Acronyme	**PS-TOF**		
Titre du projet en français	Développement des détecteurs à la picoseconde et leur application en physique des particules au LHC et aux futures usine à B.		
Titre du projet en anglais	Picosecond's timing detectors and application in Particle Physics at the LHC and future B factories.		
CSD principale	☐ 1 ☐ 2 ☐ 3 ☒ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9		
CSD secondaire ***(si interdisciplinarité)***	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9		
Aide totale demandée	920712 €	**Durée du projet**	48 mois

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1. CONTEXT AND POSITIONNING OF THE PROPOSAL

The aim of the present ANR consists in **developing the Picosecond Timing Detectors.**

To reach this ambitious goal a crucial step is to design the fast readout electronics able to perform at about 5 picosecond level. The second aspect is related to the study of the performances of the available photodetectors. Furthermore, the full chain composed by the detector, the photo-detectors and the electronics have to be set-up and tested, both in a test bench and in a test beam to ensure that the **final timing resolution is of the order of 10 picoseconds.**

This is an ambitious project with numerous applications both in Particle Physics and Medical applications. In the following we will focus on two main applications in Particle Physics: the particle identification at future Super-B factories and the diffractive physics at LHC.

Challenges at the Super-B factories

The primary physics goal of the B factories experiment is to study CP violation in the B meson system produced in Upsilon(4S) decays. The study of CP-violation in hadronic final states of the B meson system requires the ability to tag the flavour of one of the B mesons via the cascade decay b → c → s, while fully reconstructing the final state of the other B. The momentum of the kaons used for flavour tagging extends up to about 2 GeV/c, with most below 1 GeV/c. On the other hand, pions from the rare two-body decays B→ $\pi\pi(K\pi)$ must be well-separated from kaons, and have momentum between 1.5 and 4 GeV/c.
The present Babar B factories (BaBar at SLAC, Belle in Japan) use an inner drift chamber tracker providing p/K separation up to approximately 700 MeV/c. An additional dedicated particle identification system is required that must perform well over the range of 700 MeV/c to about 4 GeV/c based on ring imaging Cherenkov detector.
B-factories successfully collected data in the last decade and studies have been started to construct, in the next decade, new B-factory machines called SuperB with hundred times the present B-factory luminosity. These new projects are really discovery machines with a twofold goal: to study the NP (measuring the couplings) if discovered at LHC and/or to explore and probe NP energy scales inaccessible at present and next-generation colliders.

For this goal, new detectors have to be conceived which are able to follow the ambitious program. In order to study new rare decay channels, the particle identification have to be more performing than in present B-factories. In particular it is now understood that there is a number of cases where the BaBar/Belle physics outputs would have benefited from a better coverage of the PID system in the forward end-cap as well as in the barrel. Even though the end-cap covers only a modest portion of the geometrical acceptance, a more hermetic detector than Babar would allow higher efficiencies for exclusive B physics channel and could be especially valuable for some of the types of studies expected to be important at SuperB.
Thus the baseline SuperB detectors will include a forward PID system [PH1]. Two candidate endcap detectors are considered: one using an areogel radiator RICH and another one using fused silica radiator to obtain very good time-of-flight (TOF) performances. Space consideration, PID performances requirements and the amount of the total material in front of the electromagnetic calorimeter (that degrades its performances) led the SuperB collaboration to pursue further the studies only of the TOF system.

How does a time-of-flight detector work and which is the required resolution?

A particle can be identified if we are able to measure its mass. To measure the mass of a particle we have to measure two quantities: its momentum or energy and its speed or related quantities. The momentum is normally measured using the magnetic field. The speed is the ratio between the distance and the time taken to cover it. In this equation the numerator is usually known since it is imposed by the geometry of the detector. For the denominator the time has to be measured starting the measurement at the time when the particle is produced at the collision point and stopping the measurement when the particle is detected in a detector named “time of flight”. The measurement seems simple but in fact is a real challenge.

As an example we take a pion and a kaon having a momentum of 2 GeV/c (typical for SuperB). After one meter they are separated by about 100ps. Since the separation in time depends on the inverse power of the momentum squared, the separation for a pion and a kaon of 3 GeV/c will be only of about 40 ps (see Figure 1).

Hence to use the time of flight to identify the particles with momentum up to 3 GeV/c in a compact detector (distance ~two meters) we need a **TOF detector able to measure the time with a precision better than 20ps.**

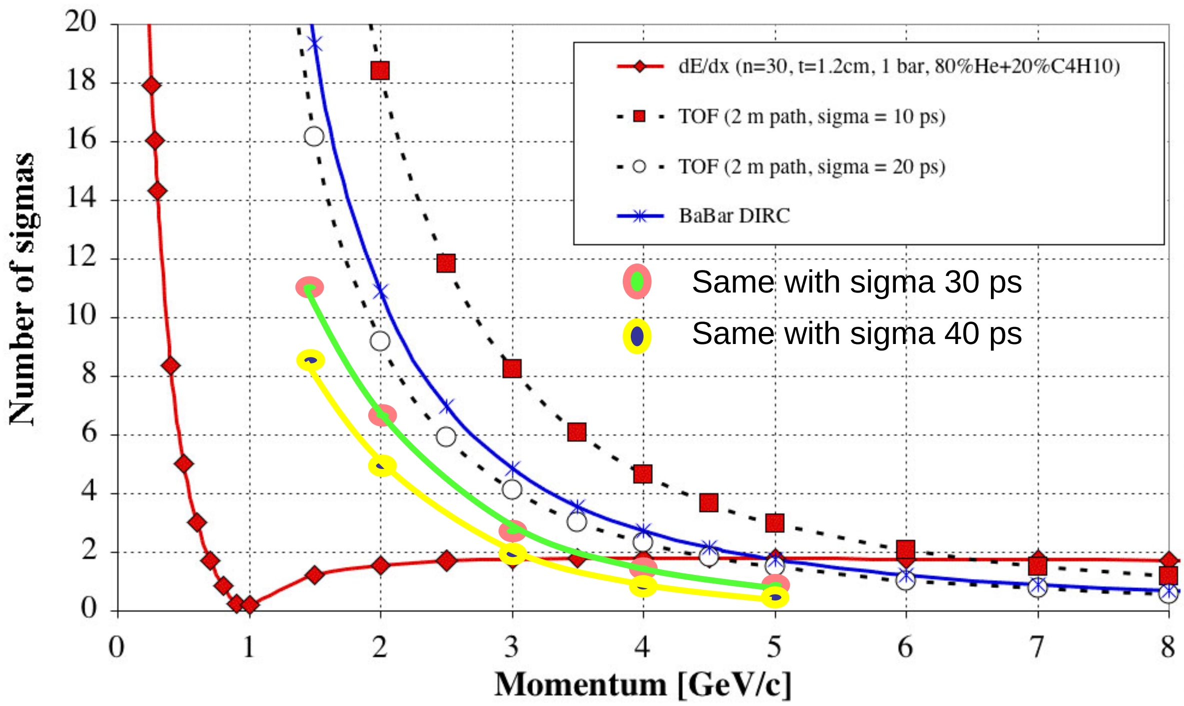


Figure 1. Expected PID performances as a function of momentum for the SuperB DIRC (same as the one actually used in BaBar), the forward end cap TOF option and the dE/dx method in the drift chamber. A TOF resolution at a level of 20ps with a path length of about 2 meter yields a performance equivalent to the present BABAR DIRC and is far superior to the dE/dx method.

Diffractive Physics at LHC

Another application of timing detectors in Particle Physics is related to forward and diffractive physics at the LHC, the new proton-proton collider at CERN, with a center-of-mass energy of 14 TeV. The main objective deals with direct tests of the Standard Model, and in particular the search for the Higgs boson and photon anomalous couplings [PH2] Diffractive events are very peculiar: protons are intact after interaction and are scattered at very small angle with respect to the beam direction. Final state protons are detected in dedicated detectors placed close to the beam in transverse directions and located 220 and 420 m from the interaction point. Of particular interest is the so-called exclusive diffractive production. In this kind of events, the full energy is used to produce the heavy object (Higgs boson, dijets, diphotons...) and no energy is lost in remnants. There is an important consequence for the diffractive exclusive events: the mass and the kinematical properties (spin...) of the produced object can be computed using the tagged protons. The advantage of those processes is obvious: we first detect all particle produced in the final state like for an e+e- collider, and in addition, we can benefit from the good forward detector resolution to get a good mass resolution, and to measure precisely the kinematical properties of the produced object. This can be applied directly to the search for Higgs bosons in this mode and the precise measurement of the W pair QED production. Any deviation from the standard model prediction would be an evidence for beyond standard model effects. Using this method, the sensitivity on anomalous photon coupling is better than any other method used at the LHC. To obtain a good measurement of mass or kinematical properties, two essential ingredients are needed, namely a good position and timing resolution. The position of the protons has to be reconstructed with a precision of about 10-15 microns, which allows a precision on mass between 1% and 2% over a wide kinematical region. At the LHC, up to 35 interactions can occur at the same bunch crossing, and it should be known if the tagged protons come from the main interaction producing the Higgs boson or the W pair or from a secondary interaction, or in other words, if the protons come from the main vertex of the interaction.
A precision of 10-15 picoseconds would lead to an acceptable signal over background ration for the search for the Higgs boson at low mass (120 GeV), whereas a better precision of a couple of picoseconds would allow to obtain negligible background.

Diffractive physics was indeed studied at Tevatron. Even if it is not possible to produce Higgs bosons or W pairs at the Tevatron since the production cross section is too small, it is possible to look for diffractive exclusive events in other channels. The CDF collaboration measured the so-called di-jet mass fraction in di-jet events --- the ratio of the mass carried by the two jets produced in the event divided by the total diffractive mass --- when the antiproton is tagged in the roman pot detectors and when there is a rapidity gap on the proton side to ensure that both proton are intact after interaction. For exclusive events, it is expected that there are two jets produced in the CDF detector, two protons, and nothing else. In other words, it is expected that the di-jet mass fraction will be close to unity given into account the detector resolution. A large tail of the dijet mass fraction towards unity was indeed observed by the CDF collaboration which cannot be explained by non-exclusive events. The CDF collaboration also looked for exclusive di-photon or χ_C production and found events compatible with exclusive production.

Other applications of Picosecond Timing Detectors

Picosecond timing detectors will have many applications in other domains, such as Medical applications. For instance, PET detectors will benefit from very good timing resolutions to identify precisely from which part of the human body the photons are coming from and also to reject fake coincidences. This should allow gaining about one order of magnitude on present PET spatial resolutions. The final idea is to be able to combine the good resolution of scanners and the good discrimination of present PET detectors to detect cancer cells in particular in one single apparatus.

The timing detectors we want to develop and test would be the first step towards such new equipment which would represent a breakthrough in Medical imaging.

The improvement of fast timing methods in photodetection is also important in Material Physics as for example, the field of Positron Annihilation Lifetime Spectroscopy – PALS, which is widely used in new material characterizations: polymers, nano-material,etc.

2. SCIENTIFIC AND TECHNICAL DESCRIPTION

2.1. BACKGROUND, STATE OF THE ART

Timing detectors in Particle Physics

Timing detectors are an essential component for the project related to diffraction at the LHC. It is true that they were not needed at the Tevatron to study exclusive diffractive events since the instantaneous luminosity was quite low and not many pile up events occured at the same time. On the contrary, at the LHC, up to 35 interactions occur per bunch crossing and it is essential to know if the diffracted protons come from the main interaction producing the Higgs boson for instance or from additional soft pile up events, not related to the main interaction. The timing detectors are thus essential at the LHC to identify from which interaction vertex the protons come from, and will open a new domain of research in diffraction, namely the search for the Higgs boson at low masses, and for photon anomalous couplings.
It is worth noticing that the search for low mass Higgs bosons is the most challenging one at the LHC and additional methods such as the diffractive one are definitely fundamental. Especially, the diffractive production allows to look in the b b decay mode of the Higgs boson, which is impossible in the non diffractive way because of the too large background. It also allows to measure the spin of the Higgs boson once it is discovered.

On the other hand, concerning B physics, we showed that, to be able to distinguish particles in the range up to 3 GeV/c in a SuperB factory environment, it is necessary to have a TOF detector with a resolution better than 20 ps.
To have an idea of the previous TOF system we take the example of the Belle detector: the time-of-flight (TOF) detector system of Belle used fine-mesh-dynode photomultiplier tubes (FMPMT) mounted directly on the TOF plastic scintillation augmented by thin trigger scintillation counters (TSC). With these “classical techniques” 100ps resolution was achieved.

Recently there has been some important progress on the TOF capabilities making worthwhile to consider such a system for particle identification for a SuperB factories.

The progress derives from three essential points:

1) The use of Cherenkov light rather than the scintillation light from thin detector and a relative high rate of photons (~30-50 photoelectrons).
2) The introduction of new and very fast vacuum-based photon detectors with transit time spread of the order of 30-50ps.
3) New ideas and technical developments which make possible to realise ultra fast readout electronics.

To show the precision needed for reaching the final time resolution, we can use the master formula for the time resolution

$$\sigma(t) = \sqrt{\frac{\sigma_{sci.}^2 + \sigma_l^2 + \sigma_{TTS}^2}{N_{eff.}} + \sigma_{elect.}^2}$$

The final time resolution would depend upon the values of the different terms. They are

- σ_{sci} : contribution of the light flash
- σ_l :variation of the travel time (schematically) due to
    - i) different point impact
    - ii) emission angle of the photons
- σ_{TTS} : photoelectron transit time spread (TTS)
- N_{eff} : number of primary photoelectrons
- σ_{elec} : spread time due to the electronics

Considering a contribution from the light flash and the variation of the travel time of 30 ps, a σ_{TTS} of 40ps with 30 primary photoelectrons and a σ_{elec} of 5ps we obtain $\sigma(t)$ of about 10.5ps. The above mentioned precisions are all challenging and needed R&D.

In the following we describe the technical aspects related to all these aspects.

State of the art for the ELECTRONICS.

The currently existing electronics dedicated to precise time measurement is mainly based on the use of constant fraction discriminators (CFD) associated with Time to Digital Converters (TDC). In this kind of solution, the discriminator's role is to transform the incoming analog pulse into a digital pulse. The constant fraction technique minimizes the time walk effect (timing dependency on the pulse amplitude). High-end CFDs, as Ortec 9327 [E1], exhibiting resolution of less than 10ps rms over a small amplitude range (16ps rms if time walk contribution is included) are already commercially available. But such an expensive commercial module houses only one or very few channels, so that they cannot be used for detectors with a large number of channels. Several attempts have been made to integrate CFD in multichannel ASICs. But the time resolution measured on the most advanced one [E2] is of the order of 30 ps rms.

Two main techniques are possible to measure the timing of the digital pulse provided by the discriminator. The first one makes use of a Time to Amplitude Converter based on voltage ramp started or stopped by the digital pulse. The obtained voltage is

converted into digital data using an Analog to Digital Converter (ADC). The timing resolution of such a system is excellent. Less than 5ps rms resolution has been reported using expensive commercial modules (TAC 566 + ADC 114 from ORTEC [E3]). But this technique is limited by its large dead time which is unacceptable for the future high rate experiments. Another popular timing technique associates a coarse measurement performed by a digital counter with a fine measurement (interpolation) using Delay Line Loop. Such a system can integrate several (8-16) channels on an FPGA or an ASIC [E4]. The most advanced DLL-based TDC ASIC exhibits timing resolution of 25 ps, but only after a careful calibration. It should be noticed that the overall timing resolution is given by the quadratic sum of the discriminator and of the TDC.

In the meantime, alternative methods based on digital treatment of the detector signal, which is analog sampled and then digitized, have been developed. Such methods permit achieving a timing resolution far better than the sampling frequency. For example, 100ps rms resolution has been reported in [E5] for a signal sampled at only 100MHz.

If the sampling frequency is large enough (several samples in the signal edge), the detector signal can be directly digitized without any shaping and then without any transition time degradation. A large variety of algorithms can be used to extract the timing, including digitally simulated CFD, cross-correlation or various types of interpolations (linear, spline). Moreover these algorithms can be made insensitive to signal baseline fluctuations due to noise or pile-up which affect the CFD techniques. Another advantage of this technique is that the ADC is the only device adding jitter or noise to the detector signal whereas both discriminator and TDC are contributing in the technique described previously. Moreover, as several samples of the signal are used to calculate the timing, a part of the sampling jitter and of the noise added in the analog to digital conversion is averaged [E6].

Unfortunately these techniques are limited by the ADC offer. Even if ADC with sampling rates above 1 GSample/s are now commercially available, they are not suited for very fast detector signals, are difficult to implement and use, consume a lot of power, and a complicated electronics is required to treat the huge amount of data they produce. This expensive and power consuming electronics makes them unusable for a low-power compact multi-channel detector.

State of the art: fast timing photo-detectors

Only two kinds of detector (Figure 2) can fulfil the requirement of a very good time resolution of tens of picoseconds: the Multi Channel Plate Photomultiplier (MCP-PMT) and the Silicium Photomultiplier (SiPM).

