	Programme Jeunes chercheuses et jeunes chercheurs	Réservé à l'organisme gestionnaire du programme N° de dossier : ANR-08-XXXX-00 Date de révision :
	Document scientifique associé	**Edition 2008**

Acronyme/*short title*	**OYSTER**
Titre du projet *(en français)*	Optimisation des stratégies de déclenchement et de reconstruction pour ANTARES
Titre du projet/*Proposal title* *(en anglais)*	Optimized Yield Strategy of Trigger and Event Reconstruction (for ANTARES)

Sommaire

1. Programme scientifique et technique/Description du projet Technical and scientific description of the proposal

1.1 Problème posé/*Rationale*

The observation of high-energy cosmic neutrinos, produced in distant astrophysical accelerators (and possibly by means of more exotic processes as well), has turned into one of the major challenges of today's astroparticle physics, motivated by the possibility to open a new observational window on the distant Universe.

The ANTARES detector (Astronomy with a Neutrino Telescope and Abyss environmental RESearch) is currently under deployment offshore Toulon (France). Since December 2007, 10 out of the 12 detector lines are operational and the telescope is expected to be achieved by May 2008. It is already the largest neutrino telescope in the Northern Hemisphere. A massive technical effort has been made to design, develop and construct the neutrino telescope and many obstacles have been overcome to refine the technology needed to work in the hostile undersea environment, as demonstrated by the smooth operation of the current 10-lines detector.

At this point, a comparable scientific effort is needed in order to exploit at best the capabilities of such a novel instrument. Operation with the real detector has shown differences with the expectations that were used to produce the original data collecting and analysis software, in particular concerning the level and variability of the background due to bioluminescent bursts.

The ideas presented in this proposal are expected to yield very significant improvements in the detector efficiency and effective area by learning from the first data and taking action based on this new information.

Once the data taking will be optimized, the development of novel analysis techniques will allow full exploitation of the scientific potential of the neutrino telescope. In this context, a significant effort will be put on the search for point sources of cosmic neutrinos, taking profit of the unprecedented sensitivity of the detector.

1.2 Contexte et enjeux du projet/*Background, objective, issues and hypothesis*

High energy neutrino astronomy

The recent development of new observational techniques to detect high-energy radiations from the cosmos (gamma-rays, charged particles, neutrinos and gravitational waves) has opened a new and challenging field in Astroparticle physics, related to the most violent phenomena in the universe. At the same time, it has been recognized that not only a multi-wavelength but also a multi-messenger approach was best suited to study the high-energy astrophysical sources such as supernovae remnants (SNRs), magnetars, black holes in active galactic nuclei (AGNs), micro-quasars and gamma-ray bursts (GRBs) (for a review, see [1]).

Indeed, despite the great success encountered by photon observations in recent high energy astrophysics, some limitations appear due their interactions with the infrared or cosmological diffuse backgrounds. As a consequence photons with energy above 100 TeV cannot travel much further than 10 Mpc. Cosmic Rays are another very promising probe used for the understanding of the Universe, but the GZK effect limits the observation depth to 50 Mpc above 100 EeV, whereas at lower energies magnetic fields deflect protons and make point-like source searches difficult.

Neutrinos do not suffer these effects: they are neutral and interact only weakly. Therefore, provided they can be detected with enough statistics, they appear to be ideal candidates for high-energy astronomy, giving access to far distances and to the heart of astrophysical sources. In this sense, high energy neutrino telescopes provide complementary observations and new investigations. In particular, the observation of such high-energy neutrinos would unambiguously confirm the presence of accelerated hadrons inside the sources and provide important clues on the mechanisms governing the emission of the observed high-energy cosmic rays. Another guaranteed, although faint, flux of so-called "cosmological neutrinos" is expected at ultra-high energies as a byproduct of the interaction of the observed UHECRs with the CMB and IR backgrounds. Finally, one should not disregard the possibility of the existence of high-energy cosmic neutrino sources that have eluded observations with other messengers up to now. A likely location of such sources would be the Galactic plane.

ANTARES: a deep-sea neutrino telescope.

The unique scientific value of measuring high-energy cosmic neutrinos has motivated in the last decade the development of a new generation of detectors: the neutrino telescopes. These installations challenge the smallness of the expected fluxes and interaction rates through the instrumentation of large volumes of naturally abundant material (water or ice) with photomultipliers (PMTs). These PMTs detect the Cherenkov light emitted by secondary particles (mainly muons, but also electron- or tau-induced showers) produced in neutrino interactions with the medium.

PMTs signals (timing and amplitude) are used to reconstruct the muon trajectory and the energy of the parent neutrino. In order to reduce the background due to the intense flux of down-going atmospheric muons present at ground, such detectors are buried deep under the surface. Moreover, since the Earth acts as a shield against all particles but neutrinos, their design is optimized for the detection of up-going muons produced by neutrinos which have traversed the Earth and interacted below the detector, with the consequence that one neutrino telescope can efficiently monitor only one half of the sky.

Several pilot projects covering an instrumented volume of the order of 0.01 km^3 have been developed and are currently taking data: the Lake Baikal experiment [2], the AMANDA detector [3] located in the South Pole ice shelf and the ANTARES detector [4], a European project which is by now the biggest neutrino telescope ever built in the Northern Hemisphere. This first generation of neutrino telescopes have demonstrated the feasibility of the technique, and it is now clear to the concerned scientific community that the natural step forward would be the construction of two km^3–sized detectors, one in each hemisphere, to ensure entire sky coverage and the accumulation of a statistically significant dataset.

One such detector (ICECUBE) is currently under construction at the South Pole with funding coming prevalently from the USA. The perspective of building a km^3 neutrino telescope in the Mediterranean Sea constitutes a unique opportunity for Europe to acquire a leading role in one of the most promising fields developing in astroparticle physics, with important impacts expected in astrophysics, particle physics and cosmology.

In this context, the ANTARES detector will have a key role to play in the upcoming years as the first neutrino telescope deployed and taking data in the Mediterranean. The detector is expected to be completed by mid 2008 and take data continuously for about a decade.

An artist's impression of the layout of the ANTARES neutrino telescope is shown in figure 1. The detector consists of 12 lines each with a total height of ~450 m which are weighted to the sea bed and held nearly vertical by syntactic-foam buoys at the top. A line has a total of 75 photomultipliers housed in glass spheres, referred to as optical modules (OM), destined to detect Cherenkov light from charged particle tracks in the sea water [5]. The sea bed at the site is at a depth of ~2500 m and the OMs are positioned at depths between ~2400m and ~2000 m.

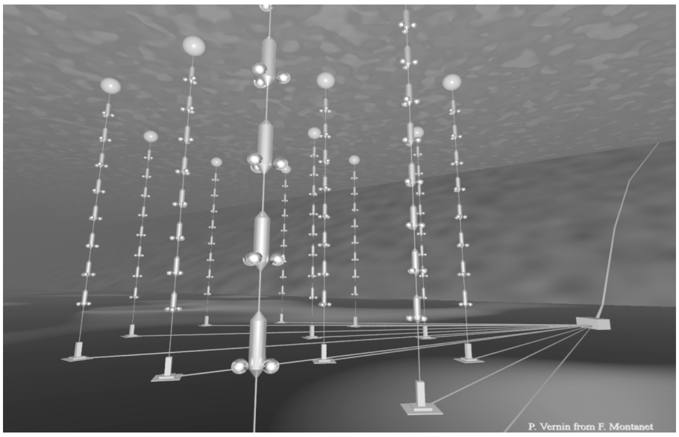

Figure 1: Artist's impression of the ANTARES neutrino telescope on the sea floor, showing the detector lines, the seabed interlink cables, the junction box and the cable to the shore (for clarity, the number of storeys per line is reduced and many items are not drawn to scale).

Deep-sea background conditions

The present software for the data acquisition and analysis of the ANTARES detector was designed on basis of the expectation that the singles rate in the 10 inch photomultipliers would be ~60 kHz, dominated by the radioactive decays of ^{40}K with occasional bursts of noise from bioluminescent organisms [6]. These expectations were supported by early measurements on the site for short periods with autonomous measurement devices and on simulations of the ^{40}K contribution. However, when the first lines became operational on the site, starting with a prototype line in 2003 and then the first instrumentation line from March 2005, the data collected indicated that the rates show significant variations in time. These variations refer both to the continuous background component, which can vary from 40 kHz up to some hundreds kHz, and to light bursts, whose number tends to increase with sea current. This bioluminescence background is somehow correlated to the biological activity, and induces in particular that the rates in spring were much higher than the rates in winter, as can be seen from figure 2.

