VATLY NEWSLETTER

"A revolutionary, comprehensive, profound, thorough change of the education and training system is a prerequisite of the impulsion of our country into a fast and stable development on the road of national modernization and international integration. It is a prerequisite of its walking abreast with developed countries all over the world in the era of informatics and globalisation".

Vo Nguyen Giap

THE VATLY TEAM WISHES ALL ITS FRIENDS A VERY HAPPY AND SUCCESSFUL NEW YEAR 2008!

CONTENT

This ninth issue of the **VATLY NEWSLETTER** *starts with the traditional report on the* **LIFE OF THE LABORATORY.** *Next,* **NHUNG**, **THAO** *and* **DIEP**, *report about a visit to the Space Technology Institute. Important results obtained by the* **PIERRE AUGER COLLABORATION** *have recently been made public: they are briefly commented upon. A* **PHOTO ALBUM** *closes the issue.*

LIFE OF THE LABORATORY

We seem to be having a hard time to issue our Newsletter at a rate higher than twice a year. Time passes by very fast and even if we feel like we are working hard, our progress is always slower than we hope for. Next Têt will soon be here, after which Nhung and Diep will leave for three months: Nhung for Paris (LPNHE Jussieu), with Pierre Billoir, from March to May and Diep for Orsay (LAL), with Alain Cordier and Marcel Urban, from early February to early May.

As soon as Newsletter 8 was issued, Diep and Nhung left for Beijing where they attended the courses of the BCSPIN Summer School (18-26 June). BCSPIN has nothing to do with spin but stands for Bangladesh-China-Sri Lanka-Pakistan-India-Nepal. Sadly enough it has been difficult in the recent history to find a year where all of these countries were living in peace. While the school was rather intended for theorists, Diep and Nhung still managed to learn many new things. They particularly enjoyed the lectures of X M Zhang, from Beijing, on dark energy and were highly impressed by the rapid development of research in China.

The International Symposium on the Physics of Unstable Nuclei, ISPUN07, came next (2-7 July). It was held for the second time in Vietnam, this time in Hoi An, a nice tourist resort with a glorious past as a wealthy harbour, and was organized by our colleague at INST, Pr Dao Tien Khoa. Apart from Nhung and Thao, the rest of the team attended and helped Khoa with the organization. Of particular interest to us were the nuclear astrophysics contributions, including the progress achieved on the understanding of the reactions implied in supernovae explosions (reported by Pr Shigeru Kubono from Tokyo). Diep presented our work in a plenary session and his talk was very well received.

At ISPUN07, in front of a replica of the famous Hoi An Japanese bridge, Prof Ken Amos from Australia and Dao Tien Khoa.

Pierre arrived one day late because he had stayed in Hanoi to meet and welcome Pr Joel Weisberg, Stark Professor of Physics and Astronomy at the Natural Sciences Carleton College, USA, who was visiting Vietnam on a private tour and had expressed interest in what we were doing. He is an expert of binary pulsars, a Nobel Prize winner topic which has provided us with the most convincing, albeit indirect, evidence for the existence of gravitational waves. He offered the team three textbooks on plasma physics for astrophysics, a topic closely related to the mechanism of cosmic ray acceleration, yet a topic of which most of us, trained in nuclear or particle physics, are usually ignorant. We are deeply grateful and hope very much that he will soon come back to Vietnam, present a seminar on his research and give us a chance to treat him with the honours which he deserves.

Shortly after the Hoi An conference came the school of astrophysics (20-26 August) organized by Quynh Lan at the Hanoi University of Education under the aegis of the International Union of Astronomers (IUA). Prs Ed Guinan, from the States, John Earnshaw, from New Zealand, and Michèle Gerbaldi, from France, gave lectures on stellar astrophysics which were highly appreciated not only by us but by the whole audience which included students and high school teachers from all over Vietnam. Pierre taught an introduction to cosmology.

