Scientific report

LABEX
ENIGMASS

Le rapport d'étape doit être rédigé en anglais (une version française pourra être jointe).

Il ne doit pas excéder 22 pages.

1. Progress of the project

1.1 Gouvernance

The Labex ENIGMASS has been officially launched in March 2012. The governance structure foreseen by the project is in place from the very beginning. The Université Grenoble Alpes is the legal entity supervising the project, however the CNRS and in particular its DR11 delegation at Grenoble manage all financial matters. The governance structure in place and running is the following:

- The steering board composed by the partners' representatives, meets once per year and approves the scientific program, the financial investments, and the overall operation.
- The scientific council composed by six internationally recognized scientists meets once per year and advise the management board on the scientific priorities.
- The management board, is composed by the project coordinator, the deputy project coordinator and the (4) laboratory directors participating to the project. It handles the day-to-day operation, and the overall follow up, defines the strategy and priorities. It meets once per month or more if needed. The decisions are taken until now by consensus.
- The activities of ENIGMASS are categorized in work packages managed by coordinators. There are in charge to drive the top actions, physics programs, education, dissemination of the results, and transfer to industry. The coordinators are included in the extended management board to discuss the global strategy and actions. Such meetings take place at least 6 times a year.

Once per year a general meeting open to all participants, is organized over one day, to review all current projects and discuss all matters related to the Labex. The big majority of the allocated resources within the Labex, concerns PhD. students, post docs and visiting scientists. Internal calls are organized every year to fill these positions, with the help of ad-hoc committees composed by external members, including people from the scientific council when possible.

The rather small number of participating laboratories, as long as a very well-focused scientific program, added to a very effective governance, have allowed the Labex to run very smoothly until today without particular problems. Its impact on the activity growth of the participating laboratories is very visible. The following figure shows the status of our budget at end of March 2015, which is a good indicator of our progress.

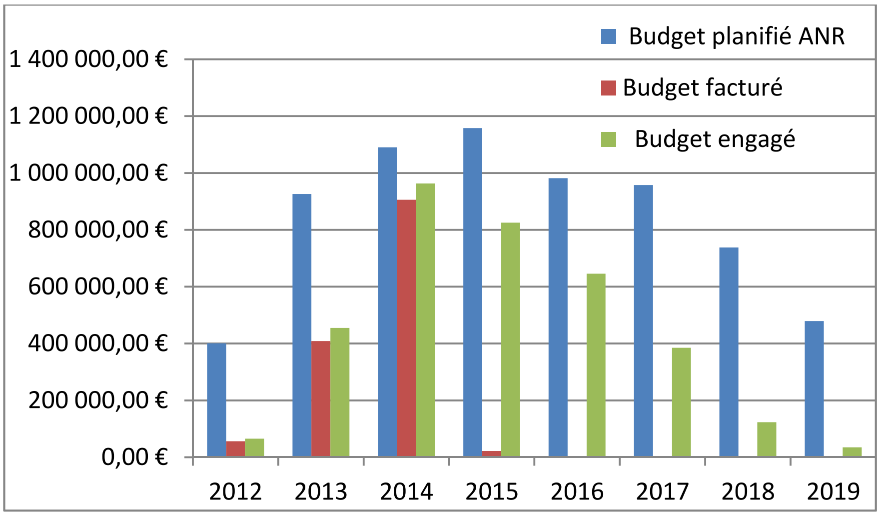

Figure 1- Labex ongoing budget

1.2 Research

The research program is organized internally in three work packages. We are focusing on three main priorities: a) the study of Higgs properties and the search for new physics beyond the standard model,

b) neutrino physics aiming to build a solid group to face the future, namely the mass hierarchy, nature and CP violation, and finally c) the dark matter problem. In parallel we are also supporting the search for gravitational waves and the development of theoretical aspects.

Higgs Properties and search for new physics

The search for the Higgs particle and for new physics through direct production or through their indirect effects in flavour physics are the cornerstone of the physics at colliders working group.

The Higgs discovery, the highlight of the first Run of the LHC in July 2012, was achieved earlier than expected. Yet many open questions remain: is the new particle the Higgs of the standard model, are there more scalars, are all measurements in agreement with the standard model expectations or hint for what lies beyond. All these questions have started to be addressed using the data available in the first Run of the LHC and will be pursued with the data of Run 2 that is starting now.

The Labex ENIGMASS has significantly contributed to this activity both through direct contributions to the hiring of students and postdocs as well as through an active visitor program and workshop organisation. All of these helped to build the links and develop common interests between the LPSC, LAPP and LAPTh teams, notably on Higgs and new physics searches.

Neutrino physics:

Neutrino physics is a very active research field with several experimental challenges ahead to be able to answer remaining fundamental questions about the neutrino nature and its properties. This research field was one of the major components of the Labex scientific project. The objectives were **to strengthen the neutrino activity existing in the different laboratories** and **to create a neutrino pole by gathering physicists of our laboratories and expert visitors around the many facets of the neutrino.** These two goals have been addressed and are in the process of being successfully covered.

Indeed, the ENIGMASS Labex allowed developing a richer neutrino physics program covering key subjects with scientific output guaranteed in a medium term thanks to the hiring of two postdocs and the invitation of a visiting professor for 1 year. The neutrino program is based on the development of the experimental activity involving teams from the different laboratories of the Labex and along three main research paths for the coming years:

- Sterile neutrinos and anomalies (STEREO detector)
- Double beta decay search (SuperNemo demonstrator)
- Neutrino oscillations: future underground projects for neutrino oscillations and astrophysics (OPERA and LBNO WA105).

This program is very close to the original one which was foreseeing two main axes: Nature and neutrino mass with the SuperNemo, double beta decay experiment at LSM and neutrino oscillations, CP violation with the future underground projects (OPERA and LBNO WA105) for neutrino oscillations and astrophysics. In addition, we have extended the scope of the neutrino physics program by including a project gathering experimental teams from two laboratories of the Labex (LAPP and LPSC) to develop a detector (STEREO) to search for sterile neutrino at the Grenoble ILL research reactor. This project is essentially funded by ANR and supported by the Labex. The proposal has been submitted end of 2012 and accepted in 2013.
This last project has evolved to take into account the choices of the international community which is converging after several design studies towards the realisation of a large detector with a technology

based on liquid argon TPC rather than water Cerenkov for very long baseline neutrino beam. We have then organised a preliminary participation to an R&D named WA105 on this different technology to continue to cover this axis and to prepare the future of the ENIGMASS neutrino pole.

The scientific goals for the coming years are to pursue the present activities in order to complete the different experiments: STEREO project by installing the detector, do the commissioning and take data such that the analysis results can start to come in about 2 years from now in 2017.

The same is for the SuperNEMO demonstrator which should be installed and commissioned by 2016 at the LSM. The physics run is expected to take 2.5 years.

For the underground detector R&D, the goal is to build and test a large Liquid Argon TPC to validate by 2019 the choice of technology for the future long baseline neutrino far detector.
The results of the different projects will be essential to define the optimal strategy for the future of the neutrino sector especially for the double beta decay search and the long baseline research project in line with the national and international roadmaps.

Dark matter

The dark matter problem is one of the most challenging issues today. Many measurements and observations give an indirect proof of its existence, however until today there is no direct observation and the questions to tackle are fundamental and numerous: how much, where, what. The Labex has significantly contributed to visible progress in various ways to try to give answers. The astroparticle experiments PLANCK, NIKA, AMS, HESS and also ATLAS on LHC are all looking for dark matter and probably the final answer will need the combination of many results.

The first phase of our scientific program had foreseen a support to the above experiments to maximise the impact of our groups. This was a success as students and post docs have produced top quality papers. In the second phase we have foreseen a multi-messenger analysis between the different observations. This is starting taking place now, and fruitful collaborations are developing between experimental groups and the theory groups or between experimental groups as the MOU which has been signed between VIRGO and NIKA thanks to the Labex.