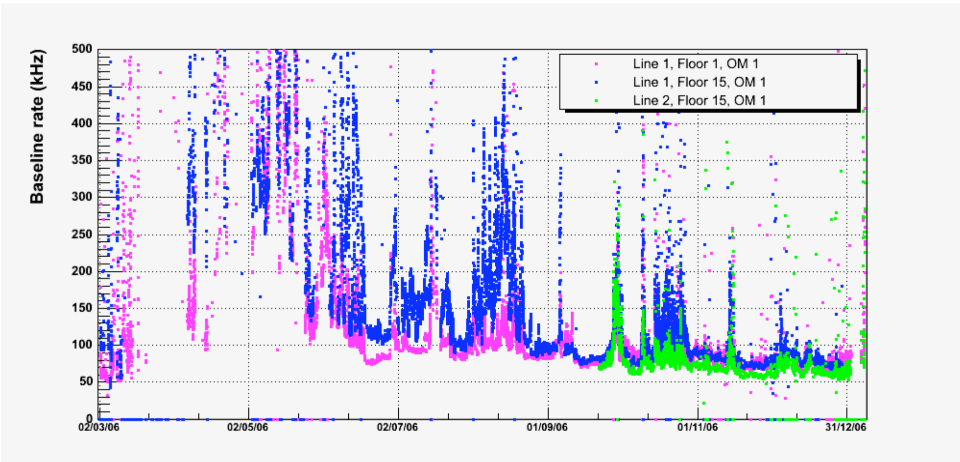

Figure 2: Baseline rate in 3 optical modules as specified in the legend box.

References

[1] Julia K. Becker, arXiv:0710.1557 [astro-ph] accepted for publication by Physics Reports
[2] See http://www.ifh.de/baikal/
[3] See http://www.amanda.uci.edu/
[4] See http://ANTARES.in2p3.fr/
[5] P.Amram et al., Nucl. Instr. and Methods A484 (2002) 369.
[6] P.Amram et al., Astropart. Phys. 13 (2000) 127-136.

1.3 Objectifs et caractère ambitieux/novateur du projet/Specific aims, highlight of the originality and novelty of the project

Because of the excellent water properties at the ANTARES site, the light diffusion is very limited and most of the Cherenkov photons arrive within a few nanoseconds of the expected arrival time, contrarily to what happens in the ice where light is much more scattered. As a consequence it is generally admitted that a deep-sea neutrino telescope can achieve an angular resolution ~10 times better than an instrument of comparable size located at the South Pole, providing thus more favorable signal to noise conditions. Therefore, despite its reduced volume, ANTARES has a unique potential for discovery of cosmic neutrino point sources, which should be fully exploited.

In that sense, it is of fundamental importance to optimize the data analysis techniques and to develop reliable statistical methods for such point source searches. It is indeed generally recognized that even the discovery of a few astrophysical neutrino events would be of great relevance for driving our understanding of astrophysical accelerator scenarios. In this respect, the ANTARES experiment will allow to explore with unprecedented sensitivity a large region of our Universe, including the Galactic Centre (know to be very active at high energy), which is not accessible to detectors at the South Pole (AMANDA). The interpretation of the first data of ANTARES on the basis of up-to-date astrophysical and cosmological models will also provide important benchmarks for the subsequent building of a cubic-kilometer-sized detector in the Mediterranean.

In view of these objectives, the first years of operation of the detector will be crucial in the setting of a high standard of data acquisition and in the development of reliable analysis methods. The first data revealed significant discrepancies in trigger rates from downward-going cosmic rays with respect to simulations. Despite important improvements recently achieved in various technical aspects of data handling, more efforts are needed to reach a fully comprehensive picture of the detector behavior. It is therefore essential to further assess the performance of the detector elements in the extreme conditions that characterize sea abysses, in particular concerning the variability of the optical background due to bioluminescence and its impact on the data taking strategies.

To match this aim, the participants to this proposal have chosen to focus their efforts on selected topics related to their fields of expertise both at the level of data collection and data analysis. By learning from the first data, the existing analysis techniques will also be extended and improved, leading to an increase in the detector efficiency and its effective area.

1.4 Description des travaux : programme scientifique/For each specific aim: a proposed work plan should be described (including preliminary data, work packages and deliverables

The project can be subdivided in three main tasks, partially overlapping in time and viewed as a contribution to the European effort carried out by the ANTARES Collaboration. It will be conducted by the APC group in collaboration with members of the groups at CPPM, GRPHE and IPHC, as described in section 1.7. The successful implication of the APC members in the tasks listed hereunder crucially depends on the participation of a new post-doc financed by the ANR and dedicated full time to the project.

<u>1. Understanding the detector and its present data</u>

A first essential step to improve the reconstruction efficiency is to understand in detail the data recorded with the existing data acquisition system and analysis software. When this proposal will start, the ANTARES detector will in principle be completed and have 12 lines operational. In parallel, a large sample of data taken with the 5-lines detector (since January 2007) and 10-lines detector (since December 2007) will already be available.

The simulation codes currently used by the collaboration rely on parameters (such as the efficiency of the optical modules, the electronics response and the sea water properties) which all come from studies and measurements made before the detector was constructed. Much effort is needed to update these parameters based on the real experience and reduce the gap between real data and Monte Carlo expectations, as described in section 1.2.

Task 1.1: Charge calibration of the PMT front-end electronics

The optical modules on the detector lines are arranged in groups of three per storey and each storey contains electronic modules where the analogue electrical outputs of the photomultipliers are digitized in a custom built ASIC chip, the Analogue Ring Sampler (ARS) before being treated by a data acquisition card, containing an FPGA and microprocessor. The digitized signal are then multiplexed at a number of levels in the detector lines and sent to the experiment shore station located at La Seyne-sur-Mer, in France. The default readout mode of ANTARES is the transmission of the time and amplitude of any light signal above a threshold corresponding to ~1/3 of a photo-electron for each optical module.

The APC group is responsible for the development of charge and threshold calibration procedures. The present efforts of the group in calibrating the front-end electronics (ARS) are a first step towards the optimization of the PMT response, but further detailed studies of the signals recorded in the detector are necessary.

One major issue is the setting of the amplitude threshold needed to send data to shore. This threshold setting can be monitored by counting rate studies or by looking at the pulse height distributions in the recorded data. But this requires a good knowledge of the amplitude calibration. Bioluminescent organisms provide a natural source of light to monitor pulses at the level of the photoelectron. Measurements of larger amplitude pulses rely on the assumption of a linear response of the front-end electronics, up to 20 photoelectrons. This linearity has been checked in the laboratory, but in situ tests should be performed to validate the charge calibration procedure. A possible way is to use artificial sources of light, like LED beacons and laser beacons, originally designed to perform time calibration studies. The calibration tools already developed within the APC group have revealed an unexpected decrease of the amplitude of the photo-electron signals of about 2% per month on average, but with significant dispersion.

In order to compensate for these gain variations, quasi-online procedures have to be set to continuously monitor the effective thresholds. For some of the ARS, a simple adjustment of the thresholds will be sufficient. Others will require adjustment in the PMT high voltage. These adjustments are very important to minimize possible efficiency losses in the data taking. There is a request from the collaboration for this procedure to become automatic and the ANR post-doc based at APC is expected to contribute to this task.

In addition, the front-end electronics allow a more detailed readout of the light signal than the standard time and amplitude mode described above. With this detailed readout (waveform mode), it is possible to sample (up to 1 GHz) the full waveform of the signal with 128 samples. Because of limited bandwidth capacities, this readout mode is only used occasionally.

The analysis of the full waveforms will permit finer calibration studies than achievable with the default mode, especially concerning timing resolution. These calibrations will therefore become indispensable when the geometrical alignment system of the detector will work in nominal regime. A good example is the “walk effect” -a time spread of few ns among homothetic synchronous signals, induced when passing a fixed amplitude threshold- which can only be carefully studied by means of the full waveforms.

Detail studies of the raw photomultiplier signals possible with the waveform mode data could be used to test various hypotheses to explain the differences in data and Monte-Carlo. We first plan to perform specials waveform runs to crosscheck the calibration of the standard default mode. This specials data taking modes will require specific signal treatments under development by the applicants. As a second stage, a correction for the walk effect will be proposed.

