Acronyme	**GET**		
Titre du projet en français	Electronique Générale pour Chambres à Projection Temporelle		
Titre du projet en anglais	General Electronics for Time projection chambers		
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	555 590 €	**Durée du projet**	48 mois

SOMMAIRE

1. CONTEXTE ET POSITIONNEMENT DU PROJET / CONTEXT AND POSITIONNING OF THE PROPOSAL

*Radioactive beams have become an essential tool in low-energy experimental nuclear physics. However, by the very nature of secondary beams, their intensity is limited, particularly for beams of the highest interest - farthest away from stability. Active targets, which can be described as time projection chamber (TPC) [1] like detectors in which the detector gas is the target, have been shown to have the highest sensitivity for quantitative high resolution studies of rare events. Noteworthy examples are obtained in measurements of reactions and radioactive decays such as the study of ^{7}H via transfer reaction or the two-proton decay. The very large dynamical range of energy loss required for the detection of ions in the gases, together with the fact that the detector gas must be chosen also to fit the experiment as target, and not only as detector gas, are very specific features for this domain of physics. The position resolution required to achieve both the energy and angular resolution demands high pad density and therefore of the associated number of electronics channels. Finally the very low recoil energies imply that often particles stop in the gas, thus only an internal trigger of the TPC may provide the information whether the event is of interest or not. With the objective to overcome these constraints**, we propose to develop a nouvelle, complete numeric electronic system with unprecedented capabilities for triggering, data read out and processing**. Thus the system conception and design will handle the new-generation Active Target and TPCs for nuclear spectroscopy and reaction studies. The project includes a demonstration by performing two experiments, which will validate the functionalities of the electronics. These experiments correspond to the benchmark physics cases addressed with active targets and are not possible with today's devices.*
The advance is generic in design, thus providing a gateway for other medium to large detection arrays that are being developed within the community. This progress is indispensable to take lead of the opportunities created by the forthcoming construction of the new radioactive ion beam facilities.

Twenty years ago, experiments employing accelerated radioactive particles were launched. New and unexpected phenomena were discovered, such as halos in light nuclei, or rare decay modes of dripline nuclei [2]. Magic numbers, one of the successful predictions of the nuclear shell model, for nuclei with an excess of neutrons were found to be different from those of stable nuclei. Such discoveries challenge our understanding of the nuclear structure, and have important consequences in other fields, such as nuclear astrophysics. The Nuclear Physics European Collaboration Committee (NUPECC) has stressed that the research on exotic nuclei is a top priority in the field of nuclear physics [3], encouraging the construction of new radioactive ion beam facilities such as FAIR at Darmstadt (Germany), SPIRAL2 at GANIL, HIE-ISOLDE at CERN and SPES at Legnaro (Italy). FAIR and Spiral2 are under construction presently.

Intensities of radioactive ion beams at the present facilities are much lower than in the case of stable beams, ranging from few particles/day to some 10^{7} particles per second (pps); their optical qualities (beam size and emittance) are also often much poorer than for stable beams. To overcome these difficulties new detection systems had or have to be conceived and built, having high geometrical efficiency and with inherent fine spatial resolution. Large arrays of highly-segmented detectors are now realised for charged particles (for example MUST2 [4] at GANIL) and gamma rays; the number of electronic channels is now of the order of thousands. For high resolution nuclear reaction studies, however, the target thickness is a limiting factor, due to the low recoil energies in inverse kinematics thus leading to high energy losses and corresponding resolution degradation. The resolution issue becomes a critical issue with the low energy heavier secondary beams that will be available with SPIRAL2.

Under these conditions the use of TPCs has become very attractive, because of their spatial efficiency, the tracking capabilities (thus reconstruction of the event vertex and angular distributions) and the potential in particle identification. In addition, one can measure the nuclear reaction processes occurring between the beam particles and the nuclei of the gas in the detector chamber – the "active target" concept. With respect to the use of a foil as target, this arrangement greatly increases the target thickness, in part compensating for the weak beam intensities. Very motivating results have already been obtained in some areas, with the "first generation" of active targets such as IKAR [5], MAYA [6] and the TPC of the Bordeaux research group (CENBG) [7]. The most significant are mentioned in section 2.1.

At the new radioactive ion beam facilities, in about five years from now it will be possible to accelerate radioactive ion beams with intensities suited for nuclear structure studies very far from stability over a broad part of the nuclear chart. This opens exciting possibilities; the powerful methods for spectroscopic studies, which have proven so effective with stable nuclei, such as transfer reactions, can be applied to exotic nuclei. "New-generation" active targets (ACTAR) have a strong physics case in this scenario, because they will still be the instruments of choice for the investigation of the most exotic systems, at the edge of experimental possibilities. The ACTAR physics case has been presented in a Letter of Intent [8] to the SPIRAL2 Advisory Committee (SAC), signed by 16 laboratories in 6 countries worldwide. The SAC has recommended proceeding with the planning for the construction of such detectors. Such active targets, that will be combined with large solid angle Si-CsI devices [6], will yield an enhanced luminosity, resolution and kinematic phase-space cover and thus increasing the sensitivity by two orders of magnitude with respect to pure Si-devices such as MUST2.

A "new generation" of Active Target -TPCs for nuclear studies is necessary to overcome the limitations due to the ion detection properties in the gases. The energy of light recoil particles, such as in a (d, p) reaction in a detector filled with a D_2 gas, varies from about 100 keV to 100 MeV in such an inverse kinematics, implying large variations of energy loss. The very different atomic numbers of the light recoil particles and the heavy secondary beam is another origin of large variations of energy loss range, and hence of the signals that are generated.

Key required, yet unattained combined characteristics are a) a high density at the front-end, where about 14000 signals need to be collected from a small volume; b) a very large dynamic range, both in the energy of detected signals and their time span; c) the possibility to record the data of interest via the generation of an external or internal trigger; d) a high-rate data transmission.

Europe is leading the present worldwide effort for the development of Active Targets for nuclear physics. France, with the laboratories presenting this ANR proposal, is the major actor. The ACtive TARgets Joint Research Activity (ACTAR JRA) within EURONS (the FP6 Integrated Infrastructure Initiative of European nuclear structure scientists) brings together researchers from 9 laboratories and universities in Europe, led by GANIL. Partners from Japan and USA (namely MSU, included in the present proposal) have later joined the effort. Studies have been carried out during the last four years, guided by the experience accumulated with the present TPCs. The most important aspect has been identified in the need for a completely new, cutting-edge electronic system for the data acquisition and processing.

The studies within the ACTAR JRA have assembled a map of the whole system and its realisation, which is in part the object of the present research proposal. It was soon realised that such a system is of great importance for the whole nuclear physics community. Its specifications imply a great flexibility, so that it could be potentially adopted for other large detector arrays [9], which are being designed for use at the forthcoming radioactive ion beam facilities. Such a possibility is to be evaluated, and the final demonstrator will reflect the needs that will emerge through a close contact with the research groups developing those new-generation detectors.

2. DESCRIPTION SCIENTIFIQUE ET TECHNIQUE / SCIENTIFIC AND TECHNICAL DESCRIPTION

2.1. ÉTAT DE L'ART / BACKGROUND, STATE OF THE ART

It is frequent that breakthroughs are drawn from rare events, where the combined adjusted mix of luminosity, efficiency and resolution has been employed. This is the case recently in employing the TPC/active target based method in nuclear physics with the MAYA active target for example for the study of ^{7}H [10], the most neutron rich system ever formed, or with the CENBG-TPC for the ^{45}Fe [11] two-proton decay.

2.1.1 MAYA active target

In the MAYA active target detector, developed at GANIL, the 3-dimensional tracking of the incoming beam and outgoing reaction partners (ejectile and gas target recoil) is attained via the projection of the created charge on a segmented cathode for the horizontal plane (32 rows of 32 hexagonal pads of ≈0.8cm size), whereas the vertical coordinate is obtained from the drift time measurement on each individual amplification wire with respect to the beam pulse. The induced charge on each cathode pad is measured using the GASSIPLEX chips [12] while the arrival time of the electrons is registered with standard analogue electronics on each amplification wire (one wire for one row of pads). For stopped particles within the gas-volume, the position resolution determines the angular and the range resolution. Together they determine the energy resolution as well as the charge and the mass resolution. In the MAYA active target detector, the resolution is limited to about 1mm (standard deviation) due to the combined effects of the pad size and the digitalisation by the amplifying wires. This arrangement, although effective [10,13,14], limits significantly the physics potential that such a method provides:

- the physics cases are limited to 2-body reactions, because the time measurement does not allow dealing with multi-hit events
- the angular coverage is limited in practice to ±45° relative to the cathode plane, thus reducing the yield and statistics by a factor of 2
- the achievable number of channels of such a set-up is at maximum about 1000 channels leading to large pad sizes and hence a lack of energy and angular resolution with a complex dependence between track direction and measured signal
- the dynamic range is limited due to the need to detect, in most cases, the incident ion, the ejectile and the recoil
- the external trigger, as with the majority of available systems, imposes a limited rate for experiments where the ions, at low energy, stop in the gas
- A lack of position resolution yields a lack of charge and mass resolution.
- a limitation brought about by the data acquisition system in terms of through-put

It is clear that in order to reach the full potentialities of the device and address physics cases where resolution and statistics are of prime importance a new electronic instrumentation is compulsory. This is particularly true in the case of SPIRAL2 beams which are heavier than those used today with MAYA and thus require high resolutions and other operational requirements. Some exotic transfer reactions with more than 2 bodies in the exit channel are also worth mentioning, such as (^{4}He,^{6}Be), (d, 2p) or any reaction where the ejectile is unbound ^{12}N(p,t)^{10}N, ^{10}C(p,t)^{8}C…

2.1.2 The CENBG TPC

The CENBG TPC was built for the study of two-proton (2p) radioactivity. Here, the 2p emitter (mother nucleus) is implanted in the centre of the active TPC volume, where the decay takes place. The electric field between the cathode and the two-dimensional detection plane makes the electrons, created by the slowing down of the mother nucleus during the implantation process and by the two protons emitted in the 2p decay, drift towards the detection plane. Before hitting this detection plane, the electrons are multiplied by a set of four Gas Electron Multipliers (GEMs) in order to achieve a manageable signal height.

The electronic signal is finally detected in two sets of 584 orthogonal strips with a pitch of 200µm. half of these strips are equipped with an ASIC read-out system based on VAT/TAT chips [15], whereas the other half is grouped into six summed signals and fed into standard electronics.

The system was recently used for the study of 2p emission from ^{45}Fe [11] and allowed to clearly identify the two protons by measuring their individual energies and their relative emission angle - measurements required to study the emission dynamics of 2p radioactivity. However, this detection scheme does have intrinsic limitations:

- Due to the use of strips instead of pads, only two particles can be observed in one event. ^{45}Fe, one of the 2p emitters studied with this chamber, has also a 3p decay branch which is difficult to identify with this set-up
- only one time stamp, and not the time evolution of the signal, is available for each strip, which limits the separation of two protons for events where the two protons overlay in the two-dimensional projection
- the use of strips instead of pads creates ambiguities in the reconstruction process for certain event geometries
- the energy resolution for the protons depends on the position resolution which in turn is limited by the charge spread due to the GEMs
- the size of the chamber is limited by the number of electronics channels which are available and which can be handled by the data acquisition employed
- 2p emitters have short half-lives (~2 ms) and the data acquisition dead time (for the detection of the mother nucleus) leads to radioactivity event losses. This evidences the need to have an efficient architecture for the data acquisition and the data flow compatible with small dead times.

Most of these limitations will be overcome with the new electronics system proposed here-in. Therefore, the new GET electronics will allow studying 2p radioactivity for very short lived isotopes with excellent energy resolution and a much straightforward reconstruction of all event geometries.

2.1.3 A brief history of particles physic TPCs electronics

Electronic systems to read Track Projection Chamber have to measure the deposited charge and the arrival time of signals on the detector readout plane. Since the mid 1990’s, work was done to improve TPC electronics to increase the number of pixels on the readout plane. It started with the NA49 and the EOS R&D program. It was materialized by the STAR (Solenoidal Tracker at RHIC) electronics [16] in 1996. Since the beginning of 2000, the only large size TPC built was the ALICE tracker for the LHC, where a complex processing system, different from STAR, was developed. It used PASA and ALTRA circuits [17]. Since 2004, two projects worked on the electronics of large size TPC. The EUDET program, founded by EU, works on the tracker for the future collider ILC and the neutrino experiment at TOKAÏ (T2K - Japan). For these projects more integrated electronics, associated with state-of-the-art ASIC [18] where developed to process analogue signals from the detector and a fast digitization based on pipeline ADCs and FPGAs with integrated processors. In the meantime IRFU, with its know-how in mixed circuit conception to readout capacitive detectors and in data acquisition systems for physics experiments, has developed an electronic system and its integration for T2K. The system is well adapted to T2K. Nevertheless, in spite of its excellent assets (low power consumption, 72 integrated channels, gain and shaping time fully settable); it carries major disadvantages incompatible with future detectors, in particular for nuclear physics. It needs new technologies, an internal trigger system and fast readout architecture.

Along with the two existing electronic systems (ALICE and T2K), there is no other electronic structure to give time and charge with adequate resolution. Building GET will place the French laboratories at the forefront of the nuclear physics instrumentation community.

2.2. OBJECTIFS ET CARACTÈRE AMBITIEUX / NOVATEUR DU PROJET / RATIONALE HIGHLIGHTING THE ORIGINALITY AND NOVELTY OF THE PROPOSAL

In the quest of the most exotic systems, an active target has strong advantages over more classical devices. To take an example, in a (d,p) reaction with a solid target of CD_2, the target thickness must be below ~500µg/cm^2, and hence ~125µg/cm^2 of D_2, or 2.10^{19}atoms/cm^2. In an active target filled with D_2 at 1atm, a vertex resolution of 1mm corresponds to 3.10^{18}atoms/cm^2, and hence to a very thin target slice of ~20µg/cm^2. Thus the influence of energy loss for the final energy resolution is only of about 20/500 with respect to the solid target. Nonetheless, using a detector of 1m length, the total thickness will be 2.10^{21}atoms/cm^2; this is 70 times more than the solid target. A TPC can have by construction a full 4π acceptance, thus giving another advantage to this type of detector. In practice, solid target experiments for such a reaction are limited to secondary beam intensities above 10^4/s, whereas with the active target good statistics results were obtained with beams in the range of 100/s to 1000/s [14]. This implies that experiments performed with active targets allow studying 2 isotopes further away from stability as compared to a solid target experiment. For example at SPIRAL2, key experiments such as transfer reactions in the region of ^{78}Ni or ^{100}Sn may be within reach only with an active target device, considering the expected production rates for these benchmark nuclei.

For similar reasons, due to the very low recoil energies, a whole class of experiments is only possible with active targets. A benchmark example is the case of giant resonance studies. Giant resonances are very rich in information on fundamental nuclear problems. The giant monopole resonance is related to nuclear compressibility [19]. The spin-isospin resonance provides a measure of the neutron skin-thickness [20]. The recoil energy in these experiments is so low, that only an active target can provide a sufficient resolution together with a reasonable target thickness [13]. For example, light low energy particles in H_2 have a ratio of their straggling over range of the order of 1%, thus with a good position resolution the energy can, in principle, be determined to about 0.5% or 5 keV at 1 MeV. With respect to Maya, where the distinction of p recoils and d recoils was not possible [13], an increased dynamic range will be essential. The spin-isospin resonance could be studied by a (d,2p) reaction [21]. Such an experiment is however impossible with Maya, due to the 2 recoil-particles in the exit channel.

Present studies have been mainly limited to light nuclear systems. With the advent of powerful secondary beam accelerators, such as Spiral2 or the gas-stopper coupled to a post-accelerator at MSU, new opportunities will be offered in the medium to heavy mass region. This implies the need for better resolution to resolve individual states in the higher mass nuclei. **This, in turn, implies a decrease of the pad-size, and hence an increase of the number of channels by one order of magnitude.**

In the inverse kinematics of such experiments, the energy of the recoil particles varies over a very large energy range, for example protons or deuterons in the energy domain of 100 keV/nucleon to several tens MeV/nucleon. The incident heavy particles have a very high specific ionisation power as compared to higher energy light particles. **Therefore an unprecedented dynamic range is needed.**

The low energy recoil particles will stop within the detector gas. This implies the need of an internal trigger**. This is a new feature with respect to existing TPCs, and the associated trigger logics are a new development.**

The properties of the gas must be chosen essentially by the needs as target, and very diverse gases, not optimised for the detection, will be used, such as Hydrogen, deuterium, ^{3,4}He. This implies a very broad range of drift-times, and consequently **the sampling frequencies will have to be adjusted between 1 Mhz and 100 MHz to follow the drift of the particles.**

Considering the expected performances in terms of data rate and number of channels, new software must be developed, based on the framework used in particles physics. It will allow rapid development of test bench and part of data acquisition computer system.

This development is **completely specific to nuclear physics, and its implementation in ASIC circuit has never been tempted** since the need for such high dynamic range was not encountered in high energy physics experiments dealing with minimum ionizing particles. In the present considerations the needs of different detector devices, planned or under construction (at low and medium energy GANIL/Actar, MSU/AT-TPC and at high energy FAIR, RIKEN, MSU-FRIB) were taken into account, and will ensure the possibility of use for very diverse detectors that may be planned in future.

The above description illustrates the innovative characteristics of the GET project and of the associated technical development under consideration. Its realisation will provide common high density electronics for various detectors under construction, to be constructed or future detectors to come. This is a new and necessary feature for an intermediate channel number of 10,000 channels, where a complete development “from scratch” would not be possible in a single project due to prohibitive costs. These electronics will provide detectors with unprecedented sensitivity and resolution that will allow reaching very far from stability in the study of exotic nuclei.

To summarise, the technical objectives of the project are to conceive parts of a new instrumentation for TPCs. It allows reaching the scientific aim presented above. We sorted four main objectives for the project positive issues:

Improvement and evolution of the readout electronic of TPC detectors in the context of nuclear physic experiments.

The front end electronics of the new system will allow a large number of channels to be captured per cm², thus easing the electro-mechanical constrains related to a density of ~25 channels/cm².

- A generic approach in the ASIC development including adjustable gains and discrimination per channel leading to a smart trigger.
- Development and test of an applicative software framework for the configuration, the acquisition and the data storage based on the new computer science technologies associated with NTIC (nouvelle technologie pour l'information et de la communication).

The present project will open the possibility to access to a new class of experiments with the most exotic nuclei, presently out of reach with existing devices. The ultimate goal of the project is therefore to construct within the next four years a prototype for the next generation of active targets and to perform some test experiments. These experiments will validate in particular the concept of the new electronics, which has been identified as the key issue to reach the full operational possibilities of the active target.