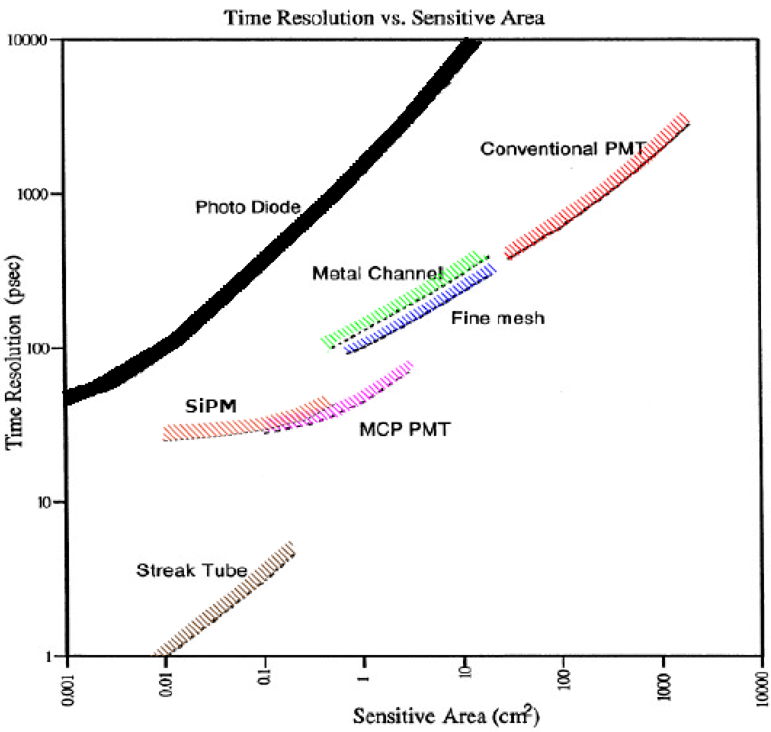
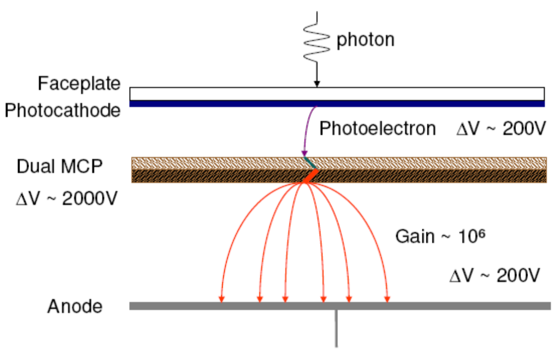


Figure 2 : Time resolution of photo-detectors in function of their sensitive area

MCP-PMT

A MCP-PMT is a lead glass structure with an array of holes (pores) typically of diameter 10–25 µm that serve as miniature electron multipliers. The schematic diagram (Figure 3) shows an incoming photon which is converted to electrons in the photocathode. The electrons then shower in the micro-channel plates (this diagram shows two plates) typically giving a gain of about 10^6. The shower is then deposited on the anode, which may be segmented to provide a multi-anode pixel capability



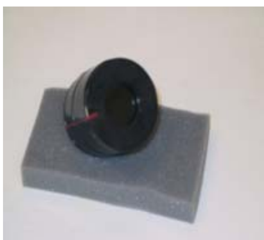


Figure.3: *left: schematic diagram showing the operation of an MCP-PMT, middle: picture of a MCP-PMT from HAMAMATSU,right: picture of a MCP-PMT from PHOTONIS*

The two major developers of MCP-PMTs are Hamamatsu Photonics [D1] and Photonis-Burle [D2]. Hamamatsu has concentrated on small active area (11 mm diameter) tubes consisting of a single channel. Photonis tubes are large (50 mm^2) and have options of 4, 64, or 1032 pixels.
Due to the reduced electron path from photocathode to anode, MCP-PMTs detectors are fast, with reported response times as low as 30 ps [D3, D4]

SiPM

The structure of a Silicon Photomultiplier (SiPM) is based on space-distributed microcells (µcells) connected in parallel on a common silicon substrate (Fig.2). Each µcell is represented by a Geiger-mode avalanche photodiode (GM-APD) connected in series with its integrated passive quenching resistance (R_{quench}) and their density can be variable depending on the producers design (e.g. from 100 to 1600 µcells/mm^2). An important advantage of such device with respect to a single GM-APD is that it acts as an analog device with an output signal representing the sum of the signals from all fired µcells, allowing the measurement of the incident light intensity.

These devices combine the performances of traditional phototubes like high speed and high signal amplification with extremely important features like low-cost voltage supply and electronics. Contrary to photomultipliers, the device is insensitive to magnetic fields and mechanically robust. Consequently, it is suitable for harsh environments. Therefore, the possible applications of these devices cover space research, biology, medical diagnostics and eventually environmental technology.

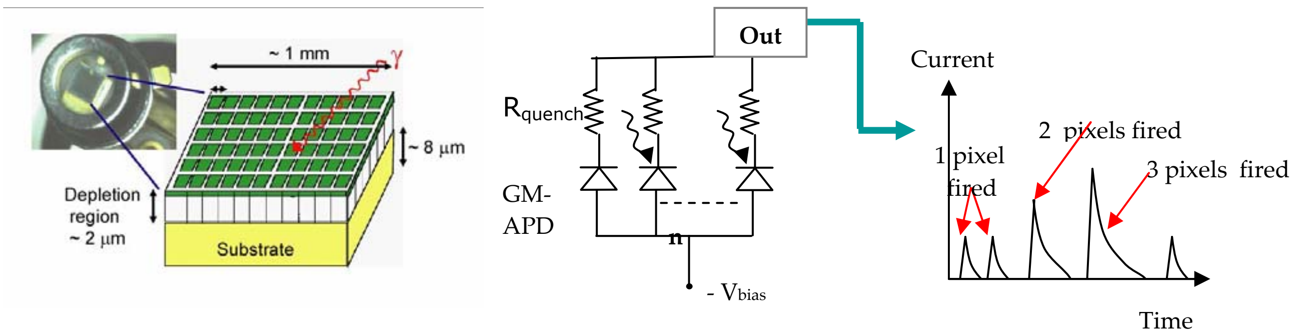


Fig 4: Schematical view of a SiPM and the principle of operation

A lot of R&D is in progress to make SiPM superior to the Photomultiplier Tube but there is still a lot to do: the main drawbacks of this kind of detector are the small available area (presently from 1 to 9 mm^2 for single device and 36 to 130 mm^2 for matrixes) and the high dark count rate (e.g. from hundreds of kHz to few MHz for single devices of 1x1mm^2, scaling proportional with the area for higher area devices).

SiPM is intrinsically a very fast device and its single photoelectron timing resolution (SPTR) is between 50 and 100 ps depending on the detector type.

The R&D on SiPM has been intense these last 5 years and several new devices are proposed by producers each year with improved characteristics. The main producers are: HAMAMATSU, SensL [D4] , F.B.K-irst [D5] and PHOTONIQUE SA [D6]. These companies propose single devices with dimensions of 1x1 mm^2 (from 100 to 1600 µcells), 3 x 3 mm^2 (from 900 to 14400 µcells) and two of them (HAMAMATSU and SensL) will propose SiPM matrixes at the end of 2008 (2x2 or 4x4 single SiPMs of 9 mm^2)

2.2. RATIONALE HIGHLIGHTING THE ORIGINALITY AND NOVELTY OF THE PROPOSAL

The project consists in performing fast timing electronics at the 5-10 picosecond level, and test the full chain from the detector to the photo-detectors (MCP-PMT or SiPM) and the electronics to ensure that the final timing resolution is of the order of 10 ps. This is an ambitious project with numerous applications.

In Particle Physics, we quote two projects in the ATLAS experiment and the future B factories where these timing detectors are essential to achieve fully the physics objectives of the project. Let us recall that the search for the Higgs boson at the LHC is one of the major objectives of the Particle Physics in the 21st century, and is especially difficult at low Higgs boson masses where diffractive events can play a role. Another major objective in Particle Physics is the future B factories where particle Identification will benefit a lot from new timing detectors.

Last but not least, many other applications in other fields exist even if it is not the main aim of this project. We can quote material sciences or PET detectors in Medical applications where the timing detectors will allow to improve the resolution by one order of magnitude. In that sense, the project we propose is fundamental and original in many areas.

It is also worth mentioning that this project will be fulfilled in deep collaboration with the University of Chicago in the United States of America (Prof. Henry Frisch) who is also interested in developing fast timing electronics.

To achieve this ambitious program of getting 10ps time resolution one of the crucial steps is to design the readout electronic. This is the original and novel aspect of this proposal.

The solution proposed in this project permits obtaining a sampling frequency above 10GHz with very low power and data rate. It consists in sampling the signal in an analog memory before sending it to the ADC. These analog memory devices are made of monolithically integrated arrays of capacitors in which the analog signal is sampled. Theses arrays are addressed in write or read mode thanks to CMOS switches. In general, the read operation is slower than the sampling one so that a slow, low cost ADC can be used for the A to D conversion. Analog memories can exhibit very high dynamic range for moderate power consumption. For this reason, several thousands chips based on these principle are already reliably running in Astroparticles or High Energy Physics Experiments (ATLAS, ANTARES, HESS). The association of analogue memories with Delay line Loop permits reaching sampling frequencies more than 3 GSample/s in mature 0.35µm CMOS technologies [E7] (see Figures 5) and up to 5 GSample/s in more recent technologies [E11] with designs not really optimised for speed. Preliminary simulations show [E6] that sampling frequency faster than 20 GSample/s can be reached using modern CMOS 130nm technologies. From Monte-Carlo simulations [E6], it appears that these values of sampling frequency together with an analogue bandwidth in the 1 to 2 GHz (also reachable in these kinds of technologies) will permit reaching our target of few picosecond rms timing resolution

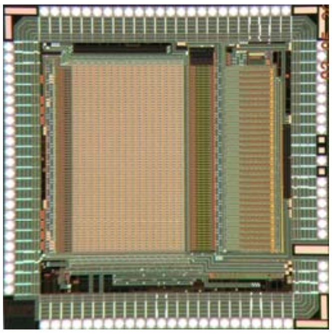


Figure 5a. The SAM chip, 0.35µm technology, 2ch / 12bits / 3.2GS/s

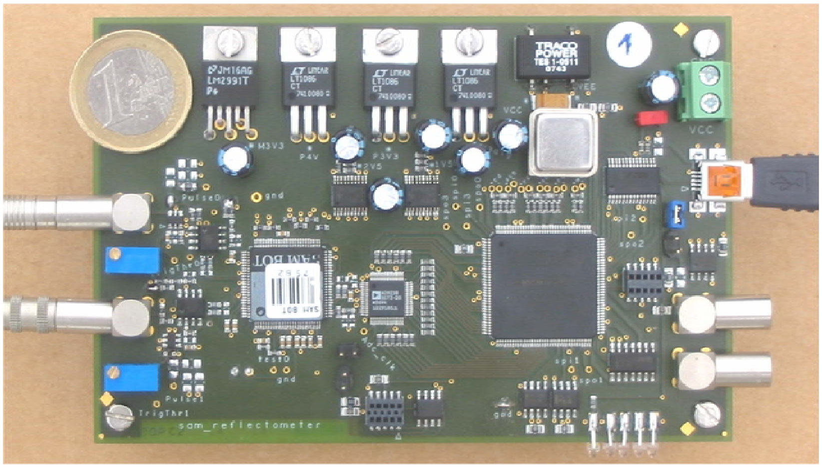


Figure 5b.The USB powered SAM_reflectometer board (3.2GS/s, time resolution of 15ps rms)

The circuit we intend to design will associate the advantage of the TDC structure together with that of the analog memories. Its core is based on a classic TDC structure as described above, associating a discriminator, a counter and a DLL. The innovation sits in adding in parallel to the DLL an analog memory where the input analog signal will be continuously sampled. The fine part of the time measurement will be performed by the analog memory the way described above. This solution greatly weakens the time precision requirement of the discriminator, particularly for what concerns the effect of the pulse shape and amplitude on the propagation time. The final time precision will only be given by the DLL intrinsic precision and the quality of the analog memory. The project will also include the development of the FPGA located downstream of the ADC and taking care of performing the algorithms necessary for the extraction of the event time from the analog sampled signal.

In summary, **the experience already acquired in the domain and the simulations performed let us think that the picosecond precision level should now become accessible at a large scale for a very reasonable cost and a very low power.**

The second aspect is related to the **study of the performances of the available photodetector**. While we do not intend to do any R&D on this aspect, we intend to study and compare two different kinds of fast photo-detectors: MCP-PMTs and SiPMs.
Very few studies on SiPMs timing properties exist, we will then, with this rigorous and complete work of characterization, make an image of the "state of the art" concerning this kind of detectors for applications where timing is crucial. This study is a challenging one since the behaviour of this device is not yet completely understood and the secondary effects (after-pulses, cross-talk) affect its performances. This study will be useful for all the community.

The performances required (as a TTS of the order of 30-40 ps) imply the construction of a test bench for very accurate timing measurements: the different photo-detectors and the detection system consisting in the photo-detector and its readout electronics will be tested on the same laser test bench.
We plan to establish collaboration with the private French company Photonis: they will provide us with MCP-PMTs and use our test results to improve the quality of the photo-

detectors. The synergy between the physics team and the Photonis Company is important to fulfill the requirements on the MCP-PMT quality.
We also plan to sign a Research Collaboration Contract with one of the SiPM producers (LAL has privilegiate relationships with the Company SensL (Irland) and the Institute Fondazion Bruno Kesler (Italy).

We plan to test the whole chain in one of the Test Beam Facilities we have access to (at Fermilab or/and at CERN).
It is also worth noticing that a deep collaboration with the University of Chicago and Fermilab concerning the development of the fast timing electronics is in progress and a financial contribution between US and France (PUF project) corresponding to exchanges of students and permanent personnel will be asked.

For the final integrated tests, we will use the gas (GASTOF) [DE1] and quartz (QUARTIC) [DE2] detectors built respectively in Louvain (Belgium) and Fermilab-Texas (USA). The GASTOF uses the Cerenkov light emitted by the particles through the gas and collected in a MCP-PMT to measure the timing of the particles, while the QUARTIC uses a quartz crystal to obtain the emitted light.

3. SCIENTIFIC AND TECHNICAL PROGRAMME, PROJECT MANAGEMENT

3.1. SCIENTIFIC PROGRAMME, SPECIFIC AIMS OF THE PROPOSAL

To achieve the challenging goal of pushing fast timing electronics and detectors at the 10 ps level, a detailed organisation is needed.

The first task deals with the Management of the proposal. A biweekly meeting will ensure that the progresses go smoothly. The general manager as well as the different task leaders should be present at each meeting, which is also opened to any member of the collaboration.

The **Design of the readout electronics** is one of the crucial steps of this program; this is the goal of task number 1, led by two senior electronics engineers, one coming from each partner. The main task can be divided in 4 subtasks described below in detail, namely the electronics definition, the ASIC design, the front-end board and the ASIC tests. These subtasks will be performed one following the other as a function of time. To help accomplishing fully this task, a PhD student will be recruited using funding coming directly from the two partners.