Task 1.2: Detailed study of the bioluminescent background and of its impact on data acquisition modes

This part of the proposal will tackle technical questions related to the operation of photomultipliers in a deep-sea environment characterized by specific non-physical backgrounds which are used for calibration:

- the presence of the beta emitter ^{40}K, which produces Cherenkov photons (~30 kHz)
- a continuous biological background (~40-80 kHz)
- the bursts of light emitted by bioluminescent organisms, which lead to increases in the counting rate of single photoelectrons on the PMT cathode. This background is highly variable in time and has to be continuously monitored

Interestingly, the ANTARES "all data to shore" acquisition system provides for the first time a real time monitoring of the bioluminescent activity according to different environmental conditions (temperature, sea current, etc). While these bioluminescent phenomena can have a negative impact on the telescope sensitivity (dead time, PMTs ageing), they are of great interest for marine science since the biological mechanism which stimulates the emission of light by microorganisms is still poorly understood.

Bioluminescence can be stimulated in the flow around the structures of the ANTARES detector. In one of the hypothesis, the stimulation depends on the shape of the object in the flow, and a current velocity threshold for the appearance of flow-induced bio-light can thus be inferred. In this case, the rates can be predicted depending on the current configuration. These predictions are very valuable in view of the future R&D studies for the cubic kilometer-scale detector.

The counting rates should be studied as a function of the orientation of the current with respect to the optical module, also accounting for possible turbulence effects due to the presence of neighboring detector components (spherical optical modules, cylindrical frames & electronics container...). This study should permit a better understanding of the counting rates as a function of current speed and direction.

Task 1.3: Optical module test bench setup

The repeated bursts caused by bioluminescence could be responsible for a premature aging of the PMTs, which could explain the 2% gain drop observed in the already deployed PMTs. Even if raising the high voltage can – for the moment - compensate the observed PMT gain drop, it is necessary to investigate this effect in more detail in order to anticipate its consequences for ANTARES both on the short and long-term. This issue will be addressed through the setup of a test bench at the APC to study the response of the PMTs under extreme conditions of light intensity that reproduce the high bursting regime of bioluminescence. The realization of this instrumental task relies on the presence at the APC of a laboratory of photodetection, which will provide all the required technical facilities.

This test bench will also be used to measure the optical module efficiency as a function of angle of incidence. In order to disentangle the different possible effect of light diffusion in the whole optical module, a precise measurement of the photocathode quantum efficiency will first be performed using a 3D scanning optical device illuminating the naked PMT. Similar studies will then be repeated with the whole optical module immerged in a water tank, providing effective parameterizations used as input to the Monte Carlo.

2. Data filtering and processing optimization

The amount and quality of the data collected by the detector crucially depends on the setting of appropriate trigger and selection algorithms, as well as on the quality of the subsequent reconstruction. The overall optical background indeed represents 99% of the data sent to shore. It is therefore crucial to optimize the selection algorithm to filter-out unphysical information.

At the present stage, although the detector hardware is capable of operating up to average rates of ~500 kHz, the data acquisition and analysis software has limits at lower rates. A variety of possible methods exist to optimize the efficiency in highly bioluminescent environment -and some examples are given below- but all ideas will require a significant effort in software development.

Task 2.1 Improvements in the filtering algorithms

The default operation mode of the detector is to send all digitized hits from the optical modules to a computer farm on shore and therein to make a software filter looking for hit patterns corresponding to muon tracks (or other physics events producing light in the water, like magnetic monopoles). Only signals passing through this pattern finding are written on disk for a further event reconstruction. The presence of three optical modules in a storey allows local coincidences to be made for this pattern finding. The current on shore filter algorithm loops over all the hits in the event but with high singles rates the combinatory background with such methods becomes enormous. In the periods of high bioluminescence rates, modifications are needed in the original software to avoid losses of data.

The present data acquisition and filtering system allows for further extension any time in the future. This is subject to the scientific interest of the collaboration and further funding resources. It is likely that any new filter system in the high rate environment will result in a higher volume of candidate events output from the data taking computer farm. This is why funding is requested to the ANR for acquiring additional CPUs in order to test the above new ideas. The requested amount of money is estimated to be 15 300€. Details are given in section 2.1.

We plan to perform studies on alternative physics event filter based on time coincidences and energy deposit inside the detector. The efficiency and viability of the new filter algorithm, in particular in conditions of high optical activity, will first be tested on the new CPUs bought with the ANR fund in order to compare it with the existing filter. If successful, a proposal will be made to the collaboration to implement the new filter permanently.

Task 2.2 Improvements in the reconstruction software

Several reconstruction strategies are available within the ANTARES collaboration, which have been developed and optimized on the basis of Monte Carlo studies for a 12-line detector with stable optical background. They predict a pointing accuracy of 0.2° at high energy (>10TeV), providing good background rejection power for point-source searches. They are currently applied to the available data from the 5-line detector and give encouraging results as can be seen on figures 3 and 4, which show the first ANTARES candidates of upward neutrinos. However, in order to maximize the effective detection area of the detector taking into account its actual conditions of operation (and in particular the periods of high optical activity), the reconstruction methods must significantly evolve and this area will require an extensive effort in the upcoming years.

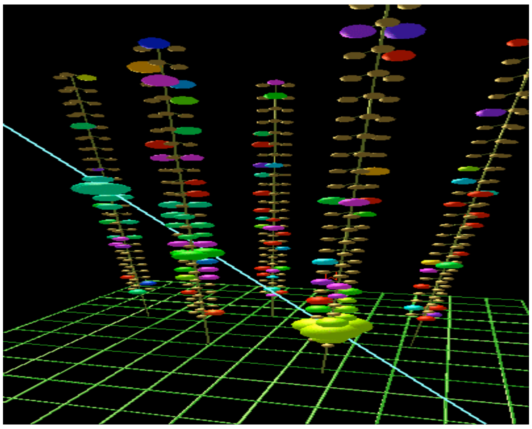

Figure 3. Candidate upward going muon (neutrino) in the 5 line telescope.

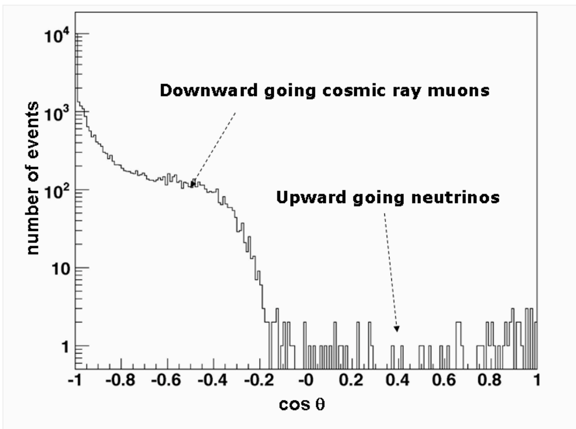

Figure 4. Zenith angle distribution of selected tracks

In a similar way to the present filter, the present reconstruction software loops over all hits in the event, which clearly becomes inefficient at higher rates. Again new algorithms must be developed which make more restrictions on the hits tested for the track fitting. There are essential differences between the signal hits and the noise hits, which can be used to reject the noise and gain reconstruction efficiency. The noise hits have low amplitude and are uncorrelated in time, contrarily to the signal hits, which are time-correlated and whose amplitude depends on the proximity of the track to the detector and on the track energy.

Compared to the present algorithms, a more refined algorithm could be designed starting with clusters of hits from detectors in adjacent storeys and then building up the hits on the track following an initial fit. It could include in different ways the amplitude information of the hits, either alone or combination with the timing information.

Other information that could be used is the direction from which the light arrives at the photomultiplier. Each storey of the detector contains three optical modules with a certain angular acceptance and orientation. The track hits have a directional correlation while the noise hits are isotropic and could be cut using the information of optical module orientation.

3. Analyzing and interpreting the data: the science case

The data set available for the present project is expected to cover more than three years of data taking with the full 12-lines detector. During that period, a significant effort will be required among the collaboration to develop reliable and efficient analysis tools in order to meet the scientific goals of the experiment.

The participants to this project have chosen to focus their contribution on the search for point sources, a field where ANTARES is expected to deliver very competitive results. The coordination of this analysis at the level of the collaboration is currently under responsibility of Antoine Kouchner. As illustrated in figure 5, the field of view covered by ANTARES is complementary to that of the south pole experiments and the sensitivity after one year of data taking should be comparable to the one achieved by AMANDA after 3 years.