3. PROGRAMME SCIENTIFIQUE ET TECHNIQUE, ORGANISATION DU PROJET / SCIENTIFIC AND TECHNICAL PROGRAMME, PROJECT MANAGEMENT

3.1. PROGRAMME SCIENTIFIQUE ET STRUCTURATION DU PROJET / SCIENTIFIC PROGRAMME, SPECIFIC AIMS OF THE PROPOSAL

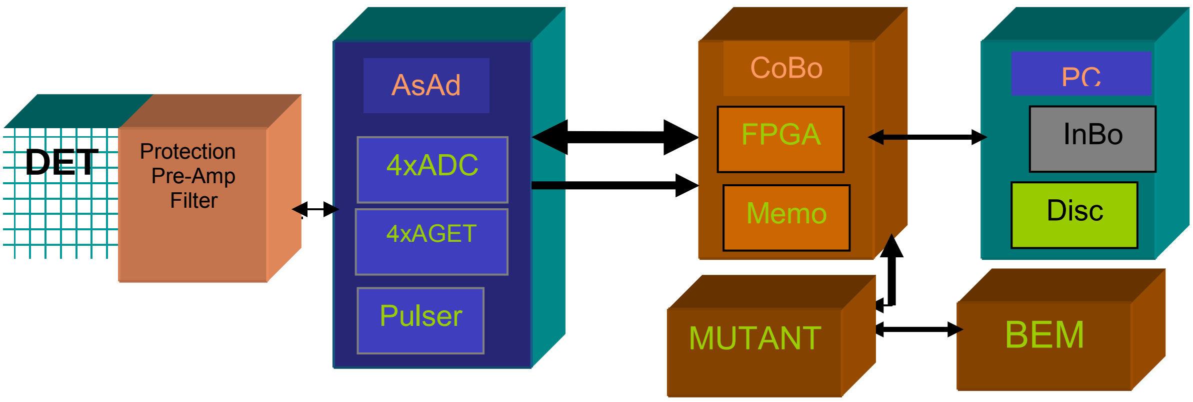


Figure 3.1

The basic hardware elements of the system to perform the experiments cited above are shown in the figure 3.1. Pads of the detectors (DET) are the source. Each pad is electrically connected to a spark protection circuit followed by the preamplifier and filter stage (Pre-Amp & File). The output is fed into one of the 72 channels of the ASIC, AGET (Asic for GET). AGET must sample the incoming signal continuously at a given frequency (~1 to 100MHz) and has also to send logic signals to the trigger unit (MUTANT) when the set threshold is exceeded. Once the appropriate combination of signals is reached in MUTANT, a trigger and a calculated hit pattern is issued. This has to stop the input-reading of AGET and the ADCs on the front end board AsAd (Asic & ADc) will read the hit channels. Numeric data from 4x (AGET+ADC) are sent via copper cables to CoBo (COllection BOard). Data reduction, time stamping and ordering as well as other more complex functions are performed in the FPGA and stored in a buffer Memory. Data is transferred on a fast optic link to InBo which resides on one of the acquisition PCs. Each CoBo fits 4 AsAd (4x4x72 channels) and each InBo fits 3 CoBo (3x4x4x72). So for a relatively large experiment 4 to 6 InBo are employed on two PCs. The data merging with other systems (spectrometers, particle detectors, etc) is accomplished using time-stamping where the internal clock of GET is synchronised to the external clock. The throughput in the system (14,000 channels) that is requested is at least 1 KHz internal triggers with a few percent dead-times for high pad occupation events. To allow for different gas amplification methods and different amplification zones of the detector a number of options are possible; the configurable external or internal pre-amp plus filter; the gain is adjustable per AGET by a factor of 100 from 100 fC with fine tuning per channel; the discriminators are set per channel; the peaking time must be adjustable from 50 to 1000ns. The time and charge resolutions will be better than 2nsec and 0.1% (at 130fC) respectively. Software control developed at IRFU/LILAS (see section 3.3.5) will be employed for the development stages and to operate, calibrate and adjust the system and protect the hardware. The French develops NARVAL system allows for data flow and run control [http://informatique.in2p3.fr/?q=node/302] will be employed.

3.1.1 METHODOLOGY

PARTNERS

Partner	
1	IRFU Saclay, France
2	GANIL, CAEN, France
3	CENBG, Bordeaux, France
4	NSCL/MSU, Michigan, US

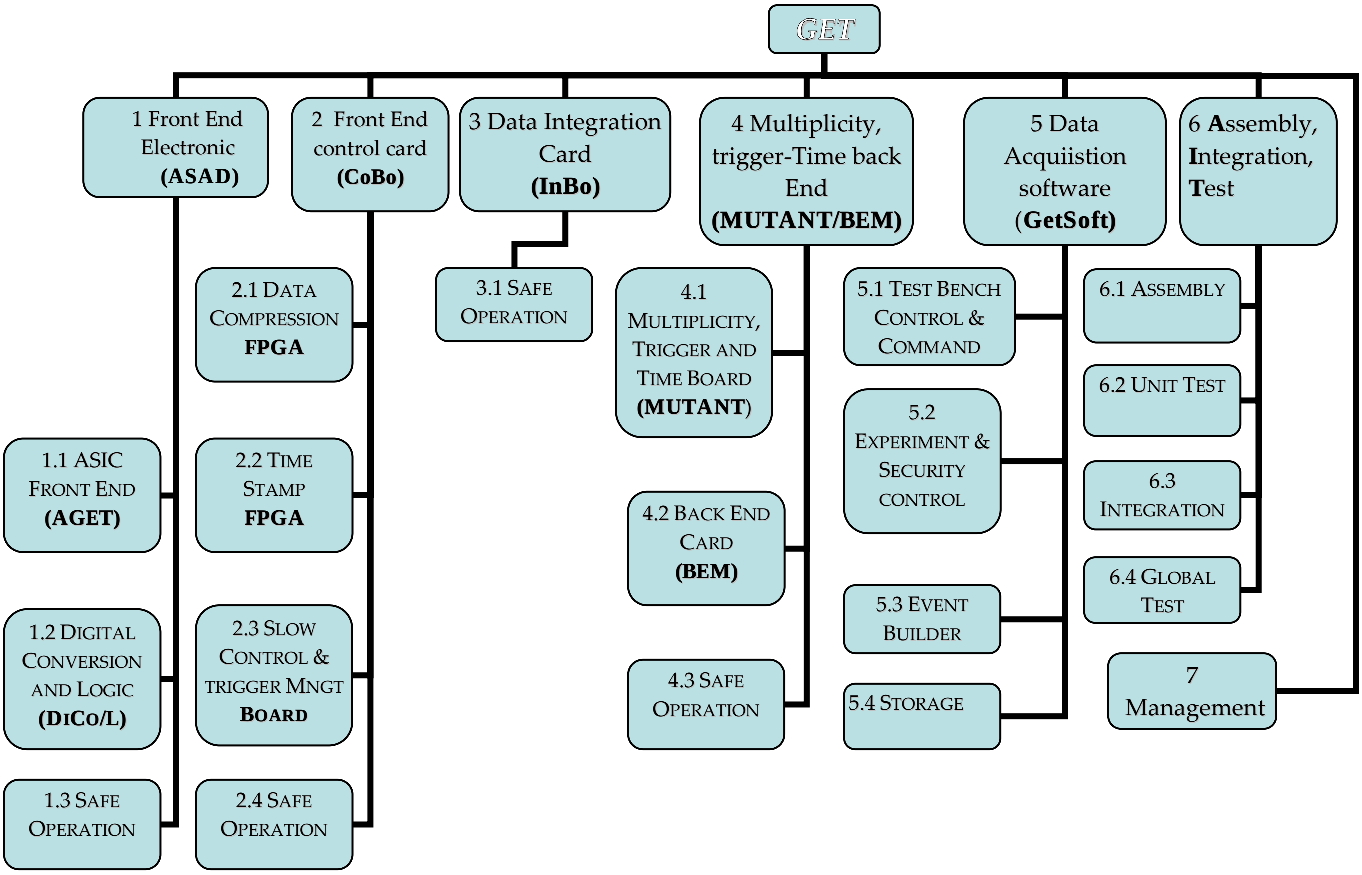
The Partners of GET are listed above. NSCL/MSU will share the budget expenditure in GET and will not profit directly from the ANR budget.

CEA and IN2P3 have a great experience in the management of projects linked to the nuclear instrumentation. The internal organization of CEA and IN2P3 [PROJ1, PROJ2], sharing the same tools, are based on a system of project reference allowing to follow the rules of the AFNOR standard (FDX50-115 December 2001).
The organization of tasks is based on the Project Breakdown Structure (PBS+WBS) and a management plan based on the Organization Breakdown Structure and WBS.

The scientific impact will be to perform experiments giving the nuclear physics community a lead in experimental physics with low energy detection and high luminosity. As for the technical impact, it will place the French community in a leading position in TPC oriented numeric data capture. Further, the technical development will try and set standards and methodology for a large fraction of systems being introduced at SPIRA2.

3.1.2 PROJECT BREAKDOWN STRUCTURE

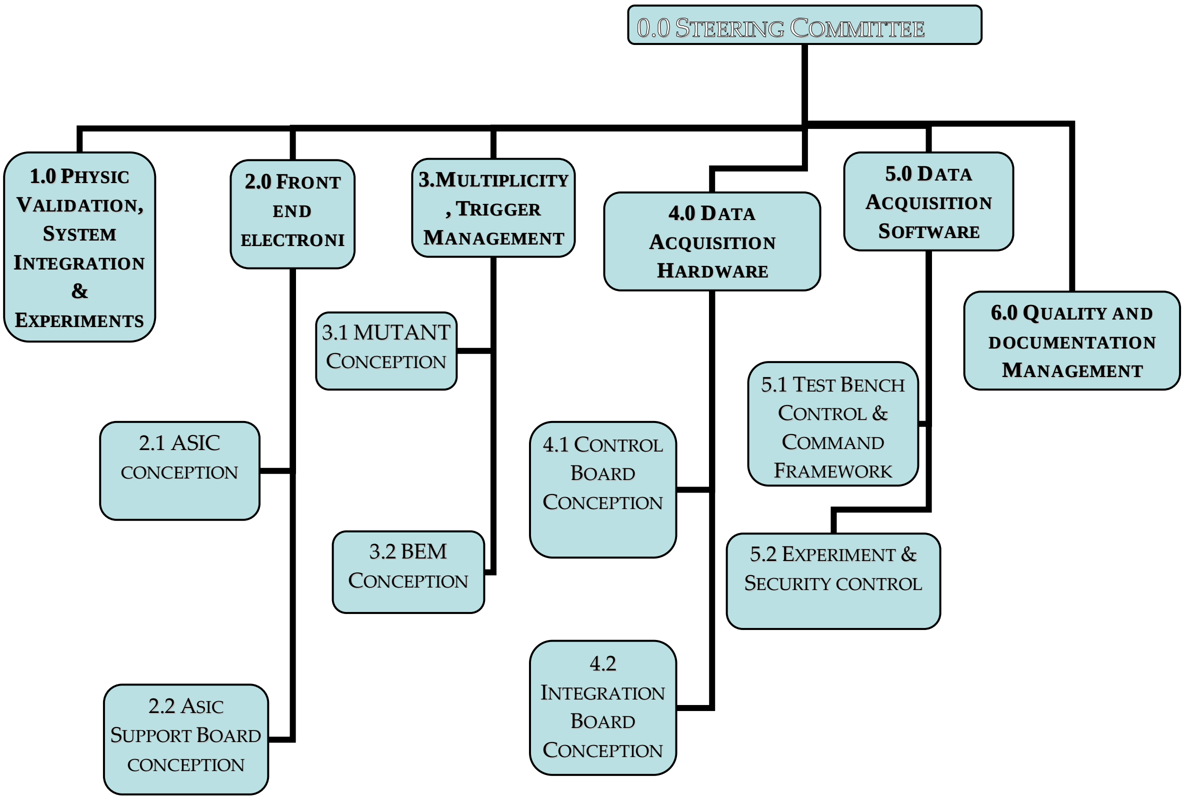
The aim of GET is to conceive a generic electronic system going from the front end to data storage, focusing on TPCs used for nuclear physics experiments.



Product id	Product Name	Description	INSTITUT
PBS_7.0	Management	It pilots the technical aspect, costs, time schedule of the different tasks, report to the steering committee, and manage the “leftover” of the project. The group will have in charge the quality assurance, the interface management between tasks (WBS) and the documentation.	IRFU,CENBG, GANIL,MSU
PBS_1.0	Front end electronic	The front end board must integrate the AGET asic, the detector connection, digitization and power management. It could incorporate monitoring functions as temperature & power supply measurement.	CENBG,IRFU
PBS_2.0	CoBo	The board controls several front end board in term of configuration, monitoring, acquisition and data processing	MSU, GANIL, IRFU
PBS_3.0	InBo	The board controls and save data from several CoBo board. It manages optical link communication aspect.	GANIL,MSU
PBS_4.0	MUTANT/BEM	The board provides Time start to all other boards; manage the multiplicity algorithms and also the trigger input.	GANIL,MSU
PBS_5.0	GETSOFT	The Software is user friendly interface to control all the hardware for configuring, acquiring and storing data in an exploitable format.	GANIL, IRFU
PBS_6.0	Assembly, Integration & Test	It will provide all procedures to integrate and to test the complete system.	CENBG, IRFU, GANIL, MSU
PBS_1.1	AGET	Front end Asic	IRFU
PBS_1.2	ASAD	Support board for the front end	CENBG
PBS_2.1	Data Compression	Algorithm to acquire and to compress data (ADC control, zero suppression…)	MSU
PBS_2.2	Time Stamp	To provide a time stamp per event relative to time information	MSU,GANIL
PBS_2.3	Slow Control & Trigger	To configure all needed parameters before starting an acquisition. It waits about a trigger signal too.	MSU,GANIL
PBS_4.1	MUTANT	To handle multiplicity algorithm and send trigger signal to all CoBo boards.	GANIL
PBS_4.2	BEM	To Provide interface between trigger and the system.	GANIL
PBS_5.1	Test Bench C&C	Build a library to develop uniform testbench software all around board development.	IRFU, GANIL
PBS_5.2	Experiment and security C&C	Development of the final software for building experiment at GANIL and elsewhere it is needed.	GANIL, IRFU
PBS_5.3	Event Builder	Create a data format for all parameters and readout data.	GANIL, IRFU
PBS_5.4	STORAGE	Storage data in a SGBD or equivalent	GANIL, IRFU
PBS_6.1	ASSEMBLY	Prepare the assembly of the different module to prepare experiment	CENBG,GANIL
PBS_6.2	Unit Test	Test of each part of the system before	CENBG,GANIL

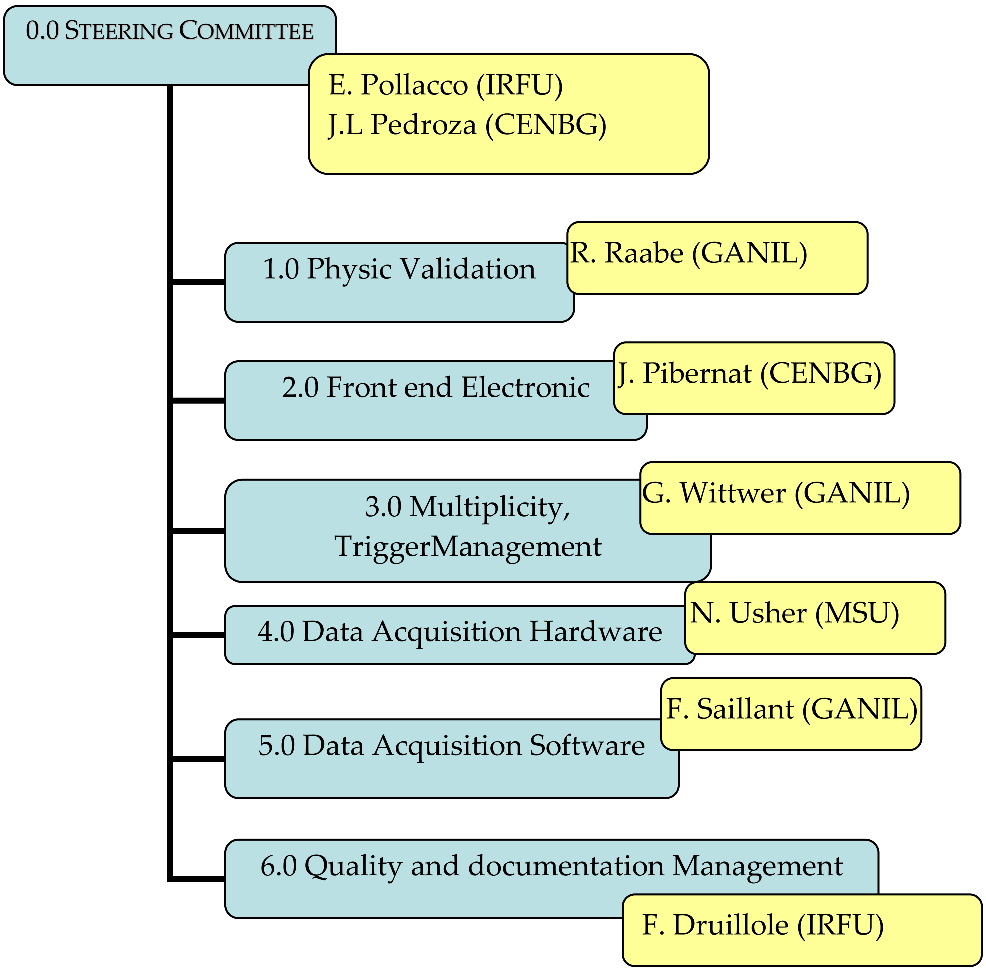
PBS_6.3	Integration	launching an experiment Integrate the system in situ for preparing the experiment	CENBG,GANIL
PBS_6.4	Global Test	Pre-check of the electronic system	CENBG,GANIL
19 products			

3.1.3 WORK BREAKDOWN STRUCTURE



3.2. COORDINATION DU PROJET / PROJECT MANAGEMENT

3.2.1 ORGANISATION BREAKDOWN STRUCTURE



3.2.2 WBS 0.0 STEERING COMMITTEE

The Steering Committee is composed of 8 members: 1 physicist and 1 engineer from each partner.

The role of the Steering Committee (WBS_0.0) is the following:

1. Coordinate the other tasks
2. Coordinate the meetings
3. Report on expenses
4. Communicate with ANR
5. Write a Conceptual Design Report.
6. Coordinate the interfaces of the project.

7. Write an Interface Design Report.
8. From the tasks intermediate reports compile the Technical Design Report.

The management checks that tasks flows go smoothly (with proper management inside the tasks), that deliverables due by each task are ready on due time and that the communication between tasks is efficient. For this, meetings will be organized every 2 months (50% by videoconference) or more frequently when necessary.
The Steering Committee coordinates the interactions with all tasks. In others terms, it guarantees that all the interfaces of the project are well defined. It follows advices from task WBS 6.0 to perform quality assurance on each task and check the appropriateness of each product to the definition of the whole system. Its entire works are based on the works of the different tasks (WBS).
The Steering Committee also coordinates the interactions with outside partners such as future users, special requests for the GET system.

Deliverables of the management task are:
- Progress reports every 6 months.
- An intermediate report showing the expenses every year.
- A conceptual design report after six months.
- An intermediate Interface Design Report (T0+12).
- A final Interface Design Report (T0+36).
- An intermediate Technical Design Report (T0+12).
- A final Technical Design Report (T0+36).

3.3. Description des travaux par tâche / detailed description of the work organised by tasks

The tasks described below have the prime objective to build and check through experiments a prototype GET system to reproduce the required specifications. With reference to the (GANIL/SPIRAL2 & GSI/NuSTAR) physics described in sections 1 and 2, it is deemed that the experimental method, in conjunction with GET for data capture, is essential to reach the physics goals and to remain competitive in the field.
Apart from the general exceptional performance, (dynamic range, charge and time resolution, through-put bandwidth, etc within a multi system approach) we integrate other essentials design features (thermal constrains, mechanical layout, E-M immunity, scalable, thermal and tension secured, portable, automated calibration and performance stabilisation, costs and schedule modular etc) and options (plug & play, online debugging, user-oriented, part future-proof etc.) necessary for nuclear physics where reliability and malleability over large sequence of experiments is a premium.

