community

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IN2P3 and IRFU, the two French institutes involved in research in particle physics, nuclear physics and astroparticle, organized in 2011 and 2012 a broad study and debate in order to prepare a roadmap for 2013-2022. Starting in April 2011, 19 working groups prepared strategy documents which were submitted to community feedback. A meeting took place in April 2012 in Giens, South of France, where talks and discussions allowed finalising the recommendations proposed by the community to the Institutes' managements. Summaries of these recommendations, updated with the latest scientific results since April, are submitted as contributions to the ESPG and to the Open Symposium. This is one of these summaries. The authors are part of the group that worked on this topic. The full document (in French) is available on request from the authors.

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Interfaces with Earth sciences. Input from the French community.

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Status and recommendations on interfaces of particle physics, nuclear physics and astroparticles with sciences of the Earth. This is a summary of a longer document, in French.

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Towards a Global Effort for Sustainable Data Preservation in High Energy Physics [DPHEP Study Group]

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Data from high-energy physics (HEP) experiments are collected with significant financial and human effort and are mostly unique. An inter-experimental study group on HEP data preservation and long-term analysis was convened as a panel of the International Committee for Future Accelerators (ICFA). The group was formed by large collider-based experiments and investigated the technical and organisational aspects of HEP data preservation. An intermediate report was released in November 2009 addressing the general issues of data preservation in HEP. The recent status report, released in May 2012, provides an analysis of the research case for data preservation and a detailed description of the various projects at experiment, laboratory and international levels. In addition, the paper provides a concrete proposal for an international organisation in charge of the data management and policies in high-energy physics. The document submitted to the European Strategy Preparatory Group presents the main conclusions of the ICFA Study Group for Data Preservation in High-Energy Physics [DPHEP].

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Searching for Dark Matter

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We argue that in the situation when LHC discovers only the Higgs boson and finds no signatures of new physics (confirming thus the Standard Model) the necessity to explain the observed beyond-the-Standard-Model (BSM) phenomena, in particular neutrino masses, Dark Matter and matter-antimatter asymmetry of the Universe, should largely shape the further development of particle physics. We concentrate on Dark Matter problem and suggest that, if the existing direct detection experiments (mostly searching for weakly interacting particles) do not show any convincing signals and if no signs of new "electro-weak" physics is detected at the LHC, a new class of Dark Matter candidates, the so-called super-weakly interacting particles should be searched for more thoroughly. If Dark Matter is made of super-WIMPs, detecting an astrophysical signal from their decay (the so called "indirect detection") may be the only way to identify these particles experimentally. However, it may be possible to check the dark matter origin of the observed signal unambiguously using its characteristic properties and/or using synergy with direct accelerator experiments. We argue that to fully explore this possibility a devoted cosmic telescope is needed. The suggested instrument will provide a major breakthrough in the field, by improving the sensitivity by two-three orders of magnitude and thus confirming or rejecting predictions of a number of particle physics models. The proposed program of search for decaying Dark Matter in combination with accelerator searches for neutral leptons with high intensity proton beams (described in details in the proposal by Gorbunov and Shaposhnikov) are capable of direct experimental resolution of three major BSM phenomena mentioned above. The proposed cosmic mission may greatly increase the value of accelerator searches for new particles, providing a number of independent cross-checks of dark matter production and baryogenesis mechanisms as well as explanation of neutrino flavour oscillations.

The suggested cosmic mission (a wide-field imaging X-ray spectrometer) will also have a number of important applications for cosmology, providing crucial insight into the nature of dark matter by studying the structure of the "cosmic web" by both searching for missing baryons in emission, and by using gamma-ray bursts as backlight to observe the warm-hot intergalactic media in absorption. However, it is first of all a mission optimized for the search for decaying Dark Matter. It will push model independent bounds on dark matter decay within its energy range as far as it is possible with current technologies. Therefore, a strong message from particle physics community supporting the necessity of such an instrument for the development of fundamental physics is very important.