The tests of the system are also a very important component to show that we can indeed achieve the desired precision of 10 ps. This is the aim of the task number 2 called "**System validation and tests**". This task is in between physics and engineering and this is why it is led conjointly by an engineer and a physicist, one coming from each partner.
The first aim, after building the test bench with a pulsed laser, will be to fully characterize different photo-detectors and to select those able to give a TTS better than 30ps. The synergy with the Photonis private company with whom the team members have privilegiate relationships will be important at this level to improve the quality of the MCP-PMTs following the test results and the possibility of building them at the industrial

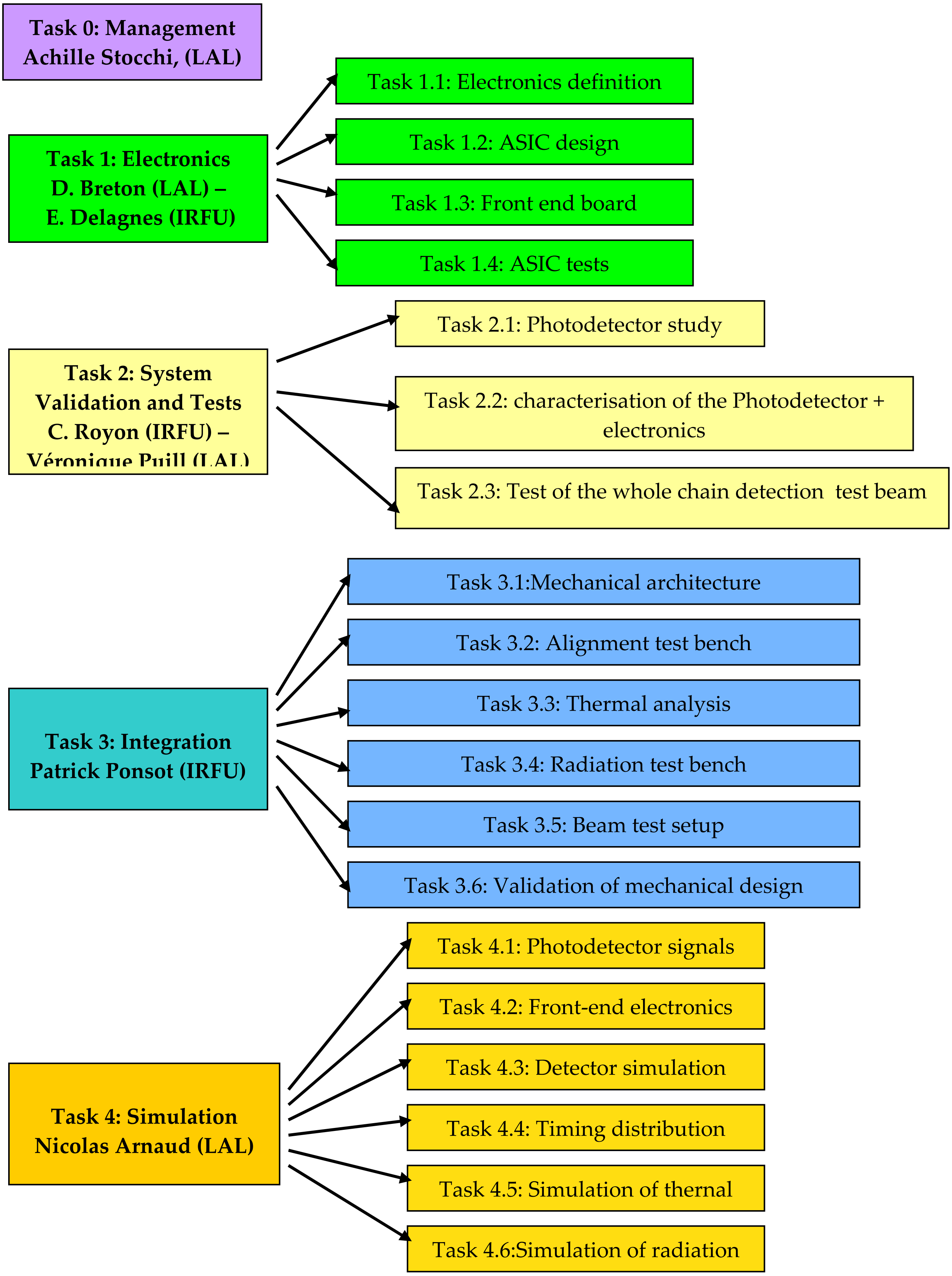
level for future applications. The collaboration with a SiPM producer will also assure the best development for this detector.
This subtask will happen in parallel with the electronics definition and the ASIC design.
The following subtask will be to perform a test of the electronics and the photo-detectors together and to compare it with the result of the simulation.
Finally, the full system including the timing detectors, the electronics and the photo-detector will be tested in real condition (test beam). Concerning this task, it is foreseen to recruit an additional PhD student in Physics and two post-docs of two and three years each, who will help to analyse the data output of task number 4 concerning thermal and radiation analyses. The recruited personnel will be shared between task number 2 and 4.

The next main task number 3 deals with the **System Integration** under the responsibility of a mechanical engineer with much experience in system integration at the LHC for instance. This task can be performed in parallel with the other ones, and can be divided in six subtasks. It is worth noticing that many components of this task do not depend strongly on the experiment where timing detectors will be used. Namely, the support for the electronics and the link between the electronics, the PMT, and the detector, the way the photo-detectors and the electronics will sustain cooling and radiation will be true for many experiments…
The first substask will be to design the mechanical architecture of the full system. The second one will deal with the alignment of the system with respect to the other part of the detectors. For instance, in ATLAS, the position of the protons will be measured using 3D silicon detectors and their timing using the electronics developed in this project. It is fundamental to study how it is possible to know precisely where the timing detectors are located and how to align and support them precisely. The third and fourth tasks deal with thermal analysis and radiation tests of the system. To reach a 10 ps precision of the gas or quartz detectors, they will have to be cooled down. It is thus important to check how the system (including the alignment and support) will behave as a function of temperature, and a test bench will be developed for this sake.
The system will have also to sustain high radiation and the response to the full system (photo-detectors, electronics and temperature). This study will benefit from the nuclear reactors available in CEA. To perform the design of the support and the alignment, a technician will be recruited under the ANR budget for 6 months.

The last task number 4 deals with **Simulation**. This is important from two different points of view. First of all, to achieve a 10 ps precision on a full system, a detailed understanding of each component (photo-detectors, electronics and detectors) and effect is needed. The second aim is also to find the best method to achieve the 10 ps performance. As an example, it is possible to study what the best way is to extrapolate the time information from the successive samples. This will be a common work between electronics and simulation. This task can be divided in 7 subtasks which deal respectively with the photodetector signal, the readout electronics, the timing detectors, the timing distribution system (how the time reference is defined and distributed), the simulation of the thermal and radiation effects, and the integrated system simulation. Each result of the simulation will be directly compared with the results of the test bench, and tuned according to it. For this sake, it is proposed that the physics student and post-docs already described while describing task number 3 will be working part-time on the simulation as well.

The structure which we outlined will allow to divide the main task of achieving 10 ps resolution detectors in subtasks which can be handled in parallel. We will discuss in the following each task individually in more details. A scheme of the overall structure is given in the next page.

Organization chart of the tasks



3.2. PROJECT MANAGEMENT

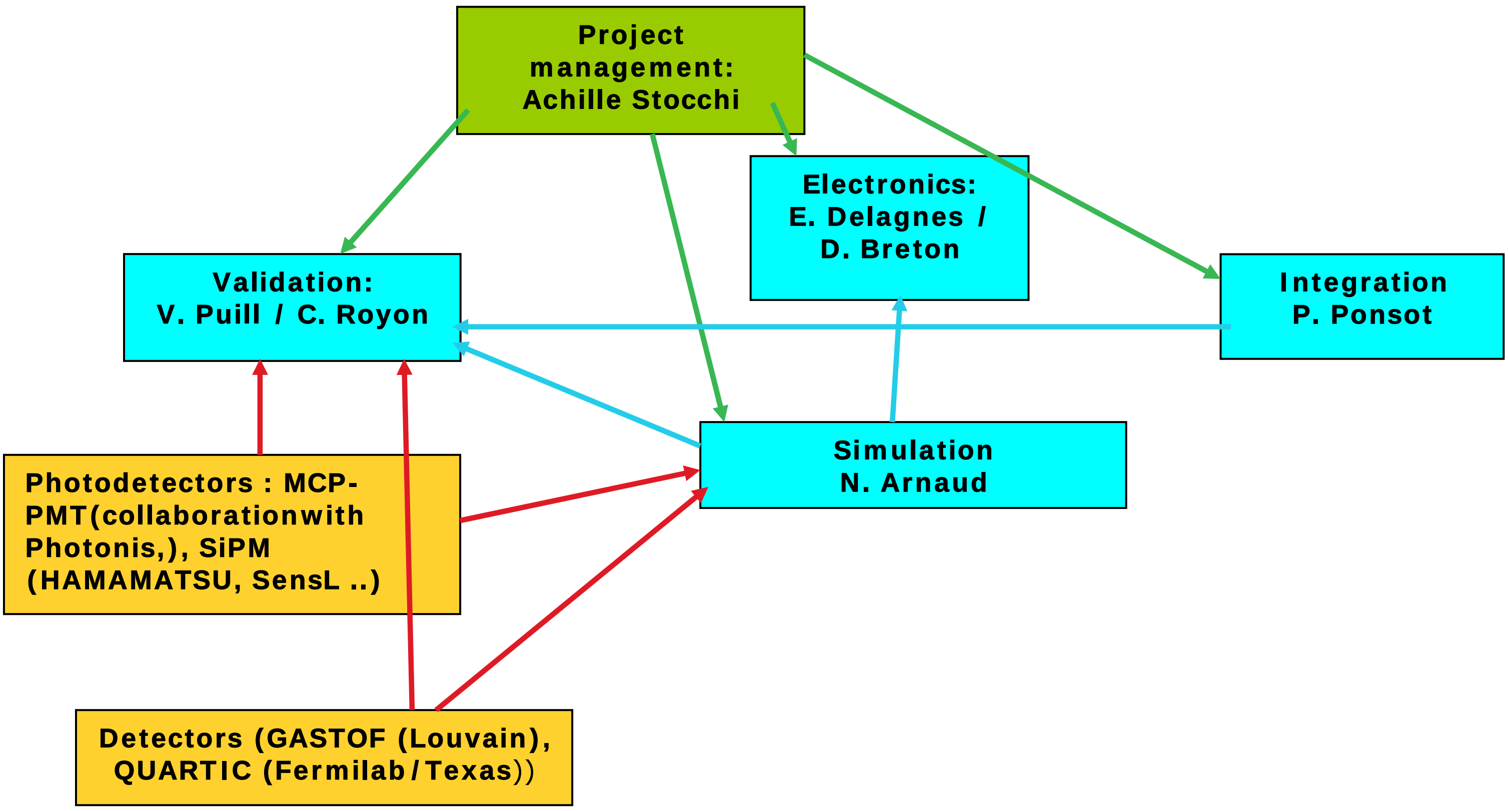
3.2.1 Task 0 : Management

The management checks that tasks flows go smoothly (with proper management inside the tasks) and that the communication between tasks is efficient. For this, meetings will be organized on a bi-weekly basis or more frequent when necessary. The manager communicates also with the ANR, report on expenses. He makes sure that deliverables due by each task are ready on time.

Deliverables of the management task are:

- Progress reports every 6 months.
- An intermediate report showing the expenses every year.
- The final report.

Organization chart of the PS-TOF project :



3.2.2 Task 1 : Electronics Design

The aims of this task are shared between different subtasks described below:

- **Subtask 1.1**: Electronics definition (including ASIC).

The goal of this task is to define a detailed electronics architecture scheme for the detector module from the specifications derived from tasks 2 and 4. One of the major goals of this subtask is to define which part of the electronics will be integrated in an ASIC (application specific integrated circuit) and which will be designed using commercial components on the boards mounted at the back of the detector module.

This scheme, also specifying the ASICs interface will be the deliverable 2.1.

- **Subtask 1.2**: ASIC design.

This task will first consist in designing the ASICs defined in task 2.1.

A first ASIC prototype will include:

- All the electronics functions required for the fine time measurement of the pulses delivered by the photodetectors. It will integrate:
    - High speed amplifiers providing low input impedance and a signal bandwidth above 1 GHz.
    - High speed comparators for triggering the TDC system.
    - A TDC system consisting of a Gray-code counter and DLLs locked on the clock period.
    - Analog memories sampling the input signals associated to said DLLs (equivalent to one column of the matrix described in [E7] and [E8] and patented in [E9] and [E10]). The sampling rate of this analog memory will be of few tens GSample/s for an analog bandwidth larger than 1 GHz.
    - Output multiplexer and buffer to transmit data towards the external ADC.
    - The required digital electronics to control the chip operation and sequencing.
    - All the peripheral analogue and digital blocks used for the slow control, the test and the chip calibration (DACs, level translators, slow control serial link…).

  The number of channels treated by this chip has to be defined.
  To reach the required performances, a high-end deep submicron CMOS technology (0.13µm gate length or less) will be used for this development.

- A second version of the ASIC should integrate:
    - A sparsifier for selecting only the event-related detector cells
    - A mixed digital and analog derandomizer for reducing the dead-time as much as possible. Data from the counter, DLL and analog memory would be temporarily kept inside, before being sent for external digitization and acquisition.

Two prototypes should be foreseen for the first chip (ASIC 1.0 & ASIC 1.1), one for the second one (ASIC 2.0). According to our experience, the chip functionalities are mainly obtained on the first prototype, but very often, a second iteration is required to match the specifications. (However, one could imagine mixing the corrections and the improvements, thus anticipating with the version 1.1 the design of the version 2.0).

The deliverable for task 2.2 will be a documentation including the specifications and a user manual for the chips.

- **Subtask 1.3**: front-end board.

In parallel with the ASIC, the front-end boards will be designed. These electronics boards will house all the necessary elements in order to test the ASIC independently from the detector. Their geometry will have to take into account the geometrical constraints due to the detector itself. Cooling is also a key point which will be carefully studied.

All the modern boards are housing FPGA and/or processors. One of the key points in this development is the algorithms necessary to extract the time information from the successive samples made on the analogue signal. The latter will thus be developed either as firmware or software, or even both.

This subtask also involves the development of DAQ and data treatment software. It will most probably be based on USB2.

<u>The deliverables for task task 2.3 will be: Manufacturing drawings (Electronics and mechanics of the front-end system), acquisition system definition and software architecture.</u>

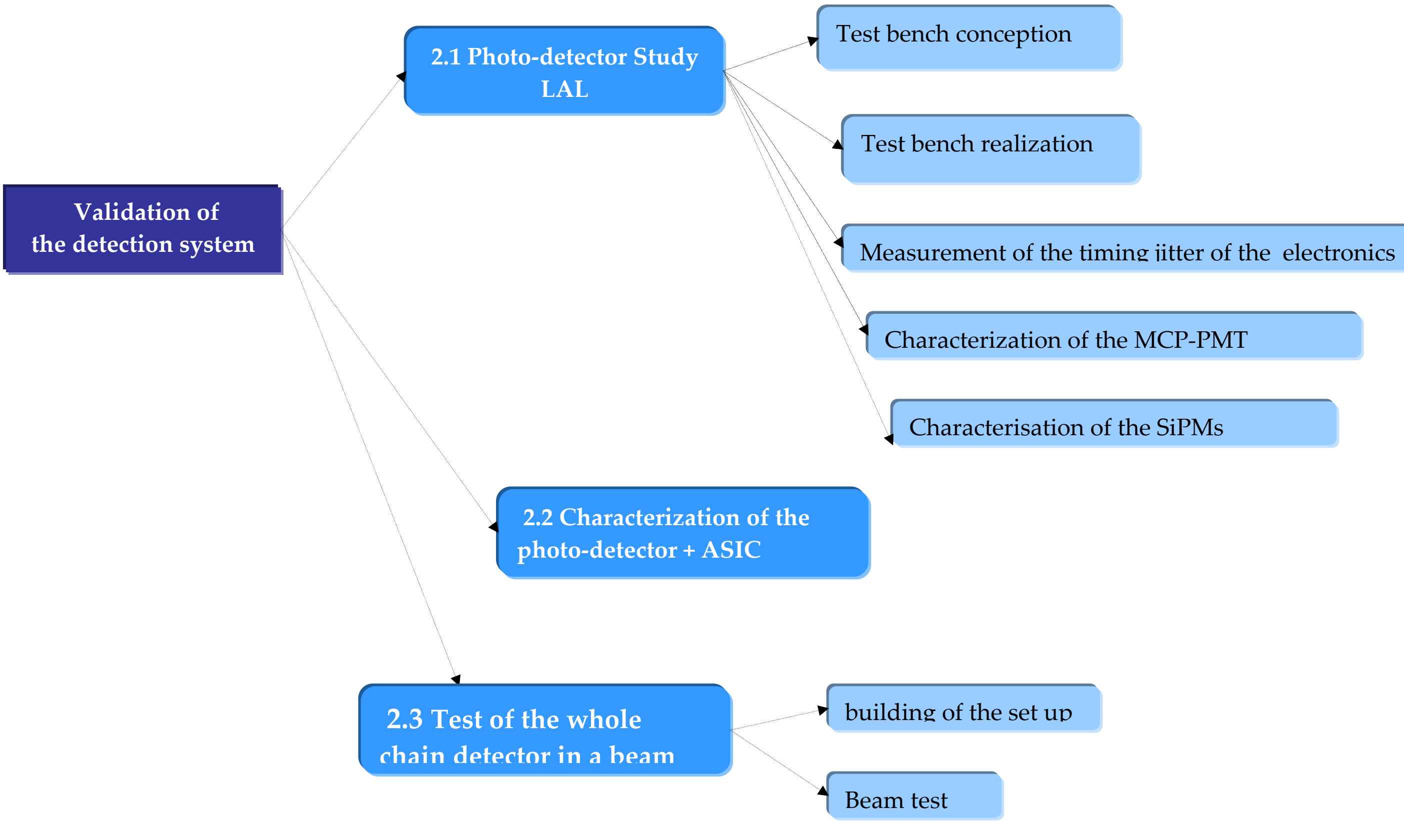
- **Subtask 1.4**: ASIC Test.

The designed ASICs are going to be finely characterized to check their performances. The main test procedures required are yet well known while already used to test either fast already existing analog memories or other types of fast TDCs [E4],[E7],[E11].