3.3.1 WBS 1.0: physic validation, system integration and experiments

- *Responsible*

Riccardo Raabe - GANIL

- *Objectives*

This task is central, and all partners are involved. Through WBS 1.0 the Conceptual Design for GET is drawn to reach the physics specifications. Further, it ensures throughout the project that the requirements are effectively implemented and validated. The task will provide the necessary framework, interfaces and experiments for the final prototype verification in nuclear physics measurements. At present time, two validation experiments are planned, to check the functionality of the GET electronics in the different configurations, for the measurement of a reaction and a decay process.

- *Detailed work program*

Implementation of the requirements for each TPC

The precise requirements on the performances of the GET electronics were formulated for the TPCs of next generation that are presently being designed. Also, the work was guided by the identification of physics cases leading to key experiments. The results constitute one of the outputs of the ACTAR JRA within the FP6 EURONS program.
The various TPCs have different specifications depending on the physics program pursued. For the GET electronics, we will consider, in first instance, the detectors developed by the partners in the present ANR:

-The new active target at the GANIL laboratory (physics case: reactions in inverse kinematics with the SPIRAL2 radioactive ion beams).
-The TPC at the MSU laboratory (physics case: heavy ion collisions).
-The TPC at the CENBG laboratory (physics case: two-proton emission and other exotic decay modes at the driplines).

We also take into account the interest and ideas expressed by other laboratories and research groups involved in the ACTAR JRA.
The specifications will be translated in a series of parameters to be implemented in each of the modules of the GET electronics (front-end, multiplicity-trigger, numeric data reduction, run and slow control). This takes place at the design level of each module. Role of the present subtask is to ensure that this is done correctly within each module and coherently across the different modules.
This is achieved by participating (at least one person in this task) in the regular meetings where the design and specifications of each module are discussed and decided. The minutes of the meetings and summary of decisions are the base for a first documentation, which is used as reference for the advance of the various designs. Regular communication between the persons in this task (by email, telephone and phone conference) is kept, to ensure a cross-check between the designs.
External reviewers will be used to help in the process. They will follow the progress of the single and overall design, collaborating with the task responsible in the evaluation. Expert from STFC Darsebury, GSI Darmstadt and KVI Groningen, who were involved in the ACTAR JRA, have been contacted.
No deliverable is associated with this step – the outcome is in the design study of each module.

Description of possible configurations of GET

The use of GET, as associated with a TPC and for a particular experiment, will be elaborated by the persons in this task. Each physicist will focus on the TPC of the corresponding laboratory; he will determine the electro-mechanical optimal parameter for a representative experiment or a set of experiments, according to the physics cases (as identified in the ACTAR JRA). The parameters will include the number of channels, dynamic range, cross-talk, trigger policy, sampling frequency, software robustness, data through-put, event-building and structure.
The deliverable is a report, in form of a "user guide", where the configurations are presented. The document will serve as a set reference in the preparation of experiments.

Preparation and execution of test experiments

The prototype will be assembled for testing and final validation in nuclear physics measurements. We have identified two key experiments to test the main functionality of the GET electronics in very different configurations. The choice of the experiments has also been made in order to cover the two main physics cases considered for the applications with the GANIL/SPIRAL2 ion beams.

- Transfer reactions: $^{12}C(^{8}He,^{7}H)^{13}N$

  This one-proton transfer reaction can be used to produce the unbound ^{7}H system. A measurement took place with MAYA [10]; in that occasion seven events were observed. The use of GET electronics, implemented in a MAYA-type active-target detector, will allow collecting a significantly larger statistics, to validate the observation of the ^{7}H ground state and its characteristics (its position, the surprisingly narrow width, its spin).

  A larger statistics (about one order of magnitude) will be achieved by a) an increase of the gas pressure in the target by a factor 2 or 3, and b) the increased geometrical efficiency for the detection of the recoil ^{13}N tracks, which identify the reaction channel. A higher pressure translates directly in a larger target thickness; however, the tracks of the recoil ^{13}N are shortened by the same factor. An increased density of detection pads, and thus readout channels, is then necessary to provide the resolution required for the identification of the recoil nuclei. Concerning the efficiency, the current limitations in MAYA (the tracks must span several pad rows) will be lifted thanks to the readout ensured by GET.

  GET will be tested with respect to the high data throughput, dynamic range, noise threshold, at the highest sampling frequency.

- Two-proton decay studies:

  In another experiment, the GET electronics will be tested in the case of radioactive decays. Two-proton radioactivity of e.g. ^{45}Fe is in competition with other complex decay modes like β-delayed 2 or 3 proton emission. The present version of the Bordeaux TPC [7] does not allow distinguishing these decay modes efficiently. In particular, if the projection of the proton traces on the detection plane overlap, the fact that the present version of the TPC has no flash-ADC like timing signals hinders the identification of these traces. The GET electronics will allow clearly identifying and distinguishing these decays.

Another problem resolved by the GET electronics is related to the data acquisition dead time. The implantation-type event of a 2p emitter (e.g. ^{45}Fe) is followed closely in time by the radioactive decay. The test of the prototype electronics will allow verifying that the data through-put is fast enough to prevent loss due to an excessive dead time of the system.

Finally the test of the prototype will also allow to study whether problems due to rather different dynamical ranges between and implantation-type event and a decay event can be handled routinely.

In the two cases the GET electronics will be configured according to the document produced at step 2.

Deliverables of this step are: the reports of the tests and experiments (summary of logbooks and conclusions); where necessary, a revision of the "user guide" produced at step 2. Scientific publications will be prepared about the results of the experiments.

3.3.2 WBS 2.0 FRONT-END ELECTRONIC CONCEPTION:

Sub-task 2.1: *Asic Conception (AGET)*

Responsible: Pascal Baron CEA/DSM/IRFU/SEDI/LDEF

The LDEF (Laboratoire des détecteurs et d'électronique frontale) will have in charge the design of the AGET asic. This laboratory has an expertise in the microelectronic domain through different projects in the fundamental physic research. AGET is an upgrade of the chip AFTER [AGET1] designed by LDEF and therefore it is the ideal laboratory to study and realize the more powerful version of this chip. Thus, this work will be achieved by the designers of the AFTER chip, therefore optimizing the time and expertise gained on an already successful project.

Since AGET is an integral part of GET, its development phase will be coupled with the other conceptions of GET. This will entail a communication between the different partners, particularly for the definition of the detailed requirements and in the validation of the prototype phase.

The goal

The alterations in AFTER are necessary to support the relative highest counting rate (1 kHz) and to participate to the definition of the trigger. These different points are:

1) **In the Front end part level**:

- Modification of the input charge range: This provides to the chip highest input charge coverage.

- Modification of the peaking time range: The drift time of the TPC is faster than the one of the T2K TPCs. It permits also to gain silicon area needed to put a part of the additional features.
- Possibility to bypass the internal CSA (charge amplifier) and to enter directly to the shaper or switched capacitor array SCA inputs. This will be useful in the case where a connection to an external CSA is needed (for topology or noise considerations).
- Auto triggering: one discriminator and one threshold (DAC) per channel. This new feature is important for the trigger generation and for the speed of the readout phase.
- Multiplicity output data: the chip will give a signal corresponding to the sum of the 72 discriminators outputs to form the trigger of level 1.

2) **In the SCA and readout part level**:

- Several modes of SCA read out: 128, 256 or 511 analogue cells.
- Several modes of channel read out: hit channel(s), specific channels or all channels.
- Read out of the hit channel address.

These readout modes permit to support highest counting rate and to have a better pulse double resolution.
These novel functionalities will offer to the AGET chip a high versatility and will permit therefore to be used in a different environment with a high level of adjustment.

Development phase

There will be two phases: the design and the test phases.

1) Design Phase: The study and validation of the new design (architecture, schematic, simulation and layout) will be made by using the CAD software tools from CADENCE. The estimated time of the global design is in order of 4 months because of previous version of the circuit.
The chip will be manufactured in a 0.35 µm CMOS AMS process and will be received back 3 months later.

2) Test Phase: In parallel to the asic design, a test bench (hard & soft) must be built and ready for the prototype test. The relative short time of the asic prototype phase will not allow the possibility to use the GET system for this test. We will focus firstly on the test bench used for the AFTER chip. This system has been developed in the CEA/DSM/IRFU/SEDI and can be upgraded in a time compatible with the schedule of the chip. Six months are estimated to modify the different test boards, the firmware and software. The time estimated for the prototype test is of order of 3 months in laboratory.
The test bench based on the T2k one will not allow to study very carefully and deeply the asic performances. Another test bench must be built based on task WBS_3.0 and task WBS_4.0. A close collaboration is needed with CENBG and MSU. It will be the role of the project group to pilot efforts in this sense.
So responsible of the task will participate to the definition and the test of the AsAd board.

If the results are positive, the final validation will be made by testing the circuit with the detector in the GET environment. Responsible of WBS_1.0 will supervise the global test phase with several TPCs, validating AGET and physic case.
In the case of failure, a second prototype phase will be launched.

Reliability of the design

The main important and critical part of the design concerns the SCA which will remain identical to the one in the AFTER circuit. It is clear that one discriminator per channel is a source of possible trouble and is not so trivial. But the risk can be minimized by using safety architecture, as differential structure for example and by taking some precautions in the layout of the chip. The laboratory has already designed this kind of functionality in several asics ([AGET2], [AGET3], [AGET4]) and has therefore a good experience in this domain.

Deliverables:

Detailed specifications. Test results of Submission. Documentation

- ***Sub-task 2.2:*** *Asic Support Board Conception*

Responsible: Jerôme Pibernat CENBG

The SE&A (Service d'Electronique et d'Automatisme) team of the CENBG/IN2P3 has an expertise in the design of frontend cards for high granularity nuclear detectors. The area of expertise covers the micro electronics analogue and digital. For the analogue part, the expertise is in the development of fast circuits with low noise. The digital expertise is related to highly integrated systems from high level languages (VERILOG, VHDL).

Main functions of the Front End Electronic card

The ASIC Support & Analog-Digital conversion (AsAd) card is connected on output of the detectors after passing through a protection circuit. Each AsAd hosts 4 AGET, each followed by an ADC 12 bits 25 MHz. The digital outputs of the 4 ADCs are transmitted by 8 differential lines with a maximum speed of 1.2 Gbit/s. In addition AsAd must manage and / or refer clock signals, multiplicity output, and slow control.
Apart from AGETs and ADCs, ASAD hosts:

- Auto test system for energy and time calibration
- Temperature gauge
- Power supply monitoring
- Board memory for identification
- Fully differential circuitry for transmission.

AsAd is very much akin to the FEC (front-end-card) of T2K with an equivalent geometrical layout. It is planned to develop a first version of AsAd for relatively low density of pads (1 pad/cm). A second version of AsAd will be also developed at a later stage for the 2p-TPC and ACTAR detectors which require high density inputs (5 pads/cm). In this case the card itself needs to be significantly smaller. In both cases cooling is necessary.

AsAd unique aspect

This frontal electronics is unique because for the first time around TPC detectors with various geometries and characteristics varied we have only one type of electronic which produces early digital signals. The combined functions will facilitate the setting of the experiments, the monitoring and the test. The high throughput capability allows efficient digital signal processing. We expect a cross talk lower than 0.1 % and a noise lower than 3000 e-.

Development planning

As noted above, the development of the cards AsAd requires a dense circuitry so that they can be used on high granularity TPCs. We therefore anticipate the development of 2 prototypes. The first will correspond to a moderate density of pads, while the second will concentrate on reaching the high density input requirements and a small format card. In 2009 we will simulate, design and built the first prototype. A bench test for the card will be designed and built in 2009 in parallel. It will be designed to allow production tests. The first prototype which will be furnished with AGET in mid 2009 will be tested before end 2009. Following positive tests of the first prototype, we will endeavour to reduce the format of the cards. We consider that the second prototype will be ready for testing in the laboratory at the end of 2010. Note: should the latter prove too difficult to achieve, at the design stage, an ASIC design of the external pre-amp + filter will be funded. This will be based on the pre-amp + filter of AGET itself. This option has to be studied as early as month 12.

Deliverables:

Specifications. First prototype tested. Contingency plan for ASIC PA. Second Prototype tested. Documentation.

3.3.3 WBS 3.0 MULTIPLICITY, TRIGGER, TIME STAMPING AND EXTERNAL COUPLING ELECTRONICS

This work package is composed of two tasks, corresponding to functions as identified through the product breakdown structure. The ensemble will provide a complex trigger unit, capable of interfacing to other existing or foreseen systems.
This is the concretization of an effort of the whole French Nuclear community, by employing the latest FPGA technological know-how that has resourcefulness and flexibility well beyond the present GANIL Multiplicity Trigger. The unit in its form will be the base for a "universal" new system for GANIL. The other aspect is that the unit breaches a difficulty which GANIL and GSI have with respect to the Time-Stamping interfaces in developing the necessary hardware and firmware to allow integration of different systems.

• ***Sub-task 3.1:*** *Multiplicity, Trigger, Time stamping*

Responsible: Gilles Wittwer - GANIL

Objectives

The aim is to design and build the electronic device that, within GET, will manage the multiplicity, the conditions for the trigger, and the distribution of the clock on the whole system.
A particular attention to these aspects is due in a system destined to be coupled to the new-generation nuclear physics detectors. At 10000 channels or more, the traditional techniques of "Trigger" used in nuclear physics (analysis-windows + sequencer) are not sufficient any more today in terms of functionality and of integration.
The device is named “MUTANT” (MUltiplicity Trigger ANd Time).
In more detail, the functions of MUTANT are:

- Regroup the numerical multiplicity at the highest level of the TPC;
- Choose the threshold of triggering and give the signal of "level 1" trigger;
- Distribute a clock to synchronise all the elements (CoBo AsAd, and AGET);
- Manage a system of "time-stamping" to give tags in every CoBo module essential in the tagging of the data, which will be sent to the acquisition computers. This allows, a posteriori, rebuilding the total event;
- Communicate with the external world via the module BEM (Back End Module) to ask and to accept a "super-decision" from the trigger of another detector and to receive the main clock (100/200 MHZ).

Detailed work program

1. Design of the module

The specifications of the module will be defined based on the requirements of the different physics cases, as supplied through WBS 1.0.
The device will be an electronic standard NIM (Nuclear Instrument Module), using the most recent numerical techniques both at the hardware level and at the software package level. Its capacity will therefore be constructed according to following criteria:

- Use of the FPGA XILINX VIRTEX 4 or 5 with an integrated processor PowerPC;
- Linux operating system for the remote “slow control” of this card via an Ethernet link network with a standard protocol TCP/IP;
- Gigabit links with fibre optics to have communicate with the module BEM (to correspond to the need of galvanic insulation front-end/back-end while keeping high data flow over several tens of meters);
- Copper wires differential links in standards LVDS and LVPECL with CoBo modules.

The task responsible formulates a proposal for the design, which can be dynamically modified in the constant interaction with physics responsibles under WBS 1.0. Technical compatibility and coherence with other modules is ensured by the Steering Committee.

The deliverables of this step are: a document with the technical specifications of the MUTANT module; a detailed estimate of the costs.

2. Realisation and tests of the prototype

The prototype is built using the technology already outlined above. A test bench is also built to validate the module.
A revision of the module could be necessary if some solutions do not perform as expected and specified. The work plan allows for contingencies (new prototype).
An expenditure report completes the deliverables.

- ***Sub-task 3.2:*** *Back-End Module*

Responsible Gilles Wittwer - GANIL

Objectives

The aim is to ensure an interface between the GET electronics, as coupled to a TPC detector, and other, ancillary equipment used in nuclear physics experiments (charged-particle and gamma-detector arrays, spectrometers). This will be achieved through the design and realisation of the BEM (Back-End Module).
The system in question will have the following functions:

- The possibility to be triggered externally;
- Synchronised clocks (internal or external);
- Coupling facilities to existing or new systems like CENTRUM, TDR, BUTIS;
- Provide the necessary links between MUTANT and other instrumentation;
- Allowing the tuning of the whole system ("inspection logic").

Detailed work program

1. Design of the module

The specifications of the module will be defined based on the requirements of the different physics cases, as supplied through WBS 1.0.
The device will be an electronic standard NIM (Nuclear Instrument Module). The BEM has the following characteristics:

- Use of an FPGA Xilinx Virtex 4 or 5 with an integrated PowerPC;
- LINUX embarked operating system employed for the slow control via Ethernet with TCP/IP standards;
- Gigabit connection via optic fibre allowing a dialogue with MUTANT;
- Differential connection for the SMA for the clock entry-exit;
- Connectors and electrical standards that will allow it to be coupled with other systems (CENTRUM, TDR, BUTIS…).

Technical compatibility and coherence with other modules is ensured by the Steering Committee.
The deliverables of this step are: a document with the technical specifications of the BEM module; a detailed estimate of the costs.

2. Realisation and tests of the prototype

The prototype is built along with its test bench.

A revision of the module could be necessary if some solutions do not perform as expected and specified. The work plan allows for contingencies (new prototype).

An expenditure report completes the deliverables.

Unique Aspects of the combined MUTANT-BEM are:

We are building within the French Nuclear community a trigger unit employing the latest FPGA technological knowhow having resourcefulness and flexibility well beyond the present GANIL MULTIPLICITY TRIGGER. The unit in its form will be bases for developing a "universal" system for GANIL. The other aspect is that the units breaches a difficulty which GANIL and GSI have with respect to the Time-Stamping interfaces in developing the necessary hardware and firmware to allow integration of different systems.

Deliverables:

Simulations and written specifications. Evaluation of kit. Development of cards and testing of the MUTANT and BEM units in stand-alone and connected to CoBo . Beam tests with the unit. Documentation of the unit.

3.3.4 WBS 4.0 DATA ACQUISITION HARDWARE

- ***Sub-task 4.1:*** *The Concentration Board (CoBo).*

Responsible: Nathan Usher, MSU/NSCL

After the digitized signal leaves the front end ASAD board it will be processed in the concentration board (CoBo). The CoBo comprises an essential piece of the data taking chain because it is responsible for applying a time stamp, zero suppression and compression algorithms to the data. These operations will be conducted within an FPGA that is housed on the board. Due to the multiple times sampling features of TPC detectors large volumes of data are typically generated per event from the readout of each pad. However, a large fraction of these samples will not contain useable data. To reduce the volume of information that must be transmitted and stored a threshold will be applied to zero suppress empty bins. From simulations it is expected that this will result in a factor of 10-100 rejection ratio depending on the experimental applications. The ability to reconstruct zero suppressed data depends critically on the application of a uniform time stamp to all events. The clock time will be provided by the Mutant module to the CoBo. The FPGA chip selected to perform these tasks will be chosen to allow sufficient memory for applying an optional compression algorithm. This algorithm will apply a peak fitting routine to the data such that only the signal amplitude, width and centre of gravity are transmitted off of the CoBo. The advantage of such algorithms is that they result in an additional reduction in the volume of data transmitted. However, as such a reduction is not necessary for all experimental applications; this is considered to be an upgrade feature that is accommodated in the original design.