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Long-term plans of the ALICE Collaboration

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The ALICE collaboration would like to contribute to the discussion about the future strategy in particle physics for the coming decade, in the field of high-energy nuclear physics. This initiative comes in time, while we are preparing an upgrade of the ALICE detector, in order to fully exploit the scientific potential of the LHC as a heavy-ion collider. With the planned upgrades, this field of research will move from the present exploratory phase to an era of high-statistics precision measurement. This will allow a detailed characterization of the high-density, high-temperature phase of strongly interacting matter, and detailed tests of the fundamental predictions of the theory. In the following, we outline the basic physics motivation for running the LHC with heavy ions at high-luminosities and summarize the performance gains expected with the upgraded ALICE detector. With the proposed timeline, starting the high-rate operation progressively after 2018 shutdown, the objectives of our upgrade plans should be achieved collecting data until the mid-2020's. We expect that this programme of research will be considered as a high-priority item by the European Strategy Group.

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Implications of LHC results for TeV-scale physics: flavor-changing processes at low energies

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We briefly review the future prospect in flavor physics in view of the recent results from the LHC.

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Implications of LHC results for TeV-scale physics: signals of electroweak symmetry breaking

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The recent discovery of a Higgs-like state at the LHC with a mass near 125 GeV has opened a new era of particle physics. It will be of utmost impor- tance to precisely determine the properties of this new state, with

the aim to identify the mechanism of electroweak symmetry breaking (EWSB). This will require a comprehensive programme of high-precision measurements. Fur- ther measurements are also important in this context, in particular searches for manifestations of extended Higgs sectors, searches for new particles, and an improvement of electroweak precision measurements such as the mass of the top quark and the W boson as well as the effective weak leptonic mixing an- gle and triple gauge couplings. Finally the study of longitudinal vector boson scattering up to the highest energy scales is one of the key methods to discrim- inate between models and to reveal the nature of the symmetry breaking. The current experimental status of exploring the physics of electroweak symmetry breaking is briefly summarised, based on the results achieved at the LHC and elsewhere. The implications of the present and possible future results from the LHC for the physics programme of proposed future colliders are discussed.

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Monte Carlo Simulation for Particle Detectors

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Monte Carlo simulation is an essential component of experimental particle physics in all the phases of its life-cycle: the investigation of the physics reach of detector concepts, the design of facilities and detectors, the development and optimization of data reconstruction software, the data analysis for the production of physics results.
This note briefly outlines some research topics related to Monte Carlo simulation, that are relevant to future experimental perspectives in particle physics. The focus is on physics aspects: conceptual progress beyond current particle transport schemes, the incorporation of materials science knowledge relevant to novel detection technologies, functionality to model radiation damage, the capability for multi-scale simulation, quantitative validation and uncertainty quantification to determine the predictive power of simulation.
The R on simulation for future detectors would profit from cooperation within various components of the particle physics community, and from synergy with other experimental domains sharing similar simulation requirements.

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Particle Physics at DESY: Strategy and Plans

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DESY is one of the leading laboratories for particle physics with more than 50 years of experience in the field. This document describes the current activities of the laboratory in accelerator-based particle physics, the plans of the laboratory and gives recommendations to the European Strategy process.

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A Staged Muon-Based Neutrino and Collider Physics Program

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We sketch a staged plan for a series of muon-based facilities that can do compelling physics at each stage. Such a plan is unique in its ability to span both the Intensity and Energy Frontiers as defined by the P5 sub-panel of the US High Energy Physics Advisory Committee. This unique physics
reach places a muon-based facility in an unequaled position to address critical questions about the
nature of the Universe.

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A view from the INFN National Scientific Committee 1

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Input for the European Strategy Update from the DESY theory groups

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LEP3: A High Luminosity e+e- Collider to Study the Higgs Boson

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The LHC experiments have discovered a new particle with a mass around 125 GeV that is a strong candidate for the scalar Higgs boson expected in the Standard Model. An e+e– collider operating close to the ZH threshold (at a centre-of-mass energy of 240 GeV) could be the tool of choice for studying this unique particle in detail.