<u>The deliverables for task 2.4 will be: ASIC test reports.</u>

TASK 1	***PARTNER-***			***-----Year 1----***				***-----Year2----***				***-----Year 3---***				***-----Year 4---***			
	1	**2**																	
1.1 Electronics & ASIC Architecture																			
1.2 ASICs Design																			
design ASIC 1.0																			
Fab ASIC 1.0																			
design ASIC 1.1																			
Fab ASIC 1.1																			
design ASIC 2.0																			
Fab ASIC 2.0																			
1.3 FE boards design																			
1.4 Asics Test																			

3.2.3 Task 2 : System Validation and Tests



- **Subtask 2.1: Photo-detectors study**

This first subtask will consist in studying and comparing two different kinds of fast photo-detectors: MCP-PMTs and SiPMs.
MCP-PMT is a relatively well known detector and it seems to be today the best choice for timing resolution measurements. The best MCP-PMT existing on the market will be chosen owing to the tests already made by our colleagues for TOF measurements for example. MCP-PMTs supplied by PHOTONIS will also be tested within the framework of our collaboration.

The study will be more important in the case of SiPM since there is still a lot to understand about this device and there are, at least, 4 different producers. The time resolution we want to obtain with this kind of detector is at the limit of the technology and our work will permit determining if the new devices on the market or still on R&D process can fulfill this very demanding requirement. Coupling a SiPM with an electronics that gives a time resolution of few tens of picoseconds will be a challenging task.
SiPMs will be supplied by our Industrial Partner and bought to other producers.

Detailed program:

- Building of the test bench for timing measurements (Figure 6)
- Measurements of the timing jitter of the test bench electronics.
- Characterization of the MCP-PMT: gain, dark count rate, quantum efficiency at one wavelength (Cherenkov light range), after-pulses, linearity, TTS.
- Characterization of 4 different SiPMs: breakdown voltage, gain, dark count rate, photo detection efficiency at one wavelength (Cherenkov light range), after-pulses, cross-talk, linearity, TTS.

Only the TTS will be measured on this new test bench, the other characteristics will be measured with another bench built in 2007 for electrical and optical SiPM characterizations. In particular, the electrical set-up allows the measurement of the static (breakdown voltage, overvoltage, quenching resistance) and dynamic (gain, dark count rate) characteristics. The optical set-up allows the estimation of the photon detection efficiency as a function of the wavelength and the operation voltage. They have been already successfully used for the characterization of single SiPM devices from different producers [D7] as well as for characterization of a 4x4 SiPMs matrix [D8].

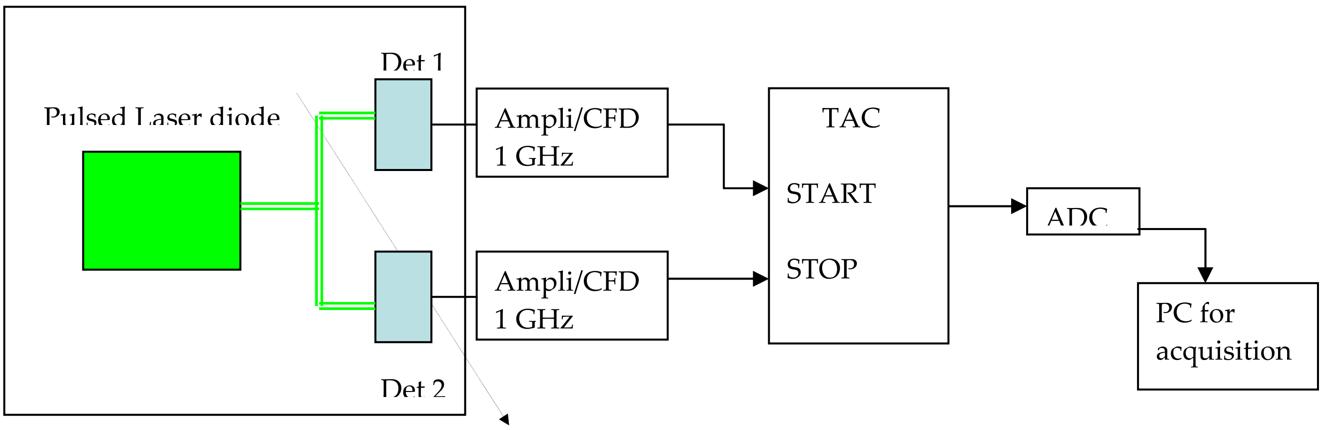


Figure 6: test bench for timing measurements

<u>The deliverable for the subtask 2.1 will be 2 reports: one on the MCP-PMT characterization, the second one on the SiPM characterization.</u>

- <u>Subtask 2.2:</u> Characterization of the photo-detector + electronics

Timing measurements will be reproduced with the boards and ASICs developed by LAL and CEA. The test boards designed will be directly compatible with the detector test bench. This way, it will be easy to compare the results obtained with the classical off the shelf electronics and with the new one. Obviously, the boards will be thoroughly tested and characterized independently before being used with the detector, in order to clearly separate their respective characteristics.

<u>The deliverable for the subtask 3.2 will be a report on the timing measurements with detector (MCP-PMT or/and SiPM) + ASIC.</u>

- **<u>Subtask 2.3:</u> Test of the whole chain detector in a beam test.**

A test beam is the best instrument to study the detection chain performances. We plan to test the whole chain in one of the Test Beam Facilities we have access to (at Fermilab or at CERN with beams of particles ranging from 5 to 120 GeV at moderate intensities (< 1 MHz)).

Program:

- building of the beam test set up : box with detector+photo-detector+ ASIC to be placed in the beam and data acquisition system
- beam test

<u>The deliverable for the subtask 3.3 will be a report on the validation of the whole detection chain</u>

TASK 2	***PARTNER***		***--Year 1---***				***--Year 2---***				***--Year 3---***				***---Year 4---***			
	1	**2**																
2.1.Photo-detectors study																		
Test bench building																		
MCP-PMT characterization																		
SiPMs characterization																		
2.2 Characterization photo-detector + ASIC																		
Detector +ASIC proto1																		
Detector +ASIC proto2																		
2.3 Test of the whole chain detector in a beam test.																		
Building of the beam test set up																		
Beam test																		

3.2.4 Task 3 : Mechanical Integration

The goal of this task is to define the mechanical architecture for the timing detectors.

- **Subtask 3.1 : Mechanical architecture**

This task will consist in defining of the mechanical structure of the timing detector

Deliverable : Preliminary design report

- **Subtask 3.2 : Alignment test bench**

The goal of this task is to define and validate the alignment system by using a prototype on a test bench.

Two types of alignment will be studied: the alignment with respect to the beam line and the alignment with respect to the detector of particles to which it is coupled.

Deliverable : Manufacturing drawings of the prototype and test bench

- **Subtask 3.3 : Thermal analysis**

This task will consist in analysing the impact of the temperature gradient on the stability of the prototype measurements.

Deliverable : Intermediate report and publication of results

- **Subtask 3.4 : Radiation test bench**

In order to position the timing detector closed to the beam, we will study the impact of the radiations by exposition of a prototype.

Deliverable : Manufacturing drawings of the prototype and test bench

- **Subtask 3.5 : Beam test setup**

This task will consist to install a prototype of the timing detector on a beam setup to validate the performances.

Deliverable : Validation of the design. Manufacturing drawings of the timing detector and beam test setup

- **Subtask 3.6 : Validation of the mechanical design (test station)**

The goal of this task is to design and to manufacture a station equipped with a timing detector to demonstrate the reproducibility of the result of the subtask 4.1 to 4.6.

Deliverable : Manufacturing drawings of the test station and final design report

TASK 3 PARTNER 2	Year 1				Year 2				Year 3				Year 4			
3.1 Mechanical architecture	■	■	■													
3.2 Alignment test bench + prototype 1																
Design				■	■											
Manufacturing						■	■									
3.3 Thermal analysis				■	■											
3.4 Radiation test bench + prototype 2																
Design						■	■									
Manufacturing								■	■							
3.5 Beam test setup + prototype 3																
Design								■	■							
Manufacturing										■	■					
3.6 Validation of mechanical design (test station)																
Design											■	■				
Manufacturing													■	■		

3.2.5 Task 4 : Simulation

Objective of the task : Develop realistic models of the photo-detectors and associated electronics that match the measurements results on a test bench, as a function of the operating parameters such as high voltage, rates, samplings, thresholds, temperature and irradiation.

- **Subtask 4.1 Photo-detectors**

4.1.1 Baseline. Signals from Physical models

Physical models of the photo-detectors allow predicting their outputs as a function of their physical parameters such as pore size, number of stages, gap sizes, high voltage, and others.

The fast photo-detectors (micro-channel plates) are described in terms of their physical behaviour: photo-cathode emission, primary gap dynamics, multiplication in the pores array, secondary gap dynamics. The motion of charges is evaluated using the Maxwell equations with the proper boundary conditions, and the current signal is deduced and passed to the front-end electronics simulations.

Deliverables : A set of C++ codes that predict the output signals for a given set of detector parameters.

4.1.2 Back-up. Signals from measurements.

Signals from the photo-detectors are measured under various conditions and a database is built to be used as a parameterized signal source in the front-end electronics simulations.

Deliverables: A database as a set of output signals, as a function of photo-detector parameters.

- Subtask 4.2 Front-end electronics.

Develop models of the electronics front-end signal processing and cross-check with measurements.

4.2.1 Front-end ASIC

A model of the Front-end ASIC.

Deliverable: A set of C++ codes that predict the sampled and digitized signals for a given input evaluated from section 6.1. Model should match the detailed electronics simulations results as well as measurements from a digital sampling oscilloscope on the test bench.

4.2.2 Front-End FPGA

A model of the Front-end FPGA.

Deliverable: A set of C++ codes that predict the extracted charge and timing for digital signals evaluated from section 6.2.1. Model should match the VHDL simulations and measurements from the front-end card assembly on the test bench with micro-channel detectors signals as input.

4.2.3 Data Acquisition

A model of the data acquisition system.

Deliverable: A set of C++ codes that simulate the whole digital data processing including the serial data transmission, error recovery, up to the raw data formatting in the ATLAS readout modules.

- Subtask 4.3 Timing detectors

Develop models of the timing detectors and cross-check with measurements.

4.3.1 GasTOF detector [DE1]

A model of the GasTOF detector including the focusing device onto the micro-channel plates photo-detectors.

Deliverable: A set of C++ codes that simulate the whole GasTOF detector behaviour in terms of output Cerenkov photons focused onto the micro-channel plate detector in response to an incident proton entering the gas radiator.

4.3.2 Quartic detector [DE2]

A model of the Quartic detector.

Deliverable: A set of C++ codes that simulate the whole Quartic detector behaviour in terms of output Cerenkov photons reflected onto the micro-channel plate detector in response to an incident proton entering the quartz bars radiator.

4.3.3 Magnesium Fluoride (MgF_2) detector

A model of a detector comprising a MgF_2 blade radiator and a focusing mirror.

Deliverable: A set of C++ codes that simulate the whole MgF_2 detector behaviour in terms of output Cerenkov photons focused onto the micro-channel plate detector in response to an incident proton crossing the MgF_2 radiator.

- **Subtask 4.4 : Timing distribution system**

Define and simulate a timing distribution strategy within the ATLAS/future B factories mainframe including all possible sources of noises and drifts.

Deliverables : Timing distribution system C++ model consistent with the associated test-bench.

- **Subtask 4.5 : Time Calibration and Thermal analysis**

Define and implement a model of the timing calibration strategy taking into account and recovering from the impact of temperature gradients and other relevant environmental parameters, e.g. voltage supplies noises and drifts, electromagnetic interferences, on the timing stability of the electronics and timing distribution system.

Deliverables : Time Calibration C++ models and their integration in the simulations.

- **Subtask 4.6 : Radiation tests**

Detector and part of the readout electronics will be exposed to a given level of irradiation. This effect should be predicted and modelled.

Deliverables : Radiation induced degradations integrated in all concerned C++ models.

- **Subtask 4.7 : Final integration and validation of the simulation.**

The goal of this task is to design and to provide an overall C++ simulation model of the Timing detector and associated electronics consistent with the test bench measurements.

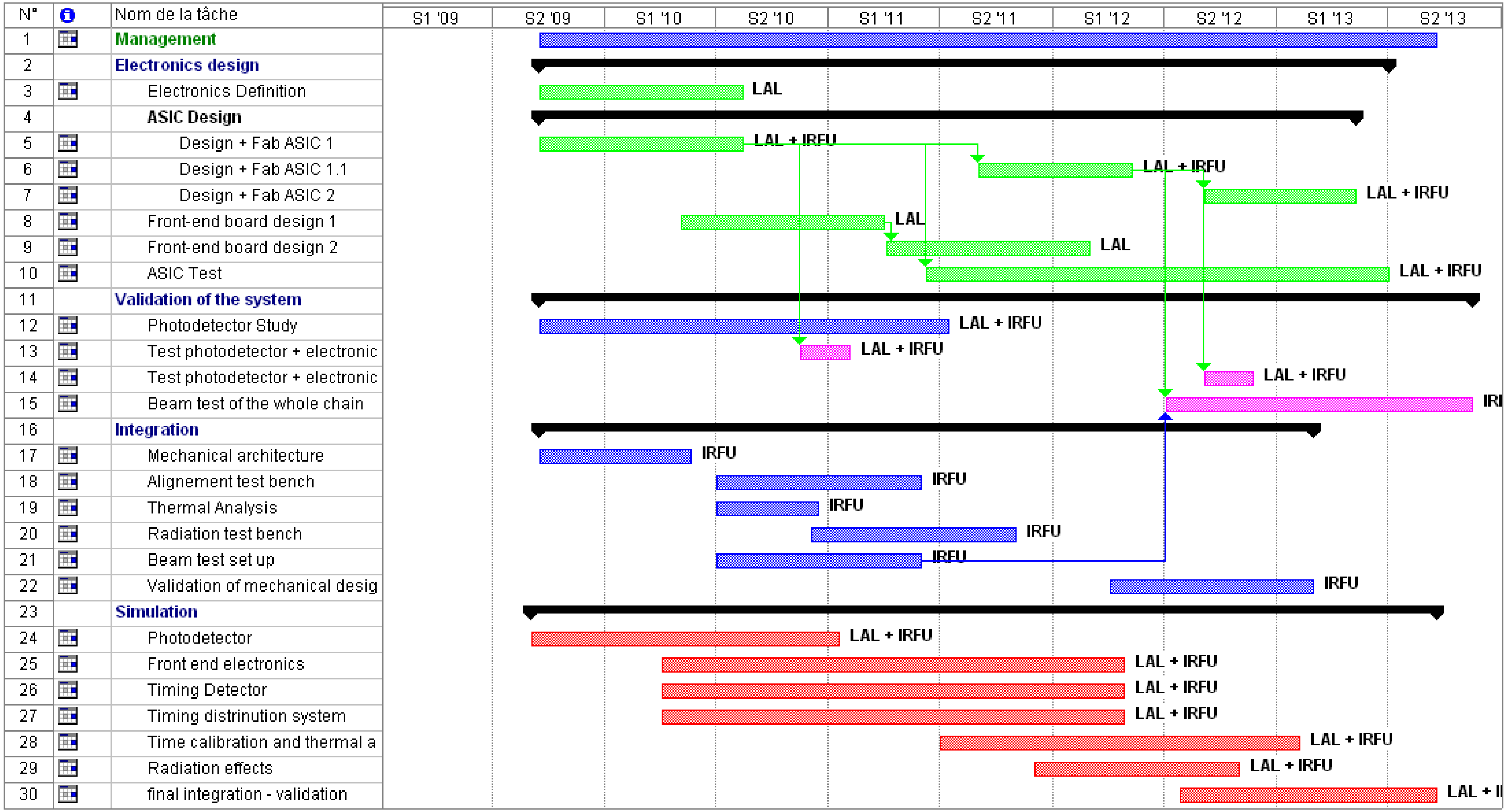
Deliverable : Full timing detector model

Task 4 Timing detectors simulations PARTNER 1 / PARTNER 2	Year 1				Year 2				Year 3				Year 4			
4.1 Photo-detectors																
4.1.1 Baseline. Physical models																
4.1.2 Backup. Measurements																
4.2 Readout Electronics																
4.2.1 Front-end ASIC																
4.2.2 Front-end FPGA																
4.2.3 Data acquisition																
4.3 Timing detectors																
4.3.1 GasTOF																
4.3.2 Quartic																
4.3.3 MgF_2 detector																
4.4 Timing distribution system																
4.5 Time calibration and thermal analysis																
4.6 Radiation hardness																
4.7 Final validation																

3.3. PLANNING OF TASKS, DELIVERABLES AND MILESTONES

Deliverables and milestones			
Task	*Title and substance of the deliverables and milestones*	***Delivery date, in months starting from T0***	*Partner in charge of the deliverable/ milestone*
0. Management			
	0.1: Month-progress Report	6,12,18,24,30,36	1
	0.2:Intermediate Report. Expenses summary	12,24,36	1
	0.3: Final Report	36	1
1. Electronics			
	1.1: Conceptual Design Report: Electronics architecture	14	1
	1.2.a: Report: Chip 1.0 specifications and User manual	21	2
	1.2.b: Report: update of specifications and User manual for Chip 1.1	33	2
	1.2.c: Report: specifications for chip 2.0		1 + 2
	1.3.a: Test bench Manufacturing plans	24	1
	1.3.b: Test bench software/ firmware	27	1
	1.4.a: ASIC 1.1 test report	32	2
	1.4.b: ASIC 1.2 test report	40	2
	1.4.c: ASIC 2.0 test report	48	1 + 2
2. Validation			
	2.1a Report :MCP-PMT characterization	12	1+2
	2.1b Report : SiPM characterization	24	1+2
	2.2 Report : timing measurements of the module : photo-detector + ASIC	27	1+2
	2.3 Test of the whole chain	48	1+2
3. Integration			
	3.1 : Mechanical architecture	9	2
	3.2 : Alignment test bench	21	2
	3.3 : Thermal analysis	15	2
	3.4 : Radiation test bench	27	2
	3.5 : Beam test setup	33	2
	3.6 : Validation of the mechanical design (test station)	42	2
4. Simulation			
	4.1 Photo-detectors	18	1,2
	4.2 Front-end electronics	33	1,2
	4.3 Timing detectors	36	1,2
	4.4 Timing distribution system	36	1,2
	4.5 Time Calibration and Thermal analysis	39	1,2
	4.6 Radiation tests	39	1,2
	4.7 Final integration and validation of the simulation.	48	1,2

Macro Planning of the PS-TOF Project:



4. DATA MANAGEMENT, DATA SHARING, INTELLECTUAL PROPERTY AND RESULTS EXPLOITATION

Scientific communication:

The results of the electronics R&D, the SiPMs timing studies and the whole detection chain characterization will be published in the adapted scientific or technological journals (IEEE TNS or NIM) and presented in international conferences on Instrumentation (IEEE NSS, 12th Vienna Conference in 2010, 6th International Conference on New Developments in Photodetection 2011). Results related to SuperB and ATLAS physics will be published in international journals and presented to international conferences.