In addition to the data processing tasks performed by the FPGA, the CoBo will also serve as a communication intermediary between the AsAd and the outside world. The slow controls signals and commands to the AsAd will be transmitted via the CoBo. It is anticipated that these signals will include, but not be limited to, the clock signal, environmental monitoring, test pulse transmission, spy channels and power. Furthermore, the CoBo will handle the transmission of the trigger signal. Each AsAd will generate a digital pulse representative of the 3D channel occupancy. Because each CoBo card services 4 AsAds, within the FPGA of the CoBo these 4 signals will be summed before being transmitted onward to the Mutant for a trigger decision. The resultant trigger decision by the Mutant will be passed back to each AsAd via the CoBo. Should a positive trigger signal be received, the SCA stop write and read commands will be issued.

To accomplish the specified tasks, the CoBo card will be based around a Xilinx Virtex-5 FXT with embedded PowerPC processors and will also include flash memory, RAM buffer, clock buffer and the requisite signal and power connectors. The high performance FPGA contains high-speed programmable logic to perform zero suppression and time stamping on incoming data as it arrives. Following zero suppression, the PowerPC cores will run more advanced compression algorithms and prepare the data for transmission. Selection of the appropriate components is in progress. A Virtex-5 LXT development kit has been purchased to evaluate data throughput rates and aid in testing of potential board designs. It is anticipated that the data will be transmitted off of the CoBo via either gigabit Ethernet or gigabit optical fibre based on the requirements of the data acquisition systems of the individual laboratories.

Funds have been committed by the laboratory to cover the initial development costs of the CoBo. The CoBo development will be considered complete when the specified functionality has been incorporated and a data throughput rate of 1 kHz is achieved.

CoBo Unique Aspects:

The CoBo represents a unique advancement in electronics development in the intermediate energy Nuclear Science community because it provides digital signal processing at a data throughput rate of 1 kHz for a large data volume. Previous FPGA boards, such as the T2K mezzanine module and the STAR readout card, have been internally limited to 10-100 Hz. A new generation of FPGA cards has just started to become available that allow event rates in the 1 kHz regime to be achieved. Two examples include the ALICE readout control units and the STAR DAQ1000 project. The CoBo is uniquely designed relative to these examples to meet the needs of the intermediate energy nuclear science community where reactions result in relatively low energy particles. These reaction conditions require the experimental capability of internal triggering since frequently the reaction products do not exit the primary detector. The CoBo represents the first FPGA card developed for a TPC that combines high data rates and internal triggering.

- ***Sub-task 4.2:** The Integration Board (InBo).*

Responsible G. Wittwer - GANIL

Objectives

The aim is to develop a device, through which the flow of data is received in a back-end PC for treatment. The device (Integration Board, InBo) will process the information collected from all the CoBos. Several levels of processing could be implemented, depending on the requirements for speed and data storage.

Detailed work program

1. Definition of the communication protocol

The InBo will typically be a commercial PCI-express card equipped with the last FPGA Xilinx Virtex 5 FXT. In order to ensure a very fast communication and at the same time galvanic insulation with the CoBos, the connection will be made through an optical link. The definition of the protocol for communication and data encapsulation is the first step of the InBo task. It has to take into account the requirements in terms of data compression and flow rate, and be compatible with the implementation on the CoBos. For this reason, the work will be carried out keeping a strong contact with the CoBo task.
The deliverable is a document describing the communication protocol (handshake, data encapsulation algorithm).

2. Definition of the data processing algorithms.

More than one optical link is usually present on an InBo card (most commonly, three links on the cards commercially available). Thus each card must be capable of collecting the information from the three links (i.e. three CoBos), verify synchronisation; make, if desired, a first low-level processing; and present the data to the PC CPU for further processing. In this architecture, more InBos are present on one computer. The amount of processing carried out at the InBo or at the PC level can thus be adjusted according to the needs (more fractioned for speed, concentrated at the highest level if only a selection of complex events is required).
Possibilities for low-level data processing will be elaborated with the support from WBS 1.0 ("Physics validation") and eventually presented in a short report (deliverable).

3. Implementation of the protocols

This step is the effective firmware programming of the InBo. For its nature, it is possible to outsource the work to an external company – solutions from the manufacturers of the PCI-express cards have been explored and appear viable.
While the previous steps were based on general specifications of the PCI-express card that will constitute the InBo, for the present step a final choice needs to be made, since the programming is based on the possibilities offered by a specific card. It is thus at this stage that the PCI-express card for the prototype will be purchased.
The deliverable is the prototype InBo card with the software implemented.

4. Testing of the card

The card will be tested for its performances in relation with the defined protocols. A test bench will be set up at GANIL. The deliverable is the validation of the card.

3.3.5 WBS 5.0 DATA ACQUISITION SOFTWARE

- ***Sub-task 5.1:*** *Test Bench Control and Command*

Responsible: Frédéric Château CEA/DSM/IRFU/SEDI/LILAS

The LILAS (laboratoire Ingénierie Logicielle pour les Applications Scientifiques) of the CEA/DSM/IRFU/SEDI, and more precisely Frédéric Château and Shebli Anvar have developed two generic frameworks to address configuration and run control execution issues. Some of these software blocks are currently being used in the KM3 and T2K experiments, and some are scheduled to be. It could save a lot of time and development efforts to use them to handle the configuration and run control tasks for GET, especially for test benches development.

The goal

The goal is to base the run control and acquisition software of GET test benches, on these frameworks. F. Château will assist the software developers for the integration work. They will also provide support, like implementing new features to meet GET's needs, and fix bugs.

Description

The CCFG (Compound ConFiGuration) framework helps software developers, electronic engineers, and physicist to handle configuration in experimental physics projects. It simplifies and automates many tasks related to the management of configurations in such projects, and provides a powerful configuration semantics that makes it really fitted for distributed and complex systems in a scientific environment.
It is composed of several tools:

– A class library to read and write configurations in text files and in memory;
– A class library to use MySql and Oracle databases to store and retrieve configurations;
– A Graphical User Interface program to enable end-users to display and edit configuration.

The DHSM (Data Host State Machine) framework helps software developers to quickly implement the state machine of the run control. It is an execution engine for state machines where the developer just has to setup the state machine: states, transitions, and so… then associate actions and data with them, and finally run it by sending events that will trigger transition crossing, state change and actions execution. All the execution logic and error handling is controlled by the framework.
One of the main features of the DHSM framework is the ability to run the state machine on a centralized distributed system. In such a system there is a master engine (typically the run control server) that controls an array of servant engines (typically acquisition nodes). All the hassle of doing network communications, state synchronization and distributed error handling is already managed by the framework (using ZeroC Ice and IceE middleware's).

All these tools run on Linux and Windows, and some parts of them run on VxWorks and RTEMS embedded systems.

Scheduled Work

The development of the run control server and acquisition software will rely on these frameworks. The run control server will use CCFG to read the configuration from the database or from files and send some parts of it to acquisition boards for their own initialization. The acquisition software will also use it to decode the configuration it receives and use it to initialize the hardware and the some software parameters. The run control user interface may also integrate CCFG widgets to enable the user to modify configuration on the fly before launching an acquisition. The aim is to implement very quickly small system to test the front end electronic (AGET + AsAd) and continue the development to reach the final software for many experiments.
The DHSM framework will be used both by the acquisition software and by the run control server. The first will use it to implement the acquisition state machine that consists of states like: On, Off, Idle, Initialized, Running, Paused, etc. The second will need it to define a similar state machine that will control the whole acquisition array.

- *Sub-task 5.2 Data acquisition software*

Responsible: Frédéric Saillant - GANIL

The objective of the task is to provide final data acquisition software, composed of tools, tested from the debugging of boards by hardware engineers. It is a key point that API's be used during the development phase and to build the final system. We will gain development time.
The data acquisition system should fit in the future "standard" GANIL data acquisition system and should use "standard" components of the GANIL system. The CCFG and DHSM frameworks could be used wherever the software design requirements and analysis will determine that their use will produce substantial gains in development efforts.
As the different boards of the system will be developed in different laboratories, the software delivered will have to be easily configurable to be adapted by the different teams.

The GET software DAQ system has basically three main functionalities:

Slow Control:

The Slow Control is in charge of setting up and monitoring the electronics: AGET ASICs, ASAD boards, COBO boards, INBO, MUTANT and BEM. The main functionalities Slow Control has to provide are:

- define which electronic boards are present in the system;
- initialize the different boards with correct values;
- save all the setup parameters of the whole electronics or a part of the electronics;

- restore a previously saved setup;
- monitor some key parameters of the boards (*e.g.* temperatures …);
- handle error/alarm events and pass them to the Run Control;
- accept some basic commands from the Run Control (setup, go, stop, get state).

The Slow Control system will be designed with a client/server approach. It will mainly consist in a Slow Control Core (SCC) communicating on one side with the different boards and on the other side with a graphical user interface which will behave as a client of the Slow Control Core. The communications between the Slow Control Core and its graphical interface could be implemented with the SOAP/XML network protocol and a WSDL (Web Service Description Language) interface.

The Slow Control Core could be based on the CCFG framework developed by the LILAS team to manage the configuration of the electronics.

Having in mind to put as much intelligence as possible inside the electronics, boards containing a Xilinx Virtex FPGA with a PowerPC core could embed a network command server running under the Linux operating system, which provides advanced network services (TCP/IP, HTTP, SOAP…). GANIL team is going to test very soon the ENX command server designed for the AGATA project. This server should be available at the beginning of 2009. We therefore propose that all the electronics boards embed the same ENX server.

Run Control:

The Run Control has the main purpose to control and monitor the DAQ components. It coordinates the several activities necessary to put the GET system and its data acquisition software into operational state. Actions like initialization, setup, start and stop of the data acquisition are performed by the operator through the Run Control system. It interacts with the Slow Control system in order to assure the correct configuration and setup of the electronic devices, before data taking is started. It also provides the monitoring of the acquisition, error report and logging capabilities.

The main tasks are outlined here:
- configure the DAQ for a run by selecting data flow active components;
- save/restore a configuration;
- basic commands to control all the active components (setup, start, stop);
- monitor the DAQ (status, data rates);
- handle error/info messages;
- log book;
- display spectra.

As the Slow Control, the Run Control system will be designed with a client/server approach. It will also consist in a Run Control Core (RCC) communicating on one side with the data flow active components and on the other side with a client graphical user interface. The

communications between RCC and its graphical interface could be implemented with the SOAP/XML protocol and WSDL interface.
The RCC could be based on the general purpose RCC skeleton currently developed at GANIL. CCFG and DHSM LILAS frameworks could also be integrated in this development.

Data Flow:

The goal is to process the data flow which is coming from the detectors up to the data storage. Data sources are the detectors after their front-end electronics (AsAd boards). The AsAd outputs are collected by the COBO boards. Then all data coming out of the COBO boards are merged together thanks to an Event Builder taking into account the physics correlations provided by the MUTANT board. At the end of the chain, data have to be provided to the physicists in an understandable and user-friendly way thanks to a Data Format library, and are stored on a large disk array.
The data flow will be based on the NARVAL data acquisition system currently used at GANIL. It is distributed and entirely configurable software which can be easily adapted to the different configurations. Some specific actors will have to be designed to answer to the different steps of the project, especially for the event builder of the whole system.

Work plan

The main steps of the work are listed below:

- Embedded Linux + command server for Virtex.
- Specific embedded drivers for each board (ASAD, CoBo, InBo, MUTANT, BEM).
- SCC specific + GUI (ASAD, CoBo, InBo, MUTANT, BEM).
- RCC specific.
- Event Builder (GET).
- Calibration.

This list considers that developments are based on standard GANIL + LILAS tools.
Finally, the data acquisition system of GET has to include a set of tools needed for doing the first online analyses of the tracks associated with the energy losses of ions of interest into the TPC. This information is crucial for the tuning of the detection setup and the checking of the data.

The first tools are the calibration procedures for the measure of the linear response function of the electronic chain and its non-linearity and for the control of its stability with respect to the experimental conditions of the data runs. The large number of channels and the scalable-design of the electronics imply the developments of specific software and hardware and the development of physical based innovative automatic procedures. These elements will also provide to the physicists the synthetic overviews of the system, the error diagnostics and warnings. Some of them are needed at different stages of the R&D especially for bench tests.

Finally, a large amount of the data flow includes trivial events, the beam passing into the TPC. The set of interesting events could represent a tiny part of the recorded events. In case of high counting rates, especially in a standalone mode without external trigger, a software selection should be needed for reducing the data flow or useful for tagging the events. This selection will provide events for the data analysis and allow a fast data readout as well. Different selection methods can be investigated (binary collision, angular correlation) in complement of the trigger selection (multiplicity, triggering pattern) leading to common developments of fast and accurate algorithms.

The DAQ system as presented in its different components (slow control, run control and data flow) has the adaptability and the performance for adding the functions of calibration and event selection. These functions are needed by the data analysis which is driven by the physicists requiring competences and specific developments of the data acquisition of GET.

3.3.6 WBS 6.0 Quality and Documentation Management

Responsable: Frédéric Druillole -CEA/DSM/IRFU/SEDI/LDEF

Objectives:

This is a collaborative project between IRFU, CENBG, MSU and GANIL. It will involve comparable, parallel efforts from four institutions. The efforts on the project are divided between institutions in a way that matches well to the expertise of the personnel and that allows efforts to proceed in a parallel manner without great interdependence. Never-the-less, close collaboration and effective communication are essential to coordinate efforts and keep the project on schedule. We will communicate by frequent phone and video conferences, emails, and regular visits between institutions. We also utilize web-based tools, such as WiKi and EDMS that keeps a cohesive record of all developments for all members of the collaboration to follow.

Detailed work program:

Each responsible of task has to provide a number of document to the project group. The list of document is listed below:

- STB: Spécification technique des besoins (Requirement):
- CDR : Conceptual Design Report :
- IDR: Interface definition Report:
- TDR : Technical Design Report :
- TR: Test Report:
- PRR: Production Readiness Report:

The framing, versioning and storage of the documentation will be created by the WBS 6.0 task members in agreement with each task leaders. The aim is to have a steady documentation to check the coherence between interfaces, to detect defaults and incoherence between products.
A second goal is the organization of review to prepare the prototype manufacturing. At least two reviews are mandatory. One concerns the description of each product before realization. The second is the production readiness review for the prototype of the system.

One important task will be the review and the validation of each paper proposed to be published like a publication committee has to do.
The last task is to maintain web-based tools for keeping aware the collaboration about each part, about the consistent schedule, stakes and due dates during the project.

3.3.7 Work Packages Summary

Task id	Product Name	Description	Responsible
WBS_0.0	Steering Committee (Management)	Pilots each task and controls the interface between products.	E. Pollacco (IRFU) JL Pedroza (CENBG)
WBS_1.0	Physics Validation	To check the appropriateness of the GET specifications and physics requirements for three existing TPCs (AT-TPC, MAYA, CENBG-TPC).	R. Raabe (GANIL)
WBS_2.0	Front End Electronic	Builds the ASIC and the near asic environment and Build the ASIC support card with all necessary added functions (protection, trigger and ADC, slow control)	J. Pibernat (CENBG)
WBS_3.0	Multiplicity, time and trigger conception	Builds the system of time and trigger management and manages the interface with other products of the system	G. Wittwer (GANIL)
WBS_4.0	Data Acquisition Hardware	Builds the cards which handle the data flow	N. Usher (MSU)
WBS_5.0	Data Acquisition Software	Develops all the Applicated Programmable Interface necessary to build test bench and final acquisition software.	F. Saillant (GANIL)
WBS_6.0	Quality and documentation management.	Organizes the review, to follow the document of each work package, takes care of the storage of the documentation and the quality process of the project.	F. Druillole (IRFU)

3.4. Calendrier des tâches, livrables et jalons / Planning of tasks, deliverables and milestones

3.4.1 Tasks and their inter-relationship

To reach the required deliverables the project is divided into 10 sub-tasks which are grouped under 6 basic Work Packages (Section 3.3). The division is done by unit module (described above). The inter-relation between of the tasks can be understood through the functions required (fig. 3.1) and in table giving the calendar (above). The efforts on the project are divided amongst institutions in a way that matches well to the expertise of the personnel and the laboratory as a whole. It allows each partner involved comparable, parallel and necessary efforts. Further, it leaves a challenge for each partner to achieve. The studied choice of division and allotment allows efforts to proceed in a parallel manner without great interdependence.

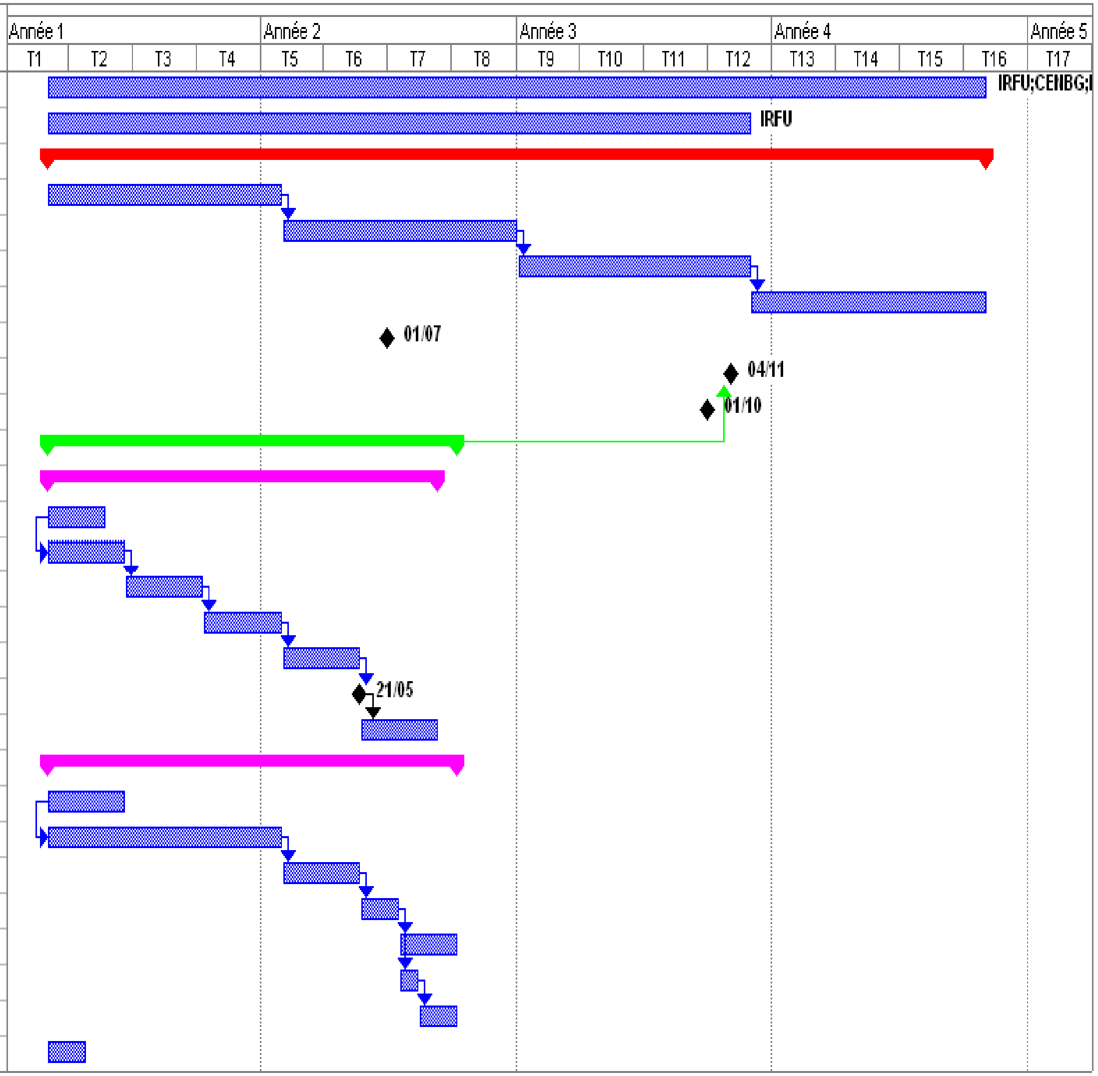
3.4.2 TASK SEQUENCING

The Task Sequencing is eased by the fact that each principle unit (AsAd, CoBo …) has a test bench development. However, the conception of the CoBo board (PBS_2.0) depends on the implementation of the ASIC support card (PBS_1.2) because of the ADC controller. This front end card, AsAd, is constrained by the trigger policy and the geometry of the readout detector plan (number of pixels, size) and should be done only when the AGET asic is ready to be built (PBS_1.1). MUTANT/BEM boards (PBS_4.1 and 4.2) are reasonably independent to build because they constraint the trigger implementation in other board such as the front end and back end boards.
The firmware for the testing of the prototypes is non-critical in the sense that most of it is almost available for the initial tests of AGET. The software development for the data merging etc., is rather independent until hardware exists. At this time, real implementation must be done to test each board and the final system.