We present here the concept of a storage ring collider, which we call LEP3. Preliminary studies show that at a centre-of-mass energy of 240 GeV, near-constant luminosities of 10^34 cm-2s-1 are possible in up to four collision points, while respecting a number of constraints including beamstrahlung limits. With an integrated luminosity of 100fb-1 per year and per interaction point, 20,000 e+e– --> ZH events would be produced per year and per experiment. LEP3 could also operate in multi-bunch mode at the Z resonance, with luminosities of several×10^35cm-2s-1, yielding O(10^11) Z decays per year, as well as just above the WW threshold, potentially improving our knowledge of W and Z properties by large factors.

The short luminosity lifetime requires the use of top-up injection, which, in turn calls for a full-energy injector. Thus the present design uses two rings (as in the BBbar factories): a low-emittance collider storage ring operating at a constant energy, and a separate “accelerator” ring that tops up the collider ring every few minutes. The LHeC lattice design has been used as a basis for our studies. Maximum luminosity is achieved with four bunches per beam. The estimated beam lifetime is about 8 minutes (for four simultaneous experiments) dominated by e+e– Bhabha interactions. Finally the synchrotron radiation losses are 50 MW per beam. Further optimization of the design is possible.

LEP3 could be installed in the LHC tunnel, serving the two LHC general-purpose detectors ATLAS and CMS, and possibly up to two dedicated ILC-type detectors. Alternatively, it could be installed in a new, longer tunnel; using a tunnel circumference of 80km, a machine operating up to the ttbar threshold can be conceived.

This preliminary study has identified no show-stoppers for the concept of the design. A number of basic questions about LEP3 are discussed and we have tried to identify the areas where R will be needed.

We consider the concept to be highly interesting and deserving of a detailed study.

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Implications of LHC results for TeV-scale physics: new physics with missing energy signatures

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This Report documents the current status of searches for transverse missing energy signatures at the LHC, their implications for SUSY models and phenomenology, and the prospects and challenges for the future searches

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Opportunities for Collaboration in the FNAL Charged Lepton Flavor Violation Program

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The first round of discoveries at the LHC has only increased the importance of searches for charged lepton flavor violation (cLFV). Fermilab's Mu2e experiment, its upgrade path, and the multiple-experiment capabilities of Project X offer unique opportunities to build a program searching for cLFV or performing measurements should it be found. The technology required will be useful in future facilities for neutrino factories or muon colliders. The first round of these experiments will start data-taking toward the end of this decade and almost immediately improve existing limits by several orders-of-magnitude. There is already significant European commitment through INFN and we welcome further participation.

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Physics at a High-Luminosity LHC with ATLAS

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The physics accessible at the high-luminosity phase of the LHC extends well beyond
that of the earlier LHC programme. Selected physics goals, spanning from Higgs boson
physics to new particle searches and rare top decays, are presented in this document. They illustrate the substantially enhanced physics reach with an increased integrated luminosity of 3000 fb-1, and motivate the planned upgrades of the LHC machine and ATLAS detector.

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Future of the ATLAS heavy ion program

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The primary goal of the heavy ion program at the LHC is to study the properties of deconfined strongly interacting matter, often referred to as “quark gluon plasma” (QGP), created in ultra-relativistic nuclear collisions. That matter is found to be strongly coupled with a viscosity-to-entropy ratio near a conjectured quantum lower bound. ATLAS has undertaken a rich programme of studies using jets, Upsilons, global event properties and measurements in proton-nucleus collisions. This programme will measure fundamental transport properties of the QGP, probe the nature of the interactions between constituents of the QGP, elucidate the origin of the strong coupling, and provide insight on the initial state of nuclear collisions. The currently planned heavy ion programme through the third long shutdown should provide 1 nb-1 of sqrt(s_NN) = 5.5 TeV Pb+Pb data. That data will provide more than an order of magnitude increase in statistics over currently available data for high-pT observables such as photon-jet and Z-jet pairs. Potentially sensitive high-pT final states will remain statistically challenged and would benefit from higher-luminosity data taking.

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Trends and perspectives for detectors in Fundamental Physics

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This overview document addresses the challenges for novel technologies for the future projects, stresses the detectors potentiality and limitation.