1.3 Training

Education is one of the priorities of the ENIGMASS project, with 23% of the budget allocated to it. The goals are to strengthen the international visibility and attractivity of the Master in Astroparticles and Subatomic Physics of the Grenoble University, as well as that of the Labex laboratories among students, and to remedy a lack of a quality training in particle and astroparticle physics instrumentation. The following initiatives have been set up: the ESIPAP school in instrumentation for particle and astroparticle physics, the subatomic experimental platform at the University of Grenoble Alpes (UGA) and the particle and astroparticle physics summer school for undergraduates (GraSPA). There is also work ongoing on the creation of an Erasmus Mundus master program on particle and astroparticle physics.

The Labex will continue to provide a support to these successful initiatives up to the end of the Labex with the objective in particular to increase the number of students at ESIPAP school.

In 2014, as announced in our labex project, we created a new European School of Instrumentation in Particle and Astroparticle Physics: ESIPAP. As JUAS (the Joint University Accelerator School), ESIPAP is organized by ESI (European Scientific Institute) which is located in the Archamps Technopole next to Geneva, 20 minutes away from CERN. ESIPAP targets mainly an international audience of post-graduate students (MSc, PhD) and young professionals working in research institutes. The idea of the School stems from two facts: the need to attract and train young physicists to the very high level of instrumentation in use in the high-energy physics community, and on the observation that ESI, located next to CERN, with its 20 years experiences in running JUAS, is the ideal place to create such a school.

ESIPAP comprises two month-long independent modules which can be followed separately, or consecutively the same year:

- Physics of particle and astroparticle detectors (about 100 hours of lectures)
- Technologies and Applications (around 100 hours of lectures)

CERN organizes and hosts practical courses in the form of « lab sessions ».
Both modules are concluded by an evaluation which enables students to gain ECTS credits recognized by the European partner universities.

More than 40 lecturers teach in ESIPAP, half of them coming from CERN. The 2015 edition of ESIPAP welcomed 12 students (7 MSc, 4 Ph.D. & 1 post-doc) coming from 7 countries. We received more than 20 applications. Now that the school program and organization are set, we are aiming at doubling our number of attendees for 2016, in order to reach 32 students in three years, which is the highest number of students we can accommodate in the present model of lab sessions organization.

The annual budget of the school is 70 k€: half of it is provided by the ENIGMASS Labex while the Conseil Général de la Haute-Savoie and the Archamps Technopole contribute the other half.

Our present partners include Université Joseph Fourier, Grenoble Institute of Technology, Université Savoie-Mont Blanc, Université de Strasbourg and CERN. Contacts have been taken with more universities in Europe (Uppsala, Helsinki...) that have already started to send us students.

The subatomic experimental platform of the University of Grenoble Alpes aims to provide a common platform of nuclear physics-related lab experiments for a variety of university degrees ranging from particle physics to nuclear engineering and medical physics. This platform comprises standard radiation-matter interaction experiments as well as more specialized topics, such as Neutronics, medical applications, a muon lifetime measurement or a Pressurized Water Nuclear Reactor Simulator. The platform is a common project of two components of the UGA, the Université Joseph Fourier and Grenoble INP, and has received additional funding of the ENIGMASS Labex (25 k€). The latter contribution has improved the instrumentation and radiation-matter interaction experiments and has provided two new experiments to the platform (measurement of the orthopositronium lifetime in the vacuum, beta radioactivity). Support from ENIGMASS is foreseen throughout the duration of the ENIGMASS Labex.

Finally, the GraSPA Summer School aims to accomplish the important mission of training young students through research and close contact and interaction with researchers. At the same time, it addresses the problem of the dwindling numbers of students enrolled in physics degrees across most of Europe. This translates in a decrease in the number of students pursuing a research career in particle and

astroparticle physics topics. To try to inspire and encourage the young physicists to opt for such a career, we have organized a Summer School aimed at third and fourth year physics students: GraSPA. The goal is to give the students an introduction and a state-of-the-art preview to the main research topics in our fields. The School format is roughly the following: about 30 students are welcomed for a 1 week-long series of lectures, on a few selected topics (LHC physics, neutrinos, gravitational waves, astroparticle physics and cosmology, at about 3 to 4 hours per topic) and a hands-on computing session. Close contact with lecturers and researchers, who actively interact with the students during lunches and coffee breaks, is constant throughout the School, and is greatly appreciated by the students. Given the audience it addresses (undergraduates), the stay of the students is highly subsidized, with the accommodation and the lunches provided and paid by the School. As for the lecturers, we take advantage of our wealth of in-house expertise and we resort mainly to local lecturers (from three of the Labex laboratories), with a few notable exceptions invited from outside institutions (e.g. Karol Lang, MINOS co-spokesperson). Two editions of the School have been organized, in 2013 and 2014, whereas the 2015 edition has already been funded and will be announced shortly. The huge success of the School, both in number and quality of applications (in 2014, 137 candidates from 21 countries, mostly European), and in the satisfaction of the students as expressed in surveys, has prompted us to continue the program in 2015 and beyond. A happy by-product is the excellent international exposure the School gives to the Labex laboratories among the physics undergraduates that will be tomorrow's researchers. The International Doctorate network in Particle, Astroparticle physics and Cosmology (IDPASC), of which the LAPP and the University Savoie-Mont Blanc are members, has contributed to this visibility. The Labex is an essential partner of the GraSPA Summer School, contributing on average 45% of the total budget (a total of 5k€ on average each year).
The Labex will continue to provide a support to these successful initiatives up to the end of the Labex with the objective in particular to increase the number of students at ESIPAP school.

1.4 Result exploitation

Within our experimental teams we are developing the future detectors for our experiments. These developments in some cases have a large potential of transferring to industry. After an internal call we have identified two projects fulfilling this condition, and the Labex is supporting them by two engineers.

A fast neutron directional detector

The first project is a fast neutron directional detector based on the prototype of the MIMAC detector devoted to directional dark matter detection. This detector has been developed at the LPSC, coupling a pixelated micromegas with a fast self-triggered electronics specially designed for the MIMAC project. The work of a valorization engineer, hired by ENIGMASS , started in August 2014, allowed us to design a demonstrator with industrial requirements leading to the submission of a a pre-proposal to the DIRE program concerning the « pre-maturation » valorisation projects to assure the market studies and intellectual property protection.

The prototype of the MIMAC detector devoted to directional dark matter detection is in fact a new and original fast neutron directional detector. This detector has been developed at the LPSC, coupling a pixelated micromegas with a fast self-triggered electronics specially designed for the MIMAC project.
The work of Nadine Sauzet valorization engineer, started in August 2014, allowed us:

- To define a new mixed gas fully compatible with industrial requirements. We have defined the 4He + 5% CO_2 as the nominal gas to be used for valorisation purposes.
- To define a preliminary design of the demonstrator.

- To define a new vacuum system for the circulation mode, in the case that a long term measurement were needed.
- To define a calibration procedure.
- To develop a simulation setup for the valorisation purposes.
- To submit a pre-proposal to the DIRE program concerning the « pre-maturation » valorisation projects to assure the market studies and intellectual property protection.

Development of a high sensitive seismic sensor

The second project is the development of a high sensitive seismic sensor to measure nano vibrations at the future linear collider and following an innovative approach, a high sensitive vibration sensor has been developed at LAPP, followed by a declaration of invention to the CNRS in 2012, a French patent application (FR 13 59336) in 2013 and a PCT extension (in progress). An engineer hired by the Labex has successfully developed a demonstrator including mechanics and electronics developments, which could be suitable for industry. At this stage, the project was presented to the evaluation committee of the regional SATT (Société d'Accélération du Transfert de Technologie) named GATE1. The project was selected, but the next step, which aims to validate the project by the investment committee in order to allocate resources is postponed due to the restructuring of the SATT.