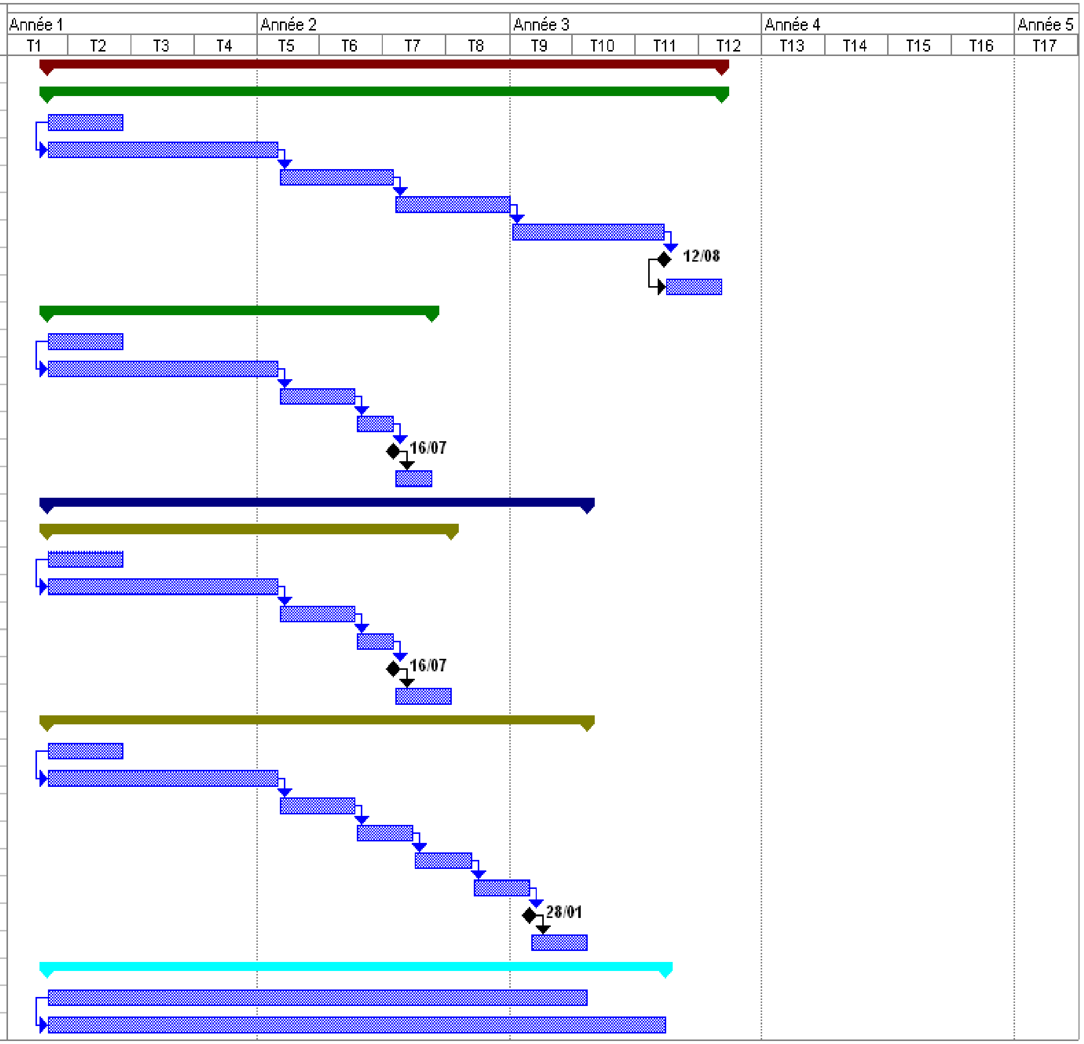
3.4.3 RISK ASSESSMENT

The risks are in general relatively small because each of the founding elements being attempted have been, by and large achieved in previous studies, for example in HIRA, MUST2, T2K and other projects. However what is particularly innovative is the combined concepts and consequently a risk is the large numbers involved, the level of control per channel as well as the speed of the data transfer and the multi-level trigger. A concern is the selective-readout however IRFU has build an asic with such a facility. Another aspect which requires vigilance is that the tasks/work packages are interdependent particularly in the final stage, thus possibly leading to costly delays. Counter actions are taken to require, when as possible, bench testing as well as to introduce simple procedures that will allow a large fraction of the system to function without certain elements. Finally, but of primordial importance, the insistence of having regular meeting to keep the whole group at breast with the progress made.

N°	WBS n°	Nom de la tâche	Noms ressources
1	0.0	**Project Management**	*IRFU;CENBG;MSU;GANIL*
2	6.0	**Quality and Documentation Management**	*IRFU*
3	**1.0**	**Physic Validation, System Integration and Experiment**	*GANIL;IRFU;MSU;CENBG*
4	3.1	Physic Requirement for Each TPC	
5	3.2	GET Configuration	
6	3.3	GET System Validation	
7	3.4	Physic Case Experiment	
8	3.5	AsAd + CoBo validation	
9	3.6	Global test	
10	3.7	System Validation in Physic Case	
11	**2.0**	**Front End Electronic**	*IRFU;CENBG*
12	**2.1**	**AGET**	
13	2.11	*Conceptual Report*	
14	2.12	*AGET submission I*	
15	2.13	*Test Bench Conception*	
16	2.14	*Test*	
17	2.15	*AGET submission II*	
18	2.16	*Production start*	
19	2.17	*Production and Test*	
20	**2.2**	**AsAd**	
21	2.21	*Conceptual Report*	
22	2.22	*Low Density Prototype I manufacturing*	
23	2.23	*Test Bench Conception*	
24	2.24	*Test*	
25	2.24	*Prototype I Pre-production*	
26	2.25	*High Density Prototype II Manufacturing*	
27	2.26	*Test*	
28	2.27	*Prototype II Pre-production*	



N°	WBS n°	Nom de la tâche	Noms ressources
29	**3.0**	**Multiplicity, Trigger Management**	*GANIL;MSU*
30	**3.1**	**MUTANT**	
31	3.11	*Conceptual Report*	
32	3.12	*MUTANT prototype manufacturing*	
33	3.13	*Test Bench Conception*	
34	3.14	*Test*	
35	3.15	*Prototype II Pre-production*	
36	3.16	*Production start*	
37	3.17	*Production and Test*	
38	**3.2**	**BEM**	
39	3.21	*Conceptual Report*	
40	3.22	*BEM prototype manufacturing*	
41	3.23	*Test Bench Conception*	
42	3.24	*Test*	
43	3.25	*Production start*	
44	3.26	*Production and Test*	
45	**4.0**	**Data Acquisition Hardware**	*GANIL;MSU*
46	**4.1**	**CoBo**	
47	4.11	*Conceptual Report*	
48	4.12	*CoBo prototype manufacturing*	
49	4.13	*Test Bench Conception*	
50	4.14	*Test*	
51	4.15	*Production start*	
52	4.16	*Production and Test*	
53	**4.2**	**InBo**	
54	4.2.1	*Conceptual Report*	
55	4.2.2	*CoBo prototype manufacturing*	
56	4.2.3	*Test Bench Conception*	
57	4.2.4	*Test + Bug Correction*	
58	4.2.5	*CoBo prototype II manufacturing*	
59	4.2.6	*Test*	
60	4.2.7	*Production start*	
61	4.2.8	*Production and Test*	
62	**5.0**	**Data Acquisition Software**	*IRFU;GANIL*
63	5.1	Test Bench Software	
64	5.2	Experiment Control & System Security	



4. STRATEGIE DE VALORISATION DES RESULTATS ET MODE DE PROTECTION ET D'EXPLOITATION DES RESULTATS / DATA MANAGEMENT, DATA SHARING, INTELLECTUAL PROPERTY AND RESULTS EXPLOITATION

Scientific communication will be organised via publications of the results in peer-reviewed journals, presentations in conferences/workshops and publication of extensive documentation to be distributed among the collaboration and to other laboratories expressing their interest in the present development. Tools will be put in place to facilitate the contacts with external research groups. The web-based structure built within WBS_6.0 for internal communication will be used as a starting point, to give access to the final technical documentation; after completion of the project it will be kept up-to-date following possible modifications of the product; and it will be complemented, for external access, with information about the physics results and aims of the collaboration. Typically, the physicists already involved in WBS_1.0 will take care of the latter task, keeping a record of results and publications, and acting as "entry points" for external research groups and laboratories.

The strategy for data management and intellectual property will be defined within a Memorandum of Understanding presently under discussion between the four laboratories involved in the present project. Any future valorisation of the GET project, in particular the production phase of the electronics and the eventual distribution to other groups will require the approval of the four partners involved in the R&D phase. For the 3 French laboratories, it is anticipated that a positive answer from ANR to the R&D phase would considerably enhance the possibility to obtain the necessary funds for the production phase. It would also contribute very positively for further publicity towards external collaborations considering the purchase of such type of electronics in the future.

5. ORGANISATION DU PARTENARIAT / CONSORTIUM ORGANISATION AND DESCRIPTION

The physics programs that will use the GET electronics are diverse and hence have brought together a number of physicists with diverse nuclear physics interests. The options taken have interests in particle physics and would be employed as test systems. Thus it is expected that such a collaboration will enhance the cross fertilisation in the field over several laboratories and across fields. A number of physicists in this consortium have already worked together in experiments which are either relevant to active target method or the physics using it. Supporting elements are publications and/or accepted novel proposals.

The four groups involved in this work have extensive experience in managing projects of similar scope. In particular the four groups have had experience in building, for Nuclear Physics, ASIC driven instrumentation (HIRA, MUST2, MAYA and 2p-TPC). In particular, IRFU and GANIL have already join forces to build ASIC based systems (VAMOS, MUST2, MAYA and MAYITO). Also, the FP6-ACTAR JRA, over the last four years was an effective in preparing the members of the consortium to work together and to gauge the complementary and relevance of each institution for this program. Thus the GET partners have the necessary drive to develop the physics program and hurdle the instrumentation barrier. To be noted that without the GET affiliation no one institution will have the resources to complete such a development.

Finally, unlike most ventures, where collaboration strives for a single outcome, the present R&D has the ambition to provide a solution to a number of projects with a common nuclear physics domain. This has relevant positive reflexes on the interest by each partner as well as being particularly effective in exploiting and complementing the community's resources. Thus the sharing in the knowhow and use of ASIC technology, time stamped and fast data recording techniques employed in medium sized systems for nuclear physics. The cooperative aspects are particularly pertinent in that it allows nuclear physics to avail itself to a fully numerical based technology which will otherwise be inaccessible for medium sized instrumentation. Finally, it is to be added that the R&D gives a (i) base system (back-end) for numeric data capture and reduction with high bandwidth capacities for small (300 channels) to large systems (20,000 channels) adapted to the nuclear physics community needs operational at SPIRAL2 and other laboratories. (ii) a demonstrator system to set standards for a generic approach for an ASIC front-end with a fully numerical back-end, thus economizing strongly on the developing time, effort and finance.

5.1. DESCRIPTION, ADÉQUATION ET COMPLÉMENTARITÉ DES PARTENAIRES / RELEVANCE AND COMPLEMENTARITY OF THE PARTNERS WITHIN THE CONSORTIUM

5.1.1 PARTNER 1 IRFU

IRFU will participate in the physics (SPhN/IRFU), hardware (LDEF/IRFU) and software/firmware (LILAS/IRFU). The structure group within SPhN/IRFU has a long history of physics employing radioactive beams for direct reaction studies. Physicists and engineers are specialists in instrumentation development and construction with collaboration experience.

The LDEF (Laboratoire des détecteurs et d' électronique frontale) of the CEA/DSM/IRFU/SEDI has in charge the design of the AGET asic. This laboratory has an expertise in the microelectronics domain through different projects in the fundamental physics research. The LDEF has designed the AFTER chip and is the ideal laboratory to study and realize the new powerful version of this chip. In this way, this work will be achieved by the same designers of the AFTER chip optimizing therefore the success and the time of the operation. It can also be said the LDEF is a world leading laboratory in the design of fast analogue memory array which will be employed in AGET allowing first and second level triggers. LDEF will also share the experience gained with T2K to CENBG and MSU to allow a rapid development for AsAd and CoBo. Complementarily here lies in that no other lab in the collaboration can provide ASIC technology expertise.

The LILAS (laboratoire Ingénierie Logicielle pour les Applications Scientifiques) and SPhN have a proven experience in developing calibration software as well as run and slow control software. Engineers from LILAS have developed the embedded software of the ANTARES experiment and several applicative software for astrophysics data management. They participate actively to the LHC experiments like ATLAS, CMS and prepare a new astro-particles framework in the KM3net European Consortium. Their competences come from embedded software to data acquisition and management software (SGBD, client/server). In addition IRFU and GANIL have collaborated successfully in the past in similar sized and oriented projects [4].

5.1.2 PARTNER 2 GANIL

GANIL is the French National Laboratory for low-energy nuclear physics, a world-leading radioactive ion beam facility. This position will be strengthened by the construction of the SPIRAL2 facility for post-accelerated exotic beams. The laboratory, with the people involved in the present GET proposal, has a strong expertise in the Active Target physics case: the MAYA detector [6] has been designed and built at GANIL. Experience in the physics case has guided the identification of the needs for the new generation of active targets, which translate into the requirements listed for the GET electronics. The design and realisation of the electronic modules described in the present proposal will be carried out by engineers in the "Group Acquisition pour la Physique" (GAP). The group has already realised ASIC-based electronics in large projects such as the ones for the VAMOS [22] and MUST2 [4] instruments, completed with the corresponding control modules and software. The GAP also possesses the key expertise for the integration of the GET electronics with the hardware/software system for data acquisition and run control which is used at the Laboratory.

5.1.3 PARTNER 3 CENBG

CENBG will participate in the physics as well in hard- and software. With the design and the construction of the CENBG TPC for the study of two-proton radioactivity, the CENBG has acquired know-how essential for the present project. This TPC is, together with the MAYA detector built at GANIL, the first TPC used in low-energy nuclear physics. Within this and other projects, the Electronics group of CENBG has shown its ability to work on large-scale highly-integrated instrumentation.

Although the ASIC used in the CENBG TPC was purchased by an outside company, the layout and the specifications were studied and determined by the CENBG. Beyond the electronic design of such systems, experience was also gained on the software concerning slow control and fast data transfer, which is essential for the large amount of data from TPCs.

5.1.4 PARTNER 4 MSU

The design and testing of the CoBo will be conducted by the NSCL Electrical Engineering Department, which has experience designing and supporting FPGA readout and control electronics. The design requirements for the CoBo are similar in complexity to other FPGA boards designed, programmed and supported by the NSCL, such as an FPGA based radio frequency controller board for the reaccelerator linac or a Xilinx based FPGA read out of the

beam tracking wire chambers used throughout the NSCL facility. The NSCL plans to use the GET electronics with an active target time-projection chamber being developed at the laboratory by a team composed of Abigail Bickley, William Lynch, Wolfgang Mittig and Gary Westfall.
The National Superconducting Cyclotron Laboratory (NSCL) at Michigan State University commits to allocating the manpower and monetary resources necessary for the design and testing of the CoBo card of the GET electronics system. The budget involved are estimated to be 30k$ (25k€) for the equipment and 400k$ (300k€) for the personnel.

5.2. QUALIFICATION DU COORDINATEUR DU PROJET / QUALIFICATION OF THE PROJECT COORDINATOR

The coordinator of GET, Emanuel Pollacco, has played a leading role in a number of instrumentation projects for Nuclear Physics exotic beam experiments. Two examples are given here.
Coordinator and designer of the MUST2 position sensitive particle telescope for direct reaction studies. MUST2 is the first ASIC based detection to be fully implemented by the French (IPN Orsay, GANIL, IRFU) Nuclear Physics community employing full numeric control. The project covered both the hardware and firmware R&D. In its full set-up it covers 60% of the kinematic phase space. It is a marked success for the experiments at GANIL. MUST2 was fully operational in 2006. The ANNULAR and ANR MUSETT as well as German and Chinese projects are founded on this work.
Coordinator and co-designer of the VAMOS detection system and acquisition for GANIL. Focal plane detection for the world largest solid angle particle spectrometer was built to cover a very large phase fraction of momentum space available for this spectrometer. The ultra economical and straightforward acquisition was based on ASIC system technology developed at CERN. It was the first time that GANIL was introduced to ASIC based front-end electronics. The time-stamping capability in the GANIL was designed and commissioned through this project. The VAMOS project was commissioned in 2002. This work was reproduced for PRISMA (LEGNARO), MAGNEX (CATANIA), SAMURAI (RIKEN) and initiated the MAYA, Beam trackers and MAYITO at GANIL.
Conceptual designer of the instrumentation GASPARD for the SPIRAL2 physics.