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CMS Submission to the European Strategy Preparatory Group

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Attached are six documents: cover letters from ATLAS+CMS on the energy frontier submission, cover letter from CMS on the Heavy-Ion programme submission, and four individual contributions on Heavy Flavours, Energy Frontier, Heavy Ions, and QCD.

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SAPPHiRE: a Small gamma gamma Higgs Factory

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A new particle with mass ~ 125 GeV that resembles the Higgs boson has recently been discovered by ATLAS and CMS. We propose a low-energy gamma gamma collider as a cost- and time-efficient option for a Higgs factory capable of studying this particle in detail. In the past, this option has been suggested as a possible application of the CLIC two-beam accelerator technology (the CLIC Higgs Experiment, CLICHE) or as an option for the ILC. Here we propose a design based on a pair of ~ 10 GeV recirculating Linacs (Small Accelerator for Photon-Photon Higgs production using Recirculating Electrons, SAPPHiRE) similar in design to those proposed for the LHeC. We present parameters for the e- beams and sketch a laser backscattering system capable of producing a gamma gamma peak luminosity of 0.36 X 10^{34}/cm2/s with ECM(gamma gamma) ~ 125 GeV. A gamma gamma collider with such a luminosity could be used to measure accurately the mass, bbar b, WW*, and gamma gamma decays of the Higgs boson. We also comment on possible synergies with other projects
such as LHeC, the ILC or CLIC, and on other physics prospects in gamma gamma and e- gamma collisions.

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A “Higgs” Factory at the Greek-Turkish Border

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We would like to propose, the construction of the photon collider based "Higgs factory" in the coming years at the Greek-Turkish border.

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A Large Hadron Electron Collider at CERN

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This document provides a brief overview on the recently published report on the design of the Large Hadron Electron Collider (LHeC), which comprises its physics programme, accelerator physics, technology and main detector concepts. The LHeC exploits and develops challenging, though principally existing, accelerator and detector technologies. This summary is complemented by brief illustrations of some of the highlights of the physics programme, which relies on a vastly extended kinematic range, luminosity and unprecedented precision in deep inelastic scattering. Illustrations are provided regarding high precision QCD, new physics (Higgs, SUSY) and electron-ion physics. The LHeC is designed to run synchronously with the LHC in the twenties and to achieve an integrated luminosity of O(100)fb^−1. It will become the cleanest high resolution microscope of mankind and will substantially extend as well as complement the investigation of the physics of the TeV energy scale, which has been enabled by the LHC.

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ORKA: Measurement of the Rare Kaon Decay K+->pi+ nu nubar at Fermilab

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Brief discussion of the newly proposed ORKA rare kaon decay experiment at Fermilab.

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Opportunities for Collaboration at Fermilab: The MicroBooNE Experiment

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Please see attached file.

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The Long Baseline Neutrino Experiment

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The Long-Baseline Neutrino Experiment (LBNE) collaboration plans a comprehensive experiment that will fully characterize neutrino oscillation phenomenology using a high intensity 1300 km baseline accelerator neutrino beam and an advanced liquid argon TPC as the far detector. The goals for this program are well recognized to be the determination of leptonic CP violation, the neutrino mass hierarchy, and underground physics, including the exploration of proton decay and supernova neutrinos. The collaboration and the project are well organized and the U.S. Department of Energy has stated their intention to carry out this program in a phased manner. The scope of the initial phase focuses on accelerator neutrino physics and does not include deep underground placement of the far detector or the full near detector. The incremental cost of moving the phase 1 detector underground or of building a full-capability near detector complex are relatively modest: the cost of each of these is only about 15% of the LBNE phase 1 cost of ~US$800M. LBNE represents a substantial investment from the US in a frontier facility for high energy physics. Thus, there is significant opportunity for new collaborators to leverage this major investment and add substantial scientific scope. Collaboration on the design and construction of the far detector, near detector, or neutrino beam could provide sufficient additional resources to allow us, together, to place the far detector underground in the first phase, and include a sophisticated near detector which would not only improve the accuracy of the long-baseline oscillation measurements, but have rich physics program in its own right. In this paper we describe the complete project as well as the phasing strategy.