Scientific collaboration :

A Scientific Collaboration Agreement will be signed with PHOTONIS or any other company that is interested in improving the timing resolution of its photo-detector.

Valorization of the results

The major challenge of this project is to design a readout electronic with the picosecond precision level usable at a large scale for a very reasonable cost and a very low power. This development will certainly interest different fields of application in Particle Physics, Astrophysics, Material Science and Medical Imagery.
Note that within this project, the person in charge of Industrial transfert is directly involved.

Intellectual property:

The parties will specify the rules regarding the confidentiality, the publications, the intellectual property rights, dissemination and exploitation of the Results originating from the project in a consortium agreement, in the best delay.

The Parties undertake to respect the following terms:

CONFIDENTIALITY – PUBLICATIONS

Any and all publication or communication of information on the Results originating from the project, by either Party , shall be subject, during the term of the consortium agreement, and for 6 months following its expiry date, to the written authorisation of the other Party, which shall provide notice of its decision within a maximum 2-month deadline as from the date of the request. At the end of said deadline, and in the absence of a reply, authorisation shall be deemed to have been given.

OWNERSHIP OF THE RESULTS

The Results originating from the project generated by one Party shall be the sole property of this Party.

The Results originating from the project generated by several Parties shall belong jointly to the Parties in accordance with the respective contribution of the Parties (Joint Results).
With the exception of the case of a waiver by one of the Parties, as provided for hereinafter, the Joint patents (Joint results patented) shall be filed, in France and abroad, in the joint names of the Parties.
The Parties undertake :

- to provide each other with all the technical or administrative documents required to register and obtain the Joint patents;
- to ensure that the names of the inventors are mentioned in the patent applications, according to effective legislation;
- to ensure that their staff, mentioned as inventors, provide any and all signatures and carry out any and all formality required for the registration, obtaining, maintenance in force, and defence of the Joint patents and, in particular, that they sign the assignment of rights relating to American procedure.

Both Parties further undertake to conclude, as soon as reasonably possible, all the agreements which are still lacking, with any and all individual or legal entity which is involved, in any manner whatsoever, either directly or indirectly, in the Project, and the obtaining of Results originating from the Project.

USE OF THE RESULTS ORIGINATING FROM THE PROJECT

Each Party may freely, and without valuable consideration, use the Results originating from the Project generated by one or more other Parties, for their own research requirements only, to the exclusion of any and all direct and indirect use for commercial purposes.

Each Party grants a non-exclusive, non assignable right that may not be sub-licensed and without financial consideration, to the other Parties, to use its Results, to perform their part of the Project.

Each Party shall be free to use and exploit the Results that it has generated by its own during the project.

The co-owner Parties of the Joint Results and the Joint patent related thereof, shall specify the terms and conditions for their use in an agreement prior to any and all industrial and commercial use. The Parties agree that any direct and/or indirect use by the co-owner Party of the Joint results or the Joint patents shall be subject to a contribution being paid to the other co-owner Party according.

5. CONSORTIUM ORGANISATION AND DESCRIPTION

5.1. RELEVANCE AND COMPLEMENTARITY OF THE PARTNERS WITHIN THE CONSORTIUM

Partner 1 : LAL-Orsay

The Laboratoire de l'Accélérateur Linéaire (LAL) is a joint research unit (UMR8607) in partnership with University of Paris Sud and the National Scientific Research Centre (CNRS).

The LAL Electronics group is a very experienced group in high energy physics and astroparticle detector electronics. It is a strong group (52 persons), half of it being composed of Research Engineers. It has been in charge of designing numerous systems, covering the full range between analog and mixed microelectronics circuits, front-end mixed boards, making use of FPGA and DSP, fast serial communication, up to complex digital systems like triggers for LHC experiments. Engineers there have been working on analog memories for 15 years, sharing patents on this subject with their colleagues from IRFU. The evolution of the use of these analog memories in the field of fine time measurement has also been studied during the last years, making this project a natural continuity of former work.

The Instrumentation Group has for missions the conception, the realization and the implementation of experimental assemblies for the Research and Development on Detectors. The Group is currently composed of 2 Reserach Engineers, one Study Engineer, one Engineer Assistant and one Technician. A strong technical support is given by the other Technical Services of the LAL (mechanics, electronics, software). The principal work and the future orientations are related to semi-conductors detectors and photodetection. These last 2 years, the group had focused its work on Silicium Photomultipliers (single device and SiPM matrixes) and their associated electronics.

Partner 2 : CEA-IRFU

IRFU, Institut de Recherche sur les lois Fondamentales de l'Univers, is one of the departments of the Direction des sciences de la matière of the CEA. Located in Saclay close to Paris, IRFU is a leading basic research laboratory in France. Its fundamental research activities cover astrophysics, nuclear physics, Particle Physics and their mutual boundaries.
IRFU is a major actor in physics instruments development, detectors or accelerators; its expertise encompasses cryomagnetism, space technologies, engineering, electronics and data processing. IRFU is involved in many experiments or projects carried out with other French laboratories within international collaborations and IRFU also plays an active part in academic training.
Three laboratories from IRFU are part of this proposal, namely the Service de Physique des Particules (SPP), the Service des Etudes des Detecteurs et de l'Informatique (SEDI) and the Service d'Integration des Systemes (SIS).

The SPP is composed of about 85 permanent physicists, and welcomes each year about 30 to 40 students and post-docs.
It takes part in many experiments on accelerators in the world such as D0 at the Tevatron (Fermilab), Babar at SLAC, ATLAS and CMS at the LHC (CERN), T2K in Japan, and the ILC project. In addition, a strong participation in astro particle and neutrino physics is performed.

The LDEF, detector R&D and front-end electronics laboratory, is a part of the detectors and electronics and computing division (SEDI) of IRFU which includes more than 120 persons. This laboratory (25 persons) is mainly focused on research and development activities on instrumentation and is composed at 2/3 of research engineers. The laboratory houses a microelectronics group (7 engineers) which has been deeply involved in the design of many front end chips for high energy physics (ATLAS, CMS, T2K…), astroparticle and astrophysics (ANTARES, HESS, ECLAIRS…) and nuclear physics (SPIRAL). **The group has been developing fast analogue memories since more than 15 years, often in close collaboration with IN2P3/LAL, and is continuously improving this technique. It is now one of the three world leaders in this domain.**

The SIS deals with mechanical engineering, general instrumentation in order to develop experimental apparatus in fundamental research. The mechanical activities group two different laboratories dealing from the conception to the industrial application. The SIS has a lot of experience in particle physics equipment and especially in radiation and thermal analyses.

5.2. QUALIFICATION OF THE PROJECT COORDINATOR

Civilité	**Nom**	**Prénom**	**Age**
Mr	Stocchi	Achille	45 ans
Grade	Professeur (2eme classe)	**Employeur**	Université Paris Sud.
Mail	stocchi@lal.in2p3.fr	**Tél**	**+33 (0)1 64 46 89 50**

Formation
2006 : Professeur à l'Université Paris-Sud
2003 : Habilitation à diriger les recherches.
1993 : Position permanente (Chargé de recherche 1) au LAL-Orsay
1993 : Thèse de Doctorat, Université de Paris XI
→**1990** : Thèse de fin d'etudes universitaires à l'Université de Milan.

Expériences de coordination :
- Responsable du groupe BaBar au LAL (2006→), DELPHI (2001-2005), SuperB (2007→)
- Deputy Spokeman de DELPHI entre 2001-2005 et coordinateur de la physique de DELPHI (2001-2004). Coordinateur de la physique du B (1999-2001).
- Conveners à différents workshops et conférences (EPS, ICHEP, CKM..)
- Co-directeur de l'Ecole de Physique de Hautes Energies TES-HEP
- Directeur du Master 2 NPAC (Noyaux Particules Astroparticules et Cosmologie)
  Directeur (à partir de Septembre 2008) de l'Ecole Doctorale Constituants Elémentaire et Système Complexes à Paris Sud [future Ecole Doctorale CEC (Constituants Elémentaires et Cosmos)]

Publications :
679 publications dans des revues référées. (DELPHI, BaBar, phénoménologie,..)
Au sein de DELPHI et BABAR je suis auteur principal d'une vingtaine de publications.
J'ai publié 30 papiers de phénoménologie qui ont reçu une moyenne de 65 citations par papiers.

Activités de recherche :
Analyse de données / physique de particules:
1993→ J'ai effectué la plupart de mon activité de recherche en travaillant sur l'analyse des données dans les expériences BaBar et DELPHI. Je me suis occupé principalement de la physique des mésons B et recherche du Higgs. J'ai souvent présenté les résultats lors des conférences et séminaires internationaux (en totale une trentaine).
Sur ces sujets j'ai encadré quatre thèses de doctorat et deux thèses sont en cours.
Activité de phénoménologie :
1997→ Depuis dix ans j'ai une activités de phénoménologie sur la recherche de la nouvelle physique dans les mesure de physique du B. J'ai présenté les résultats de ces travaux à une trentaine de conférences et séminaires. Mes travaux phénoménologiques et de revue ont donné lieu à 30 publications phenomenologiques qui ont reçu une moyenne de 65 citations par papiers. En 2000 j'ai fondé la collaboration UTFit. Je suis co-fondateur et parmi les organisateurs de la série de conférences sur la physique du B (CKM Workshop). Nous avons organisé cinq workshops : en 2002 au CERN, 2003 Durham, 2005 San Diego, 2006 Nagoya, 2008 Roma.
J'ai coordonné les activités pour écrire le Conceptual Design Report (CDR) pour l'élaboration du programme de physique d'une machine à haute luminosité pour l'étude de la physique des saveurs
Activité détecteurs/accélérateurs:
Au début de ma carrière j'ai participé à la caractérisation du détecteur de silicium de DELPHI et à la conception du système pour en contrôler l'alignement. J'ai aussi contribué au système de SLOW Control.
En Septembre 2007 j'ai formé un groupe au LAL pour travailler sur l'expérience de Frascati pour

tester les nouvelles idées de schéma d'accélération pour une future usine à B. Nous avons participé à la caractérisation des calorimètres pour mesurer la luminosité, à l'électronique, shifts et analyse de données

Activités didactiques :

Je suis professeur à l'Université Paris Sud. J'ai enseigne des cours à l'Ecole Doctorale, Master et aux premières années. J'enseigne ou enseigné dans différents Ecoles Doctorales (Rome, Valencia..) et donné plusieurs cours aux écoles internationales d'hiver ou d'été. Je suis co-fondateur et co-directeur de l'Ecole de Physique de Hautes Energies TES-HEP (étudiants de l'Ouest et de l'Est Europe).

Liste des 5 publications (ou brevets) les plus significatives des cinq dernières années:

- A. J. Buras, F. Parodi, A. Stocchi, ``The CKM Matrix and The Unitarity Triangle: Another Look'' **JHEP 0301 (2003) 029.**
- M. Battaglia, A. Buras, P. Gambino and A. Stocchi (Editors) ``The CKM Matrix and the Unitarity Triangle'' (Yellow-Book) **CERN-2003-002-corr (2003)**
- B. Aubert et al. (BaBar Coll.) "Time-dependent Dalitz plot analysis of B0 --> D-/+K0 pi+/- decays," **Phys. Rev. D 77, 071102(R) (2008)**
- D. Alesini et al. « DAFNE upgrade » Sept. 2008, .**Phys.Proc.Suppl.181-182:385-389,2008.**
- M. Bona et al. "SuperB: A High-Luminosity Asymmetric e+ e- Super Flavor Factory. Conceptual Design Report" **SLAC-R-856, INFN-AE-07-02, LAL-07-15, May 18, 2007. 480pp. arXiv:0709.0451 [hep-ex]**

5.3. CONTRIBUTION AND QUALIFICATION OF EACH PROJECT PARTICPANT

Partner 1 : LAL

Nom	Prénom	Emploi actuel	%	Pers.mois	Rôle / Responsabilité dans le projet
STOCCHI	Achille	Professeur	60	28.8	Projet Coordinator- Simulation
ARNAUD	Nicolas	Ch. De recherche	40	19.2	Responsible of task 4
BURMISTROV	Leonid	PH. Student	50/2 ans	12	Subject of PHD thesis related to task 4
PEREZ	Alejandro	Post Doc	100/1 an	12	Post Doc, subject related to task 2 and 4
BRETON	Dominique	IR *	25	12	Co-responsible of electronics task number 1
MAALMI	Jihane	IR	40	19.2	Digital electronics, especially the time extraction from the digitized samples
BEIGBEDER	Christophe	IR	25	12	Digital electronics and board design
TOCUT	Vanessa	IR	25	12	ASIC design
PUILL	Véronique	IR	40%/30months	12	Co-responsible of the system validation task number 2 - Test benches conception – photodetector characterization
DINU	Nicoleta	IR	10%	3	Measurements analysis
CHAUMAT	Vincent	AI	50%/30 months	15	photodetector characterization (timing resolution)
VAGNUCCI	Jean François	Technicien	20%/30months	6	Test bench building
BAZIN	Cyril	Ingénieur d'Etude	40%/30months	12	Photodetector characterization (gain, dark-count rate, QE ...)
SYLVIA	Christophe	AI	20%/24months	4.8	Acquisition software
?	?	Post Doc 2 ans	100 %	24	simulation and participation to the tests
?	?	IR CDD 2 ans	100%	24	Test benches conception – photodetector characterization

* IR : Ingénieur de Recherche, AI : Assistant Ingenieur

Partner 2 : CEA-IRFU

Nom	Prénom	Emploi actuel	%	Personne.mois	Rôle/Responsabilité dans le projet 4 lignes max
ROYON	Christophe	Directeur de Recherche CEA	60%	28.8	Co-responsible of the system validation task number 2 (Photodetector and electronics)
DELAGNES	Eric	Ingenieur CEA	25%	12	Co-responsible of electronics task number 1
PONSOT	Patrick	Ingenieur CEA	25%	12	Responsible for integration task number 4
STASZEWSKI	Rafal	Etudiant	40%	19.2	Tests of electronics and detectors, radiation and beam tests
SALEK	David	Etudiant	25%	12.	Electronics simulation
KEPKA	Oldrich	Etudiant	10%	4.8	Photodetector tests
?	Student 3 years	To be employed (paid by IRFU)	100%	36	Engineer – Working on ASIC design, electronics tests
?	?	Technician to be employed (paid by ANR)	100%	6	Mecanical design for Integration task
?	Post-doc 3 years	To be employed (paid by ANR)	100%	36	Simulation, test bench, beam tests

6. SCIENTIFIC JUSTIFICATION OF REQUESTED BUDGET

6.1. PARTNER 1 : LAL

Expenses :

Tâche	Type	Prix HT (k€)
Task 1 : electronics	Sous-traitance	61
	Small equipment	4
Task 2 : photodetector tests + électronics	equipment	80
	Small equipment	17,2
	Internal bill	0,5
	Personal	108
Task 4 : Simulation	Personnal	103.6
Total		**374.3 k€**

Time expenses :

Years	Year 1	Year 2	Year 3	Year 4
Test bench (ASIC 1.1)		5		
Test bench (ASIC 1.2)			5	
Test bench (ASIC 2.0)				6
Prototype ASIC 2.0				45
Small electronics equipment	1	1	1	1
Test bench equipment + ASIC	20	60		
Small equipment (+ intern subcontacting) detector test bench + ASIC	11.1	6.6		
CDD engineer 24 months	54	54		
Post-Doc	51.8	51.8		
Expenses except missions (k€)	122.9	184.4	6	52
Missions (k€)	23	23	23	21

Equipment

The characterization of SiPM and MCP-PMT at the picosecond level required the purchase of fast electronics equipment (Figure 6), and of course, the purchase of the photodetectors.