Civilité	Nom	Prénom		Age
Mr	Pollacco	Emanuel		58
Grade	Physicist	Employeur	CEA	
Mail epollacco@cea.fr		Tél	+33 (0)1 69 08 4288	

Cursus et Situation actuelle :

Professional Preparation

Sussex University	BSc in Mathematical Physics	
ANU University	Nuclear Physics	Ph.D. 1976

Appointments

1976 – 1979	Post Doc Univ of Bermingham, UK
1980 - 1982	Lecturer Univ of Malta
1983 - 1985	Collaborator Etranger, SPhN, Saclay
1985- 1986	Assist. Prof. Univ of Grenoble.
1986 -	Engineer CEA

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

MATE, a single front-end ASIC for silicon strip, Si(Li) and CsI detectors
Baron, P.; Atkin, E.; Blumenfeld, Y.; Druillole, F.; Edelbruck, P.; Leterrier, L.; Lugiez, F.; Paul, B.; Pollacco, E.; Richard, A.; Rouger, M.; Wanlin, E.;
Nuclear Science Symposium Conference Record, 2003 IEEE,
Volume 1, 19-25 Oct. 2003 Page(s):386 - 390 Vol.1

A. Drouart et al.
Very large emissive foil detectors for the tracking of low-energy heavy ions
NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH SECTION A, 579 (3): 1090-1095 SEP 11 2007

P. Lautesse, L. Nalpas et al.
Evolution of the fusion cross-section for light systems at intermediate energies
EUROPEAN PHYSICAL JOURNAL A, 27 (3): 349-357 MAR 2006

A. Obertelli et al.
Shell gap reduction in neutron-rich N=17 nuclei
PHYSICS LETTERS B, 633 (1): 33-37 FEB 2 2006

E. Pollacco et al.
MUST2: A new generation array for direct reaction studies
EUROPEAN PHYSICAL JOURNAL A, 25: 287-288 Suppl. 1 2005

5.3. QUALIFICATION, ROLE ET IMPLICATION DES PARTICIPANTS / CONTRIBUTION AND QUALIFICATION OD EACH PROJECT PARTICPANT

Coordinator **SPhN/IRFU & SEDI/IRFU**	Nom	Prénom	Emploi actuel	Discipline*	Personne .mois	Rôle/Responsabilité dans le projet
Coordinateur/responsable	Pollacco	Emanuel	Physicist	Nuclear Physics	30	Coordinator of the project
Autres membres	Nalpas	Laurent	Physicist	Nuclear Physics	12	WBS 1.0
	Gillibert	Alain	Physicist	Nuclear Physics	4	WBS 1.0
	Ducret	Jean-Eric	Physicist	Nuclear Physics	5	WBS 1.0
	Baron	Pascal	Engineer	Micro Elec. Engineer	24	Responsible for the ASIC, AGET WBS 2.0 (subtask 2.1)
	Château	Frédéric	Engineer	Software Engineer	13	Responsible for WBS 5.0 (subtask 5.1)
	Druillole	Frédéric	Engineer	Electronic. Engineer	24	Responsible for AGET bench-test (WBS 2.0) and responsible WBS 6.0

Partenaire 2 – **GANIL**	Nom	Prénom	Emploi actuel	Discipline*	Personne. mois	Rôle/Responsabilité dans le projet 4 lignes max
Coordinateur/responsable	Raabe	Riccardo	Physicist		16	Responsible for WBS 1.0
Autres membres	Roussel-Chomaz	Patricia	Physicist		7	WBS 1.0
	Savajols	Hervé	Physicist		10	WBS 1.0
	Chbihi	Abdou	Physicist		7	WBS 1.0
	Wittwer	Gilles	Engineer		16	Responsible WBS 3 and subtask 4.2
	Saillant	Frederic	Engineer		16	WBS 5.0 - Responsible subtask 5.2 Data Acquisition Software

Partenaire 3 **CENBG**	Nom	Prénom	Emploi actuel	Discipline*	Personne .mois	Rôle/Responsabilité dans le projet
Coordinateur/responsable	Pedroza	jean-Louis	IR1 CNRS	Electronic Engineer	12	Co-Responsible for task WBS 0.0.
Autres membres	Pibernat	Jerôme	IE2 CNRS	Electronic Engineer	24	WBS 2.0 Responsible subtask 2.2
	Hellmuth	Patrick	IE2 CNRS	Electronic Enginneer	12	WBS 2.0 Subtask 2.2
	Tizon	Arnaud	AI CNRS	Electrnic technician	24	WBS 2.0 Subtask 2.2
	Blank	Bertram	DR CNRS	Researcher	8	WBS 0.0 and WBS 1.0

Partenaire 4 **NSCL/MSU**	Nom	Prénom	Emploi actuel	Discipline*	Personne .mois	Rôle/Responsabilité dans le projet
Coordinateur/responsable	Mittig	Wolfgang	Hannah Chair	Dept of Physics	6	WBS 1.0
Autres membres	Bickley	Abigail	Assistant Professor	Dept of Chemistry	6	WBS 4.0
	Usher	Nathan	Engineer	NSCL	24	WBS 4.0 Responsible subtask 4.1
	Lynch	William	Professor	Dept of Physics	1	Consultation

6. JUSTIFICATION SCIENTIFIQUE DES MOYENS DEMANDES / SCIENTIFIC JUSTIFICATION OF REQUESTED BUDGET

6.1. PARTENAIRE 1 / PARTNER 1: IRFU

- *Équipement / Equipment*

No equipment with a unit cost larger than 4 k€ is required.

- *Personnel / Staff*

The 18 months CDD requested for the IRFU is an indispensable additional member to IRFU, which is responsible for the study of the acquisition software with regards to GET. It will be the responsibility of the CDD to study and extract the necessary operational specifications, to delimit the development and develop the middleware under the following themes;

- Architecture and software engineering on portion concerning hardware/software with regards to acquisition processes.
- Architecture and software engineering on portion regarding data flow for the test benches developed by the collaboration which include the calibration and reconstruction of events.
- The evolution and maintenance of the existent frameworks which are essential for the GET testing and evaluative procedures.

The drawn specification documents have to be developed in software modules formats allowing for substantiation of the conceptual developments. In turn these modules will form an integral part of the acquisition system of the future active target instrumentation.

The candidate in question will integrate the additional responsibility for the report deliverables as part of the ANR financial commitments.
This position asks for an in-depth knowhow in software engineering and modelling with object oriented, data base and distributed software technology.

- *Prestation de service externe / Subcontracting*

Task	Description	Unit price (k€)	Qt.	Total (k€)
WBS_2.0	Prototyping ASIC Front-End	50,00	x 2	100,00
				TOTAL 100,00

We propose to design an ASIC based on the AFTER ASIC of the experiment T2K280m. We plan to realise two fabrication prototypes.
The general quotation for the prototyping of an ASIC includes fabrication, encapsulation and delivery of 25 pieces.
For the fabrication we intend to work with the CMP (46 av. Felix Viallet 38031 Grenoble Cedex), a mixed unit of the CNRS, the Université Joseph Fourier and the INPG (UMS 3040). This organism allows the access to advanced microelectronics technologies for users that do not require large volumes, on one side; on the other, it groups the projects of different clients to let them produce within a single batch. This permits to share the manufacturing costs (masks…), which have become dominant in microelectronics. This possibility is economically interesting especially in the case of fabrication of prototypes.

- *Missions / Missions*

The mission costs are based on the number of involved persons during the project taking into account their working time. Table below describes the percent of equivalent time per person.

	% ETP (equivalent time people)																
Tear	1st				2nd				3rd				4th				
trimester	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	% ETP/an
E. Pollacco	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
L. Nalpas	0	0	0	0	36	36	36	36	36	36	36	36	36	36	36	36	25
P. Baron	80	80	80	80	80	80	80	33	33	33	33	33	33	33			50
F. Château	36	36	36	36	36	36	36	36	36	36	36	36					25
F. Druillole	66	66	66	66	66	66	33	33	33	33	33	33	33	33	33	33	50
CDD 18mois			100	100	100	100	100	100									
Total	242	242	342	342	378	378	345	345	245	245	245	245	209	209	209	209	Total/3year
Annual yield	292				361				245				209				957

Every year, following missions are foreseen:

- 3 missions in France for work group participation
- 1 mission for global collaboration meeting
- 2 missions for expertise between products (AGET, AsAd, CoBo)

The cost per person per mission is about 500€ (2 nights)

We foresee also two missions in USA in second and third year. It allows the setting up and the test with MSU product. The total foreseen cost is 5k€.
The two last years, missions in situ are foreseen to do experiment with part and with the whole system. The cost per person is 200€ for travelling and 70€ per day.

Moreover, we want to participate to a conference (like NSS); the estimated cost is 2.1K€.

Years	1st Year	2nd Year	3rd Year	4th Year
Travel expenses (k€)	9500	11100	16380	12280

- *océdure de facturation interne / Internal acturation interne / Internal expenses*

- *Autres dépenses de fonctionnement / Other expenses*

Task	Description	Unit price (k€)	Qt.	Total (k€)
WBS_2.0	Licenses CAO microelectronics	3,00	x 2	6,00
WBS_2.0	Laboratory Power Supply (GPIB)	1,00	x 1	1,00
WBS_2.0	PC power supply	0,20	x 2	0,40
WBS_2.0	Electronic and cable components	0,25	x2	0,50
WBS_2.0	T2K280m System called Fem_STUC	2,50	x1	2,50
WBS_2.0	Kit Xilinx Virtex 5	1,50	x1	1,50
WBS_2.0	Participation of Waverunner oscilloscope cost (20%)	0,60	x2	1,20
WBS_2.0	PC	1,20	x1	1,20
WBS_2.0	Network card	0,10	x1	0,10
				TOTAL 14,40

Development and testing of the ASIC:
The design of integrated circuits requires the use of expensive CAD software. Nevertheless the annual costs for the right of use are reduced in the case of a research context and the framework Europractice, to which we adhere. We plan the use of a complete CAD licence for a period of 2 years.
The fine characterisation of the ASIC requires the use of a programmable test bench. Such equipment was developed in the framework of the experiment T2K280m. The duplication of the bench electronics is thus necessary for the present project. Then, an acquisition system based on the AsAd and CoBo cards will allow testing the ASIC in conditions similar to those of the final GET prototype. For this purpose we need a Xilinx development kit emulating the CoBo card. Interface cards are useful to build a front-end demonstrator at Saclay and the use of a performing oscilloscope is necessary to read the rapid signals.

6.2. PARTENAIRE 2 / PARTNER 2: GANIL

- *Equipement / Equipment*

Task	Description	Unit price (k€)	Qt.	Total (k€)
WBS_3.0	MUTANT card	5,00	x 1	5,00
WBS_3.0	BEM card	5,00	x 1	5,00
WBS_3.0	NIM crate	5,00	x 1	5,00
WBS_4.0	InBo card	5,30	x 3	15,90
				TOTAL 30,90

The costs for the MUTANT and BEM cards sum up the costs of components and are based on the experience with similar developments carried out at GANIL.
The NIM crate will host the CoBo, the MUTANT and BEM cards, which will be realised in this form factor.
The hardware for the InBo card is a PCI-express card of the last generation.

- *Personnel / Staff*

Task 3 – 24 man/months
The MUTANT and BEM cards require 20 man/months each. Expertise from GANIL engineers is required in the initial phases of design and development, for a total of 14 man/months. The remainder (26 man/months) will be carried out by an engineer on a CDD.

Profile CDD – MUTANT/BEM

The engineer will need to have a double competence to be able to complete successfully both the hardware and software developments:

1) He has to be well acquainted with the FPGA technologies and the associated description languages VHDL and/or Verilog. He will have to conduct the simulations to validate the design (using the Modelism software). Knowledge of the solutions around optical transmission of data will be an advantage.
2) He has to ensure the development of the cards, from the choice of components based on the design, to the routing of the signals, passing by the realisation of the scheme. The knowledge of a toll such as Cadence "Allegro Design Entry" (tool IN2P3) will be an advantage.

Task 4 – 18 man/months
The InBo card requires essentially firmware development, which can be carried out by a person on a CDD (engineer). The CDD cost will be financed by the collaboration connected with the ACTAR program through GANIL. The time estimated for this work is 18 man/months.

Profile CDD – InBo

The engineer will be in charge of the integration of commercial PCIexpress electronic cards in a personal computer dedicated to the data acquisition in the experiments performed with the new TPCs implementing the GET electronics. To succeed in the task, he has to be well acquainted with the FPGA (Field Programmable Gate Array) technologies and the associated description languages VHDL and/or Verilog. He will have to conduct the simulations to validate the design (using the Modelism software). Knowledge of the PCIexpress standard or of high-bandwidth transceivers mounted on FPGA will be an advantage.

- *Prestation de service externe / Subcontracting*

- *Missions / Missions*

The mission costs are based on the number of involved persons during the project taking into account their working time. Table below describes the percent of equivalent time per person.

	% ETP (equivalent time people)																
Year	1st				2nd				3rd				4th				
trimester	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	% ETP/an
R. Raabe	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33
P. Roussel-Chomaz	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
H. Savajols	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
A. Chbihi	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
G. Wittwer	33	33	33	66	66	66	66	33	33	33	33	33	0	0	0	0	33
F. Saillant	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33
CDD 24mois				100	100	100	100	100	100	100	100						
Total	149	149	149	249	249	249	249	249	249	249	249	149	113	113	113	113	Total/4year
Annual yield	174				249				224				113				760

Every year, following missions are foreseen:
- 3 missions in France for work group participation
- 1 mission for global collaboration meeting
- 2 missions for expertise between products (AsAd,CoBo,InBo,MUTANT,BEM)

The cost per person per mission is about 500€ (3 nights)

We foresee also two missions in USA in the second and third years. It allows the setting up and the test with MSU product. The total foreseen cost is 5k€.

Moreover, we want to participate to a conference (like NSS); the estimated cost is 2.1K€.

Years	1st Year	2nd Year	3rd Year	4th Year
Travel expenses (k€)	5250	10000	9220	3360

- *Dépenses justifiées sur une procédure de facturation interne / Internal expenses*

- *Autres dépenses de fonctionnement / Other expenses*

Task	Description	Unit price (k€)	Qt.	Total (k€)
WBS_3.0	Testing MUTANT card	1,50	x 1	1,50
WBS_3.0	Pre-production MUTANT	3,00	x 3	9,00
WBS_3.0	Testing BEM card	1,50	x 1	1,50
WBS_3.0	Pre-production BEM	3,00	x 3	9,00
WBS_3.0	Optical link	3,00	x 1	3,00
WBS_4.0	Testing InBo card	1,50	x 1	1,50
WBS_4.0	PC	3,00	x 1	3,00
				TOTAL 28,50

The testing of the various cards requires a test bench with a support card.
Three MUTANT and BEM cards will be realised, one for each laboratory, where they will be made available for combined testing of the system.
The optical link is used for communication between the CoBo and the InBo cards. This type of connection is required to sustain the large data flow.
The InBo cards will be hosted in a fast PC.

6.3. PARTENAIRE 3 / PARTNER 3: CENBG

- *Équipement / Equipment*

Task	Description	Unit price (k€)	Qt.	Total (k€)
WBS_2.0	Pulse Generator	4,00	x 1	4,00
WBS_2.0	ASIC PreAmp	10,00	x 2	20,00
				TOTAL 24,00

- *Personnel / Staff*

- *Prestation de service externe / Subcontracting*

- *Missions / Missions*

The mission costs are based on the number of involved persons during the project taking into account their working time. Table below describes the percent of equivalent time per person.

	% ETP (equivalent time people)																
Year	1st				2nd				3rd				4th				
trimester	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	% ETP/an
J.L Pedroza	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
J. Pibernat	50	50	50	50	100	100	100	100	50	50	50	50	0	0	0	0	50
P. Hellmuth	0	0	0	0	50	50	50	50	50	50	50	50	0	0	0	0	25
A. Tizon	50	50	50	50	100	100	100	100	50	50	50	50	0	0	0	0	50
B. Blank	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
Total	141	141	141	141	291	291	291	291	191	191	191	191	41	41	41	41	Total/4year
Annual yield	141				291				191				41				664

Every year, following missions are foreseen:

- 3 missions in France for work group participation
- 1 mission for global collaboration meeting
- 2 missions for expertise between products (AsAd, CoBo, InBo, MUTANT,BEM)

The cost per person per mission is about 500€ (3 nights)

We foresee also two missions in USA in the second and third year. It allows the setting up and the test with MSU product. The total foreseen cost is 5k€.
The two last years, mission in situ are foreseen to do experiment with part and with the whole system. The cost per person is 200€ for travelling and 70€ per day.

Moreover, we want to participate to a conference (like NSS); the estimated cost is 2.1K€.

Year	1st Year	2nd Year	3rd Year	4th Year
Travel expenses (k€)	4200	10000	9130	2800

- *Dépenses justifiées sur une procédure de facturation interne / Internal expenses*

--

- *Autres dépenses de fonctionnement / Other expenses*

Task	Description	Unit price (k€)	Qt.	Total (k€)
WBS_2.0	Licenses CAO microelectronics	3,00	x 2	6,00
WBS_2.0	Laboratory power supply	1,00	x 1	1,00
WBS_2.0	PC for CAO	1,50	x 1	1,50
WBS_2.0	PC for testing	1,00	x 1	1,00
WBS_2.0	Participation Oscilloscope 8 Gs/s	3,00	x 1	3,00
WBS_2.0	Prototype Components	1,00	x 2	2,00
WBS_2.0	Cables and connectors	0,50	x 2	1,00
WBS_2.0	PCB AsA	1,50	x 2	3,00
WBS_2.0	Test ASIC PCB	1,50	x 1	1,50
WBS_2.0	AsAd Test bench Upgrade	1,50	x 1	4,50
WBS_2.0	AsAd 1 production Manufacturing	1,00	x 8	8,00
WBS_2.0	AsAd 2 production Manufacturing	1,50	x 8	12,00
				TOTAL 44,50

7. ANNEXES

7.1. REFERENCESS BILIOGRAPHIQUES / REFERENCES

Section 1

[1] J. A. MacDonald (ed.): The Time Projection Chamber, AIP Conf Proc. 108 (American Inst. of Physics, New York 1984); Time Projection Chamber 25th Anniversary Symposium, Lawrence Berkeley Laboratory, 2003 (www-tpc.lbl.gov/symposium).
[2] B. Blank, M. Ploszajcak, Rep. Prog. Phys. 71, 25 (2008)
[3] NuPECC Long Range Plan 2004: Perspectives for Nuclear Physics Research in Europe in the Coming Decade and Beyond,
http://www.nupecc.org/pub/lrp03/long_range_plan_2004.pdf.
[4] E. Pollacco et al., Eur. Phys. J. A 25, s01, 287 (2005).
[5] A.A. Vorobyov et al., Nucl. Instr. and Meth. A 270, 419 (1988).
[6] C.E. Demonchy et al., Nucl. Instr. and Meth. A 583, 341 (2007).
[7] B. Blank et al., Nucl. Instr. Meth. B. 266, 4606 (2008)
[8] Direct and Resonant Reactions with an Active Target, Letter of Intent for SPIRAL2, 2006, http://www.ganil.fr/research/developments/spiral2/files/LoIs_SP2_final/LoI_SP2_15_ACTAR.pdf.
[9] SPIRAL2 LoI for GASPARD and PARIS, www.ganil.fr/spiral2

Section 2

[10] M. Caamano et al, Phys. Rev. Lett. 99 (2007) 062502
[11] J. Giovinazzo et al., Phys. Rev. Lett. 99, 102501 (2007)
[12] J.C. Santiard et al., CERN-ECP/94-17, 1994
[13] C. Monrozeau et al., Phys. Rev. Lett 100 (2008) 042501
[14] I. Tanihata et al, Phys. Rev. Lett 100 (2008) 192502
[15] IDEAS, www.ideas.no
[16] "Front End Electronics for the STAR TPC", S. R. Klein, et al., IEEE Transations on Nuclear Science Vol. 43 n° 3, (1996) p1768-1772.
[17] "The ALICE TPC Front End Electronics", L. Musa, et al., IEEE NSS, (2003), Vol.5, p3647-3651
[18] "AFTER, an ASIC for the Readout of the Large T2K Time Projection Chambers", P. Baron, et al., IEEE Nuclear Science Symposium Conference Record, Hawaï, 2007, pp1865-1872.
[20] M. Harakeh and A. van der Woude, Giant resonances, Oxford Studies in Nuclear Physics, Oxford University Press, 2001
[21] D.Vretenar et al, Phys Rev Lett. 91 (2003) 262502
[22] R. Zegers, private communication
[23] H. Savajols et al. Nucl. Phys. A654 (1999) 1027c