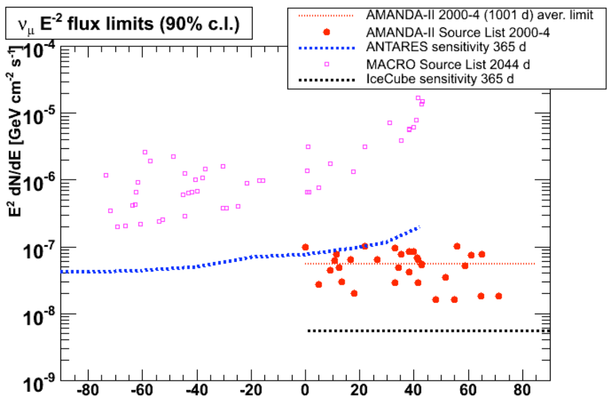

Figure 5 : ANTARES expected sensitivity to point sources, compared other experiments.

Task 3.1 Point source studies

The point source search program of ANTARES requires the estimation of the sensitivity of ANTARES to source candidates observed in gamma-ray or cosmic ray experiments, in view of the up-to-date phenomenological information on the expected production and acceleration mechanisms. This approach will be developed inside the high energy astrophysics group at APC which gathers members of different astroparticle physics experiments (AUGER, HESS, INTEGRAL…) and theoreticians working on the phenomenology of cosmic radiation and astrophysical sources.

In particular, this collaboration could be exploited to establish a short list of the most promising sources to be studied with special attention, possibly including the Galactic Center, a microquasar, an SNR, or an AGN. Indeed, it is foreseen to implement a few dedicated online directional filters which should allow to enhance the sensitivity towards specific directions in sky.

This strategy is particularly relevant for the low energy regime (100 GeV-10TeV) where the background level is higher.

Appropriate statistical techniques also have to be developed to allow the extraction of a signal of point source from the background and the correct estimation of the significance of an observed clustering of events. Such methods should be studied in view of their application to known sources either individually or in group (“stacking analysis”).

This will be done in collaboration with the ANTARES group in Valencia, which is also active on this topic and has well-established contacts with the group at APC formalized in the “Accord de cooperation” between IN2P2 (in France) and MEC (in Spain).

1.5 Résultats escomptés et retombées attendues/*Expected results and potential impact*

The scientists involved in this proposal are already among the experts in the ANTARES collaboration in the areas described in this document. The funding requested here will enable them to extend their capabilities, both in technical infrastructure and in manpower, in order to achieve the extra scientific effort required by the ANTARES collaboration in this very important phase of development of the project and to fully exploit the scientific potential of the neutrino telescope which was, for a large part, conceived and constructed with the technical expertise and financial support of France.

The studies considered in this proposal (charge calibration, PMT response, data filtering and analysis) are expected to lead to a significant improvement of the detector efficiency and sensitivity. After 3 years of data taking with complete detector, ANTARES will provide information on the intensity of cosmic neutrino fluxes that will serve as benchmarks for larger-scale projects. Thanks to its innovative design, that exploits at best the good optical properties of the seawater, and despite its reduced size, ANTARES itself is already expected to yield scientific results competitive with the other currently running experiments, and maybe to observe the first high-energy cosmic neutrinos ever detected.

The work performed by the applicants will be an important contribution to the overall scientific effort undertaken by the ANTARES collaboration in the upcoming years. The support provided by this project to the APC group, in particular through the hiring of a post-doc, will be crucial to reinforce its credibility and presence at all levels of the experiment, from the detector instrumentation to the data analysis and interpretation. The development of technical activities related to the testing of optical modules, in collaboration with the APC photodetection laboratory, will also constitute the first technical contribution of the APC group to the ANTARES collaboration.

1.6 Organisation du projet/*Project management*

CD : Corinne Donzaud
AK: Antoine Kouchner
JPE: Jean-Pierre Ernenwein
SE: Stéphanie Escoffier
TP: Thierry Pradier
VVE: Véronique Van Elewyck
ANR: Post-doc

For each task, the responsible is marked in bold face

Tâche/Tasks		Année 1 Year 1		Année 2 Year 2		Année 3 Year 3	
		6	12	18	24	30	36
1. Understanding the detector and its present data	Task 1.1: Charge calibration of the PMT front-end electronics	CD, **AK**, TP					
	Task 1.2: Studies of bioluminescent background	SE, **TP**					
	Task 1.3: Optical module testing	CD, AK, **VVE**, ANR					
2. Optimizing of data filtering and processing	Task 2.1: Improvements in the filtering algorithms	JPE, **SE**, AK, , ANR					
	Task 2.2: Improvements in the reconstruction software			JPE, SE, TP, VVE, **ANR**			
3. Analyzing and interpreting the data	Task 3.1: Point source studies	CD, **AK**, VVE, ANR					
	Rapports d'avancement annuel Progress report/expenses		☺		☺		
	rapport final final report						☆

☺ : Rapport d'avancement semestriel/6 month-progress report
☆: Rapport de synthèse et récapitulatif des dépenses/Final report and expenses summary

1.7 Organisation

1.7.1 Constitution de l'équipe proposée/*Composition of the team.*

Most of the physicists participating in this proposal have been collaborating for several years within the ANTARES experiment. They are the youngest physicists with permanent position among the collaboration, and are involved in many aspects of the experiment, from calibration and monitoring to simulations and data analysis, as can be appreciated from the sections 1.7.2 and 1.7.3.

The core of the present project will be carried out as part of the activity of the High Energy Astrophysics and Neutrino Physics poles at APC. The development of activities related to high-energy neutrino astrophysics has become a priority of the APC with the creation, two years ago, of an ANTARES group led by a young expert in the field, Antoine Kouchner, who has been working on the experiment since 1998 (first at CEA) and has largely participated to the testing and monitoring of the first detector lines. The group has been recently reinforced by the arrival of two more permanent researchers, Corinne Donzaud (who worked for 2 years in collaboration with the ANTARES group at CEA) and Véronique Van Elewyck, whose recruitment was motivated by her background expertise in both phenomenological and experimental aspects related to the physics of high-energy cosmic rays and cosmic neutrinos. This reinforcement testifies of the will of the head of the laboratory to support the project at the time of exploiting real data and performing physics analysis.

However all the individuals of the APC group have heavy teaching duties (192 hours per year), which reduce their traveling capacities and limit the time available for research. Among them, 2 participants match the criteria for a modulation of the teaching duties proposed by the ANR, namely Antoine Kouchner and Véronique Van Elewyck. It is of particular importance for Antoine Kouchner who is involved at the level of 80% in the project. But it is also very appropriate for Véronique Van Elewyck, the first years of teaching demanding a particularly heavy investment.

In order to enable them to concentrate on the present proposal, it is asked to the ANR a release of 96h per year to be shared among the group for the full lasting project. Such a possibility - that will represent a total expense of 10000 € per year- will considerably benefit to the project, allowing the members of the proposal to regularly meet all together and to provide appropriate support and availability to the incoming post-doc.

1.7.2 Complémentarité et synergie des membres de l'équipe/*Relevance of the team members.*

The actors of this proposal have acquired complementary knowledge from their past research activities in nuclear, particle and astroparticle physics. Some of them have been involved in long R&D phases while others have a prior experience in experimental collaborations which were in the phase of data taking. Most of them have been working in the ANTARES collaboration for several years by now, and have acquired specific expertise at different level in the operation of the detector. They now wish to use and combine them in order to optimize the detector efficiency and scientific potential.

Antoine Kouchner, Corinne Donzaud, Thierry Pradier and Jean-Pierre Ernenwein took an active part in the development and analysis of test benches dedicated to the study of the front-end electronics of the detector. Stéphanie Escoffier is in charge of the calibration tests of the ANTARES lines that are performed in darkroom at CPPM before immersion. Together with Thierry Pradier, she has performed detailed studies of the optical background induced by bioluminescence. They have looked for correlations with environmental variables and tried to model the parameters triggering increases of background activity.

1.7.3 Qualification du responsable scientifique et des membres de l'équipe/*Principal investigator and team members : résumé and CV*

Antoine Kouchner is Maitre de Conférences at University Paris 7. He has been working on the ANTARES experiment since he started his Ph. D in 1998. During the first year of his thesis, Antoine Kouchner's work was dedicated to the study of the neutrinos originating from gamma-ray bursters. Another part was dedicated to the analysis/exploitation of the data from a demonstrator line immersed off Marseilles in 1999. His expertise both in technical and scientific issues related to the detector are now widely acknowledged among the collaboration, which can be appreciated from his high level of responsibility.