For the purpose of measuring nano vibrations at the future linear collider and following an innovative approach, a high sensitive vibration sensor has been developed at LAPP, followed by a declaration of invention to the CNRS in 2012, a French patent application (FR 13 59336) in 2013 and a PCT extension (in progress). The mechanics and the electronics developments have been continued by a young engineer hired by the Labex (B. Aimard) with two goals: increasing the performances and cost reduction. Various successive prototypes have been carried out in order to obtain a demonstrator which could be suitable for industry. At this stage, the project was presented to the evaluation committee of the regional SATT (Société d'Accélération du Transfert de Technologie) named GATE1. The project was selected, but the next step, which aims to validate the project by the investment committee in order to allocate resources is postponed due to the restructuring of the SATT.

In parallel, several actions of outreach were processed. First, the aim was to meet potential industrial partners from various fields in order to refine the possibilities of technical transfer. The sensor was presented to seismic sensors users (Techniovib, ISTerre), some mechatronics actors (CEDRAT Technologies) and potential investors (EFI Automative). These meetings allowed us to understand the potential applications, to better know the market actors and to initiate the first industrial contacts.

In addition, the communication and demonstration aspects have been reinforced. Beyond to communications within the community of particle accelerators (ex: CLIC, ATF2), the next step was to do an evaluation in experimental sites. So it has been tested in comparative measurements at CERN and is now integrated with both applications. First, a contract for the provision of metrology services with this new sensor was signed with the IRSN (Institut de Radioprotection et Sûreté Nucléaire) Cadarache in the context of two measurement campaigns. Then, this sensor will be installed this summer on the site of the Virgo interferometer in Italy. In both applications, the sensor is connected in parallel with commercial sensors to allow the evaluation of vibratory phenomena. The objective is to demonstrate the ability to be used like the best sensors on the market and increase its scientific reputation.

Finally, the sensor is the subject of a scientific publication and is regularly presented during internal events (mechatronics conference, school visits, science party…).

All these developments have been initiated, implemented and coordinated by the involvement of B. Aimard, research engineer in outreach and mechanics, hired by the Labex.

1.5 *Visibility, outreach, sharing and promoting actions of the Labex*

The strategy to promote the Labex follows two main axes:

- Promotion within the high energy physics community, by supporting the organization of national and international events, conferences, workshops, dedicated schools etc., within the scientific perimeter of our project. The budget allocated to this action is 70k€, and 39k€, is already engaged.
- Outreach actions, targeting a large public. The goal here is to explain our field of research to everyone, share with them our ideas, make them dream. The discovery of the Higgs boson in 2012 gave us a big opportunity to largely communicate and promote the Labex. A special care is given to attract young students to study physics and the researcher's careers.

The budget allocated to this action is 145k€, and 20k€, is already engaged. A call for 2-3 important projects is actually still running.

To enhance the impact of these two actions we have initiated a fruitful collaboration with other Labex programs, P2IO, OCEVU, LIO, and coordinated together the support of few nationwide events.

Here is a list of a few typical examples that better illustrate our outreach action:

- The Night of the two infinities (Nuit des Deux Infinis) is an annual event jointly organized with the Labex P2IO.It is held in full duplex using modern communication technologies. It usually attracts an attendance of 600-800 persons on both Grenoble and Orsay. The program focuses on forefront scientific advances, like in 2012 the discovery of the Higgs Boson, in 2013, the results of Planck and in 2014, CERN's 60th anniversary and the landing of Philae on Choury. Conferences made by first class scientists alternate with artists performances. At several occasions a virtual online visit of CERN (ATLAS control room and CMS detector) enabled the attendees to visit the place where the Higgs Boson was discovered, and to ask all types of questions to CERN guides.
- Educational projects with secondary schools at all levels : International Masterclasses (hands on particle physics) where high-school students are invited to our laboratories to perform measurement on real data, teaching projects where ENIGMASS members directly intervene in secondary school classes and high school conferences delivered on demand.
- General public conferences on many aspects directly linked to ENIGMASS' program: Higgs Boson discovery, cosmology, Planck results, astroparticle physics but also related to societal concerns like the energy challenge or the scientific puzzles of XXIst century. All in all, more than 20 general public conferences per year are given by ENIGMASS members in many cities.
- Writing of general public books: Des univers multiples, Big Bang et au-delà – Balade en cosmologie by Aurélien Barrau.
- Open Days at our laboratories during the national annual science festival (in October), where we welcomed hundreds of visitors of all ages.
- Science exhibitions: Carré des Sciences in Modane, a science museum dedicated to the puzzling questions of the Universe.
- Participation to the exhibition for all public for the CERN's 60th anniversary Palais de la Découverte à Paris.

- Invitation in several debates following the projection of the movie Particle Fever.

2 / Label and associated funding impact

A) Scientific achievement description

Higgs Properties and search for new physics

The Labex allowed to gather theorists and experimentalist's teams from LAPP, LPSC and LAPTH to enhance contributions to the data analysis, interpretation, theory developments and detector R&D. The reporting period coincide with an intense activity of the Higgs and New physics working group corresponding to the completion of Run1 at the LHC. Altogether the data accumulated at 7 and 8 TeV exceed an integrated luminosity of 25 fb-1. The highlight of this first run was in deniably the discovery of a new particle in July 2012, the Higgs boson. As important to the full understanding of the origin of mass were the measurements of Standard Model processes, for example in the electroweak and top sectors, the searches for new physics and the search for rare processes in B mesons. The Labex ENIGMASS experimental teams (ATLAS and LHCb) were involved in several aspects of detector development, data gathering and physics analyses and made significant contributions to all these topics while sharing expertise with the theoretical teams (LAPTh and LPSC).

The LAPP group has been deeply involved in the Higgs searches in the photon-photon final state in ATLAS, contributing significantly at different levels of both detector and physics analyses. An ENIGMASS member was project leader for the electromagnetic calorimeter until 2013 - the calorimeter ran with a very high efficiency (reaching 99.1% in 2012) - the whole team contributed to this achievement and took on responsibilities for different aspects of the data analysis process. The optimization in selection performance and in the reconstruction of electrons and photons for which the group contributed significantly (group coordinator) has allowed to reduce the systematic uncertainties to the few percent level. This had a direct impact on the precision measurements of processes with electron and photons in the final states – including the Higgs. This ground work combined with a solid expertise on statistical data analysis meant that the group made a significant contribution to the discovery of the Higgs boson in the two-photon final state.
This major discovery was however just a beginning and raised many question: is the new particle the Higgs boson predicted by the standard model? Does it point towards some new physics? What are the implication for new physics models … All these questions were addressed by our working group. At the experimental level an ENIGMASS student is involved in the measurement of the properties of the new Higgs particle (mass and couplings). In parallel the theorists in our laboratories work actively on the implications of the LHC results for the Higgs. This involve making global fits to all Higgs couplings, interpreting these in the framework of new physics scenarios, examining the possibility that the Higgs be composite, suggesting how to determine the CP properties of the Higgs. All of these will be explored further with the increased precision available at the 13TeV run starting this year. Moreover cross section measurements in 2photons plus jets were performed, this channel could be both a signature for new physics and a QCD background for the Higgs self-coupling measurement, a long term objective of our group as it will provide a crucial test of the Higgs potential.

During the first run of the LHC many measurements of standard model processes and searches for new particles were also performed. Taking advantage of their expertise on electrons, the LAPP group realized the first measurement with a precision better than one percent ever performed at the LHC (phi* in inclusive Z production). Moreover the team is leading the effort in the precision measurement of WZ in

Run-1 and will continue this work for Run-2 with the strong involvement of an ENIGMASS postdoc. R. Schwienhorst and C. Gabaldon (respectively ENIGMASS visitor and postdoc at LPSC) are working on a measurement of the single top quark production in association with a W boson - a rare electroweak process. They have processed all of the ATLAS data and simulation samples to compute the expected and observed event yields for data signal and background. They have then implemented a multivariate approach and advanced statistical tools to measure the cross section. The results are documented in an internal ATLAS note, currently under review.