The organizers of the astrophysics school. From left to right: John Earnshaw, Quynh Lan, Michèle Gerbaldi and Edward Guinan.

Vietnam is not a member of IUA yet and we took the opportunity of a meeting with the Rector to plead the case for Vietnam to join. After the school, we wrote a letter to him and to the President of the Academy of Sciences asking them to take the necessary steps with their respective ministers but we did not get an answer yet. IUA has programs to support and promote astrophysics training and research in developing countries, an opportunity which Vietnam should not miss.

At the end of summer we got the good news that the World Laboratory had accepted to renew the fellowships allocated to the lab for the coming academic year. We wish not to miss this opportunity to express our deepest gratitude to the World Laboratory and to its president, Professor Nino Zichichi, for this invaluable support.

In September, Nhung, Dong and Diep were awarded a 4.2 Mdong fellowship by Odon Vallet at a ceremony held at Van Mieu, the emblematic temple of Vietnamese culture.

Fellowship award ceremony at Van Mieu with from left to right: Diep, Odon Vallet, Nhung and Dong.

In October the yearly party of the VAEC gave Thao, Diep and Dong an opportunity to show their talents as singers: they were part of a sextet which was awarded the third prize. On the same occasion Diep won the first prize of the badminton tournament (single) and also the first prize (double) while Dong won the third prize (double).

Dong and Diep applied for an Evariste Galois fellowship, the same which Nhung was awarded in April, with the French Embassy. On

this occasion we met Alexandre Minski and Laurent Grosclaude who are responsible for an interesting French initiative that has just started in Vietnam and which is bound to be successful: it consists in establishing in Hanoi and Ho Chi Minh City small islands of French universities (the name is Poles Universitaires Français) delivering French University degrees up to master level which are directly equated to Vietnamese degrees without further requirement. Lecturers are both from France and from Vietnam. We invited Alexandre and Laurent to visit the lab and to have lunch with us and they organized for us a general audience conference downtown on December 19th. Diep and Pierre shared the stage, each speaking his mother tongue with simultaneous translation in the other language. It was attended by many people, including young university and high school students. We had entitled it "Hanoi listening to cosmos" (Hanoi à l'écoute du cosmos) and this somewhat pompous title, together with a beautiful photograph of Centaurus A, made a nice poster which worked as a good advertisement.

General Giap received Pierre in the autumn and encouraged him to continue fighting for better Vietnamese universities.

Pierre has continued to argue the case for better universities and research in the country, whenever an opportunity was at hand, and the point has been taken by several newspapers that published articles and interviews of his. A summary article, translated by Diep into Vietnamese, appeared in a book collecting numerous articles on the subject which all agreed on the diagnostic even if proposing sometimes different remedies. The book is prefaced jointly by General Giap (an excerpt of his message is quoted at the head of the present Newsletter), who is very concerned about the problems of education in the country, and by the new Minister for education, Nguyen Thien Nhan. It is entitled "Current problems in education: points of view and solutions proposed" (in Vietnamese, Nhung vân dê giáo duc hiên nay; quan diêm & giai pháp). In this context Pierre had a chance to meet an adviser to the Ministers of Education and of Research and had the great honour to be received by General Giap, who is now 97 years old but has kept his mind young and clear. "It was a very moving meeting, Pierre said, General Giap was fatherly holding my hand in his and encouraging me to keep fighting, arguing that Vietnamese Universities cannot be satisfied with step by step changes but are rather in need of a real revolution".

On November 9th, when Science published the recent Auger discovery (see separate article in the present issue) establishing that ultra-high-energy cosmic rays can be unequivocally associated with AGN rich regions, we took care of transmitting, explaining and commenting the official Auger press release to the media. This owed us a few interviews and a nice photograph of the team on the first page of Tien Phong, one of the major Vietnamese newspapers.