His has indeed been assigned the task of charge and energy calibration of the detector together with the in-situ effective setting of the thresholds of the front-end electronics. He has also developed a framework software (based on ROOT, C++, and ORACLE) to address calibration issues. His software package is used by the collaboration, in particular by the shifters controlling the detector.

In parallel with these technical responsibilities, the collaboration also granted him the coordination of the "point sources" group (one of the most important scientific goals of the experiment), which underlines his good skills as coordinator of a project. One topic of this group concerns multi-messenger surveys. In this view, an important work is to infer neutrino fluxes from other experiments results like HESS or more recently AUGER. Being member of APC is, in that sense, a very big advantage, since the laboratory gathers all these experiments. Such an environment will also benefit to the candidate post-doc.

Corinne Donzaud is Maitre de Conférences at University Paris XI. She has been involved in the ANTARES project since 2004. She was working in collaboration with the ANTARES group of CEA/Saclay while formally attached to the Institut de Physique Nucléaire d'Orsay. She worked with Antoine Kouchner on the analysis and comparison of the data from different test benches dedicated to the front-end electronic chip (ARS) characterization. They made a follow-up of the calibration constants of the chip (75 slow control parameters) from the "naked chip" stage to in situ measurements via different integration stages (motherboard, electronic container, dark room tests). They have written an internal note on this topic. Corinne Donzaud has now officially joined the APC group since September 2007.

It was also in September 2007 that Véronique Van Elewyck was appointed by the University Paris 7 as Maitre de Conférences and joined the ANTARES team at APC. She was previously working on the Pierre Auger Observatory, a detector of ultra-high energy cosmic rays deployed in Argentina, where she was mainly involved in the development of methods to enhance the detection potential of Auger for ultra high energy neutrinos. She also benefits from a strong background in cosmic neutrino phenomenology acquired during her Ph. D. and post-doc activities, which will undoubtedly help in data interpretation. In ANTARES, she is currently working on the data analysis, but she is also willing to increase her participation in the more technical aspects of this proposal in order to gain experience with the detector.

Stéphanie Escoffier has a solid expertise on the study of the bioluminescence (with 2 other prototype lines called PSL -2003- and MILOM -2005,2006-). She closely collaborated with specialists in this field in order to sort out the different components of the optical background light, and to study correlation with other parameters such as temperature, current velocity… She is currently undertaking a study of the counting rates induced by the bioluminescence in view of considering the possible options of triggering to better handle the background noise.

Jean-Pierre Ernenwein is involved in the monitoring of the environmental data of the detector. He also works mainly on the detection of the muons of high energy, therefore dealing with various trigger strategies, developing dedicated selection and reconstruction methods, mainly based on multi-dimensional techniques. In this context the first line data are analyzed to improve the Monte Carlo simulation reliability.

Thierry Pradier also worked in the field of bioluminescence. He has been developing comprehensive models of bioluminescent phenomena based on data from the prototype lines. These models could be the basis for the construction of a dedicated strategy to handle bioluminescence bursts during data taking. He also has a deep expertise on gravitational wave detection (PhD on VIRGO) and he is currently undertaking a study of the coincidences between neutrino telescope and gravitational wave detector.

1.8 Accès aux grands instruments/ Access to large facilities

Tableau de récapitulatif des données financières de la fiche budgétaire

FICHE BUDGÉTAIRE - JCJC

Récapitulatif des données financières

Nom Complet du partenaire	Catégorie de partenaire	Base de calcul pour l'assiette de l'aide
	Organismes publics de recherche	Coût marginal

Données financières (montant HT en € incluant la TVA non récupérable) 1

EQUIPEMENTS (€)	Personnels						Prestations de service externe (€)	Missions (€)	Autres dépenses (€)	Compensation	Dépenses justifiées sur facturation interne (€)	Totaux (€)
	permanents		non permanents à financer par l'ANR		Autres non permanents							
	personne . mois	Coût (€)	personne . mois	Coût (€)	personne . mois	Coût (€)				30 000		
15 300	*93,00*	246 675	*30,00*	135 600				45 000	30 000			472 575
									Autres dépenses DE FONCTIONNEMENT(€)			

Montant maximum des frais de gestion/ frais de structur	9 036	9 036	<--Frais de gestion / frais de structure demandés (€)--> 9 036
Uniquement pour laboratoire d'organisme public de recherche ou fondation financé au coût marginal, indiquer le taux d'environnement	80,0%	Frais d'environnement (€)	305 820
		Coût complet (€)	**787 431**
		Coût éligible pour le calcul de l'aide : Assiette (€)	**234 936**
1 — Taux d'aide demandée)-->	100,0%	***Aide demandée (€)***	***234 936***

2. Justification scientifique des moyens demandés/*Requested budget : detailed financial plan*

2.1 Equipement/*Large equipment*

In order to achieve the goals described in this proposal, in particular the optimization of the trigger strategies (both off-line and on-line), an important amount of computing resources is requested, together with significant data storage capacities. Indeed, the standard muon trigger foreseen for the 12 line detector requires the totality of the CPUs already available in the shore station. In the present situation, one can operate this standard muon trigger only up to 250 kHz singles rate for the full 12-line detector although the detector hardware is capable of operating up to average rates of ~500 kHz. Therefore, any new trigger algorithm study would demand additional computing facilities. Our request aims to cover part of the necessary computing investment that the collaboration will have to make in the very near future in order to allow new studies such as the one we propose.

The current state of technology allows a set of 48 processor units (cores), distributed on 6 machines, with a raw storage capacity of 6 TB (4 within a RAID5 setup), for a total amount of 15300 € HT. The amount of memory available for each core is 2 GB in this setup. This system will enable the testing, comparison and development of loose and tight trigger strategies, with local data storage capability in the path of several triggering levels, before data are sent to the final repository in the Lyon Computing Center (CCIN2P3).

These new computing resources will also enable us to perform quasi on-line event reconstruction. This last step is already available in a preliminary form for shifters. However, we would like to extend the functionality to several specialized reconstruction strategies and to automate this process, providing the shifters with data quality estimators.

It should be clear that all estimates given above strongly depend on the singles rate and the supplier's offer and therefore can only remain provisional.

2.2 Personnel/*Manpower*

The individuals leading the proposal at APC are experts in most of the tasks discussed in this projects, but they are all researchers and teachers at the same time so that they cannot cope with all proposed tasks by themselves and need help from a full time researcher. To be able to fullfill the present proposal they therefore require a dedicated post-doc for two years and a half (30 months) located at the APC laboratory. The candidate should be a researcher with experience in data taking, data analysis and software. Such a reinforcement of the group would clearly help for acquiring visibility and autonomy towards the collaboration.

Candidates to the OYSTER post-doc position at APC should have a Ph.D in experimental Particle/AstroParticle Physics. Previous experience in High Energy Physics and more specifically in cosmic ray/gamma/neutrino astrophysics, although not essential, will be considered an important asset. Good knowledge of data analysis, data storage, in high-energy experiments is required. The candidate should also have demonstrated abilities in software developments (C++, ROOT, ORACLE).

The successful candidate will participate in the calibration of the detector and study multi-field aspects (important for the understanding of the behavior of the detector and of its duty cycle) such as stimulated bioluminescence. He/she will have the opportunity to analyze 3 years of data collected with the complete 12 lines of the **ANTARES** neutrino telescope, the most sensitive one in the northern hemisphere, and therefore to produce scientific results.