Numerous searches for new physics were done by the LHC collaboration in a variety of channels. While no signal was observed, limits are provided either within specific new physics models or using a simplified model approach. The LPSC and LAPTh teams are developing tools that allow the reinterpretation of these limits within the context of different new physics models, including dark matter motivated models. This effort require numerous exchanges between theorists and experimentalists and has led to the first release of a public analysis database. Moreover an ENIGMASS student has realized a tool for automatic higher order QCD corrections in models with new vector-like quarks.

The ATLAS groups of ENIGMASS are also deeply involved in instrumentation and are preparing for the LHC upgrades. This includes the development of the Pixel detector and the upgrade of the liquid argon calorimeter. First the group got involved in the support and cooling structure for the new layer of Pixel (IBL) installed in ATLAS in 2014. In parallel an innovative geometry ('Echelle Alpine') in the positioning of Pixel sensors was proposed to the ATLAS collaboration for the high luminosity future upgrade of the LHC. The contribution of an ENIGMASS post-dc (A. Rummler) was crucial in acquiring new expertise on the Pixel sensors that should be installed in the first prototypes. C. Gabaldon, made a major contribution to the upgrade of the ATLAS liquid argon calorimeter for 2019-2023 data taking. The ATLAS group at LPSC is involved since 2011 in the development of an analogue to digital converter of high performance, to be used in the future front-end electronics for triggering and data taking. Thanks to a precise knowledge of the ATLAS calorimeter and of the requirements for physics analysis, C. Gabaldon was an invaluable mediator for the LPSC micro-electricians, by her ability to connect the circuit specifications to the performance of the future detector. In addition, she contributed to the measurement of the performance of the various prototypes.

Finally the search for new physics through their indirect effect in B meson decays is also one important activity of our teams. Within ENIGMASS, the LHCb group is studying the B meson radiative decays used for probing new physics via the measurement of the photon polarisation in the $b\to s\gamma$ transition. An ENIGMASS student, L. Beaucourt is studying $B\to V\gamma$ decays ($V=K^*$ or ϕ) and uses photons which convert inside the detector material as the LAPP group has the expertise in converted photons reconstruction. First the branching ratio and CP asymmetries of these decays will be measured, then more radiative decays will be studied and the photon polarization measured. Encouraged by the recent LHCb result on $B\to Kl^+l^-$ ($l=e,\mu$), the LAPP-LAPTh collaboration recently started on the search for lepton flavor violation with B mesons rare decays such as $B\to Ke\mu$.

Neutrino physics:

SuperNEMO project

The activities of the neutrino Work Package focussed on two main experimental projects: the SuperNEMO demonstrator and the STEREO experiment involving teams from LAPP, LPSC and LSM.

The participation to the SuperNEMO neutrinoless double beta decay demonstrator which should be installed next year in the Modane underground laboratory (LSM) started beginning of 2013. The ENIGMASS teams from LAPP and LSM are completing now the R&D to produce the central double beta decay selenium source. The group is also developing the slow control system of the experiment. The hiring of an ENIGMASS postdoc at LAPP on this project in March 2013 was decisive to setup a research activity in collaboration with LSM and to bring the project to a well advanced state. It is now recognised as one of the reference team in the SuperNEMO international collaboration from what concerns the Selenium source group. The coordinator of this working group has also been invited for one year by the Labex to work at LAPP from July 2014. This has also strengthened the international collaboration already started in 2013.

Development of the double beta source foils for SuperNEMO

LAPP is in charge for the production of half of the double beta decay source for the Demonstrator. The source system is composed of 37 strips 3 m long, 13 cm wide and 200 microns thick. These strips or foils are made with Selenium powder mixed with poly vinyl alcohol to form a mixture allowing long strips to be realised. Those strips need some supporting structure which can be outside layers of Mylar films or an internal light supporting structure.

A new design has been proposed and developed at LAPP which uses light nylon fabric (tulle) as internal foil support. This promising approach was tested in 2013 and the foil production protocol was defined. All the tools have been built and are ready. It includes a long rigid and mechanically precise table to produce the long strips. The challenge when building elements of this SuperNEMO particle detector is to use materials with negligible natural radioactivity in order to reach the expected sensitivity for the rare neutrinoless beta decay search. According to their properties, all materials to be used in foil production have been defined and radio-purity measurements have been performed all along 2014 in collaboration with LSM, LAL and the underground Canfranc laboratory LSC in Spain. The LAPP group is also performing the simulations related to the possible source design in order to optimize them and to calculate the final sensitivity of the detector.

In the meantime the LSM is investigating the method to purify the Selenium powder which should be radio pure as much as possible before being used in the foil source fabrication. For this activity the group is working closely with Russian collaborators experts in SuperNEMO in this domain.
In parallel to the realisation of Selenium strips an important effort has been done to perform the detector sensitivity study comparing different possible design of the source foil. For this, results from recent radio-purity measurements have been taken into account. The study shows that LAPP proposal provides compatible performance with alternative design. It represents the most recent sensitivity study available in the SuperNEMO collaboration. Other relevant contribution on simulations and reconstruction chain are underway with a new PhD student who started in October 2014.

All these activities on the source and the analysis have been possible thanks to the Enigmass Labex support.

Development of the detector 'Slow control' for SuperNEMO

Another activity initiated within the Labex framework on this project is the system which will allow the control and monitoring of the environmental parameters, the detector subsystems, and the data acquisition from local or remote sites.

To fulfil these requirements a system able to be interfaced and to operate heterogeneous devices based on the industrial OPCUA computer framework is being developed.

After collecting the information to fill the interface Control Document (ICD) of the different sub-systems and defining the control and command use cases in 2014 a first mock up using the SuperNEMO coil power supply is setup this year to test the full software chain for remote control and monitoring and to validate the selected architecture and the technical choices.
The goal is to be able to install and commission the systems at LSM by 2016 and start running the detector and perform data analysis.

STEREO project

The second project which emerged within the Labex neutrino pole concerns the search for sterile neutrinos at the ILL research reactor in Grenoble. The teams from LPSC and LAPP have started the design studies of the STEREO detector early 2013. The Labex partners are in charge of the shielding support structure, the calibration systems, electronics, DAQ and monitoring and the cosmic veto counter. Prototyping of various parts are under progress in both laboratories. The hiring of an ENIGMASS postdoc in November 2014 at LPSC will allow to bring the necessary manpower to develop the data acquisition and the muon veto systems. It also reinforces the activity around neutron background measurement and the preparation of the analysis together with LAPP.

The calibration system illustrates perfectly the synergy created by the Labex, with the two laboratories working closely in two different but related parts of the calibration process. The LAPP has conceived a system allowing the positioning of radioactive sources in and around the detector, the goal being to set the absolute energy scale and to study the uniformity of the detector response. The light injection system, which the LPSC is in charge of, completes the calibration by allowing the study of the gain and response of the individuals PMTs. Prototypes of the radioactive source transport and light injection systems are currently being tested at LAPP and LPSC, respectively.

One of the challenges of the STEREO project is the suppression and precise modelling of the (remaining) gamma and neutron backgrounds produced by the close proximity to the nuclear reactor. Both the LPSC and the LAPP have taken part in measurement campaigns and in the understanding of the results through simulation, with the Enigmass postdoc at LPSC playing an active role here.