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Opportunities for Collaboration in the Design and Development of the Project-X Accelerator Complex and Research Program

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High Luminosity Large Hadron Collider

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The Large Hadron Collider (LHC) is the largest scientific instrument ever built. It has been exploring the new energy frontier since 2009, gathering a global user community of 7,000 scientists. It will remain the most powerful accelerator in the world for at least two decades, and its full exploitation is the highest priority in the European Strategy for Particle Physics, adopted by the CERN Council and integrated into the ESFRI Roadmap. To extend its discovery potential, the LHC will need a major upgrade around 2020 to increase its luminosity (rate of collisions) by a factor of 10 beyond its design value. As a highly complex and optimized machine, such an upgrade of the LHC must be carefully studied and requires about 10 years to implement. The novel machine configuration, called High Luminosity LHC (HL-LHC), will rely on a number of key innovative technologies, representing exceptional technological challenges, such as cutting-edge 13 tesla superconducting magnets, very compact and ultra-precise superconducting cavities for beam rotation, new technology for beam collimation and 300-metre-long high-power superconducting links with zero energy dissipation.

HL-LHC federates efforts and R of a large community towards the ambitious HL-LHC objectives and contributes establishing the European Research Area (ERA) as a focal point of global research cooperation and a leader in frontier knowledge and technologies. However, it relies on a strong participation from outside the (ERA), in particular leading US and Japanese laboratories, which will facilitate the implementation of the construction phase as a global project. The proposed governance model is tailored accordingly and may pave the way for the organization of other global research infrastructures.

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LIU Project at CERN

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PLANS FOR THE UPGRADE OF THE LHC INJECTOR COMPLEX
The LHC injector complex is composed of 6 accelerators (Linac2, PSB, PS and SPS for protons, plus Linac3 and LEIR for other ions) which were initially commissioned with beam many years ago (up to 53 years in the case of the PS). Thanks to successive waves of upgrade and consolidation, these accelerators operate today with a high reliability and progressed in performance up to being capable to supply beam to the LHC with characteristics exceeding the nominal design goal. Moreover, many other experimental facilities benefit from beam pulses not used by the LHC, over all the energy range covered by the different synchrotrons (ISOLDE and REX-ISOLDE for the PSB, AD and East Hall for the PS, North Hall and CNGS for the SPS).
Extensive consolidation is necessary to continue to supply reliably the present beams to all users, including the LHC. However, users expect beam characteristics to further progress (e.g for LHC and for neutrino physics), and hence, consolidation is not sufficient and upgrade is mandatory. In 2010, after detailed study, the CERN management took the decision to base the future of the LHC injector complex on the replacement of Linac2 by Linac4, and on an ambitious consolidation and upgrade programme of all the other accelerators. The LHC Injectors Upgrade (LIU) project has been created to coordinate this effort.
The goal of the LIU project is to provide the beam required for the High Luminosity operation of the LHC. The main components of the LIU work programme for protons are the completion of Linac4, the modification of the PSB for H- injection at 160 MeV and acceleration up to 2 GeV, the modification of the PSB to PS beam transfer equipment for 2 GeV, and, in the PS and SPS the modification and additions required for preserving beam stability in all planes with more than twice the intensity in the same emittances (e.g. installation of new feedbacks, impedance reduction campaign, RF power upgrade, cure of electron cloud generation). The actions required in the injector complex for the High Luminosity operation of the LHC with other ions are under investigation.
The other users will directly benefit from the LIU project, thanks to the increased reliability and the improved beam characteristics.
The implementation of consolidation and upgrades can only take place during shutdowns and it is therefore tightly linked to the LHC planning. The LIU project is presently planned to complete after the second long LHC shutdown (LS2, starting at end 2017), and most probably during awinter shutdown preceding LS3. The total material cost, in addition to the cost of Linac4 (91 MCHF) is estimated approximately at 180 MCHF (80 % consolidation, 20 % pure upgrade).