Tiền phong

CÔNG BỐ PHÁT HIỆN ĐỘT PHÁ VỀ TIA VŨ TRỤ

Nhóm Vật lý trẻ Việt Nam là đồng tác giả

Không được để dân đói

Đến "chân tường" mới tăng giá xăng dầu

Bình Dương dẫn đầu, Hà Nội tụt hạng

Front page of Tien Phong,s November 9th 2007 issue

In early November, a school on large scale computing and the GRID was organised jointly in Hanoi by the Institute of Information Technology

(Academy of Sciences) and the French CNRS/IN2P3. On this occasion Francois Le Diberder (IN2P3) came to Hanoi at the head of a small French group including Patrick Aurenche to promote the creation of a LIA (Laboratoire International Associé). This is a good opportunity for VATLY to secure additional support in the collaboration with French teams: in particular, on a short time scale, for the students under joint supervision (cotutelle) at the occasion of their stays in France. A meeting of the IN2P3 delegation was organized with the Director and Vice-director of the Vietnam Atomic Energy Commission, which Pierre attended on the Vietnamese side. Their response was very positive and, at the same time, they expressed interest in receiving support from abroad, and in particular from France, to help with the training of future engineers and scientists in the fields of power reactors and accelerators. Indeed the country is planning to operate two power reactors of 1 GW each by 2020 and to extend this to 5 GW by 2025. On the accelerator side several projects are either planned or under construction for medicine, industry and research. Some students have already been selected and a course started in last October and will go on till end February 2008. While some experience in reactor physics exists in the country from the research reactor in Da Lat, there is virtually none in accelerator physics. A microtron, which was given to Vietnam by Dubna, has stopped operation some ten years ago. On VAEC request, Pierre will give the selected students some basic introductory lectures on machine physics.

The new Head of the Institute, Dr Le Van Hong, has reorganised the place: VATLY is now part of what is called a "centre for accelerators and electronics", an entity headed by Dang Quang Thieu. Hong has expressed his clear intention to continue support to VATLY at the same level as before. Recently Nguyen Ai Viet has stepped down from his position as Head of the Institute of Physics and has been replaced by Nguyen Dai Hung who runs a laser lab at the Academy of sciences. Both are good friends of VATLY and we take this opportunity to thank Viet for the help he always gave us and to wish Hung success and pleasure in his new function.

Prof Dang Vu Minh has been promoted from his position at the head of the Academy of Sciences and Technology to a higher position in the Government where he is in charge of scientific affairs directly under the Prime minister. The name of his successor having not yet been decided, he will keep his position ad interim for a few more months.

As usual, several friends of VATLY visited the laboratory this summer, including Pierre's grand children and Jean-Michel Rieubland and his family with whom we enjoyed a good dinner before their departure for Pierre's house in Quan Lan.

Thao defending her master thesis at the National University of Sciences

Turning now to each team member individually, we start with Thao who defended successfully her master thesis (she got a mark of 9/10) at Hanoi National University of Sciences on August 10th. Her results concerning the main properties of air showers detected by a three-tank coincidence on the roof of the laboratory have been the subject of a new article which has been submitted for publication in Communications in Physics. They concern the angular distribution, the average energy and the mean multiplicity of the detected showers. Particularly rewarding are the facts that each three-tank coincidence trigger is associated with a signal in the main tank (which is surrounded by the smaller trigger tanks) and that the optical quality of the main tank has very significantly improved. Once the paper was completed, Thao undertook the task of making the system easier to operate, the idea being that we

should take and record data continuously with each member of the team taking in turn, on a weekly basis, the responsibility of operating the detectors. At the same time the trigger and the on-line data acquisition program had to be modified in order to allow for parallel data taking between the PMT test bench of Dong and the set of water Cherenkov counters on the roof. Dong and Thao met several problems related to the age of the equipment, such as failures of the Camac crate, which caused some delays. The hardware is now back in order and Thao is now fine tuning the monitoring and data taking protocols.