Section 3

[PROJ1] « Organisation du Management par Projets au CEA », DES/DIR/2001-081
[PROJ2] « Manuel qualité du CEA ».
[AGET1] AFTER, an ASIC for the Readout of the Large T2K Time Projection Chambers
Baron, P. Calvet, D. Delagnes, E. de la Broise, X. Delbart, A. Druillole, F. Mazzucato, E. Monmarthe, E. Pierre, F. Zito, M. , Nuclear Science, IEEE Transactions on, June 2008
Volume: 55, Issue: 3, Part 3, page(s): 1744-1752.
[AGET2] **IDeF-X ECLAIRs: An ultra low noise CMOS ASIC for the readout of Cd(Zn)Te detectors**
Gevin, O.; Baron, P.; Coppolani, X.; Delagnes, E.; Daly, F.; Limousin, O.; Lugiez, F.; Meuris, A.; Pinsard, F.;
Nuclear Science Symposium Conference Record, 2007. NSS '07. IEEE
Volume 1, Oct. 26 2007-Nov. 3 2007 Page(s):326 – 332
[AGET3] **MATE, a single front-end ASIC for silicon strip, Si(Li) and CsI detectors**
Baron, P.; Atkin, E.; Blumenfeld, Y.; Druillole, F.; Edelbruck, P.; Leterrier, L.; Lugiez, F.; Paul, B.; Pollacco, E.; Richard, A.; Rouger, M.; Wanlin, E.;
Nuclear Science Symposium Conference Record, 2003 IEEE,
Volume 1, 19-25 Oct. 2003 Page(s):386 - 390 Vol.1
[AGET4] **SFE16, a low noise front-end integrated circuit dedicated to the read-out of large Micromegas detectors**
Delagnes, E.; Abbon, P.; Bedfer, Y.; Faivre, J.C.; Kunne, F.; Magnon, A.; Platchkov, S.; Rebourgerad, P.; Thers, D.;
Nuclear Science, IEEE Transactions on
Volume 47, Issue 4, Part 1, Aug. 2000 Page(s):1447 – 1453
[ASAD1] First direct observation of two protons in decay of 45Fe with a TPC
J. Giovinazzo, B. Blank, C. Borcea, G. Canchel, C.E. Demonchy, F. de Oliveira Santos, C. Dossat, S. Grévy, L. Hay, J. Huikari, S. Leblanc, I. Matea, J.L. Pedroza, L. Perrot, J. Pibernat, L. Serani, C. Stodel and J.C. Thomas,
Physical Review Letters, vol. 99, number 10 (2007)
[ASAD2] A 23-24 GHz low power frequency synthesizer in 0.25um SiGe
O. Mazouffre, H. Lapuyade, J.B. Begueret, A.Cathelin, D. Belot, P. Hellmuth, Y. Deval,
Gallium Arsenide and Other Semiconductor Application Symposium, 2005.
EGAAS 2005. European Volume, Issue, 3-4 Oct. 2005
[ASAD3] Conception d'une électronique de traitement de signaux de forte dynamique, issus d'une chambre à projection temporelle
J. Pibernat Phd 2007, Université Bordeaux 1, Dec 2007.

7.2. BIOGRAPHIES / CV, RESUME

Partner 1 IRFU

Civilité	Nom	Prénom		Age
Mr	Pollacco	Emanuel		58
Grade	Physicist	Employeur	CEA	
Mail	epollacco@cea.fr	Tél	+33 (0)1 69 08 4288	

Cursus et Situation actuelle :

Professional Preparation

Sussex University	BSc in Mathematical Physics	
ANU University	Nuclear Physics	Ph.D. 1976

Appointments

1976 – 1979	Post Doc Univ of Bermingham, UK
1980 - 1982	Lecturer Univ of Malta
1983 - 1985	Collaborator Etranger, SPhN, Saclay
1985- 1986	Assist. Prof. Univ of Grenoble.
1986 -	Engineer CEA

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

MATE, a single front-end ASIC for silicon strip, Si(Li) and CsI detectors
Baron, P.; Atkin, E.; Blumenfeld, Y.; Druillole, F.; Edelbruck, P.; Leterrier, L.; Lugiez, F.; Paul, B.; Pollacco, E.; Richard, A.; Rouger, M.; Wanlin, E.;
Nuclear Science Symposium Conference Record, 2003 IEEE,
Volume 1, 19-25 Oct. 2003 Page(s):386 - 390 Vol.1

A. Drouart et al.
Very large emissive foil detectors for the tracking of low-energy heavy ions
NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH SECTION A, 579 (3): 1090-1095 SEP 11 2007

P. Lautesse, L. Nalpas et al.
Evolution of the fusion cross-section for light systems at intermediate energies
EUROPEAN PHYSICAL JOURNAL A, 27 (3): 349-357 MAR 2006

A. Obertelli et al.
Shell gap reduction in neutron-rich N=17 nuclei
PHYSICS LETTERS B, 633 (1): 33-37 FEB 2 2006

E. Pollacco et al.
MUST2: A new generation array for direct reaction studies
EUROPEAN PHYSICAL JOURNAL A, 25: 287-288 Suppl. 1 2005

Civilité	Nom	Prénom		Age
Mr	NALPAS	Laurent		40
Grade	Physicien	Employeur	CEA Saclay	
Mail	laurent.nalpas@cea.fr	Tél	+33 (0)1 69 08 24 58	

Cursus et Situation actuelle :

Master de Physique fondamentale et appliquée, spécialité «Noyaux, particules, astroparticules et cosmologie», Université Paris-sud (1992).

Docteur en physique, spécialité « Physique nucléaire », Université Paris-sud (1996).

Physicien au Service de physique nucléaire de l'IRFU (ex-Dapnia) depuis 1997.

Après une thèse sur les noyaux chauds formés dans les collisions d'ions lourds, j'ai travaillé sur plusieurs projets instrumentaux en structure nucléaire : système de détection pour le spectromètre Vamos au Ganil (chambres à dérive, détecteurs d'électrons secondaires pour la trajectographie des ions), détecteurs au silicium sensible à la position pour l'étude la fusion autour de la barrière coulombienne, dispositif Must2 pour l'étude de noyaux radioactifs par réactions directes.

Expertise : traitement et analyse de données, commande et contrôle des équipements.

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

A. Drouart et al.
Very large emissive foil detectors for the tracking of low-energy heavy ions
NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH SECTION A, 579 (3): 1090-1095 SEP 11 2007

P. Lautesse, L. Nalpas et al.
Evolution of the fusion cross-section for light systems at intermediate energies
EUROPEAN PHYSICAL JOURNAL A, 27 (3): 349-357 MAR 2006

A. Obertelli et al.
Shell gap reduction in neutron-rich N=17 nuclei
PHYSICS LETTERS B, 633 (1): 33-37 FEB 2 2006

E. Pollacco et al.
MUST2: A new generation array for direct reaction studies
EUROPEAN PHYSICAL JOURNAL A, 25: 287-288 Suppl. 1 2005

R. Raabe, J.L. Sida et al.
No enhancement of fusion probability by the neutron halo of He-6
NATURE, 431 (7010): 823-826 OCT 14 2004

Civilité	Nom	Prénom		Age
Mr	BARON	Pascal		46
Grade	Ingénieur Electronicien	Employeur	CEA	
Mail	pascal.baron@cea.fr	Tél	+33 (0)1 69 08 67 31	

Cursus et Situation actuelle :

Diplôme Ingénieur CNAM électronique 1995

Depuis 1982, agent CEA à l'IRFU (anciennement DAPNIA) au CEA Saclay.
Depuis 1995, Ingénieur de développement au sein du SEDI / LDEF de l'IRFU au CEA Saclay, spécialiste des circuits intégrés front end pour les détecteurs capacitifs.

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

AFTER, an ASIC for the Readout of the Large T2K Time Projection Chambers
Baron, P. Calvet, D. Delagnes, E. de la Broise, X. Delbart, A. Druillole, F. Mazzucato, E. Monmarthe, E. Pierre, F. Zito, M. , Nuclear Science, IEEE Transactions on, June 2008
Volume: 55, Issue: 3, Part 3, page(s): 1744-1752.

IDeF-X ECLAIRs: An ultra low noise CMOS ASIC for the readout of Cd(Zn)Te detectors
Gevin, O.; Baron, P.; Coppolani, X.; Delagnes, E.; Daly, F.; Limousin, O.; Lugiez, F.; Meuris, A.; Pinsard, F.;
Nuclear Science Symposium Conference Record, 2007. NSS '07. IEEE
Volume 1, Oct. 26 2007-Nov. 3 2007 Page(s):326 – 332

MATE, a single front-end ASIC for silicon strip, Si(Li) and CsI detectors
Baron, P.; Atkin, E.; Blumenfeld, Y.; Druillole, F.; Edelbruck, P.; Leterrier, L.; Lugiez, F.; Paul, B.; Pollacco, E.; Richard, A.; Rouger, M.; Wanlin, E.;
Nuclear Science Symposium Conference Record, 2003 IEEE,
Volume 1, 19-25 Oct. 2003 Page(s):386 - 390 Vol.1

Civilité		Nom	Prénom		Age
Mr		Château	Frédéric		25
Grade		Ingénieur Informaticiel	Employeur	CEA	
Mail	frederic.chateau@cea.fr		Tél	+33 (0)1 69 08 62 81	

Cursus et Situation actuelle :

2006 Ingénieur Informaticien de l'Université Technologique de Compiègne.

2006-2008 : CEA / Saclay Irfu (DAPNIA) / SEDI / LILAS
Ingénieur de développement informatique en CDD dans le cadre du projet europeen KM3net.

Depuis Octobre 2008, Ingénieur de développement informatique en CDI au CEA / Saclay Irfu (DAPNIA) / SEDI / LILAS.

Civilité	Nom	Prénom		Age
Mr	DRUILLOLE	Frédéric		35
Grade	Ingénieur Electronicien	Employeur	CEA	
Mail	frederic.druillole@cea.fr	Tél	+33 (0)1 69 08 23 94	

Cursus et Situation actuelle :

1997 Ingénieur ENSEIRB option micro-électronique.
1997 DEA électronique de l'Université de Bordeaux I (mention Bien).
1995 Ingénieur maître en Génie Electrique et Informatique Industrielle de l'Institut Universitaire Professionnalisé de Bordeaux.

Depuis 1999 : CEA / Saclay Irfu (DAPNIA) / SEDI / LDEF
Ingénieur de développement en instrumentation nucléaire dans le laboratoire d'études des détecteurs et d'électroniques frontales du service DSM / DAPNIA / SEDI au CEA Saclay. Participation à ANTARES, MUSTII, T2K280m.

De février 1998 à Juin 1999 : Lawrence Berkeley National Laboratory, Californie USA
Ingénieur de recherche au sein du groupe de measure de la division Engineering du LBNL.

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

- « The analog ring sampler : an ASIC for the Front-end Electronics of the ANTARES Neutrino Telescope » F. Druillole, D.Lachartre, F.Feinstein,J. Fopma, E.Delagnes, H. Lafoux. IEEE trans. Nucl. Sciences vol 49 n°3 June 2002.
- « Mate, a single front end ASIC for Silicon Strip, SiLi, and CsI detectors » P.Baron, A. Atkin,F. Druillole. Conference IEEE NSS Portland 20-25 Octobre 2003.
- « Methodology to measure front end ASIC performances for physic experiments » F. Druillole, Conference IEEE NSS Portland 20-25 Octobre 2003.
- « News from the ANTARES underwater neutrino telescope » F. Druillole, Nuclear Instruments and Methods in Physics Research A 581 (2007) 147–150
- «AFTER, an ASIC for the Readout of the Large T2K Time Projection Chambers» Baron, P. Calvet, D. Delagnes, E. de la Broise, X. Delbart, A. Druillole, F. Mazzucato, E. Monmarthe, E. Pierre, F. Zito, M. , Nuclear Science, IEEE Transactions on, June 2008 Volume: 55, Issue: 3, Part 3, page(s): 1744-1752.

Partner 2 GANIL

Civilité		Nom	Prénom		Age
Mr		Raabe	Riccardo		41
Grade		Physicien	Employeur	CEA (GANIL)	
Mail	raabe@ganil.fr		Tél	+33 (0)2 31 45 46 25	

Cursus et Situation actuelle :

Degrees:
- 2001 PhD in Physics
  Katholieke Universiteit Leuven (Belgium)
  thesis: "Study of Low-Energy Reactions with the Halo-Nucleus ^{6}He"
  Supervisors: Prof. M. Huyse, Prof. P. Van Duppen
- 1992 University Degree in Physics, 110/110 cum laude
  Università degli studi di Pavia (Italy)
  thesis: "Solar Oscillations and the BOREX Experiment"
  Supervisor: Prof. B. Bertotti

Appointments
Jan 2008 – present: Researcher (permanent position), Commissariat à l'Energie Atomique
Grand Accélérateur National d'Ions Lourds, Caen (France)
Oct 2003 - Dec 2007 Postdoctoral Fellow of the Research Foundation - Flanders (FWO)
Instituut voor Kern- en Stralingsfysica, K.U.Leuven (Belgium)
May 2001 - Apr 2003 Post-Doc Researcher, Commissariat à l'Energie Atomique
CEA / DAPNIA / Service de Physique Nucléaire, Saclay (France)
Mar 1996 - Apr 2001 Research Assistant
Instituut voor Kern- en Stralingsfysica, K.U.Leuven (Belgium)
June 1995 - Feb 1996 Project Manager, Resinex, Adro (Italy)
(offshore and deep-sea equipment for navigation, oil extraction and containment)
Mar 1994 - Mar 1995 High school Teacher (various schools, Italy)
Dec 1992 - Mar 1994 Civil service - ambulance service in Brescia, Italy

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

R. Raabe, A. Andreyev, M. J. G. Borge, L. Buchmann, P. Capel, H. O. U. Fynbo, M. Huyse, R. Kanungo, T. Kirchner, C. Mattoon, A. C. Morton, I. Mukha, J. Pearson, J. Ponsaers, J. J. Ressler, K. Riisager, C. Ruiz, G. Ruprecht, F. Sarazin, O. Tengblad, P. Van Duppen, and P. Walden
Beta-delayed deuteron emission from ^{11}Li: decay of the halo
Physical Review Letters, accepted for publication October 2008

A. Chatterjee, A. Navin, A. Shrivastava, S. Bhattacharyya, M. Rejmund, N. Keeley, V. Nanal, J. Nyberg, R. Pillay, K. Ramachandran, I. Stefan, D. Bazin, D. Beaumel, Y. Blumenfeld, G. de France, D. Gupta, M. Labiche, A. Lemasson, R. Lemmon, R. Raabe, J. A. Scarpaci, C. Simenel, and C. Timis

1n and 2n transfer with the borromean nucleus ^{6}He near the Coulomb barrier
Physical Review Letters 101 (2008), p. 032701 (4 pages)

N. Keeley, R. Raabe, N. Alamanos, and J. L. Sida
Fusion and direct reactions of halo nuclei at energies around the Coulomb barrier
Progress in Particle and Nuclear Physics 59 (2007), pp. 579–630

M. Freer, E. Casarejos, L. Achouri, C. Angulo, N. I. Ashwood, N. Curtis, P. Demaret, C. Harlin, B. Laurent, M. Milin, N. A. Orr, D. Price, R. Raabe, N. Soic, and V. A. Ziman
α:2n:α molecular band in ^{10}Be
Physical Review Letters 96 (2006), p. 042501 (4 pages)

R. Raabe, J. L. Sida, J. L. Charvet, N. Alamanos, C. Angulo, J. M. Casadjan, S. Courtin, A. Drouart, D. J. C. Durand, P. Figuera, A. Gillibert, S. Heinrich, C. Jouanne, V. Lapoux, A. Lepine, A. Musumarra, L. Nalpas, D. Pierroutsakou, M. Romoli, K. Rusek, and M. Trotta
No enhancement of fusion probability by the neutron halo of ^{6}He
Nature 431 (2004), pp. 823–826

Prix, Distinctions, autres responsabilités:

Scientific Prize SCK•CEN Professor Van Geen
Brussels, Belgium, October 2007

Civilité	Nom	Prénom	Age
Mr	Wittwer	Gilles	48
Grade	Ingénieur Electronicien	**Employeur**	IN2P3-CNRS
Mail	wittwer@ganil.fr	**Tél**	+33 (0)2 31 45 45 55

Cursus et Situation actuelle :

Cursus : Ingénieur DPE - ENSEA- Cergy Pontoise

Situation actuelle : Ingénieur de recherche au GANIL dans le Groupe Acquisition pour la Physique (GAP) du Secteur Techniques de la Physique (STP)

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

14th IEEE-NPSS Real Time Conference – Stockholm, Sweden - June 4-10,2005

"Merging Several Data Acquisition Systems at GANIL"

Civilité	Nom	Prénom		Age
Mr	Saillant	Frédéric		39
Grade	Ingénieur de Recherche	Employeur	CNRS	
Mail	saillant@ganil.fr	Tél	+33 (0)2 31 45 47 29	

Cursus et Situation actuelle :

Diplôme d'Ingénieur de l'Ecole Centrale de Lyon (1992)

Ingénieur de Recherche CNRS affecté au GANIL en tant qu'Expert en développement logiciel de systèmes d'acquisition de données (depuis 1994)

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

The new GANIL data acquisition system
Boujrad, A.; Saillant, F.;
Nuclear Science Symposium Conference Record, 2000 IEEE

Volume 2, 15-20 Oct. 2000 Page(s):12/192 - 12/193 vol.2

Partner 3 CENBG

Civilité	Nom	Prénom	Age
Mr	Pedroza	Jean-Louis	57
Grade	Ingénieur de Recherche IR1	**Employeur**	CNRS-IN2P3-CENBG
Mail pedroza@cenbg.in2p3.fr		**Tél + 33 557 120 829**	

Cursus et Situation actuelle :

2002-Present :
Research engineer Grade IR1
Head of electronics and acquisition dept CENBG.
Technical coordinator project R&D SUPERNEMO calorimeter CENBG
Technical coordinator project 2 Protons Chase CENBG
1995-2002 :
Research engineer Grade IR2
Technical coordinator projects EUROGAM & EUROBALL Readout system
Projects manager
teaching engineering schools
1983-1995:
Studies and development engineer hardware and software CENBG
teaching engineering schools
1983:
Conservatoire National des Arts et Métiers degree.
1974-1983 :
Developement engineer CENBG

Publications

Production cross-sections of proton-rich 70Ge fragments and the decay of 57Zn and 61Ge
B. Blank, C. Borcea, G. Canchel, C.E. Demonchy, F. de Oliveira Santos, C. Dossat, J. Giovinazzo, S. Grévy, L. Hay, P. Hellmuth, S. Leblanc, I. Matea, J.L. Pedroza, L. Perrot, J. Pibernat, A. Rebii, L. Serani, J.C. Thomas,
The European Physical Journal A, 2007, pp. 267-272

First direct observation of two protons in decay of 45Fe with a TPC
J. Giovinazzo, B. Blank, C. Borcea, G. Canchel, C.E. Demonchy, F. de Oliveira Santos, C. Dossat, S. Grévy, L. Hay, J. Huikari, S. Leblanc, I. Matea, J.L. Pedroza, L. Perrot, J. Pibernat, L. Serani, C. Stodel and J.C. Thomas,
Physical Review Letters, vol. 99, number 10 (2007)