Dell S.A.
7, rue Eugène et Armand Peugeot
92563 Rueil Malmaison

Standard : 01 55 94 71 00
Fax commande : 0825.004.388
Fax principal : 01 55 94 71 01
Internet : www.dell.fr

Date: 08-02-2008 N° de Devis 20493247

Responsable Commercial : PHILIPPE MASSIQUET (Tél 0499756048)

Qté	Description	Prix unitaire ou Quantité	Total
5	PE1950 III Quad-Core Xeon E5410 2.33GHz/2x6MB 1333FSB	2.100,00	10.500,00
	PE1950 PCIE Riser (2 Slots)	1	
	French - Documentation and Rack Power Cord	1	
	PE1950 Bezel Assembly	1	
	8GB 677MHz FBD (4x2GB dual rank DIMMs)	1	
	PE1950 III - Additional Quad-Core Xeon E5410 2.33GHz/2x6MB 1333FSB	1	
	500GB SATA2 Universal (7,200 rpm) 3.5 inch Hard Drive	2	
	PE1950 III 3.5" HDD support chassis	1	
	Perc 6i Integrated Controller	1	
	8X IDE DVD-ROM Drive	1	
	PE1950 III Redundant Power Supply - No Power Cord	1	
	Cable d'alimentation, PDU (Rack)	1	
	Broadcom TCP/IP Offload Engine functionality (TOE) Not Enabled	1	
	No Operating System	1	
	PE1950 OpenManage kit and FI Driver	1	
	You have chosen not to take the Dell PowerEdge installation service	1	
	Sliding Combination Rapid/Versa Rail with CMA	1	
	PE1950 III - C3,MSSR1, ADD IN PERC 5i/6i or SAS6iR, min 2 / max 2	1	
	PowerEdge Order - France	1	
	Base Warranty	1	
	1Yr Basic Warranty - Next Business Day	1	
	3Yr Basic Warranty - Next Business Day	1	
	Declined ProSupport	1	
1	PE2950 III Quad-Core Xeon E5410 2.33GHz/2x6MB 1333FSB	4.800,00	4.800,00
	Riser with PCI Express Support (2x PCIe x8 slots; 1x PCIe x4 slot)	1	
	PE2950 French rack power cord	1	
	PE2950 Bezel Assembly	1	
	2GB 667MHz FBD (4x512MB single rank DIMMs)	1	
	PE2950 III Additional Quad-Core Xeon E5410 2.33GHz/2x6MB 1333FSB	1	
	1TB SATAu (7.200 rpm) 3.5-inch Hard Drive	6	
	PE2950 III - Chassis 3.5HDD x6 Backplane	1	
	PE2950 III - PERC 6/iR, Integrated Controller Card x6 backplane	1	
	8X IDE DVD-ROM Drive	1	
	CD/DVD CABLE	1	
	PE2950 III - Redundant PSU No Power Cord	1	
	Cable d'alimentation, PDU (Rack)	1	
	Broadcom TCP/IP Offload Engine functionality (TOE) Not Enabled	1	
	No Operating System	1	
	PE2950 Open Manage Drivers No Docs	1	
	You have chosen not to take the Dell PowerEdge installation service	1	
	PE2950 Rapid/Versa Rack Rails	1	
	PE2950 III - C4,MSSR5, ADD IN PERC 5/I or Perc6/i,, m	1	
	PowerEdge Order - France	1	
	Base Warranty	1	
	1Yr Basic Warranty - Next Business Day	1	
	3Yr ProSupport for End Users and 4hr Mission Critical	1	

Détail de la TVA

Code TVA	TVA (%)	EUR Total H.T.	EUR TVA
S	19.6	15.300,00	2.998,80

Sous-total H.T.	15.300,00
Frais de port H.T.	0,00
TVA	2.998,80
Total T.T.C.	18.298,80

2.3 Prestation de service externe/*Services, outward facilities*

2.4 Missions/*Travels*

We plan trips to the European institutes collaborating in ANTARES to develop in common the ideas presented in the proposal. These missions will be to France, Holland, Germany, Italy and Spain. We plan two visits of one week to this list of place in Europe every year for a total estimated amount of 20000€.

These meetings are crucial for the success of the present proposal since it requires input from experts geographically dispersed in different institutes of the collaboration.

In addition, numerous exchanges within the groups member of the project (Paris, Mulhouse, Strasbourg and Marseille) are planed. It is also necessary to foresee different travels to the ANTARES shore station for installation and maintenance of the offshore trigger system. This travels should represent a total amount of 25 000 €.

2.5 Dépenses justifiées sur une procédure de facturation interne/*Expenses for inward billing*

2.6 Autres dépenses de fonctionnement/*Other expenses*

Annexes

Description des participants/Team members *informations* (cf. § 1.7.1)

Biographies/*Résumés and CV* (cf. § 1.7.3)

Antoine KOUCHNER

Né le 18 juin 1975, nationalité française, célibataire, 2 enfants.

Expérience scientifique

Depuis 2002	**Maître de Conférence**	Université Paris VII Denis Diderot
	Coordinateur Astronomie Neutrino	Laboratoire APC UMR 7164
	Group coordinator « Charge and Energy Calibration » ANTARES Experiment	
	Group coordinator « Astrophysical Point-like Sources» ANTARES Experiment	
2001 -2002	**Volontaire civil expérience DØ** *Couplages anormaux du quark top et étalonnage des détecteurs à muons*	Fermilab - CEA/DAPNIA/SPP
1998 – 2001	**Thèse de doctorat** *Possibilité d'observation, par le télescope ANTARES, de neutrinos de haute énergie associés aux sursauts gamma et validation des techniques de détection à l'aide d'un prototype »* Directeur : Luciano Moscoso	Université Paris VII - CEA/DAPNIA/SPP

Responsabilités diverses

Depuis 2005	**Responsable Tutorat de Physique**	Université Paris VII
2004 -2007	**Membre élu au Conseil de Laboratoire**	Laboratoire APC UMR 7164
Depuis 2004	**Membre suppléant CSE 29**	Université Paris VII
Depuis 2004	**Membre suppléant CSE 29**	Université Montpellier II

Organisation

Sept. 2008	**15th ISVHECRI International symposium**	Paris, France
Avril 2008	**3rd VLVnT international Workshop**	Toulon, France
Mai-Juin 2006	**Encadrement Stage JANUS A. Hallou**	"Electronique frontale ANTARES"
Décembre 2004	**Journées Jeunes Chercheurs** **Coordinateur** « Astroparticules et Neutrinos »	Organisées par SFP et SBP Ile de Berder, France
Avril 2004	**Exposition de Physique** **« Les géants de l'infiniment petit »**	Palais de la découverte, Paris
Juin 2003	**3e atelier international APC** **« High Energy Neutrino Astronomy»**	Laboratoire APC – CEA/Saclay

Publications

A. Kouchner , 30th International Cosmic Ray Conference 2007, Mérida, Mexique, Juillet 2007, arXiv:0710.0272
The ANTARES Neutrino telescope : status report (Subvention du Comité français de Physique)

ANTARES, M. Ageron *et al*, Nuclear Instr. and Methods in Phys. Res. A 581 695-708 (2007)
Studies of a full scale mechanical prototype line for the ANTARES neutrino telescope and tests of a prototype instrument for deep-sea acoustic measurements

ANTARES, M. Ageron *et a*l, Nuclear Instr. and Methods in Phys. Res. A 578 498-509 (2007)
The ANTARES Optical Beacon System

ANTARES , J.A. Aguilar *et al.* , Nuclear Instr. and Methods in Phys. Res. A **570**, 107-116, 2007
The data acquisition system for the ANTARES neutrino telescope

S. Hundertmark , A. Kouchner, Comptes Rendus Physique **6**, 789-797, 2005
High energy neutrino astronomy - Astronomie neutrino à haute énergie

Jean-Pierre Ernenwein (01/03/1971) **Age: 37 ans**

Thèse soutenue en 1997 (Directeur J-P Martin, IPNLyon), sujet : *Contribution à la recherche du boson de Higgs Standard et non Minimal par les canaux $H^0e^+e^-$ et $H^0\mu^+\mu^-$ dans l'expérience L3 à LEP.* 2 articles dans des revues internationales avec CL, 1 note interne L3, 1 rapport jaune CERN.
HDR soutenue en 2007 (Université de Haute Alsace).

1998-1999 : ATER IPNLyon: calorimètre électromagnétique de CMS : participation au développement d'un banc de test des photodiodes à avalanche collectant la lumière des cristaux de $PbWO_4$, tests sur faisceau d'électrons au CERN d'une matrice de 30 cristaux équipés de leur électronique de lecture, étude par simulation de la séparabilité π^0/γ (E=30-70 GeV, réseau de neurones type perceptron). 1 conférence avec actes, 2 notes CMS.
Depuis 1999 : MCF Université de Haute Alsace/GRPHE (UPRES EA3438, directeur R. Blaes) :
1999-2001 : Trajectographe CMS (3 articles dans revues avec CL) : tests de MSGCs au PSI sous faisceau de pions de haute intensité, mise au point d'algorithmes de reconstruction de vertex primaires et secondaires (environnement ORCA) .
2001-2003 : Trajectographe CMS : réalisation d'un banc de test des détecteurs silicium assemblés en « modules » par éclairement infra-rouge (diodes) des pistes, avec lecture synchronisée de la charge induite (LabView, C++/ROOT) (encadrement d'un stage de maîtrise). Banc exploité à l'IPHC (Strasbourg).
2001-2003 : Imagerie médicale, dosimétrie: (collaboration avec le service de médecine nucléaire de l'hôpital de Hautepierre, Strasbourg) : dosimétrie opérationnelle et imagerie du petit animal par scintigraphie: tests de dispositifs et simulation de prototypes de gamma-caméra pour petit animal (2 stages: DEUG et maîtrise).
2003-aujourd'hui : ANTARES et KM3NeT (3 conférences avec actes, 1 conférence sans acte, 5 articles dans revues avec CL) :

- Etude de la sensibilité du télescope aux neutrinos de plus de 10 PeV, horizontaux et descendants (encadrement thèse à 80%, directeur : R Blaes) : simulation, reconstruction.
- Tests des cartes portant l'électronique de lecture des photomultiplicateurs de ANTARES (en collaboration avec l'IPHC de Strasbourg)
- Monitorage des données « slow control » du détecteur ANTARES.
- Physique des $\nu\mu$>10 PeV dans le cadre de KM3NeT (encadrement d'un post-doc financé par l'Europe)

Enseignements : 192h/an à l'IUT de Mulhouse : mathématiques appliquées et physique.