Dong completed the assembly of the test bench he had designed, inspired from that he had used while at IPN/Orsay. It turned out that the surface quality of our scintillators was inadequate to take reliable data with an alpha source (Americium). Polishing would probably not have been sufficient. We therefore changed our strategy and decided to use both LEDs and an electron (Cesium) source instead. Much time was spent in repairing faulty units. The idea is to have the system operating before Dong leaves for Orsay in order to have a clear understanding of which measurements can be performed in Hanoi and which measurements cannot.

In addition Dong also assembled some electronics for the radio interferometer and, in early January, he will attend the VSOP school in Quy Nhon together with Van who will leave us after New Year. But Diep, Nhung and Thao will stay in Hanoi. Pierre will go there for a week and give lectures on cosmology.

Diep got bad news at the beginning of the summer: it turned out at the last moment that the University of Catania was not entitled to sign joint supervision agreements with Vietnam: Antonio Insolia, who was supposed to be his joined supervisor, was taken by complete surprise. A solution had to be found in a hurry to avoid Diep's PhD to be delayed by a full year and it has been Alain Cordier from LAL-Orsay who saved us by offering to take Diep in his team with Marcel Urban working on muon-electron separation in the PAO surface detector data. This is essentially the subject which Nhung is already working on, albeit with a quite different approach. It will allow Diep and Nhung to work more closely together in synergy and to exchange ideas and experiences.

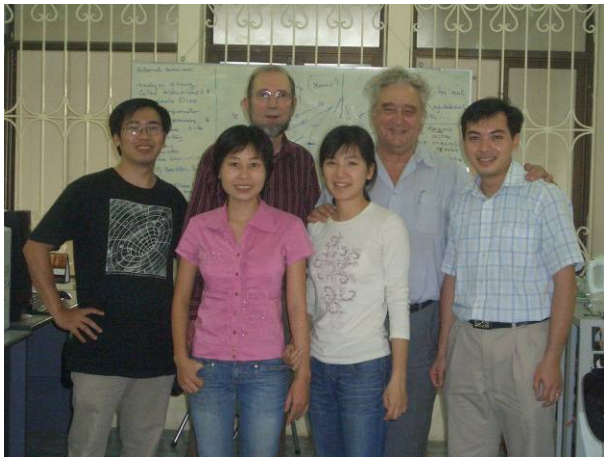
On October 26th Diep became the father of a beautiful baby named Khoi. Mother Dung and child are very well, as you can judge from the photograph below. Best wishes of happiness to the young Khoi from the whole team! Diep has progressed with his Monte Carlo study of shower development which he had undertaken some time ago, the idea being to treat secondary showers globally as fluctuating Gaisser-Hillas profiles and to obtain this way a good understanding of the parameters of relevance in the definition of the muon to electron ratio. He had been so busy with other things, however, that progress has been slower than we hoped for. He will now concentrate on this study until Têt.

Diep's son, Khoi, and wife, Dung, happily looking at each other.

Nhung has made much progress with her work on the pattern recognition of FADC traces and she summarized it in an official Auger note (GAP 2007-131). Together with some refinements of the standard method, she contributed the addition of the early time PMT asymmetry as a tool to help separating individual signals. Her results are quite clean but of little relevance, if any, to topics such as the shower energy measurement: they are however quite useful to ease the handling of problems dealing with small signals, such as the separation of muons from the

low energy photon background and even more the identification of decay electrons from stopping muons.

Early in December, Pierre Billoir paid a visit to us and we took advantage of his stay to make him work hard at teaching us new things. He easily convinced us that we should look for stopping decaying muons as an independent way to evaluate the muon to electron ratio and that we should study the divergence of the showers which is different for muons and for electrons and photons (muons coming from higher up). Such studies are now possible thanks to the huge number of events collected. Nhung is now exploring these topics using the tools which have been developed in Hanoi. At the same time she is finalizing the strategy to isolate muon peaks with a good efficiency. None of this would be possible if it were not for the outstanding quality of the optics and electronics of the Auger tanks. Hopefully, most of this work will be completed when she will go to Paris where she will have to concentrate, among other things, on comparing her results with the prediction of Monte Carlo simulations.