Studies with Exotic Nuclei: Two Proton Radioactivity
C. Borcea, B. Blank, G. Canchel, C.E. Demonchy, J. Giovinazzo, L. Hay, J. Huikari, S. Leblanc, I. Matea, J.L. Pedroza, J. Pibernat, L. Serani, F. de Oliveira Santos, S. Grévy, L. Perrot, C. Stodel, J.C. Thomas, C. Dossat,
Carpathian Summer School of Physics, Sinaia, Romania, 20 au 31 août 2007

A time projection chamber to study two-proton radioactivity
B. Blank, L. Audirac, G. Canchel, F. Delalee, C.E. Demonchy, J. Giovinazzo, L. Hay, P. Hellmuth, J. Huikari, S. Leblanc, S. List, C. Marchand, I. Matea, J.-L. Pedroza, J. Pibernat, A. Rebii, L. Serani, F. de

Oliveira Santos, S. Grevy, L. Perrot, C. Stodel, J.C. Thomas, C. Borcea, C. Dossat, R. de Oliveira, Nucl. Instrum. Meth. B266, 4606 (2008)

Electronique de traitement dédiée à la détection de la radioactivité di-protons
J. Pibernat, A. Fabre, J.L. Pedroza,
6e Colloque sur le Traitement Analogique de l'Information du Signal et ses Applications
Ecole Polytechnique Universitaire de Marseille, Octobre 2005

Civilité	Nom	Prénom	Age
Mr	Hellmuth	Patrick	57
Grade	Ingénieur d'Etude IE2	**Employeur**	CNRS-IN2P3-CENBG
Mail	hellmuth@cenbg.in2p3.fr	**Tél + 33 557 120 827**	

Cursus et Situation actuelle :

2004-Present :
Studies and development engineer Grade IE2 CENBG
teaching IUT Bordeaux I
2000-2004 :
Studies and development engineer IXL

Publications

A 5GHz tunable Injection Locked Oscillator for wireless applications
P. Hellmuth, J.B. Bégueret, H. Lapuyade, O. Mazouffre, Y. Deval
Journal of Microwaves and Optoelectronics, Vol. 3, N.o 5, July 2004, pp. 31-40

A 23-24 GHz low power frequency synthesizer in 0.25µm SiGe
O. Mazouffre, H. Lapuyade, J.B. Begueret, A. Cathelin, D. Belot, P. Hellmuth, Y. Deval,
European Microwave 2005, GAAS Symposium, Volume 3, Issue , 4-6 Oct. 2005, pp. 533-536

A Radiation-Hardened Injection Locked Oscillator Devoted to Radio-Frequency Applications
H. Lapuyade, V. Pouget, J.B. Begueret, P. Hellmuth, T. Taris, O. Mazouffre, P. Fouillat, Y. Deval,
Nuclear Science, IEEE Transactions on, Volume 53, Issue 4, Aug. 2006, pp. 2040 - 2046

Production cross-sections of proton-rich 70Ge fragments and the decay of 57Zn and 61Ge
B. Blank, C. Borcea, G. Canchel, C.E. Demonchy, F. de Oliveira Santos, C. Dossat, J. Giovinazzo, S. Grévy, L. Hay, P. Hellmuth, S. Leblanc, I. Matea, J.L. Pedroza, L. Perrot, J. Pibernat, A. Rebii, L. Serani, J.C. Thomas,
The European Physical Journal A, 2007, pp. 267-272

A time projection chamber to study two-proton radioactivity
B. Blank, L. Audirac, G. Canchel, F. Delalee, C.E. Demonchy, J. Giovinazzo, L. Hay, P. Hellmuth, J. Huikari, S. Leblanc, S. List, C. Marchand, I. Matea, J.-L. Pedroza, J. Pibernat, A. Rebii, L. Serani, F. de Oliveira Santos, S. Grevy, L. Perrot, C. Stodel, J.C. Thomas, C. Borcea, C. Dossat, R. de Oliveira, Nucl. Instrum. Meth. B266, 4606 (2008)

Civilité	Nom	Prénom	Age
Mr	Pibernat	Jérôme	33
Grade	Ingénieur d'Etudes IE2	**Employeur**	CNRS-I2P3-CENBG
Mail	pibernat@cenbg.in2p3.fr	**Tél + 33 557 120 828**	

Cursus et Situation actuelle :

2005-Present :
Studies engineer (Analogue Electronics & Microelectronics) ; Grade IE2
1997-2005 :
Development engineer (CENBG); Grade AI
2007:
Ph.D in Electronics (Bordeaux I University): Conception d'une électronique de traitement de signaux de forte dynamique issus d'une chambre à projection temporelle
2002:
Master degree in Analogue Microelectronics and Microtechnologies (Clermont-Ferrand II University)

Publications

Production cross-sections of proton-rich 70Ge fragments and the decay of 57Zn and 61Ge
B. Blank, C. Borcea, G. Canchel, C.E. Demonchy, F. de Oliveira Santos, C. Dossat, J. Giovinazzo, S. Grévy, L. Hay, P. Hellmuth, S. Leblanc, I. Matea, J.L. Pedroza, L. Perrot, J. Pibernat, A. Rebii, L. Serani, J.C. Thomas,
The European Physical Journal A, 2007, pp. 267-272

First direct observation of two protons in decay of 45Fe with a TPC
J. Giovinazzo, B. Blank, C. Borcea, G. Canchel, C.E. Demonchy, F. de Oliveira Santos, C. Dossat, S. Grévy, L. Hay, J. Huikari, S. Leblanc, I. Matea, J.L. Pedroza, L. Perrot, J. Pibernat, L. Serani, C. Stodel and J.C. Thomas,
Physical Review Letters, vol. 99, number 10 (2007)

Studies with Exotic Nuclei: Two Proton Radioactivity
C. Borcea, B. Blank, G. Canchel, C.E. Demonchy, J. Giovinazzo, L. Hay, J. Huikari, S. Leblanc, I. Matea, J.L. Pedroza, J. Pibernat, L. Serani, F. de Oliveira Santos, S. Grévy, L. Perrot, C. Stodel, J.C. Thomas, C. Dossat,
Carpathian Summer School of Physics, Sinaia, Romania, 20 au 31 août 2007

A time projection chamber to study two-proton radioactivity
B. Blank, L. Audirac, G. Canchel, F. Delalee, C.E. Demonchy, J. Giovinazzo, L. Hay, P. Hellmuth, J. Huikari, S. Leblanc, S. List, C. Marchand, I. Matea, J.-L. Pedroza, J. Pibernat, A. Rebii, L. Serani, F. de Oliveira Santos, S. Grevy, L. Perrot, C. Stodel, J.C. Thomas, C. Borcea, C. Dossat, R. de Oliveira,
Nucl. Instrum. Meth. B266, 4606 (2008)

Electronique de traitement dédiée à la détection de la radioactivité di-protons
J. Pibernat, A. Fabre, J.L. Pedroza,
6e Colloque sur le Traitement Analogique de l'Information du Signal et ses Applications
Ecole Polytechnique Universitaire de Marseille, Octobre 2005.

Partner 4 NSCL

Abigail Bickley

- **Professional Preparation**

Dartmouth College	Chemistry	BA High Honors, 2000
University of Maryland	Nuclear Chemistry	Ph.D. 2004

- **Appointments**

2007 – present	Assistant Professor Chemistry, NSCL/MSU
2004 - 2007	Research Associate, University of Colorado

- **Publications**
  - B.B. Back *et al.*, "Centrality Dependence of Charged Antiparticle to Particle Ratios Near Mid-Rapidity in d+Au Collisions at sqrt(s_NN) = 200 GeV," Phys. Rev. C70, 011901(R) (2004)
  - B.B. Back *et al.*, "Charged Antiparticle to Particle Ratios Near Midrapidity in p+p Collisions at sqrt(s_NN) = 200 GeV," Phys. Rev. C71, 021901(R) (2005).
  - A. Adare *et al.*, "Cold Nuclear Matter Effects on J/Psi as Constrained by Deuteron-Gold Measurements at sqrt(s_NN) = 200 GeV", accepted by Phys. Rev. C, arXiv:0711.3917v1 [nucl-ex].
  - Adare *et al.*, "J/Psi Production vs Transverse Momentum and Rapidity in p+p Collisions at sqrt(s) = 200 GeV," Phys. Rev. Lett. 98, 232002 (2007).
  - A. Adare *et al.*, " J/Psi Production vs Centrality, Transverse Momentum, and Rapidity in Au+Au Collisions at sqrt(s_NN) = 200 GeV," Phys. Rev. Lett. 98, 232301 (2007).

Collaborators and Other Affiliations

- **Collaborators**
  Phobos Collaboration, Relativistic Heavy Ion Collider, Brookhaven National Laboratory
  PHENIX Collaboration, Relativistic Heavy Ion Collider, Brookhaven National Laboratory

- **Graduate & Postdoctoral Advisors**
  Prof. A. Mignerey, University of Maryland
  Prof. J. Nagle, University of Colorado at Boulder

- **Thesis Advisor and Postgraduate-Scholar Sponsor**
  Student: K. Cruse (NSCL/MSU, since 2007)
  M. Evans (NSCL/MSU, since 2007)
  J. Vredevoogd (NSCL/MSU, since 2007)

Total Number of Graduate Students Advised: 3
Total Number of Postdoctoral Scholars Sponsored: 0

Wolfgang Mittig

- **Professional Preparation**
  University of Bonn, GermanyPhysics 1967 Hauptdiplom of Physics
  University of Paris, France Physics 1971 Docteur ès Sciences
  University of Sâo Paulo Physics 1977 Livre Docente,
- **Appointments**

2008 – present	Hannah Professor, Michigan State University and NSCL
1982 - 2007	Research physicist at the CEA GANIL, Caen, France
2006	Visiting Professor at Riken-RIBF Japan, on sabbatical leave
1980 - 1982	Research physicist at the CEA, Saclay, France
1977 - 1979	Professor Livre Docente, Univ. Sâo Paulo IFN-USP, Brazil
1975 - 1977	Assistant Professor, Univ. of Sao Paulo IFN-USP, Brazil
1971 - 1974	Researcher at the CEA-CEN Saclay, DPhN/BE, France

- **Publications**
  - C.E. Demonchy, et al., “Maya: An Active-Target Detector for Binary Reactions with Exotic Beams”, Nucl. Instr. Meth. A573, 145 (2007).
  - W. Mittig, P. Roussel-Chomaz and A.C.C. Villari, “Exotic Nuclei, why and how to make them?”, Europhysics News 35, 113 (2004).
  - W. Mittig, A. Lepine-Szily and N.A. Orr, “Mass Measurements Far from Stability”, Ann. Rev. Nucl. Part. Sci. 47, 27 (1997).
  - M.Caamano, D.Cortina-Gil, W.Mittig, H.Savajols, M.Chartier, C.E.Demonchy, B.Fernandez, M.B.Gomez Hornillos, A.Gillibert, B.Jurado, O.Kiselev, R.Lemmon, A.Obertelli, F.Rejmund, M.Rejmund, P.Roussel-Chomaz, R.Wolski, “Resonance State in ^{7}H”, Phys. Rev. Lett. 99, 062502 (2007).
  - C. Monrozeau, E. Khan, Y. Blumenfeld, C.E. Demonchy, W. Mittig, P. Roussel-Chomaz, D. Beaumel, M. Caamano,˜D. Cortina-Gil, J.P. Ebran, N. Frascaria, U. Garg, M. Gelin, A. Gillibert, D. Gupta, L.N. Keeley, F. Mar´echal, A. Obertelli, and J-A.Scarpaci1, “First Measurement of the Giant Monopole and Quadrupole Resonances in a Short-Lived Nucleus: ^{56}Ni”, Phys. Rev. Lett., accepted for publication.
- **Collaborators and Other Affiliations**
  - **Collaborators**
    M. Chartier, B. Fernandez (Olivier Lodge Laboratory, Liverpool, UK), F. Rejmund, A. Navin, P. Roussel-Chomaz, H. Savajols, A. Villari, (GANIL), H A. Navin J. Benlliure, M. Caamano, D. Cortina-Gil, (Univ. de Santiago de Compostela, Spain), A. Fomichev, M.S. Golovkov, P.A. Rodin, S. Sidorchuk, S. Stepantsov, G. Ter-Akopian (FLNR/JINR, Dubna, Russia), A. Gillibert, A. Obertelli, E. Pollacco (CEA/DSM/DAPNIA/SPhN), B. Blank, C.E.Demonchy (CENBG), Y. Blumenfeld, E. Khan (IPN Orsay), R. Lemmon (CCLRC Daresbury), R. Wolski (Henryk Niewodniczanski Institute Nucl. Phys., Krakow), P. Egelhof (GSI)
  - **Graduate & Postdoctoral Advisors**
    Graduate Advisor: L.Papineau (retired)
    Postdoctoral Advisor: Not Applicable
  - **Thesis Advisor and Postgraduate-Scholar Sponsor**
    C.E.Demonchy (thesis, now CNBG, Bordeaux-Gradignan, France), H.Wang (Pos-doc 2004, now IMP Lanzhou, China)
  - **Total Number of Graduate Students Advised: 10**
  - **Total Number of Postdoctoral Scholars Sponsored: 8**

William Lynch

- **Professional Preparation**
  University of Colorado   Physics   BA, 1973
  University of Washington   Physics   Ph.D., 1980
- **Appointments**
  1992-present   Professor, Physics and Astronomy, MSU.
  1987-1992   Assoc. Prof., Physics and Astronomy, MSU.
  1984-1987   Assist. Prof., Physics and Astronomy, MSU.
  1980-1984   Postdoctoral Researcher, NSCL, MSU.
- **Publications**
  - Determination of the Equation of State of Dense Matter, P. Danielewicz, R. Lacey, W.G. Lynch, *Science* ***298*** *(5598): 1592 (2002).*
  - Survey of Ground State Neutron Spectroscopic Factors from Li to Cr Isotopes, M. B. Tsang, J. Lee, and W. G. Lynch, *Phys. Rev. Lett.* ***95****, 222501 (2005)*.
  - Isospin fractionation in nuclear multifragmentation, H. S. Xu, M. B. Tsang, T. X. Liu, X. D. Liu, W. G. Lynch, W. P. Tan, A. Vander Molen, G. Verde, A. Wagner, H. F. Xi, C. K. Gelbke, L. Beaulieu, B. Davin, Y. Larochelle, T. Lefort, R. T. de Souza, R. Yanez, V. E. Viola, R. J. Charity and L. G. Sobotka, *Phys. Rev. Lett.* ***85****, 716 (2000).*
  - Isospin Diffusion in Heavy Ion Reactions, M. B. Tsang T.X. Liu, L. Shi, P. Danielewicz, C.K. Gelbke, X.D. Liu, W.G. Lynch, W.P. Tan, G. Verde, A.Wagner, H.S. Xu, W.A. Friedman, L. Beaulieu, B. Davin, R.T. de Souza, Y. Larochelle, T. Lefort, R. Yanez, V.E. Viola Jr, R.J. Charity, L.G. Sobotka, *Phys. Rev. Lett.* ***92****, 062701 (2004).*
  - Probing the isospin dependence of the in-medium nucleon-nucleon cross sections with radioactive beams B.A. Li, P. Danielewicz, and W.G. Lynch, *Phys. Rev. C 71, 054603 (2005).*
- **Collaborators and Other Affiliations**
  - **Collaborators**

    A. B. McIntosh, A. Gade, A. L. Cole, A. M. Rogers, A. Moroni, A. Stolz, A. Vander Molen, A. Wagner, A.Z. Mekjian, Akira Ono, B. A. Brown, B. Davin, B. E. Nett, B.A. Li, C. J. Metelko, C.B. Das, C.F. Chan, C.K. Gelbke, D. Bazin, D. G. Sarantites, D. Henzlová, D. J. Oostdyk, D. S. Bracken, D. S. Ginger, D.A. Brown, E. Cornell, E.C. Pollacco, F. Delaunay, F. Gimeno-Nogues, F. M. Nunes, F. Montes, G. F. Peaslee, G. Verde, H. Breuer, H. F. Xi, H. H. Wolter, H. Hua, H. Iwasaki, H. L. Clark, H. Sakurai, H.S. Xu, J. A. Tostevin, J. Brzychczyka, J. Clifford, J. M. Cook, J. Telfer, J.A. Tostevin, Jenny Lee, K. Kwiatkowski, K. R. Herner, K.B. Morley, L. Andronenko, L. Beaulieu, L. G. Sobotka, L. Pienkowski, L. Shi, L.K. Kwong, M. A. Famiano, M. Andronenko, M. B. Tsang, M. Colonna, M. Di Toro, M. J. Saelim, M. Mocko, M. Niikura, M. S. Wallace, M. Steiner, M. W. Cooper, M. Zielinska-Pfabe, M.A. Famiano, M.B. Tsang, M.-J. van Goethem, M.S. Wallace, N. Aoi, N. H. Frank, P. A. DeYoung, P. Danielewicz, P. Santi, P. Schotanus, P. T. Hosmer, R. Alfaro, R. Donangelo, R. Huang, R. J. Charity, R. Korteling, R. Krishnasamy, R. Legrain, R. R. C. Clement, R. Roy, R. Shomin, R. T. de Souza, R. Yanez, R.G. Korteling, R.J. Charity, S. Das Gupta, S. Gushue, S. Hudan, S. J. Yennello, S. Labostov, S. Lukyanov, S. R. Souza, S. Turbide, T. Ginter, T. Glasmacher, T. Lefort, T. Motobayashi, T. Onishi, T. X. Liu, V.E. Viola Jr., W. A. Friedman, W. Benenson, W. F. Mueller, W. P. Tan, W.-C. Hsi, X.D. Liu, Y. Larochelle, Z. Y. Sun

- **Graduate & Postdoctoral Advisors**
  Prof. John Cramer, University of Washington
  Prof. C. Konrad Gelbke, NSCL/Michigan State University

- **Thesis Advisor and Postgraduate-Scholar Sponsor**
  Tapan Nayak, HongMing Xu, Fan Zhu, Wen-Chien Hsi, Cornelius Williams, Min-Jui Huang, James Dinius, Richard Shomin, Wanpeng Tan, Tianxiao Liu, Paul Hosmer, Mark Wallace, Andrew Rogers, Joshua Veazey, Alisher Sanetullaev, Davitt Driscoll, Micha Kilburn, Michael Youngs, Marc-Jan Van Goethem, Michael Famiano, Franck Delaunay, Daniela Henzlova, Vladimir Henzl
- **Total Number of Graduate Students Advised: 18**
- **Total Number of Postdoctoral Scholars Sponsored: 12**

7.3. IMPLICATION DES PERSONNES DANS D'AUTRES CONTRATS / 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	Druillole	8	Design Study FP6 (663kE pour IRFU)	KM3Net (design Study)	U. Katz (Un. Erlangen)	1/02/06-1/02/09
1	Pollacco		ANR	**MUSETT**	Ch. Theisen	Ends 12/08
1	Château	24	Design Study FP6 (663kE pour IRFU)	KM3Net (design Study)	U. Katz (Un. Erlangen)	1/02/06-1/02/09
3	Blank	12	ANR 2006	**VS3**	JC Thomas	2006-2010