Equipment > 4000 Euros	Prix unitaire (k€)	Quantité	Prix HT (k€)
Task 2			
MCP-PMT	20	2	40
MCP-PMT HV power supply 2 channels	5	1	5
Picosecond pulsed laser	20	1	20
Chassis	10	1	10
ADC 14 bits	5	1	5
Total Equipment			**80**

Manpower

Task 2 : a CDD research engineer for 24 months (105 k€)

Mission :

The engeneer in scientific and experimental technics will take part in the study and the building of the test bench for photodetectors and electronics

Activities :
- Conception of the test bench
- Porgramming the data acquisition system for the test bench
- Take part in detector characterisations

Experience :
- General knowledge in physics
- Knowledge in engineering : electronics, data acquisition, optics, mechanics, industrial drawing
- Technical English

Task 4 : One post-doc of two years is asked related to the project. The post-doc will be employed in the end of 2009 for two years, and will be mainly working on the simulation and participate in the tests of the PM and the PM + electronic chain collaborating with people working on the task 3.

The cost for one post doc is 103.6 kEuros for 2 years.

Subcontracting

The development of the test bench mainly resides in the design of the test board. Once the latter is complete, the components have to be ordered, the PCB has to be manufactured and the board cabled. Those three aspects will be covered by external companies. Two boards will be produced for each bench, in order to be able to compare their results and to set up two benches in different labs.

The standard offer for the prototyping of an ASIC in decribed in the section of partner 2 (IRFU).

Subcontacting :	Prix unitaire (k€)	Quantité	Prix HT (k€)
Test board 1.1	2,50	x 2	5,00
Test board 1.2	2,50	x 2	5,00
Test board 2.0	3,00	x 2	6,00
prototype ASIC 2.0	45,00	x 1	45,00
Total Subcontacting			**61,00**

Missions

Each year, the following travels are foreseen:

Task 1:

- 2 travels to USA, (typically one week each), for working meetings with the American experts of the domain (university of Chicago, SLAC). Estimated cost : 3.5k€/year.
- Attendance to one conference for 3 engineer/ year : 4.5 k€/an

Task 2:

- 2 travels to USA, (typically one week each), for working meetings with the American experts of the domain (university of Chicago, SLAC) : 3.5 k€
- Attendance to one conference / year : 1.5 k€/an

Task 4:

- 2 travels to USA, (typically one week each), for working meetings with the American experts of the domain (university of Chicago, SLAC) for 2 people: 7 k€
- Attendance to one conference / year for 2 people : 3 k€/an

Années	Year 1	Year 2	Year 3	Year 4
Task 1 (k€)	8	8	8	8
Task 2 (k€)	5	5	5	3
Task 4 (k€)	10	10	10	10
TOTAL MISSIONS	23	23	23	21

Internal expenses

Internal expenses Task 2:	Price HT (k€)
Detector supports, assembly of Faraday cage	0,5
Total : Internal expenses	**0,5**

Other expenses

Small equipment	Unit Price (k€)	Quantity	Price HT (k€)
Small equipment Task 2			
amplifier 1 GHz + timing discriminator	2,8	2	5,6
time to amplitude converter	1,9	1	1,9
cables, connectors, small electric equipment	2	1	2
Optics table	0,7	1	0,7
Optical material : fibers, filters, support …	1,5	1	1,5
Faraday cage	1	1	1
PC + screen	0,8	1	0,8
licence Labview	0,3	1	0,3
SiPM 1 mm2	0,2	10	2
SiPM 9 mm2	0,35	4	1,4
Small equipment task 1	1	4	4
TOTAL SMALL EQUIPMENT			21,2

6.2. PARTNER 2 : IRFU

Total expenses (no mission) :

	Type	Unit price (k€)	Quantity	Price HT (k€)
« Europractice » CAD Licenses	Equipement > 4 **k€**	3	x 4	12,00
Pulse generator	Equipement > 4 **k€**	20	x 1	20,00
Small equipment	Small equipment	1	x 4	4,00
Prototyping ASIC 1	Subcontacting	30,00	x 2	60,00
Timing detectors	SUBCONTACTING	30,00	X 2	60,00
Total				**156,00**

Répartition du financement souhaité pour les différentes dépenses envisagées :

Year	Year 1	Year 2	Year 3	Year 4
ASIC 1		30	30	
Licences	3	3	3	3
Pulse generator	20			
Small equipment	1	1	1	1
Timing detectors	0	0	1	1
Expenses except missions(k€)	24	34	64	34
Missions (k€)	15	15	15	20

Equipment

Development and test of ASICs :

The design of integrated circuits makes it necessary to make use of very costly CAD software tools. Nevertheless, for a use in a context of academic research, and in the frame of Europractice to which we belong, the yearly fee for the user rights for these software tools is reduced. We foresee to make use of such a licence for 4 years.

The fine characterization of foreseen ASICs makes it necessary to make use of an ultra-fast pulse generator, with transition times tunable within a ns and programmable pulse width. This synchronizable and multi-channel generator will be used to simulate the pulses delivered by the photodetectors. The laboratory currently doesn't own such an equipment.

We also need to purchase timing detectors to construct the whole detection chain and to test it in beam.

Equipment > 4000 Euros	Unit Price (k€)	Quantity	Price HT (k€)
Timing detectors	30	x 2	60,00
Licenses CAO « Europractice »	3	x 4	12,00
Pulse generator	20	x 1	20,00
Total Equipment			**92,00**

Small Equipment	Unit Price (k€)	Quantity	Price HT (k€)
Small equipment	1	x 4	4,00
Total Small Equipment			**4,00**

Manpower

Post-doc:

One post-doc of three years is asked related to the project. The post-doc will be employed in the end of 2009 for three years, and will be mainly working on the simulation and participate in the tests. The first months will be dedicated to the participation in the tests of the photodetectors. The rest of the first year will be devoted to the electronics simulation. The post-doc will be directly related to the test stand so that he can compare the results of the simulation to the tests. The second task will be the simulation of the detector and of the full system (photodetectors, electronics and detectors) so that it can be used directly in GEANT. The post-doc will be helped by a student to be recruited in ATLAS-Saclay. The last year of the post-doc will be more dedicated to the tests of the full system using the test stand and beam tests at CERN or Fermilab.

The cost for one post doc is 155.4 k€ for 3 years.

CDD research engineer:

One research engineer will be employed for 6 months on the mechanical design (Integration task)

The cost for one CDD is 27 k€ for 6 months.

Subcontracting

The standard offer for ASIC prototyping comprises, besides manufacturing, the delivery of 25 prototypes out of which 5 only are packaged in ceramic. The associated cost is integrated in the overall prototyping cost.
Concerning ASIC manufacturing, we feel like making use of CMP (46 av. Felix Viallet 38031 Grenoble Cedex), mixed research entity between CNRS, Université Joseph Fourier and INPG (UMS 3040)), or of his Belgian (IMEC) or American (MOSIS) equivalents. Theses organisms first permit accessing advanced microelectronics technologies for user wihtout big production volumes. Moreover, they gather projects from different customers to have them manufactured in a unique production site. In particular, this permits sharing the tool costs (masks…) which have become prominent in microelectronics. This possibility is particularly worth it on the economical point of view in the case of a prototype production.
The price estimates are based on the costs of prototypes designed by the lab during the last years.

Subcontacting :	Unit price (k€)	Quantity	Price HT (k€)
prototyping ASIC 1	30,00	x 2	60,00
Total Subcontacting			**60,00**

Missions

Each year, the following travels are foreseen:

- 4 trips to USA, (typically 1 week each), for working meetings with the American experts of the domain (university of Chicago, SLAC), Estimated cost 6kE/year. This covers also the expenses for the post-doc. Meetings at CERN, with photonis 3kE/an
- Attendance to 4 conferences / year : 6 kE/an (2 conferences are for the post-doc)
- Participation to beam tests in 2012 : 5 kE

Year	Year 1	Year 3	Year 3	Year 4
Expenses Missions (k€)	15	15	15	20

7. ANNEXES

7.1. REFERENCES

[PH1] M. Bona et al. "SuperB: A High-Luminosity Asymmetric e+ e- Super Flavor Factory. Conceptual Design Report" SLAC-R-856, INFN-AE-07-02, LAL-07-15, May 18, 2007. 480pp. arXiv:0709.0451 [hep-ex].
T. Browder, M. Ciuchini, T. Gershon, M. Hazumi, T. Hurth, Y. Okada, A. Stocchi "On the Physics Case of a Super Flavour Factory" JHEP 0802:110,2008. e-Print: arXiv:0710.3799 [hep-ph].
[PH2] M. Boonekamp, R. Peschanski, C. Royon, Phys. Rev. Lett. 87 (2001);
V.A. Khoze, A.D. Martin, M.G. Ryskin, Eur. Phys. J. C19 (2001) 477;Eur. Phys. J. C23(2002) 311;
B. Cox, F. Loebinger, A. Pilkington, JHEP 0710 (2007) 090;
S. Heinemeyer et al., Eur.Phys.J. C {\bf 53} (2008) 231.

[E1] http://www.ortec-online.com/electronics/amp/9327%20spec.htm
[E2] Binkley et al. Nuclear Science, IEEE Transactions on, Volume 49, Issue 3, Part 2, June 2002 Page(s):1130 – 1140
[E3] J.Va'vra et al., Nucl.Instr. and Meth. A 572 (2007) 459–462.
[E4] M. Mota et al., « A High-Resolution Time Interpolator Based on a DLL and a RC Delay Line », IEEE JSSC, vol 34,n°10,oct99.
[E5] L. Bardelli et al « Time measurements by means of digital sampling…. », NIM A A 521 (2004) 480–492
[E6] Genat J.F., private communication.
[E7] E. Delagnes et al., Nucl. Instr. Meth. A567 (2006) 21
[E8] D. Breton, E. Delagnes, M. Houry, "Very High Dynamic Range and High Sampling Rate VME Digitizing Boards for Physics Experiments", Nuclear Science, IEEE Transactions on, VOL. 52, NO. 6, DEC. 2005, pp 2853-2860
[E9] "Echantillonneur analogique rapide à grande profondeur mémoire ", D. Breton, E. Delagnes, 24 avril 2001 (Brevets ref FR2924177, WO022315, US N° 6 859 375).

[E10] " Echantillonneur analogique rapide pour enregistrement et lecture continus et système de conversion numérique ", D. Breton et E.Delagnes, 25 juin 2005, Fr 2 872 331 (EP1759394).
[E11] G. Varner et al, NIM A591 (2008) 534

[D1] http://sales.hamamatsu.com
[D2] http://www.photonis.com/industryscience
[D3] *A 30 ps timing resolution for single photons with multi-pixel burle MCP-PMT*, J. Va'vra.et al., NIMA, 2007, vol. 572, n°1, pp. 459-462
[D4] *Proximity focusing RICH with TOF capabilities*, P. Kriˇzanab et al., Nuclear Physics B (Proc. Suppl.) 172 (2007) 227–230
[D4] http://www.sensl.com
[D5] http://www.fbk.eu/research/scientific
[D6] http://www.photonique.ch
[D7] *Characterization of a prototype matrix of Silicon Photomultipliers*, N. Dinu, P. Barrillon, C. Bazin, N. Belcari, M.G. Bisogni, S. Bondil-Blin, M. Boscardin, V. Chaumat, G. Collazuol, C. de La Taille, A. del Guerra, G. Llosá, S. Marcatili, M. Melchiorri, A. Tarolli, C. Piemonte, V. Puill, J.F.Vagnucci, N. Zorzi J.F.Vagnucci, Proceedings of the New Developments in Photodetection Conference 2008, NIM A (to be published)
[D8] *Electro-optical characterization of SiPM: a comparative study*, N. Dinu, Z. Amara, C. Bazin, V. Chaumat, C. Cheikali, G. Guilhem, V. Puill, C. Sylvia,, Proceedings of the New Developments in Photodetection Conference 2008, NIM A (to be published)

[DE1] L. Bonnet et al (for the FP420 Collaboration) Vol. 38 (2007) ACTA PHYSICA POLONICA B No 2
[DE2]http://www.fp420.com/conference/dec2005/talks/QUARTIC%20A%20Precise%20ToF%20Detector%20for%20the%20FP420.ppt

7.2. CV, RESUME

Civilité	Nom	Prénom		Age
Mr	ROYON	Christophe		40
Grade	Research Director	Laboratory	IRFU-SPP, CEA Saclay	
Mail	royon@hep.saclay.cea.fr	Tél	+33 1 69 08 83 76	

Formation 1987-1991: Ecole Normale Superieure, Physics
1990: Agregation in Physics
1994: PhD in Particle Physics, University of Orsay and CEA Saclay
1998: Habilitation to lead researches, University of Orsay

Experience: 1991-2000 H1 Experiment, DESY. Hamburg
1999-present: D0 Experiment, Fermilab, Chicago
2000-2002: Convener of D0 muon group
2000-2005: Member of the D0 'speakers'bureau'
2002-2004: Convener of the QCD physics group
2004-2006: Convener of the D0 Jet Energy Scale group
2006-present: ATLAS Experiment, CERN, Geneve
2008-present: Project coordinator with Brian Cox of Manchester University to install forward detectors in the ATLAS collaboration.
Chairman of the organizing committee of the Low x and Small x (Fermilab) series of conferences Member of the International Organising Committee of the Diffraction series of conferences.
Organisation of the QCD and diffractive sessions at the DIS workshops, responsible for the QCD session at the ICHEP 2006 conference in Moscow
PhD advisor of 9 students (3 ongoing)

Publications : 415 publications (H1, D0, DELPHI experiments and phenomenology) in independently reviewed articles

List of 5 publications :

1. Inclusive Higgs boson and dijet production via double pomeron exchange, M. Boonekamp, Robert B. Peschanski, C. Royon, Phys. Rev. Lett.87:251806, 2001.
2. Anomalous WW gamma coupling in photon-induced processes using forward detectors at the LHC, O. Kepka, C. Royon, Phys. Rev. D78:073005, 2008.
3. Search for exclusive events using the dijet mass fraction at the Tevatron. O. Kepka, C. Royon, Phys. Rev. D76:034012, 2007.
4. Measurement of the inclusive jet cross-section in p anti-p collisions at s**91/2) =1.96-TeV, D0 Collaboration, Phys. Rev. Lett. 101:062001,2008.
5. Diffractive SUSY particle production at the LHC, M. Boonekamp, J. Cammin, S. Lavignac, Robert B. Peschanski , C. Royon. Phys. Rev. D73:115011, 2006.

Civilité	**Nom**	**Prenom**	
Mr	STASZEWSKI	Rafal	24
Grade	M.Sc.	**Laboratory**	CEA Saclay/IFJ PAN Krakow
Mail	rafal.staszewski@gmail.com	**Tél**	+48 693-416-310

Formation:
2008 – …International PhD Studies at the H. Niewodniczanski Institute of Nuclear Physics Polish Academy of Sciences (IFJ PAN)
2003 – 2008 Jagellonian University in Krakow, Faculty of Physics, Astronomy and Applied Computer Science. Thesis title: "*Diffractive processes at the LHC and simulation of silicon detectors for measurement of diffractive protons at very small angles*". Final grade: very good.
1999 – 2003 Tadeusz Kosciuszko High School no. 4 in Krakow

Experience:
2008 Trans-European School of High Energy Physics, Buymerovka, Ukraine.
2007 DESY Summer Student Programme, Hamburg, Germany.

Civilité	**Nom**	**Prenom**	
Mr	Burmistrov	Leonid	25
Grade	M.Sc.	**Laboratory**	LAL-Orsay
Mail	burmistr@lal.in2p3.fr	**Tél**	

Education
2008→PhD student, Université de Paris XI
2008 Master 2 NPAC (Noyaux Particules Astroparticules et Cosmologie), Université de Paris XI
2007 Master 2 Experimental Nuclear Physics, National Taras Shevchenko University of Kyiv

Research activities
1. Data analyses / nuclear physics:
2005-2007 I was working on Width of Giant Dipole Resonance. During this work I obtained new physical ground formula for the width. This formula has a good consistence with experimental data. I studied fitting packages as FUMILI (FORTRAN) and MINUIT(C++). The result of my work was presented in two student conferences.
2. Work with Detectors:
2006 During two months I participated in GSI International Summer Student Program. I was working on Time of flight (TOF) system for Hyper Nuclei Spectroscopy With Heavy Ion Beam (Hyphi) experiment. A big amount of my time was devoted for time calibration of plastic scintillator detector. CAMAC and VME data acquisition system were used. The results were presented on the student conferences.
3. Work with simulation packages:
2008 I work on simulation of the DAFNE upgrade interaction region, for this I am studying GEANT4 Monte Carlo package. Some results were presented on the TES HEP summer school in Ukraine.