Cosmic rays crossing the detector constitute the other important background, a problem addressed by the muon veto, designed and implemented by the LPSC. A 0.7-scale prototype of the proposed water Cerenkov detector has been built and run in 2014, validating the technology.
All of the STEREO electronics, from the PMT bases to the data acquisition and the slow control system, have been designed and validated at the LPSC. Part of the electronics has already been implemented and tested, whereas the writing of the slow control software interface with the host laboratory is ongoing. The Enigmass postdoc has taken part in the R&D of the data acquisition system and is currently preparing the data analysis.

Finally, the support structure of the lead and polyethylene shieldings surrounding the detector has been designed at LAPP. Naturally, the coordination of the mechanical integration of the different shielding and detector parts has been done at LAPP. Our mechanical engineers have also proposed and designed the retained solution (air cushions) to put into place the 90+ tonnes of the detector+shielding assembly from their mounting location. Additionally, they have conceived a system to guide the assembly during this delicate transport phase.

The status of the project suggests that the detector could be installed and commissioned at ILL reactor by 2016. Then the Labex teams will be involved in the running of the experiment and the data analysis. Two PhD students are doing their thesis work on this project.

Long Baseline Neutrino Oscillations

In parallel to these two neutrino projects a third research axis is pursued and maintained on neutrino beam experiments and future underground projects for neutrino oscillations and astrophysics. This corresponds to the participation to the R&D on a large liquid argon TPC working in a double phase (liquid-gas) regime to allow long drift distances. This project started in 2014 and the implication from the Labex is essentially originating from LAPP at the moment but is under discussion to be extended to the other partners. The involvements include the anode deck suspension system and electronic development for the photomultiplier readout of the scintillation light emitted when a charged particle ionizes the argon.

Dark matter

Planck experiment

The Planck satellite experiment has measured the density of cold dark matter today (0.3156 +/- 0.0091 Planck 2015, Planck alone). Now, we have a common reference (more than 3000 citations for the 2013 Planck cosmological parameters paper in two years). The quality of the last results, which use polarization information, rely on an exquisite study of systematic effects. It was the subject of the Enigmass post-doc attributed to C. Combet in 2014 (now CR2 at CNRS). The Planck experiment has followed the foreseen schedule for the temperature analysis while the polarization full analysis had to be delayed by roughly one year.

As scheduled, Planck has also produced a catalogue of 1653 galaxy clusters detected via the interaction between the relic radiation and the hot intergalactic gas. This effect gives an access to the dark matter distribution. Some of these clusters have been observed in details by the NIKA camera to map the mass distribution. It was the main part of the subject of the Enigmass PhD grant attributed to R. Adam (2012-2015, already 14 astro-ph papers on Planck or NIKA).

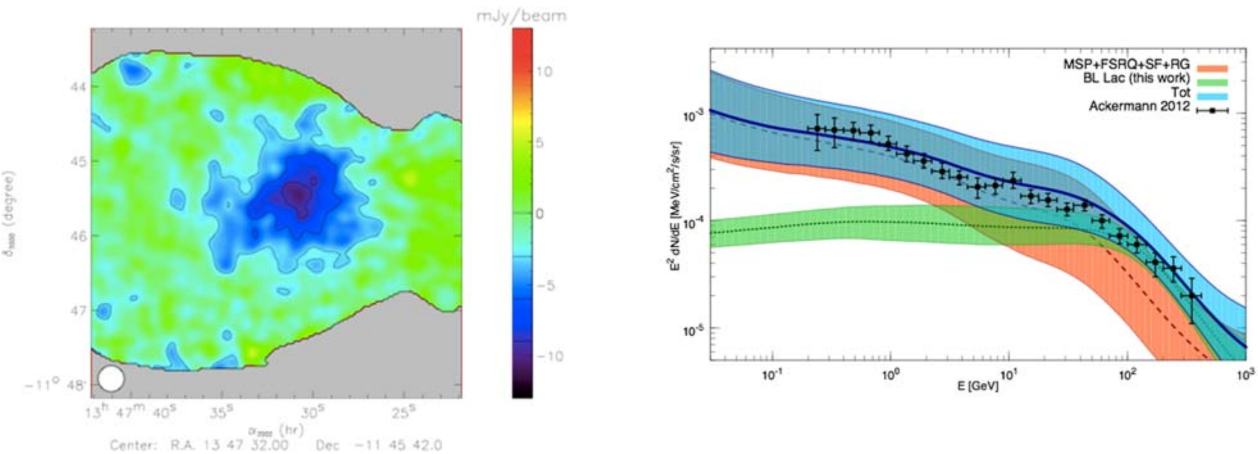

*Figure 2 - **Left:** NIKA map of the cluster RX J1347.5-1145 at 140 GHz. The decrement, due to the spectral distortion of the relic radiation produced by the hot gas, is proportional to the electronic pressure along the line of sight (astro-ph 1310.6237). **Right:** global view of the diffuse γ-ray predictions (best fit models and relevant uncertainty band, astro-ph 1311.5708)*

Mimac project

The dark matter particle direct detection is the goal of many experiments around the world. The LSM houses Edelweiss, the main French experiment in this domain since more than 20 years and the prototype MIMAC, which should take advantage of the directionality of the events. The neutron detector developed for this project could have various other uses. An Enigmass engineer (N. Sauzet) works since August 2014 on the valorization of this instrument (medical uses for instance). The MIMAC prototype has been developed but the deployment is currently delayed as the ANR has been refused last year.

Indirect detection

Indirect detection is a complementary approach to identify dark matter (DM) particle properties. In the Enigmass laboratories, we use photons (HESS experiment) and charged particles (AMS experiment).

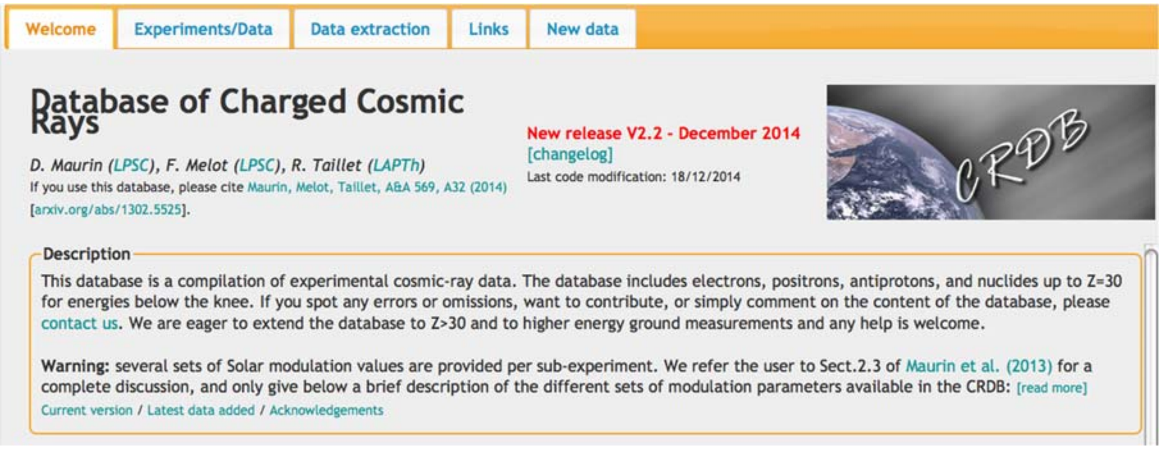

Figure 3- Screen capture of the Database of Charged cosmic-rays. It is the result of a collaboration between the LAPTh and the LPSC.

The goal is to search for an excess with respect to known astrophysical background. This search is a recurrent research subject in the gamma-ray astronomy and the cosmic-ray physics.

A study of the diffuse gamma-ray background, including BL Lac objets (a class of AGN), has shown that no excess that could be attributed to DM particles annihilation is present the spectral energy distribution. It has been studied by the Enigmass post-doc D. Sanchez in 2013.