Responsabilités collectives

Membre titulaire des commissions de spécialistes 29^{ième} section de l'UHA (Mulhouse), ULP (Strasbourg), et UCBL (Lyon I). Membre de l'Institutional Board et du Publication Commitee de ANTARES. Membre de l'assemblée générale de KM3NeT et du steering commitee du WP2 de KM3NeT.

Sélection de 5 publications

Studies of a full scale mechanical prototype line for the ANTARES neutrino telescope and tests of a prototype instrument for deep-sea acoustic measurements.
ANTARES Collaboration**, Nucl. Instrum. Meth. A581 :** 695-708, 2007

The ANTARES Optical Beacon System.
ANTARES Collaboration**, Nucl. Instrum. Meth. A578 :** 498-509, 2007

First results of the Instrumentation Line for the deep-sea ANTARES neutrino telescope.
ANTARES Collaboration, **Astropart. Phys.26 :** 314-324, 2006.

The ANTARES neutrino telescope. JP Ernenwein for the ANTARES Collaboration**, 40th Rencontres de Moriond :** 365-368, 2005.

Experimental and simulation study of the behaviour and operation modes of MSGC + GEM detectors. M Ageron et al, **Nucl. Instrum. Meth. A489 :** 121-139,2002.

Stéphanie ESCOFFIER
34 ans (née le 09/02/1974)
Chargée de recherche au CPPM depuis le 01/10/2006.

ACTIVITÉS DE RECHERCHE

Depuis octobre 2006 : CR2 au CPPM (CNRS/IN2P3) – projet ANTARES

- Coordination de la calibration en temps du détecteur ANTARES intégré au CPPM.
- Etudes sur le trigger de Niveau 2, et de l'incidence de la bioluminescence sur les performances du détecteur.
- Etudes de la détection de monopoles magnétiques avec ANTARES.
- Participation au programme européen KM3Net.

2004-2006 : Contrat postdoctoral CNRS au CPPM (CNRS/IN2P3) – projet ANTARES
Etude de la bioluminescence marine avec le détecteur ANTARES. Calibration en temps du détecteur. Chef de mission des campagnes en mer NOCTILUC.

2002-2004 : Contrat CNES au CETP (CNRS/INSU) - Projet CLUSTER II
Développement de logiciels interactifs de traitement et de visualisation de données de l'instrument WHISPER, pour l'étude des interactions entre la magnétosphère terrestre et le vent solaire.

1998-2001 : Thèse de doctorat de l'Université Paris VII, soutenue le 19/10/2001 au CEA/DAPNIA/SPhN, Saclay, mention très honorable avec félicitations du jury.
Mise en œuvre d'un polarimètre à effet Compton inverse pour la mesure de la polarisation du faisceau d'électrons du Jefferson Laboratory (VA,USA).

RESPONSABILITÉS ET ENCADREMENTS

Membre du steering committee du Work Package 9 ″Associated Sciences″ de KM3Net.
Expert laser du laboratoire CPPM, membre invité au CHS.
Co-encadrement de 2 stagiaires Master en 2006-2007.
Co-encadrement d'un doctorant, pour la période 2007-2010, sur la « Détection de monopoles magnétiques avec le détecteur ANTARES ».

PUBLICATIONS

Nombre total de publications dans des revues internationales à comités de lecture : 18, dont

The ANTARES Optical Beacon System.
By ANTARES Collaboration, **Nucl.Instrum.Meth.A578:498-509, 2007**.

The data acquisition system for the ANTARES neutrino telescope.
By ANTARES Collaboration, **Nucl.Instrum.Meth.A570:107-116, 2007**.

First results of the Instrumentation Line for the deep-sea ANTARES neutrino telescope.
By ANTARES Collaboration, **Astropart.Phys.26:314-324, 2006**.

Accurate measurement of the electron beam polarization in JLab Hall a using Compton polarimetry.
By S. Escoffier *et al.*, **Nucl.Instrum.Meth.A551:563-574, 2005**.

Recoil polarization for delta excitation in pion electroproduction.
By J.J. Kelly *et al.*, **Phys.Rev.Lett.95:102001, 2005**.

Curriculum Vitae

PRADIER, Thierry *35 ans, né le 10/02/1973*

– **Cursus et expériences professionnelles**

- **Thèse** soutenue en 2001 (Directeur P. HELLO, LAL Orsay) : Etude d'algorithme pour la détection de signaux impulsifs d'ondes gravitationnelles & Contrôle de la cavité *Mode-Cleaner* de **Virgo** ; *5* articles dans des revues internationales avec CL, dont 4 ***Phys. Rev. D***, 2 conférences.

- **2001-2002 : ATER Paris 7 au SPP/saclay:** Collaboration **ANTARES**, Interface Reconstruction-Base de Données - Coïncidences Ondes Gravitationnelles/Neutrinos de Haute Energie

- **Depuis 2001 : MCF Université Louis-Pasteur Strasbourg-I / IPHC Strasbourg : ANTARES**
  - Analyse des Tests des cartes portant l'électronique de lecture des photomultiplicateurs d'**ANTARES**, en collaboration avec le *GRPHE/UHA;*
  - Etude de la bioluminescence stimulée sur **ANTARES** : mécanismes, prédiction et réduction ;
  - Etude de sources potentielles d'ondes gravitationnelles et de neutrinos de haute énergie et des informations accessibles grâce à des coïncidences **Virgo-ANTARES**

- **Enseignements :** 192h/an à l'Université, au niveau L en Physique générale
- **Encadrements :** 1 Post-doctorant de l'Université Louis-Pasteur, 1 doctorant (resp. Ch. Racca)

Sélection de 5 publications

- **The data acquisition system for the ANTARES neutrino telescope, ANTARES** Collaboration, J.A. Aguilar *et al*. 2006, Accepted in Nuclear Instr. and Methods in Phys. Res. A astro-ph/0610029

- **First results of the Instrumentation Line for the deep-sea ANTARES neutrino telescope. ANTARES** Collaboration (J.A. Aguilar *et al.*). Jun 2006. **Astropart.Phys.26:314-324,2006**.

- **Study of large hemispherical photomultiplier tubes for the ANTARES neutrino telescope. ANTARES** Collaboration (J.A. Aguilar *et al.*). Oct 2005. **Nucl.Instrum.Meth.A555:132-141,2005**.

- **ANTARES Status & Milestones : News from Deep-Sea.** Th. Pradier**, IReS & University Louis Pasteur -** Proceedings of the 3rd International Conference on Frontier Science - Physics and Astrophysics in Space(2004), Frascati Phys.Ser. 555 (2004) 1-7

- **Gravity Wave and Neutrino Bursts from Stellar Collapse: A Sensitive Test of Neutrino Masses.** N. Arnaud, M. Barsuglia, M.A.Bizouard, F. Cavalier, M. Davier, P. Hello & **Th. Pradier** **Phys.Rev. D65** (2002) 033010

Corinne DONZAUD

41 ans (née le 26/01/1967)
Maître de conférence à l'université Paris X1, Orsay depuis 1995
Adresse : Laboratoire APC, Bâtiment Condorcet, 10 rue Alice Domon et Léonie Duquet, 75205 Paris Cedex 13
Téléphone : 01 57 27 61 56
Courriel : donzaud@apc.univ-paris7.fr

ACTIVITÉS DE RECHERCHE

2007-2008 : Laboratoire de rattachement : APC, dans le groupe Astrophysique des hautes énergies, projet ANTARES
Calibration de la puce électronique du détecteur ANTARES, in situ

2007 : Demande de création d'une équipe ANTARES au sein de l'IPNO, refusée

2004-2006 : Collaboratrice du Service de Physique des Particules de l'IRFU-CEA-Saclay
Calibration de la puce électronique du détecteur ANTARES, avant intégration

1995-2004 : Laboratoire de rattachement : Institut de Physique Nucléaire d'Orsay
Etude de la structure nucléaire des noyaux riches en neutrons, travail expérimental et analyse de données

1994-1995 : Position post-doctorale au laboratoire GSI-Darmstadt
Analyse de la première expérience de fission utilisant un faisceau d'^{238}U aux énergies relativistes et préparation de la seule expérience qui a mis en évidence le ^{78}Ni.