Education activities
2005-2007 I was supporting and developing laboratory work for students as well as making control of their knowledge.

Civilité	**Nom**	**Prénom**	**Age**
Mr	PONSOT	Patrick	49 ans
Grade	Ingénieur mécanicien	**Laboratory**	CEA-Saclay /DSM/IRFU
Mail	**Patrick.ponsot@cea.fr**	**Tél**	**01 69 08 79 30**

Formation

Ingénieur mécanicien ISTAé (Institut des Sciences et Techniques de l'Aéronautique)

Experience

1996 - 1997 : Diplôme d'ingénieur mécanicien à l'ISTAé (Institut des Sciences et Techniques de l'Aéronautique)
1998 - 2001 : Ingénieur d'études - Responsable de l'architecture mécanique d'instrument de physique
2002 - 2008 : Chef de projet Atlas-Muon (responsable du système d'alignement des chambres à muons)
2007 - 2008 : Chef du laboratoire SIS/LCAP chargé de prendre en charge l'architecture et la conception mécaniques des projets de l'IRFU (Laboratoire de Conception et d'Avants-Projets de l'IRFU)

Research Activities

1983 - H1 (Desy) – Cryostat argon liquide des calorimètres (EM et Hadronique) – Etudes cryomécaniques et cryogéniques.
1986- DELPHI-TPC (CERN-LEP) – Etude de la cage en composite carbone-alu, de l'intégration des détecteurs et de l'installation en caverne
1990 - RD3 (R&D CERN-LHC) – Avant-projets et étude d'un prototype de calorimètre hadronique argon liquide puis de son cryostat de test
1992 - ATLAS-Toroïde – Etude de l'architecture mécanique du toroïde; Etude et suivi de la campagne de test à froid des systèmes de glissement des biellettes en titane.
1994 à 2008 - ATLAS-Muons – Système d'alignement et de mesure magnétique – R&D, conception, définition, réalisation, assemblage et calibration de plus de 4000 capteurs sur le site de Saclay, intégration sur les chambres au CERN, installation et réception en caverne (hardware et software).

List of publications :

1) ATLAS 2004 Combined Test Beam results : Muon Chamber Alignment and Muon Reconstruction ATL-MUON-PUB-2007-003; ATL-COM-MUON-2006-012.- Geneva : CERN, 14 Apr 2006
2) System Test of the ATLAS Muon Spectrometer in the H8 Beam at the CERN SPS. ATL-MUON-PUB-2007-005; ATL-COM-MUON-2007-011.- Geneva, CERN, 2007
Study of the ATLAS MDT Spectrometer using High Energy CERN combined Test beam Data. ATL-COM-MUON-2007-013.- Geneva, CERN, 2007
3) Combined test beam results on the alignment of muon chambers and muon reconstruction in the 2004 ATLAS H8 setup.
Prepared for 10th Pisa Meeting on Advanced Detectors: Frontier Detectors for Frontier Physics, La Biodola, Elba, Italy, 21-27 May 2006. Published in Nucl. Instrum. Meth. A 572, 98-101, 2007.
4) **The control on the deformation of the ATLAS barrel toroid warm structure.**
Prepared for 10th Pisa Meeting on Advanced Detectors: Frontier Detectors for Frontier Physics, La Biodola, Elba, Italy, 21-27 May 2006. Published in Nucl. Instrum. Meth. A 572, 145-148, 2007
5) The alignment system of the barrel part of the ATLAS muon spectrometer
The alignment system of the muon spectrometer of the LHC experiment ATLAS is described. Emphasis is put on the optical systems, and the fitting programs used to calculate the actual muon chamber positions. [...] ATL-COM-MUON-2008-002.- Geneva : CERN, 2008

Civilité	Nom	Prénom		Age
Mr	Delagnes	Eric		41
Grade	Ingénieur Electronicien	**Employeur**	CEA	
Mail eric.delagnes@cea.fr		**Tél**	+33 (0)1 69 08 22 52	

2002- : Chef du laboratoire R et D détecteur et électronique frontale (LDEF) à l'IRFU (Saclay)
1992- : CEA/DAPNIA (puis IRFU) Saclay. Ingénieur en conception d'ASICs analogiques et dédiés à l'équipement d'instruments de recherche. Développements pour les différents thèmes de recherche du DAPNIA (Physique de particules, nucléaire, astrophysique, astroparticules…) ATLAS, INTEGRAL, ANTARES, COMPASS, HESS2, T2K : 300000 canaux d'électronique conçus en fonctionnement ou en cours d'installation dans ces diverses expériences.
1991-1992 : Thomson RCM : ingénieur en conception d'ASICs analogiques pour application
1990-1991 : CEA DAM (Bruyères-le-Chatel) : Scientifique du contingent : Etude de la vulnérabilité de la technologie microélectronique DMILL aux radiations ionisantes.
1990 : Ingénieur Electronicien ENSEEIHT 1990.
1990 : DEA Microélectronique INPT 1990.

Expertise sur les circuits microéléctroniques frontaux bas bruit et à grande dynamique, en particulier basés sur des mémoires analogiques.

Liste des 5 publications (ou brevets) les plus significatives des cinq dernières années:
Auteur ou co-auteur actif d'une quarantaine de publications dont voici un échantillon significatif :

1. **"A Low Power Multi-Channel Single Ramp ADC With Up to 3.2 GHz Virtual Clock".,**Delagnes, E.; Breton, D.; Lugiez, F.; Rahmanifard, R.;Nuclear Science, IEEE Transactions on Volume 54, Issue 5, Part 2, Oct. 2007 Page(s):1735 – 1742
2. **"SAM: A new GHz sampling ASIC for the HESS-II front-end electronics "**, E. Delagnes, Y. Degerli, P. Goret , P. Nayman, F. Toussenel, P. Vincent, Nucl.Instrum.Meth.A567:21-26,2006.
3. **"Very High Dynamic Range and High Sampling Rate VME Digitizing Boards for Physics Experiments"**, D. Breton, E. Delagnes et M. Houry, Nuclear Science, IEEE Transactions on, VOL. 52, No. 6, Dec. 2005, pp 2853-2860
4. **"The Analog Ring Sampler: an ASIC for the Front-End Electronics of the ANTARES Neutrino Telescope"** Druillole, F.; Lachartre, D.; Feinstein, F.; Fopma, J.; Delagnes, E.; Lafoux, H.; Nuclear Science, IEEE Transactions on Volume 49, Issue 3, Part 2, June 2002 Page(s):1122 – 1129
5. **"SFE16, A Low Noise Front-end Integrated Circuit Dedicated to the Read-out of Large Micromégas Detectors"** Delagnes, E.; Abbon, P.; Bedfer, Y.; Faivre, J.C.; Kunne, F.; Magnon, A.; Platchkov, S.;Rebourgeard, P.; Thers,D. Nuclear Science, IEEE Transactions on , Volume: 47 Issue: 4 Part: 1 , Aug. 2000 Page(s): 1447 –1453.

Prix Yves Rocard 2005 de la Société Française de Physique : "Développement d'un échantillonneur analogique rapide à très grande précision pour applications en oscilloscopie".

2005- : membre du conseil scientifique du GIS Photonis-IN2P3

Civilité	Nom	Prénom		Age
Mr	Arnaud	Nicolas		34 ans
Grade	Chargé de recherche 1classe	**Laboratory**	LAL-Orsay	
Mail narnaud@lal.in2p3.fr		**Tél**	**+33 1 64468950**	

Formation
2007 : Chargé de recherche première classe.
2003 : Position permanente (CNRS, chargé de recherche deuxième classe) au LAL-Orsay (8607).
2002 : Thèse de Doctorat, Université de Paris XI.
1999 : Ingénieur de l'Ecole Nationale des Ponts et Chaussées.

Expériences de coordination :
- Responsable de la qualité des données de l'expérience BaBar (octobre 2007 – décembre 2008).
- Responsable de la prise des données du détecteur BaBar (janvier-juin 2007).
- Responsable du sous-système Cerenkov du détecteur BaBar (juin 2006 →).

Publications :
Plus de 200 publications dans des revues référées. (expériences Virgo, LHCb et BaBar).
Auteur principal d'une dizaine de publications.

Activités de recherche :

1) Analyse de données / physique de particules et astroparticules

Depuis mon entrée au CNRS je fais partie de l'expérience BaBar. Je termine actuellement ma quatrième année d'expatriation à SLAC (Californie, USA) où se trouve le détecteur. Cette mise à disposition m'a permis d'associer un travail d'analyse de données (désintégration de mésons B avec ou en sans charme dans l'état final) à des activités plus techniques liées à la prise de données. Ces dernières se sont accompagnées de responsabilités importantes au sein de l'expérience et m'ont permis de participer à l'encadrement de plusieurs doctorants (provenant d'universités françaises comme américaines) sur des périodes de plusieurs mois.
Lors de ma thèse, j'ai participé à la préparation de l'analyse des données de l'interféromètre Virgo (recherche directe des ondes gravitationnelles) et à l'élaboration des premières études de détection en coïncidence dans un réseau mondial d'interféromètres, en particuliers pour les signaux impulsionnels.

2) Activités détecteurs/accélérateurs

Depuis 2004 j'ai travaillé sur le sous-détecteur Cerenkov (essentiel pour l'identification des particules chargées) de BaBar ; en particulier j'ai été en charge de son bon-fonctionnement pendant deux ans.
En 2007-2008, j'ai participé à l'expérience LUMI située à Frascati et qui utilise un calorimètre plomb-scintillateur pour quantifier le gain de luminosité apporté par le design novateur du point de croisement des faisceaux électrons-positrons. J'ai travaillé sur la simulation de la réponse du détecteur, participé à la prise des données sur site et à leur analyse.
Pendant ma thèse, j'ai travaillé sur le contrôle de l'interféromètre central du détecteur Virgo, en particulier sur les algorithmes utilisés pour amener le détecteur à son point de fonctionnement et à l'y maintenir.

Liste des 5 publications (ou brevets) les plus significatives des cinq dernières années:

- Coincidence and coherent data analysis methods for gravitational wave bursts in a network of interferometric detectors. By Nicolas Arnaud, et al., Phys.Rev.D68:102001,2003

- Detection of a close supernova gravitational wave burst in a network of interferometers, neutrino and optical detectors. Nicolas Arnaud, et al., Astropart.Phys.21:201-221,2004
- Observation of CP violation in B0 ---> K+ pi- and B0 ---> pi+ pi-. By BABAR Collaboration Phys.Rev.Lett.99:021603,2007
- Measurement of CP-Violating Asymmetries in B0-->(rhopi)0 Using a Time-Dependent Dalitz Plot Analysis, By BABAR Collaboration Phys. Rev. D 76, 012004,2007
Evidence for D0-anti-D0 Mixing. By BABAR Collaboration Phys.Rev.Lett.98:211802,2007

Civilité	**Nom**	**Prénom**		**Age**
Mr	BRETON	Dominique		46
Grade	Ingénieur Principal de Physique Nucléaire 1ère Classe	**Employeur**	CNRS / LAL ORSAY	
Mail breton@lal.in2p3.fr		**Tél**	+33 (0)1 64 46 83 30	

2008- : coordinateur de l'électronique pour la collaboration internationale de la future expérience SuperB
2007- : responsable du groupe du LAL pour l'électronique de l'expérience BAO-radio à Nançay
2006- : chef du groupe « Systèmes » en charge de la réalisation de cartes électroniques et systèmes au LAL (Orsay)
2006- : coordinateur de l'électronique pour la collaboration internationale de la future expérience SUPERNEMO
2005- : responsable du groupe du LAL pour l'électronique de l'expérience CODALEMA à Nançay
2003- : développement de cartes d'acquisition à base de mémoires analogiques avec échantillonnage à très haute fréquence et très grand rapport signal sur bruit, valorisées et vendues sous licences de brevet par plusieurs sociétés européennes.
1998-2008 : coordinateur de l'électronique des calorimètres pour la collaboration internationale de l'expérience LHCb au CERN
1995-2008 : responsable de l'électronique du détecteur DIRC pour la collaboration internationale de l'expérience BABAR à SLAC
1993-2008 : responsable du groupe du LAL dans l'électronique front-end du calorimètre argon liquide pour la collaboration internationale de l'expérience ATLAS au CERN
1990-2007 : responsable de l'électronique des calorimètres et des triggers de premier et deuxième niveau pour la collaboration internationale H1 à DESY
1984-1999 : développements d'électronique analogique et numérique pour la collaboration internationale ALEPH au CERN, puis maintenance de ces équipements.

1984 : diplôme d'ingénieur SUPELEC.

Grande expérience sur les circuits microélectroniques frontaux bas bruit et à grande dynamique, en particulier basés sur des mémoires analogiques. Expertise en développement de cartes mixant l'analogique et le numérique. Grande expérience en développement de FPGA et de cartes numériques. Expérience en DSP et microprocesseurs. Grande expérience en développement de bancs de tests et en logiciels de test en langage C.

Auteur ou co-auteur actif de nombreuses publications dont voici un échantillon récent significatif :

1) "A Low Power Multi-Channel Single Ramp ADC With Up to 3.2 GHz Virtual

Clock".,Delagnes, E.; Breton, D.; Lugiez, F.; Rahmanifard, R.;Nuclear Science, IEEE Transactions on Volume 54, Issue 5, Part 2, Oct. 2007 Page(s):1735 – 1742
2)"Very High Dynamic Range and High Sampling Rate VME Digitizing Boards for Physics Experiments", D. Breton, E. Delagnes et M. Houry, Nuclear Science, IEEE Transactions on, VOL. 52, No. 6, Dec. 2005, pp 2853-2860
3)"ATLAS liquid argon calorimeter front end electronics", N J Buchanan et al 2008 JINST **3** P09003.
4)"A Simple And Complete USB Interface Package For Test Bench Development", D. Breton, C. Cheikali, proceedings of IEEE NSS 2007 conference, Honolulu, Oct. 2007.
5)"SPECS: A Serial Protocol For Experiment Control System In LHCb", D. Breton, D. Charlet, P. Robbe, I. Videau, proceedings of ICALEPS 2007 conference, Geneva, Feb. 2007.

Prix, Distinctions, autres responsabilités :

a. **Prix Yves Rocard 2005** de la Société Française de Physique : "Développement d'un échantillonneur analogique rapide à très grande précision pour applications en oscilloscopie".
b. **Cristal du CNRS en 2004.**
c. **2ème prix de la valorisation de la DSM/CEA en 2003 :** applications des mémoires analogiques en oscilloscopie numérique.

Membre du conseil scientifique du LAL. Membre du comité scientifique des écoles de l'IN2P3.

2 brevets déposés et un en cours de rédaction dans le domaine des mémoires analogiques rapides, de la conversion analogique-numérique, ou de la mesure de temps à très haute précision. Le premier brevet est directement applicable dans le cadre de notre proposition de développement, ainsi que celui en cours de dépôt.

- **"Echantillonneur analogique rapide à grande profondeur mémoire "**, D. Breton, E. Delagnes, 24 avril 2001 (Brevets ref FR2924177, WO022315, US N° 6 859 375).
- **"Echantillonneur analogique rapide pour enregistrement et lecture continus et système de conversion numérique "**, D. Breton et E.Delagnes, 25 juin 2005, Fr 2 872 331 (EP1759394).
- "**Un TDC à mémoire de charge**", brevet en cours de rédaction.

Civilité	**Nom**	**Prénom**		**Age**
Mme	Maalmi	Jihane		26
Grade	Ingénieur de Recherche	**Employeur**	CNRS IN2P3 – Laboratoire : LAL	
Mail	jmaalmi@lal.in2p3.fr	**Tél**		

Depuis Déc. 2007 **CNRS Laboratoire de l'Accélérateur Linéaire – ORSAY,** Ingénieur de Recherche.