Group picture in the lab. In front of the two Pierre's, from left to right, Dong, Thao, Nhung and Diep.

We made Pierre work so hard that little time was left for pleasure; he barely could find the time to go shopping in the old town. Yet we managed to have some good moments together, including a lunch at Diep's place and a few restaurant dinners.

Finally a young student in her fourth year at the University of Education was introduced to us: she will join the team after Têt for her graduation thesis. We intend to have her work on a toy Monte Carlo of diffusive shock acceleration and to collect from the web, and of course digest, information on colliding galaxies. Her name is Le Thi Huong.

SPACE TECHNOLOGY INSTITUTE

At the occasion of the summer school on astrophysics, we learned of the existence of an institute implied in space research. In fact, it turned out to be the Space Technology Institute (STI) which has been in operation for one year. Nhung, Thao and Diep visited it on January 4th, 2008 and interviewed its Deputy Director, Dr Doan Minh Chung (DMC), asking him about the mission and achievements of his institute.

VATLY: Doctor Chung, could you please tell us about the Institute?

DMC: STI was established on November 20th, 2006 by a decision of the Prime Minister. It is a national research institute dedicated to space technology and is under the Vietnamese Academy of Science and Technology (VAST). Its mission is to perform basic research on space science and technology, to do R&D on satellites, to plan and carry out projects of the national program in the field of space technology applications. In a word, it is the national laboratory for space technology. It includes five departments: R&D on satellite technology; R&D on instrumentation; remote sensing technology, GIS and GPS; remote sensing applications; aerospace dynamics and precision mechatronics. The research staff is planned to increase from 52 today to some 100 to 150 in 2010.

VATLY: Could you tell us more about the staff, how it is recruited and trained?

DMC: The staff includes some ten PhDs and the younger contingent amounts to about two thirds of the total. They are all strongly motivated by space science and technology. They need to be conversant with several fields of material science, mathematics and informatics technology, precision mechatronics, telecommunication and related electronics, geography, etc. Nowhere in

Vietnam can they be trained on all these simultaneously: we recruit students graduated from universities and train them in the Institute. We are opening to recruit students from abroad as long as they show interest and have the necessary competence. We have cooperation agreements with foreign countries where we send some of our staff to be trained, either young students or more senior staff who attend short courses and can teach on return those who stayed at home. Several Viet Kieus are willing to help us with this training. In addition, the Institute and the National University of Technology, Hanoi are setting up a joint program aimed at training engineers in space technology.

VATLY: You mentioned "on job" training at the Institute, could you tell us more about it?

DMC: The Vietnam Academy of Science and Technology is responsible for a project to design and develop a small satellite in which STI is taking part. This small satellite, called VNREDSAT (VietNam Resource Environment Disaster SATellite) will be used to observe ground for the management of natural resources, environment and natural disasters in Vietnam. Concretely, we are collaborating with some foreign space agencies for establishment of the VINAREDSAT project. Through the cooperation for small satellite development, the agencies provide "on job" training for our younger staff.

VATLY: What are you busy with while waiting for VNREDSAT?

DMC: We maintain contact with countries such as the United States, Japan, Korea and Russia where many institutions are willing to help us with the basic training of our students. While some of this training is free, it also happens that training in specialized domains of space technology better suited to our needs must be paid for. Our current efforts concentrate on giving our staff the best possible training for their competence to reach the necessary excellence when it comes to do the real work.

VATLY: Which are the main purposes of manufacturing VNREDSAT?

DMC: There are two main purposes: one is technology transfer, learning concretely how to master the satellite making technology; another is exploitation, learning how to apply space technology to the monitoring of natural resources and to environment management. Many of our staff were previously working on, and are experienced in, remote sensing technology. But we could only analyze images which we had to buy from abroad. With VNREDSAT we shall have our own images. The resolution may be limited but the field of view will be broad and a large quantity of information would be treated in a short time.