1990-1994 : Thèse de doctorat de l'université Paris X1 et ATER
Etude expérimentale du mécanisme de fragmentation lors de collisions périphériques de noyaux à plusieurs centaines de MeV/nucléon

ACTIVITÉS D'ENSEIGNEMENT

1995-2008 : Poste de Maître de Conférence à l'université Paris X1, Orsay
Travaux dirigés de physique en L1 (mécanique) et L2 (électrostatique et magnétostatique)
Travaux dirigés de mathématique en L3 PIST
Travaux dirigés d'informatique en L3 Physique Fondamentale
Travaux pratiques de physique nucléaire en M1
Responsable des travaux pratiques de mécanique et optique en L1 (2000-2004)
Création d'une option de physique expérimentale en L1 (2000-2004)
Création d'une salle de travaux pratiques en L1 (2002-2004)
Création d'un cours de soutien de mathématique en L3 PIST (2005-2008)
Création d'un module « Ordre et Chaos » en L1 (2005-2008)

1993-1994 : ATER de l'université Paris X1, Orsay

1990-1993 : Monitorat d'enseignement à l'université d'Evry

PUBLICATIONS

15 publications dans des revues à comité de lecture depuis 2004
Structure nucléaire (11)
Expérience ANTARES (4)

Curriculum Vitae
Véronique Van Elewyck – née le 22 Mai 1976

Parcours depuis la thèse

2003 — **Docteur en Sciences - Université Libre de Bruxelles (ULB)**
Thèse : *Neutrinos et micro-trous noirs: deux tests phénoménologiques des modèles d'Univers-membrane* (directeur : J.-M. Frère) – soutenue le **24/10/2003**

2003 – 2005 — **Contrat post-doctoral à l'Université Nationale Autonome du Mexique (UNAM)**
phénoménologie des neutrinos cosmiques et activités dans le cadre de la collaboration « Observatoire Pierre Auger »

2005 (3 mois) — **Chercheuse visiteuse à l'Université de St-Jacques-de-Compostelle**
activités dans le cadre de la collaboration Pierre Auger

2005 – 2007 — **Boursière Marie Curie à l'Institut de Physique Nucléaire d'Orsay**
activités dans le cadre de la collaboration Pierre Auger

Depuis Septembre 2007 — **Maître de Conférences à l'Université de Paris 7 Denis Diderot**
activité scientifique au Laboratoire AstroParticules et Cosmologie (UMR 7164) dans le cadre des collaborations ANTARES et KM3Net

Activités pédagogiques et responsabilités diverses

2001 – 2003 — **ULB : encadrement de TD/TP et coordination pédagogique: 400h**
Mécanique, Electromagnétisme, Electronique (niveau L1/L2)
+ représentante des scientifiques non-permanents au Conseil d'Administration
+ responsable d'un Journal Club interuniversitaire «Dimensions Supplémentaires »

2005 — **UNAM : cours de Physique des Astroparticules (en espagnol) : 10h** (niveau L3-M1)
+ responsable d'un atelier « Astroparticules » à l'Institut des Sciences Nucléaires

2007-2008 — **Université de Paris 7 : encadrement de TD : 145h**
Mécanique (niveau L1), Physique Subatomique (niveau L3 et M1)

Thèmes de recherche

- *Phénoménologie des neutrinos* ***(notamment dans les modèles de physique exotique), en lien avec la physique des astroparticules; production et propagation des neutrinos cosmiques***
- *Depuis 2004: physique des astroparticules expérimentale*

– détection et étude des rayons cosmiques ultraénergétiques par l'Observatoire Pierre Auger (contribution au déploiement et commissionning du détecteur, simulation et analyse des données) ; en particulier étude des gerbes inclinées et des méthodes de détection de neutrinos ultraénergétiques

- détection des neutrinos cosmiques dans ANTARES/KM3NeT: caractérisation du détecteur et analyse de données (recherche de sources ponctuelles) (depuis Sept. 2007)

Sélection de publications:

- *Randall-Sundrum black holes and strange stars*
M. Fairbairn and V. Van Elewyck, **Phys. Rev. D67 (2003) 124015**
- *Ultra High Energy neutrino damping in a thermal gas of relic neutrinos*
J. C. D'Olivo, L. Nellen, S.Sahu and V.Van Elewyck, **Astropart. Phys. 25 (2006), 47**
- *Detection of inclined and horizontal showers in the Pierre Auger Observatory*
V. Van Elewyck [Pierre Auger Collaboration], **AIP Conf. Proc. 809 (2006), 187**
- *Correlation of the highest energy cosmic rays with nearby extragalactic objects*
J. Abraham *et al.* [Pierre Auger Collaboration], **Science 318 (2007), 938-943**.
- *Exploring the ultra-high energy sky: status and first results of the Pierre Auger Observatory*
V. Van Elewyck [Pierre Auger Collaboration], **Mod. Phys. Lett. A Vol. 23 No 4 (2008), 221-236.**

Au total, 9 publications dans des revues internationales (+ 2 soumises), 7 contributions écrites (en tant qu'auteur principal) à des actes de conférences internationales, 1 cours invité sur Auger à l'Ecole Internationale d'Erice 2006, 11 séminaires invités, 14 communications orales dans des réunions scientifiques internationales (hors réunions de collaboration).

Implication des personnes dans d'autres contrats/*Principal invsetigator and team members' involvement in other projects* (cf. § 1.7.3) *(un tableau par participant)*

Nom de la personne participant au projet Name of the person involved in the project	Personne. Mois Man.month	Intitulé de l'appel à projets Source de financement Montant attribué Name call for proposals Other fundings from different organisms Allocated budgets	Titre du projet Proposal title	Nom* du coordinateur Name Principal Inverstigator	Date début - Date fin Start- End of the project
JP. Ernenwein	7	**6e PCRD** **Financement européen** 50 000 €	KM3NeT	Uli Katz	01.02.2006 29.11.2008
S. Escoffier	11	**6e PCRD**	KM3NeT	Uli Katz	01.02.2006 29.11.2008

Demandes de contrats en cours d'évaluation[1]/Other proposals under evaluation

Nom de la personne participant au projet Name of the person involved in the project	Personne. Mois Man.month	Intitulé de l'appel à projets Source de financement Montant demandé Name call for proposals Other fundings from different organisms Expected grants	Titre du projet Proposal title	Nom* du coordinateur Name Principal Inverstigator
V. Van Elewyck		Marie Curie European Reintegration Grant FP7-PEOPLE 45 000 € / 3 ans	NEUTEL-APC	V. Van Elewyck

[1] *Mentionner ici les projets en cours d'évaluation soit au sein de programmes de l'ANR, soit auprès d'organismes, de fondations, à l'Union Européenne, etc. que ce soit comme coordinateur ou comme partenaire. Pour chacun, donner le nom de l'appel à projets, le titre du projet et le nom du coordinateur.*

université PARIS DIDEROT PARIS 7

UFR DE PHYSIQUE

Je soussigné, Vincent Berger, directeur de l'UFR de Physique, autorise Antoine Kouchner, Maître de Conférences à l'UFR de Physique de l'université Paris 7 Diderot et porteur du projet ANR jeune chercheur 2008 "OYSTER", à demander une décharge d'enseignement de 96h TD par an à répartir entre les enseignants-chercheurs du projet pendant toute la durée du projet.

Fait à Paris, le 21 février 2008

Vincent BERGER

Bureaux :
Campus Paris-Rive gauche
Bâtiment Condorcet

Adresse postale : Direction de l'UFR
3ème étage - pièce 376 A - Case 7008
F-75205 Paris Cedex 13

tél. +33 (0) 1 57 27 61 00
fax +33 (0) 1 57 27 61 01
www.physique.univ-paris7.fr