2008 Mars
2008 Nov. Projet : Interface USB 2 sur la base du circuit CY7C68001 de Cypress

- *Etude et choix d'un composant pour le développement d'une interface USB 480Mbits/s*
- *Réalisation d'une carte électronique sur la base du circuit choisi et d'un FPGA*
- *Développement en Verilog de l'interface USB High Speed.*
- *Validation et tests sur la carte*

2007 Déc.
2008 Mars Projet : Interface USB sur la base du circuit FT245 de FTDI

- *Développement en Verilog d'une interface USB en **full speed**, avec un protocole spécifique au LAL, en partant d'un document de spécifications*
- *Validation et tests sur carte.*

2005 Juin - **CNRS Service d'Aéronomie –Verrières-le-Buisson,** Ingénieur de Recherche
2007 Déc. Projet : **Microsatellite PICARD** destiné à l'observation du soleil. *(Lancement prévu été 2009)*

- *Développement des FPGAs de la carte centrale de gestion de la charge utile*
-
    - Définition des spécifications
    - Conception et Développement en VHDL
    - Tests et validation
- *Suivi du développement Hardware du modèle de Vol de la carte CPU.*
- *Définition des Interfaces avec les cartes SOVAP (**Belgique**) et PREMOS (**Suisse**).*
- *Collaboration avec le CNES (Toulouse) pour le suivi des développements.*

2004 Oct. - **Cap Gemini – Rome – Italie,**
2005 Avril Projet : Nouveau Système de Facturation (NBS New Billing System) pour **TIM (Telecom Italia Mobile)**
Développement en **langage C** et **Shell Script** d'un outil de test pour le traitement de bases de données relatif aux opérations de facturation de l'opérateur téléphonique :

- *Participation au développement du Query System pour la réception et l'envoi de requêtes à la base de données du NBS en **langage C** et **Pro*C.***
- *Exécution de Tests de validation du NBS.*

2004 Sept. Diplômée de **l'Ecole Supérieure d'Electricité** (SUPELEC) à Gif-Sur-Yvette.
Option **ISM** (Information, Signaux et Mesures)
Langues Français (bilingue), Arabe (langue maternelle), **Anglais** (lu, écrit, parlé), **Italien** (lu, écrit, parlé),
Japonais (Bases)
Langages **VHDL, Verilog**, **C**, C++, SVG, XML, XSLT
Systèmes Windows, Linux.
Logiciels **Quartus, Libero, Synplify, ModelSim** , **Allegro Design-HDL,** Matlab, XML

Civilité	**Nom**	**Prénom**	**Age**
Melle	Tocut	Vanessa	34
Grade	IR2	**Employeur**	CNRS
Mail	tocut@lal.in2p3.fr	**Tél**	**01.64.46.83.35**

Depuis Décembre 1996 : Ingénieur de Recherche en conception de circuits intégrés analogiques bas bruit et mixtes (front-to-back) au Laboratoire de l'Accélérateur Linéaire (IN2P3 / CNRS) – Orsay.

2008-2006 :
- Responsable du développement de l'ASIC de lecture des signaux des CCD de la caméra de LSST. Technologie AMS CMOS 0.35µm.
- Participation en collaboration avec le LPC Caen à l'ASIC chargé de la mesure du temps (TDC) pour le détecteur SuperNemo. Technologie AMS CMOS 0.35µm.

2007-2000 :
- Conception d'un ASIC générateur d'horloges à retard programmable pour une horloge d'entrée de 40MHz pour les calorimètres du détecteur ATLAS, la calibration des photomultiplicateurs, le détecteur Preshower. Réalisation du banc de test et mise en production de 3500 exemplaires distribués a la collaboration (CERN, Université de Barcelone, LPSC clermont Ferrand) – Technologie AMS CMOS 0.8µm
- Conception d'un ASIC de type 'shaper' 4 voies pour le front-end du calorimètre de LHCb. Conception du banc de test, réalisation des tests de vieillissement et mise en production de 3500 exemplaires.
- Participation à la conception d'une mémoire analogique de type pipeline en collaboration avec le DAPNIA/CEA & Columbia Nevis Lab. Fréquence d'échantillonnage : 40MHz, fréquence de lecture 5MHz, profondeur de 144 points. Technologie durcie DMILL. Participation au transfert vers l'industrie de la mémoire analogique pour la société METRIX.
- Participation en collaboration avec le LPNHE de Jussieu à l'upgrade de l'ASIC chargé de la mesure du temps (TDC) pour le détecteur BaBar. Mise en place du circuit sur le site du Stanford Linear Accelerator, San Francisco pour équiper 11.000 voies.
- Développement d'un semi-flash ADC 10 bits/100Mhz – moins de 100mW – projet AUGER. Technologie AMS CMOS 0.35µm & BiCMOS SiGe 0.35µm.

Depuis Septembre 2002 : Responsabilité des TD d'électronique analogique pour les élèves de 1ère et 2ème années de l'Institut Supérieur d'Electronique de Paris (ISEP).
Depuis Septembre 2005: Co-Responsable de l'enseignement 'électronique analogique' – 'électronique mixte' en 1ère et 2ème année à l'ISEP.

Publication :
- ***"Large Dynamic Range Integrated Front-End Electronics for Photomultiplier Tubes"*** – *GENOLINI B., RAUX L., de LA TAILLE C., POUTHAS J., TOCUT V., 2005, Nuclear Instruments and Methods in Physics Research A, In press (Presented at the 2005 Beaune conference on Photodetection)*

Civilité	Nom	Prénom		Age
Mr	Salek	David		26
Grade	PhD student	Laboratory	IPNP, Charles Univ., Prague	
Mail	salekd@mail.desy.de	Tél	+420221912436	

Formation: 2000-2006, Master in Praticle and Nuclear Physics at Charles University, Prague
2006-, PhD student in Particle Physics, Charles Univ.
2007-, PhD student in Particle Physics, IRFU-SPP Saclay (cotutelle)

Experience: DESY laboratory, Germany – analysis, shifts
Saclay laboratory, France – phenomenology, simulation of electronics

Publications : G. Beuf, R. Peschanski, Ch. Royon, D. Salek, Systematic Analysis of Scaling Properties in Deep Inelastic Scattering, Phys.Rev.D78:074004,2008

Research Activities :
H1 experiment: Measurement of the Longitudinal Proton Structure Function in Diffraction
calibration of the calorimeter (hadronic final state particles, iterative method)
phenomenology: Study of geometrical scaling in F2, F2c and DVCS data and QCD parametrisati
hardware: Simulation of picosecond fast timing detector electronics in C++
List of publications :

1. G. Beuf, R. Peschanski, Ch. Royon, D. Salek, Systematic Analysis of Scaling Properties in Deep Inelastic Scattering, Phys.Rev.D78:074004,2008
2. H1 Collaboration (F.D. Aaron et al.), Measurement of the Proton Structure Function F(L)(x, Q**2) at Low x, Phys.Lett.B665:139-146,2008
3. H1 Collaboration (F.D. Aaron et al.), A Search for Excited Neutrinos in e- p Collisions at HERA. Phys.Lett.B663:382-389,2008
4. H1 Collaboration (F.D. Aaron et al.), Measurement of isolated photon production in deep-inelastic scattering at HERA, Eur.Phys.J.C54:371-387,2008
5. H1 Collaboration (F.D. Aaron et al.), Measurement of deeply virtual Compton scattering and its t-dependence at HERA, Phys.Lett.B659:796-806,2008

Civilité	Nom	Prénom		Age
Mr	Beigbeder- Beau	Christophe		49
Grade	Ingénieur d'études	Employeur	CNRS	
Mail	beig@lal.in2p3.fr	Tél	01 64 46 83 35	

Qualifications
1991 : Ingénieur d'études– concours interne CNRS
1985 : Assistant ingénieur
1982 : Diplôme Universitaire de Technologies, spécialité mesures physiques.
1978-1982 : Etudes à l'Institut Universitaire de Technologies, université d'Orsay
1978 : Baccalauréat série D

Responsabilités

Responsable des cartes d'acquisitions du calorimètre de l'expérience LHCb au Cern.
Responsable de l'étude de la carte d'acquisition de l'expérience Bao radio.

Membre du conseil de laboratoire du LAL
Membre de la section 03 du comité national

Membre de la commission régionale de formation permanente

Activités de recherché :

2007-2008 Participe a la définition de l'architecture de l'électronique de l'expérience SuperB TDR est en cours d'élaboration.
1998-2007 : Conception, réalisation et installation des 255 cartes d'acquisition du calorimètre hadronique et électromagnétique de l'expérience LHCB au Cern (Genève, Suisse). Etude la partie numérique d'unAsic mixte 4 sorties ajustables par pas de 1 ns d'une horloge d'entrée à 40 Mhz.
1991-1998 : Conception, réalisation et installation des 168 cartes d'acquisitions du sous détecteur DIRC de l'expérience Babar à Slac (Stanford ,Etats Unis)
Upgrade de la carte décision du trigger de H1 avec le processeur ADSP 21020
1986-1991 : Conception, réalisation et installation de l'électronique du trigger de deuxième niveau de l'expérience H1 à Desy (Hambourg, Allemagne). Développement d'un Asic numérique pour la recherche de cluster.
1985-1986: Développement d'une carte de trigger pour l'expérience NA31 basée sur un DSP.

Dans le cadre de l'enseignement du magistère : encadrement de travaux dirigés de Verilog. Presentation à la " 9th International Conference on Calorimetry in High Energy Physics ", LAPP, Annecy, France, 9 - 14 Oct 2000, pp.227-238

1. **The DIRC front-end electronics chain for BaBar** / Bailly, P; Chauveau, J; Del Buono, L; Genat, J F; Lebbolo, H; Roos, L; Zhang, B; Beigbeder-Beau, C; Bernier, R; Breton, D *et al.*. *Nucl. Instrum. Methods Phys. Res., A* 433 (1999) 450-455

2 **The front end electronics for LHCb calorimeters** / Beigbeder-Beau, C; Breton, D; Cacéres, T; Callot, O; Cros, P; Delcourt, B; Jean-Marie, B; Lefrançois, J; Tocut, V; Truong, K D *et al*LHCb-99-053.- Geneva : CERN, 1999 ECAL

Civilité	Nom	Prénom		Age
Ms	PUILL	Véronique		35
Grade	Ingénieur de Recherche	Employeur	CNRS	
Mail	puill@lal.in2p3.fr	Tél	01 64 46 84 23	

Depuis Novembre 2002 : Ingénieur de Recherche en Instrumentation au Laboratoire de l'Accélérateur Linéaire (IN2P3 / CNRS) – Orsay.

Responsabilités

Responsable du Groupe Instrumentation (5 personnes)
Correspondante de Valorisation du LAL

Membre du Comité d'Organisation de la conférence NDIP (New Developments in Photodetection)

Activités de Recherche :

2005-2008 : Etude des Photomultiplicateurs Silicium (SiPM), support technique aux Expériences de Physique (ATLAS Pixel, LSST)

2002-2004 : Développement d'un détecteur gazeux de type Micromégas
1997-2000: Thèse de Doctorat au CEA Saclay : Participation à la calibration du Calorimètre Electromagnétique de l'Expérience CMS

Autre expérience professionnelle :

2000–2002 : ingénieur chargé des grands projets de Physique des Hautes Energies chez HAMAMATSU Photonics France

Publications (5 dernières années) :

Proceedings of IEEE Nuclear Science Symposium, Portland 2003 :
- ***Micromegas TPC R&D for the futur Linear Collider*** V. Lepeltier et al.,
- ***Performance of a New Type of Micromegas Detector with Stainless Steel Woven Wire Mesh*** V. Puill et al.

Proceeding of the NDIP08 Conférence, Aix-les-Bains 2008, NIMA :

- ***Characterization of a prototype matrix of Silicon Photomultipliers***, N. Dinu, P. Barrillon, C. Bazin, N. Belcari, M.G. Bisogni, S. Bondil-Blin, M. Boscardin, V. Chaumat, G. Collazuol, C. de La Taille, A. del Guerra, G. Llosá, S. Marcatili, M. Melchiorri, A. Tarolli, C. Piemonte, V. Puill, J.F.Vagnucci, N. Zorzi J.F.Vagnucci
- ***Electro-optical characterization of SiPM: a comparative study***, N. Dinu, Z. Amara, C. Bazin, V. Chaumat, C. Cheikali, G. Guilhem, V. Puill, C. Sylvia

Civilité	Nom	Prénom	Age
Ms	PEREZ	Alejandro	27
Grade	Post Doc	Employeur	
Mail	aperez@lpnhe.in2p3.fr	Tél	01 64 46 83 00

1999-2004 : Undergraduate student at *Universidad de los Andes, Physics Department*, Mérida, Venezuela.
2004-2005 : *Magna cum Laude* Degree in physics (Master level) at *Universidad de los Andes, Physics Department*. Degree subject : *Measurement of the inclusive branching ratio of the* B0→ $K+\pi-\pi0$ *decay channel with the BaBar experiment at SLAC*, under the supervision of José Ocariz.
2005- : PhD student at Université de Paris 7 on the BaBar experiment, under the supervision of José Ocariz at LPNHE-Paris.
Thesis subject : *Time-Dependent Amplitude Analysis of* B0→ K0S $\pi+\pi-$ *channel with the BaBar Experiment and constraints on the CKM matrix with the* B → K* π *and* B→ ρK *modes.*
Defense date : Dec. 9th 2008, at 14h30, Amphi Grosstête, LPNHE-Paris, Paris-France.

Professional Experience
Jan.–Aug. 2007 : *Commissioner* of the Detector of Internally Reflected Cherenkov Light (DIRC) of the BaBar experiment. Based at SLAC, Stanford, USA.
Sep.–Dec. 2007 : $\pi0$ selection from $\pi\pm$ decays for monitoring of π 0 mass resolution of the BaBar experiment.Work with the BaBar Neutral Working Group.
Jun. 2008- : Constraints on the CKMmatrix from the B →K* π and B → ρK modes. Work with the CKMfitter group.

Publications

– B. Aubert *et al.* (BABAR Collaboration), in *Procs. of the 23th International Symposium On Lepton And Photon Interactions at High Energies*, **arXiv/0708.2097[hep-ex]**.
– B. Aubert *et al.* (BABAR Collaboration), *Phys. Rev.* D**78**, 052005 (2008).
– B. Aubert *et al.* (BABAR Collaboration), in internal Review, publication in *Phys.Rev.*D.
– I'm also author of 5 internal note of the BaBar collaboration.

<u>*Conferences*</u>
– *Dalitz Analises at BaBar*. Invited poster, APS April Meeting (Jacksonville,Florida (2007)).
– *Charmless B decays at BaBar* talk. 10th InternationalWorkshop on Meson Production, Properties and
Interaction, KRAKÓW, POLAND (2008). Procs. to be published in *International Journal of Modern Physics*

<u>*Seminars*</u>
Jan. 2006 :*Mesure du rapport d'embranchement inclusif* B0 → K+ π– π0 *dans BaBar*. LPNHE-Paris Fridaymeeting.
Aug. 2007 : *Time-dependent amplitude analysis the* B0 → K0S π+ π– *channel*. BaBar Collaboration-wide talk.
Sep. 2007 : *Un Análisis dependiente del tiempo de amplitudes en el canal* B0 → K0S π+ π–. Seminar at the Universidad de Los Andes (ULA), Venezuela. Supported by the HELEN program.
Sep. 2007 : *Premiers résultats sur l'analyse Dalitz dépendante du temps pour le canal* B0 → K0S π+ π– *dans l'expérience BaBar*. LPNHE-Paris Friday meeting.
Sep. 2007 : *DIRC Status Report*. DIRC plenary talk, BaBar Collaboration Meeting.
Oct. 2008 : *Time-dependent amplitude analysis the* B0 → K0S π+ π– *channel*. BaBar Collaboration Meeting plenary talk.

<u>*Teaching and Research experiences*</u>
2002-2005 : Research assistant at the Centro Nacional de Cálculo Científico de Venezuela, http ://www.cecalc.ula.ve. Research work under the supervision of Luis Núñez and José Ocariz.
2002-2004 : Teaching assistant on mathematics for physicists.

<u>*Computing skills*</u>
– C++, Mathematica, MAPLE, UNIX, and Microsoft softare.

<u>*Language skills*</u>
– Spanish (native), English (good), French (good).

<u>*References*</u>
– José Ocariz, LPNHE-Paris. ocariz@in2p3.fr.
– Jacques Chauveau, LPNHE-Paris. chauveau@in2p3.fr.
– Alejandro'sWeb Page : http ://www.slac.stanford.edu/_aperez/

<u>*Other Interests*</u>

– Martial arts, trekking, literature

7.3. INVOLVEMENT OF PROJECT PARTICIPANTS TO OTHER GRANTS, CONTRACTS, ETC

Part.	Nom de la personne participant au projet	Personne. mois	Intitulé de l'appel à projets Source de financement Montant attribué	Titre du projet	Nom du coordinateur	Date début & Date fin
1	N. Dinu	24	ANR blanc	VITESSE	A. Lounis	01/09 12/13
1	N. Dinu	24	ANR blanc 2009	SILIMED	L. Menard	36 mois
1	V. Puill	9.6	ANR blanc	VITESSE	A. Lounis	01/09 12/13
1	J.F Vagnucci	7.2	ANR blanc 2009	SILIMED	L. Menard	36 mois
1	V. Puill	10	ANR Blanc 2009	SILIMED	L. Menard	36 mois
1	V. Puill	2.4	ANR Blanc	MightyLaser	F. Zomer	01/09 12/13
1	V. Tocut	18	ANR blanc 2009	LSST	R.Pain	36 mois
1	D. Breton	6	ANR blanc 2009	radio@auger	R.Dallier	48 mois
1	J. Maalmi	6	ANR Blanc 2009	radio@auger	R.Dallier	48 mois
2	E. Delagnes	9	ANR Blanc	Nectar	JF.Glicenstein	01/09 12/11
1	A. Stocchi	7.2	ANR Blanc 2009	LFV-CPV-LHC	A. Abada	36 mois