A precise knowledge of the cosmic background is crucial. A collaboration between the LAPTh and the LPSC has produced a public database of charged cosmic-rays. It has been slightly delayed with respect to the originally expected schedule but it is now operational, known and used by the community and regularly updated. On the experimental side, for instance, the Enigmass post-doc N. Tomassetti has precisely measured cosmic-rays composition. A workshop organized with the support of Enigmass focused on Cosmic-rays and Dark matter has gathered about 30 people from Annecy and Grenoble but also from Montpellier, Marseille, Toulouse and Geneva in March 2015.

In order to inform and federate our Labex community around the dark matter and dark energy problems in the cosmological framework, a workshop dedicated on cosmology in general and on the LSST project in particular has been organized in June 2014.

Observing the sky to access to extreme phenomena

The physics at the beginning of the Universe, around the inflation epoch, or close to black holes and other compact stellar objects is, and will stay for ever, out of reach of experiments on Earth. To understand the phenomena in extreme conditions, we must observe, try to model or derive constrains from what happened in these conditions.

The very massive black holes are the engine of active galactic nuclei (AGN). These AGN are observed with the HESS telescopes. The energy distribution and the variability of the very high energy signal are key information to understand the acceleration processes operating in the jets, but they can also be used to provide constrains on fundamental principles like the Lorentz Invariance Violation (D. Sanchez, Enigmass post-doc). The AGN study is a long-term program of the gamma-ray astronomy. Time and "luck" are necessary as progress is driven by multi-wavelength observation of flares, as shown by one of their last result arXiv:1501.05087.

In the very near future, the gravitational waves should be directly detected from pairs of neutron stars and/or stellar black holes. The Enigmass labex supports this project in this key period where Advanced-Virgo will start observations, opening a new window in the following months. Measurements are extremely challenging, but the expected sensitivity should now allow direct detection of these new messengers. Multi-wavelengths observations of VIRGO/LIGO candidates will be crucial to identify the sources and exploit the results, and the LPSC team is largely involved in NIKA: they are ready to use a part of their observation time to follow VIRGO candidates after an alert.

The history of the expansion rate of our Universe presents a first major event, the cosmic inflation with a huge expansion during an extremely brief period at the very beginning, and now another acceleration since a few billions of years due to the domination of the dark energy on the matter in the mean energy content. The inflation is observationally studied via the in-prints in the relic radiation. Planck of course plays a crucial role now with its own constraints on the inflation parameters, and for the next years with its unique data on Galactic polarization emission which must be taken into account by any other ground-based or balloon-borne experiment looking for primordial gravitational waves. The Enigmass PhD student and post-doctorant played a crucial role in this results. The next generation satellite has not successfully passed the European selection process (mainly too expensive), but the next call could be in the near future. The subject federate all the community (Europe, US and now Japan). With the cryogenic and perhaps (probably) the most promising detector matrices, "Grenoble" (Institut Néel, IPAG, LPSC) should continue to play an important role in this field.

Finally we want to understand what happened "at the Big-Bang". The General relativity and the Quantum mechanics must be merged to reach the beginning of the time. The Loop quantum gravity is a proposition to unify these two theories. The Enigmass PhD L. Linsefors (papers on astro-ph) works on the cosmological consequences of this theory. It is particularly promising as an inflation period with a duration compatible with the current observational constraints is naturally generated in this framework. The work will continue in the 3 next years with a new student to compute possible observational signatures, especially in the scalar polarization signal of the relic radiation.

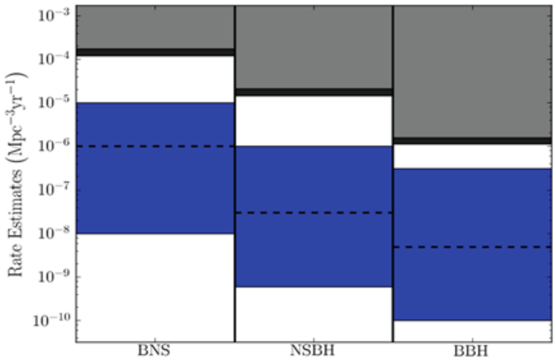

Figure 5 - The cumulative 90%-confidence rate upper limits of the binary coalescence of binary neutron star, neutron star-black hole and binary black hole

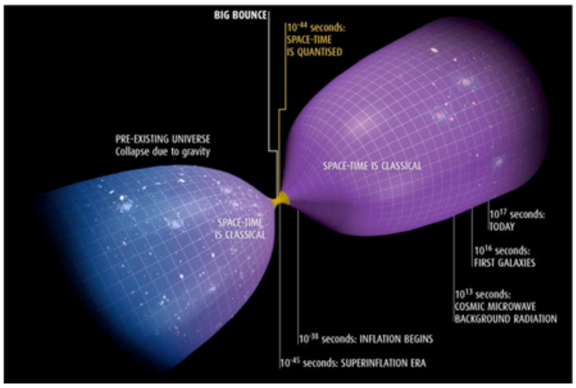

Figure 4 - Artistic view of the Big Bounce which replaces the Big-Bang in the Loop quantum gravity theory.

B) Human resources

The ENIGMASS Labex has undoubtedly a major structuring effect which is expressed in particular by the results in terms of recruitment and resulting scientific dynamics. Specifically, on a purely accounting point of view, the Labex has led to a substantial increase in the number of PhD students and postdocs. Beyond this aspect, this clearly led to the strengthening and deepening of scientific collaborations between the Labex partners, which was indeed one of the aim of the Labex.

In particular, it has helped to develop common topics between the Labex laboratories, topics for which we were able to implement postdocs' recruitments and shared thesis supervisions. In the review processes to attribute positions, in addition to the scientific policy to support in priority some physics lines, collaborating projects receive a high attention. In this context, the HR policy of the Labex has certainly played a catalytic role in bringing together the Labex laboratories and structuring the site Grenoble-Alpes in high energy physics.

One of the strengths of the Labex for doctoral and post-doctoral policy is a better internationalization of recruitment and the excellence of the candidates. This contributes to reinforce the worldwide visibility of this structure. The Labex HR policy is based of course on the scientific objectives of the project.
From an operational point of view, the objectives of the Labex HR policy are implemented by a two-step procedure.
First, ad hoc committees (separate for PhD students and postdocs) select the subjects chosen annually in line with the scientific policy of the Labex. The committees include in particular external members selected for their scientific skills and possibly members of the Scientific Council of the Labex. The selected topics are brought to the attention worldwide by advertising in the major sites of HEP community (e.g. INSPIRE), the job sites for PhD, and also professional circuits (e.g. brightrecruits.com, inclusion in the cerncourier.com jobswire). Second, for PhD students, a selection of the applicants is done by the committee on the basis of the excellence of the candidates. Globally for the selected PhD candidates, about 40% come from abroad, 30% come from other French universities and 30% are of local origin. In the case of post-doctorants recruitment, the selection is more focused on the layout of the projects. Proposed projects are selected based on 'blind analysis' of application forms performed in parallel by 2 members of the advisory committee (1 external and 1 internal). At the end of the scrutiny process, after a final meeting of the advisory committee, a ranked recommendation list is sent to the Labex management board to decide. Finally, the winning projects are left free for the recruitment process of the postdocs, which is supposed to converge before that the next recruitment campaign starts. Such a

large period of time allows matching the usual calendars of experimental and theory community and is flexibly enough to hire the fittest candidates. To date 11 postdocs have been appointed and they originates in 75% of cases from foreign countries and with prior positions at large laboratories such as CERN and DESY. Among them 1 recruitment at CNRS CN01 was achieved in 2014 and 3 postdocs managed to be on the final shortlists of the CNRS 2014 recruitment contests CN01 and CN02.

A Gantt chart of the various recruited PhD and postdocs (at various carrier levels) is available on *Figure 6*.