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High Energy LHC

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LHeC - Preparations for a Future Proton-Lepton Collider in the TeV CM Regime

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This document briefly describes some key items for development over the years 2012-15 in preparation of a decision for the building of the Large Hadron electron Collider facility, the LHeC, at CERN, which complements the LHC physics programme with an additional 60 GeV energy electron beam.

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LEP3 – Higgs factory in the LHC tunnel

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CERN Accelerator Infrastructure for Neutrino Physics

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The CERN's potential for future Neutrino Physics based on accelerator-generated neutrinos is described. CERN is presently operating the CNGS neutrino beam, which will soon successfully complete its approved program. The design and operation of this second generation conventional neutrino beam facility provides important expertise towards the realization of future projects. CERN is also participating in various EU funded design studies
for future neutrino facilities, done in collaboration with several European Labs and international efforts gathering experts from worldwide.

CNGS uses the proton beam from SPS, which already today offers sufficient beam power at the sub-MW range to create competitive neutrino beams for neutrino oscillation physics, with further improvement possible in the future, as a side product of the foreseen injector upgrade for LHC (LIU project). The conventional neutrino beam technology of CNGS could be further optimized to produce lower energy neutrino beams, as presently favored by the recent measurements of the neutrino mixing parameters (è13). This technology can be exploited with the creation of a neutrino facility with a short baseline conventional neutrino beam in support of physics measurements and neutrino detector R, or as a first stage for a third-generation long (2300 km)-baseline conventional neutrino beam to a far site located in Europe. Such a program could provide unique physics opportunities, complementary to other programs world-wide. In a second stage, this facility, depending on the physics landscape at that time, could be upgraded to reach additional physics goals like precision measurements in the neutrino/lepton sector, using either an upgraded high-power (2 MW) proton driver or a lowenergy neutrino factory to the same long-baseline beam, or alternatively, to a near (130 km)- baseline site using a high-power (4 MW) super-beam or/and beta-beam.

CERN has a long tradition in developing neutrino beams. The available expertise and ongoing R for a high-power proton Linac (SPL), targetry (including for radioactive ion beams), horns, and superconducting magnets, combined with the existing infrastructure and know-how on building large accelerator projects, are significant assets that can be of benefit and at the
same time important ingredients in future neutrino programs. The CERN laboratory participates in the design studies and has developed a close collaboration network with colleagues world-wide working on neutrino beams, which can be further expanded and continue on mutually interesting targeted R topics or collaborations.

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Physics and Technology for the Next Generation of Radioactive Ion Beam Facilities: EURISOL

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R related to the High Power Superconducting Proton Linac (HP-SPL)

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Following the decision of the CERN management in 2010 to base the future of the LHC injector complex on the replacement of Linac2 by Linac4 and on the upgrade of all the other accelerators, the R for a Superconducting Proton Linac (SPL) was oriented towards high power applications. Until the end of 2014, this activity is aimed at the design, construction and test of a 4 cavity cryomodule, linked with the upgrade of the CERN infrastructure for superconducting RF to the present state-of-the-art standards. It takes place in collaboration with the European Spallation Source (ESS) project which will be built in Lund (Sweden). and it is supported by the French CEA and CNRS in the context of an in-kind contribution to CERN. After the year 2014, numerous subjects could be investigated [e.g. getting reproducibly the required gradient, reducing cost by investigating different fabrication techniques (Nb deposition on Cu), designing a full size 8 cavity cryomodule and/or investigating alternative high power RF sources]. The precise goals will have to be adapted to the results of the first phase of R and to the updated scientific strategy of CERN.

The SPL R can be directly used in future projects which require a high power proton driver, like neutrino or radioactive ion beam facilities. It could also be used in the renovation of LHC injectors, for example in the context of HE-LHC.
Beyond these possible applications, this R serves to update CERN competencies and infrastructure for superconducting RF (e.g. SM18 clean room, High Power RF, High Pressure Water Rinsing facility, Diagnostics for superconducting RF cavities, New e-beam welding machine, Electro-polishing installation, etc.). It is also of interest for a number of other options which depend upon the extensive use of superconducting RF systems to accelerate leptons, like LHeC and LEP-3. A prototype ERL could for example be assembled using the cryomodule(s) and RF system(s) built in the context of the SPL R & D.

This activity is presently supported every year with approximately 1.7 MCHF (CERN material budget) and 6 FTE. It benefits also from miscellaneous contributions (French in-kind, EU programmes like EUCARD and CRISP) and from the ESS-CERN collaboration. That amount of support is necessary for pursuing R at a level which preserves the core competence and capability on which a future construction project would rely.

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CERN Beam Test Facilities Infrastructure

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The CERN's infrastructure for beam test facilities is described.

CERN presently offers a number of test beam facilities for high-energy detector R and several fixed-target and neutron experiments attached to the operating accelerators of the complex. This includes the PS East Area, the nTOF facility, the SPS North Area, and low-energy anti-proton beam area in the AD, and ion beams in the ISOLDE facility.

In addition, CERN operates special facilities for irradiations like proton irradiation in the PS East Area, mixed-field irradiation facilities in the SPS North Area, and a dedicated accelerator R material test facility (HiRadMat) in SPS. In the near future an upgraded proton and mixed field irradiation facility in the PS East Area will become available, along with a Gamma (and possibly Neutron) Irradiation facility in the North Area.

The present status, characteristics and upgrade plans for these facilities are described. For the PS and SPS test areas, beams of protons but also heavy (Pb82+) or in the near future light ions(Ar, Xe) can become available.

Finally, CERN is presently investigating the possibility to provide light ion beams from the LEIR machine to a test area for medical applications.

The particle beams and test facilities at CERN are unique world-wide. Each year a large number of experiments and teams from a very wide community, including HEP, nuclear physics, radiation detection and monitoring, astro-particle detectors, medical physics and material scientists, visit CERN to conduct their experiments and profit from the available infrastructure.

Facilities at CERN are open and free of charge to the users that come from the Member States but also from any Physics Lab world-wide.

Operation and user support to these facilities is a non-negligible load for CERN, but is also part of the Lab's mission and self-feeding mechanism, as it is at the test facilities where the future of accelerators and HEP begins!

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Applications of Accelerators

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LHC heavy ion programme

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Pre-Feasability Assessment for an 80 km Tunnel Project at CERN

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This report presents the initial findings of a pre-feasibility study advising on the construction of a new 80km tunnel project in the CERN region. The feasibility assessment if focussed on geological, environmental and construction considerations. Three potential tunnel layouts are presented and compared to identify the most feasible option. A more detailed report from two specialist firms (GADZ and ARUP) is expected by the end of July 2012.

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National Research Centre 'Kurchatov Institute' input to the European Particle Physics Strategy Update

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Geant4 Near and Medium Term Strategy

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The Geant4 simulation toolkit is now in the 14th year of its production phase. Geant4 is the choice of most current and near future HEP experiments as their simulation engine.
Geant4 is a still evolving code under continuous development and it keeps aiming at improving physics quality and computational speed and at enriching its functionalities. But Geant4, designed on the computing paradigm of the 90', has to face the major challenge of the evolution and adaptation to the new hardware technologies while still maintaining its usability to the wide user community. The Geant4 Collaboration has identified several options and
possibilities. It has accommodated some of these by providing a multi-threading version based on event-level parallelism. This version, distributed as a prototype today, will become the main distributed product from the next major release, in 2013. In this article we discuss the Geant4 Collaboration development strategy for the coming years.

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Proton Driven Plasma Wakefield Acceleration (AWAKE) Experiment

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The construction of ever larger and costlier accelerator facilities will eventually require new technologies to push the energy frontier. Plasma Wakefield acceleration (PWA) is a rapidly developing field which appears to be a promising candidate technology for future high-energy accelerators. Proton Driven PWA has been proposed as an approach to accelerate an electron beam to the TeV energy regime in a single plasma structure. The advantage of proton- over laser- or electron-driven PWA is the high stored energy available in the driver; both for the bunch as a whole and for the individual drive particles. Existing proton bunches carry many kJ of stored energy while high power lasers are presently approaching the 1-5 J regime. Proton bunches are therefore promising drivers for high-energy lepton accelerators, with the potential of reducing drastically the number of required driver stages.