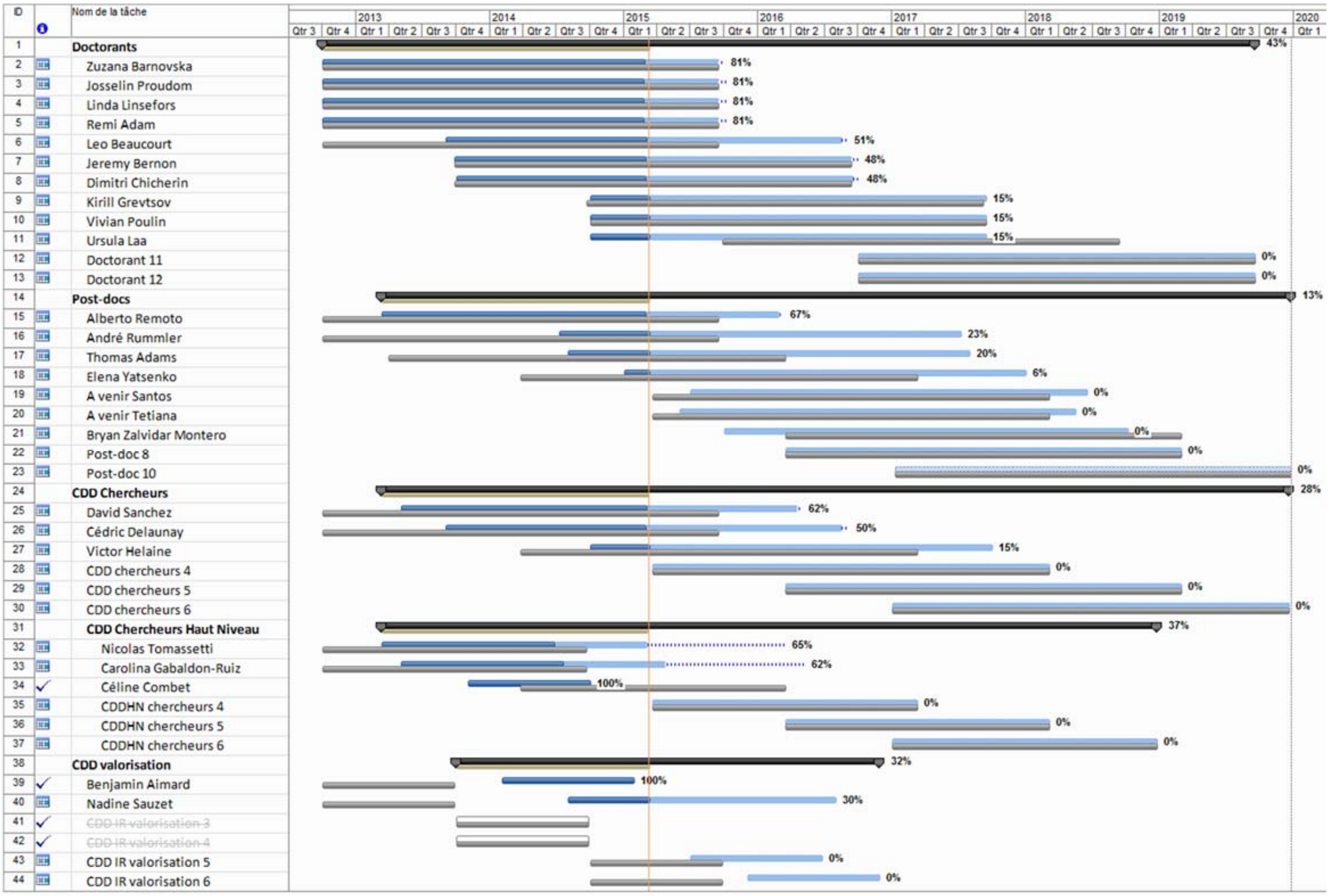

Figure 6 - Gantt plot of the hired PhD and postdocs among the Labex timelines and projection for incoming recruitment campaigns. (Grey = planned, dark blue= in progress, light blue= remaining time)

C) Financial resources, leverage effect

A distinctive feature of the ENIGMASS Labex that sets it apart from many Labexes we know is that *i)* it involves a small number of laboratories (four) *ii)* it covers some strongly interconnected topics which are at the heart of the main research areas of the four laboratories *iii)* the laboratories have had a proven track record collaborating together even prior to the launch of the Labex. These features explain why the program of the Labex has been, from its onset, in total coherence with the scientific priorities of the laboratories. In fact, ENIGMASS provided the laboratories with extra resources not only to strengthen some common projects for

which the existing resources such as the *Projets Blancs* of the ANR, even when pooled from 2 or 3 laboratories, where far from sufficient to bring into fruition such projects, but perhaps more importantly to start new projects. Examples in this category are the collaborations around the ATLAS analyses and upgrade. The setup of the strategic "neutrino pole" that we underlined in our application, with the subsequent proposal and implication in the STEREO project, is another important achievement that ENIGMASS has greatly enabled to trigger. The ENIGMASS funding, most important of all in terms of human, resources have enabled the laboratories to enhance their impact in both experimental and theoretical physics, secure new R&D programs linked to long term projects, improve their offer in terms of teaching and academic training, as well as boosting their capabilities to valorize their expertise towards the industrial world. In the area of training, the contribution of ENIGMASS to the ESIPAP school has been crucial for the initiative to really burgeon. The contribution of the Labex to several conferences and workshops organized by members of ENIGMASS has been a boon, in many instances the basic budget would not have sufficed for a smooth running of the workshops. In turn these actions are also beneficial for the visibility of the Labex.
More specifically:

1) Experimental physics :
   a. The ENIGMASS Labex played a major role in reinforcing the need of the ATLAS groups of both LAPP and LPSC around all important axes of the project: data reconstruction and analysis in the Higgs and Top quark physics fields, R&D around the pixel activities and converter for calorimetry in the framework of the Phase II of the LHC upgrade (HL-LHC). It also allowed to structure new collaborations between theorists (LAPTh and LPSC) and experimentalists in the field of SM, Higgs and Top quark physics;
   b. The ENIGMASS Labex helped reinforce the activities in astro-particle physics, covering the long-term implications of LAPP, LAPTh and LPSC laboratories in Cosmic Ray physics within the AMS project, in ground bases gamma-astronomy with HESS, in the gravitational wave field within the VIRGO-LIGO collaboration, as well as Cosmic Micro-wave Background (CMB) with the Planck-Nika group.
   c. The ENIGMASS labex definitely allowed to reinforce new activities among the LAPP, LPSC and LSM in the field of neutrino physics, via the hiring of PhD students and postdoctoral positions in the STEREO and SuperNEMO projects. It also allowed to foster the efforts from the three partners and help is setting up a common strategy for future implications of the three laboratories in view of Long Baseline Oscillation neutrino experiments, as well as double-beta experiments.
2) Teaching and academic training
   a. The Labex allowed to improve the offer in terms of teaching platforms towards students coming from the UJF at the Master levels (M1, M2) and from the Engineering school Grenoble-INP which welcome about 500 students every year. In particular, it allowed the funding of new radioactive sources for nuclear physics installation at the LPSC, in order to cover all fields of knowledge (alpha, gamma, beta, cosmic ray and neutron irradiation). Besides, the labex provides funding for a significant effort of complete restructuration of the platform, in link with both university and engineering school, that is being started and is aimed at redesigning the 16 training posts, acquiring new

acquisition systems with up-to-date systems, and significantly improve the capabilities and visibility of the platform at LPSC

b. The Labex also allowed to put in place new academic training program within the framework of a European school around the CERN area in the domain of instrumentation (ESIPAP) for particle and astroparticle physics, helping funding the contributions from teachers originated from both laboratories, CERN and elsewhere as well as participation of several students. This offer of a field of expertise that is central for our activities is now largely recognized a platform that is region-wide;

3) Valorization and transfer outside the academic domain

   a. The Labex provided funding for engineering positions in valorization aspects, with contribution in seismic sensor developments, as well as in the rapid neutron flux detectors that can be used by industry and are now object of contract with the IRSN at Cadarache (CEA) site.