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Executive Summary of the German Roadmap on Astroparticle Physics

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This document is an executive summary of the German Roadmap on Astroparticle Physics from 2010. It has been revisited with respect to the actual status of the field. We focus on those questions which are of relevance to particle physics rather than to astrophysics. The document is submitted by the Komitee für Astroteilchenphysik (KAT, Committee for Astroparticle Physics) which is the elected representation of all German astroparticle physicists at Universities, Helmholtz Centers and Max-Planck Institutes (about 600 FTE). Our description and recommendations are in accordance with the ASPERA Roadmap for Astroparticle Physics and the ASPERA Input to the European Strategy Process; at the same time we highlight the German priorities.

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Geant4 Near and Medium Term Strategy

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The Geant4 simulation toolkit is now in the 14th year of its production phase. It is the simulation engine choice of most current and near future HEP experiments. Geant4 is still evolving with continuous developments aiming at improving its physics quality and
computational speed and at enriching its functionalities. But Geant4 was designed within the computing paradigm of the 90s' and must face the major challenge of the evolution and adaptation to the new hardware technologies while still maintaining its usability to the wide
user community. The Geant4 Collaboration has identified several options and possibilities. It has accommodated some of these by providing a multi-threading version based on event-level parallelism. This version, distributed as a prototype today, will become the main distributed
product from the next major release, in 2013. In this contribution we discuss the Geant4 Collaboration development strategy for the coming years.

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Prospective Studies for LEP3 with the CMS Detector

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On July 4, 2012, the discovery of a new boson, with mass around 125\,GeV/c2 and with properties compatible with those of a standard-model Higgs boson, was announced at CERN. In this context, a high-luminosity electron-positron collider ring, operating in the LHC tunnel at a centre-of-mass energy of 240 GeV and called LEP3, becomes an attractive opportunity both from financial and scientific point of views. The performance and the suitability of the CMS detector are evaluated, with emphasis on an accurate measurement of the Higgs boson properties. The precision expected for the Higgs boson couplings is found to be substantially better than that predicted by Linear Collider studies.

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Swiss contribution to the Update of the European Strategy for Particle Physics (Part 2)

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The document adds a more focused strategic part to the July 2012 input of CHIPP, emphasizing future activities that are expected to represent a major priority of the Swiss particle physics community.

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LEP3 and TLEP: High luminosity e+e- circular colliders for precise Higgs and other measurements

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An update and summary of submissions to the Open session of the European Strategy Preparatory Group

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Physics at a High-Luminosity LHC with ATLAS (Update)

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The physics accessible at the high-luminosity phase of the LHC extends well beyond that of the earlier LHC programme. Selected physics goals, spanning from Higgs boson physics and vector boson scattering to new particle searches and rare top decays, have been presented in a note submitted to the open symposium in Cracow. This note updates the studies on Higgs-boson properties and vector boson scattering. They illustrate the substantially enhanced physics reach with an increased integrated luminosity of 3000 fb-1, and motivate the planned upgrades of the LHC machine and ATLAS detector.

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On the Relation of the LHeC and the LHC

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The present note relies on the recently published conceptual design report of the LHeC and extends the first contribution to the European strategy debate in emphasizing the role of the LHeC to complement and complete the high luminosity LHC programme. The brief discussion therefore focusses on the importance of high precision PDF and α_s determinations for the physics beyond the Standard Model (GUTs, SUSY, Higgs). Emphasis is also given to the importance of high parton density phenomena in nuclei and their relevance to the heavy ion physics programme at the LHC.

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Higgs cross sections in pp collisions at very high energy

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We present in this contribution the extrapolation to very high energies of the theoretical cross sections, in proton-proton collisions, for the production of a 125 GeV Standard Model Higgs boson. The results are obtained using the same tools and framework defined in the two reports3 of the LHC Higgs Cross Sections Working Group.

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CMS at the High-Energy Frontier

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