D) Labex Impact on its ecosytem policy

From the early stages of the conception of the project through its inception, the idea behind the setup of the Labex ENIGMASS was based on building and strengthening a strong scientific strategy that structures and brings together the four major laboratories involved in experimental and theoretical high energy physics and astrophysics in the "Alps" region, taking advantage of the unique environment offered by the proximity of CERN. Moreover, this strategic structuring and pooling of resources could not be more timely in an era where the priority in the field was the search for the Higgs boson, which was discovered since then, and the elucidation of the origin of mass as well as the search for Dark Matter. Reinforcing collaborations in this area and bringing our laboratories together, with added resources from the Labex, seemed crucial and opportune at a time where the landscape of research and higher education in France was going through major changes calling for mergers of one sort or the other and aiming at excellence. In particular, for LAPP and LAPTh this was a chance not to be missed if one wanted a rapprochement with a large research centre such as Grenoble, considering the isolation within a small and disconnected campus and the very modest size of the Université de Savoie Mont Blanc as a whole where the influx of physics students has been on a dangerous decline. From the LPSC point of view, there had been a certain a thematic isolation considering the presence of large and successful structures in other domains of physics and science in general. For LSM, it has been the opportunity to develop closer links with LAPP and LPSC laboratories. The project took root from *i)* the successful CIPHEA (International Centre for High Energies Physics and Astrophysics), *ii)* collaboration between Annecy and Grenoble laboratories in some ANR "white" projects *iii)* and the association with the nearby underground laboratory and international platform, the LSM.

Impact on the scientific structuring

From a scientific point of view, the Labex has already fulfilled its role in strengthening the existing joint projects between our laboratories as well creating new opportunities for collaboration on specific topics, for example between LAPP and LPSC or between LAPTh and LPSC if we were to only mention interactions between Annecy and Grenoble. Indeed, without the Labex, funding for some PhD students and postdocs "shared" between two laboratories of the Labex would not have been possible. This has helped cement several joint projects and has even allowed the success of applications to calls (*ANR Projets Blancs*) involving the laboratories of the Labex. In addition, ENIGMASS has enabled the emergence of a "neutrinos pole" thanks to the know-how and excellence of the physicists of our laboratories coupled with the participation of a nearby platform, the underground laboratory LSM. From a structural point of view, the Labex ENIGMASS was one of the cornerstones for the setup of the scientific cluster PAGE (Particle Physics, Astrophysics, Geosciences, Environment and Ecology), which is one of the six scientific clusters set in place within the structure of the research COMUE Grenoble-Alpes. These clusters are *the* place for discussions on the scientific strategy of the whole site of Grenoble-Alpes. These scientific clusters form the backbone of the structure of the research project IDEX Grenoble Alpes which was submitted in January 2015. Participation in PAGE, strengthened by our membership in the Labex ENIGMASS, offered also possibilities to foresee collaborations with others laboratories and structures of the cluster which are involved, among other topics, in Astrophysics and Planetology (IPAG - *Grenoble Institute of Planetology and Astrophysics*, OSUG - *Grenoble Observatory for Universe Sciences*).

With the Labex ENIGMASS, we were also able to participate in the development of the strategy of building bridges between the different poles of the COMUE. The working group on instrumentation and the link with the TGIR (Very Large Research Instruments policy) was *instrumental* in this respect. Discussions with other Labexes outside of Grenoble (P2IO - *Physics of the two Infinites and the Origins*, and OCEVU - *Origin, Constituents and Evolution of the Universe*) on the pooling of resources, setting up and coordinating strategies on joint scientific projects have taken place. In fact, this has already materialised for some outreach activities with the P2IO Labex (*nuit des 2 infinis*).

Impact on training policy

This policy of rapprochement between our laboratories that the Labex triggered or further amplified has had a direct impact on many aspects related to training. In particular, our training policy has relied on the fact that the units that make up the Labex have, for many years now, shared Masters in subatomic physics (specialty of the Master's degree in Physics from Grenoble, accredited jointly with the University of Savoie Mont Blanc). There is therefore a long history of cooperation in terms of training which has allowed new common training activities to be implemented easily (see section 1.3). Regarding the Master Erasmus Mundus project, conception and decision making took longer to initiate due to the fact that the last few years coincided with *i)* at the national and local level, a restructuring of the Masters (our laboratories and universities are within wave “A” of the HCERES evaluation) *ii)* at the European level, the setup of the new European program H2020 (Erasmus+ actions). In this context, our priorities for 2015 as concerns training with an international dimension is to work towards setting up a Master Erasmus+, possibly in conjunction with a European Joint Doctorate proposal within the Marie Sklodowska-Curie H2020 scheme, both these projects are in the field of high energy physics (experimental and theoretical). In order to constitute a force to reckon with, we plan to join efforts with the Labex OCEVU.

3 / SOCIO-ECONOMIC IMPACT

3.1 *Partnerhips with social and economic actors (industrial actors, competitiveness clusters, fundations…) and established agreements; start-up creation; hosting of industrial actors in the Labex for instance…*

Our Labex program is focused on fundamental physics, data analysis and theoretical interpretations, however the R&D effort to build our next generation detectors, can in principle be the vector for valorisation and partnership with industry. For example in the Annecy region we are in contact with the local cluster of competitiveness dedicated to mechatronics and mechanics.

3.2 Relationship with the SATT (Tech-Transfert Societies), where possible, IRT (Technological research instituts) or ITE (Technological research instituts in the field of energy) and with other transfer systems involved in higher education and research institutions

The two valorisations projects will emerge through le regional SATT. The seismic sensor has already be presented and we are waiting the validation, which must drive new resources.

3.3 Commercial relations with European public-private partnership research institute, within the Framework Programmes, etc.

3.4 Promotion measures for knowledge dissemination ; schedule, durability of the measures (excluding publications in scientific journals)

The following list shows our main actions where ENIGMASS contributions were of prime importance to organize the event.

École nationale de l'IN2P3 de Gif de physique des particules, organised at LAPP Annecy, 16-20 septembre 2013 : Astroparticles the cosmos messengers, http://lapp.in2p3.fr/GIF2013 ;

Workshop international des Houches : Physics at the TeV scale, 3-21 June 2013, and next coming edition : June 2015, http://phystev.in2p3.fr/. This a renowned biennial international event brings together theorists and experimentalists for more than two weeks. Its objective is to set new avenues for collider and cosmology programs. This year's session is particularly awaited as it will happen just at the beginning of LHC run II.

Implications of the 125 GeV Higgs Boson, 18-22 March 2013, 24-28 March 2014, held at LPSC in Grenoble: http://lpsc.in2p3.fr/Indico/conferenceDisplay.py?confId=861. This very efficient workshop, annually held on invitation, tries to review all implications of the newly discovered Higgs Boson and to draw some perspectives on potential new physics measurements that could be done to improve our knowledge of the Standard Model and its possible extensions.

School of Statistics : an annual school co-organized by CNRS and CEA that aims at teaching the latest statistical methods and tools used in modern high-energy physics analyses.
http://indico.in2p3.fr/event/9742

FREE COMMENTS

The ENIGMASS Labex focuses on fundamental questions of physics. The main effect of the Labex is the reinforcement of the links between the four laboratories, LAPP, LAPTh, LSM and LPSC. This allowed us to launch common scientific programs, and generate multiple contacts between our teams. The Labex has enabled us to define a common strategy and the result is the recognition of our domain by the future Universite de Grenoble Alpes, which has created a scientific pole, PAGE (Particles, Astrophysics, Geoscience and Environment). The financial support of the Labex is very important, most of it spent to hire students, post docs, support education actions, etc, but more important is the fact that today the four laboratories are a significant actor in the future university, and of course at the international level among our collaborations.