Dr Doan Minh Chung interviewed by Diep (seen here), Nhung and Thao at the Space Technology Institute

VATLY: A first satellite (VINASAT) will be launched in March 2008 for the Ministry of Information and Telecommunication of Vietnam. Do you take part in this project?

DMC: No, we don't. VINASAT will be used exclusively for telecommunication while VNREDSAT will be used exclusively for Earth observation: floods, forest fires, natural resources, meteorology, natural disasters, ground surveys.

VATLY: We heard that waiting for VNREDSAT, STI was involved in the making of another satellite, called the Pico Satellite. Can you tell us about it?

DMC: This is a project at the scale of VAST. It is currently ongoing and will be completed by next year. It is a very small satellite, weighing about 1

kg, but operated on the same principle as a normal satellite, and used for training. It is meant to make us familiar with satellites and to gain experience in preparation for the future. The most important for us is to be able to get practical experience.

VATLY: Does the Institute have some research activities ?

DMC: We have a long experience in the manufacturing of the Earth receiving stations. We have assembled small satellite modules, designed a small onboard computer, performed tests of communication between the Earth receiving station and satellites. In the future, our STI will move to the Hoa Lac high-tech park in the Hanoi suburban area, and our laboratories will have modern equipments allowing to reproduce the conditions in space. We will then be able to test in real space conditions the instrumentation which we developed. Our main interests are the processing of satellite images in association with other information, such as GIS and GPS, in order to measure or identify the soil moisture, the vegetation water content, the soil surface structure, the impact of the vegetation on the underlying soil radiation, etc.

VATLY: After one year of operation, what has STI achieved and what do you hope for the future?

DMC: In just one year of operation, STI has completed its organization with five research departments operated in two main directions: design and manufacture of small satellites and applications of remote sensing technology. We have trained some more master students in these domains and have sent some others abroad to attend training courses. We are active in taking initiatives aimed at broadening international cooperation with JAXA, ESA and many companies from Europe, Japan, Korea, Malaysia as well as with American universities. We organized some international conferences on space technology in Vietnam. In the coming years we will play an important role in the establishment of a Space Technology R&D area in Hoa Lac, with the support of the Government, Ministry of Planning and Investment, Ministry of Finance, Ministry of Science and Technology, VAST and others.
Launching small satellites will be our first task and we hope that in the near future we shall be able to master this field in Vietnam and contribute in this way to the development of our country.

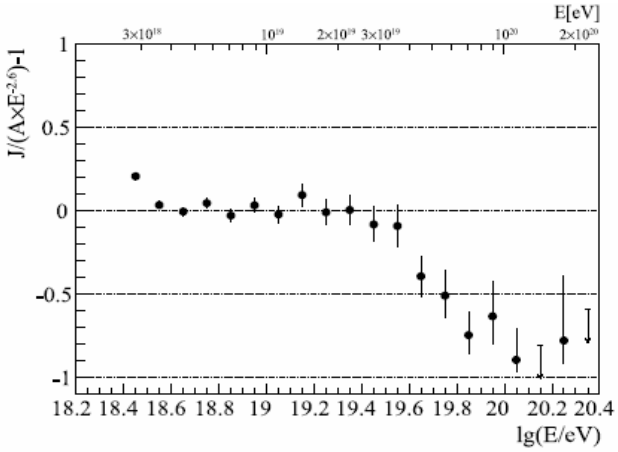
VATLY: Thank you very much Dr Chung for the time you gave us.

IMPORTANT RESULTS FROM THE PIERRE AUGER COLLABORATION

Two important results have recently been published [1] by the Pierre Auger Collaboration. While this Newsletter is not the place where to present such results, they are of such an importance that we thought it appropriate to say a few words about their impact and to introduce them briefly to the non-expert. They address two of the main motivations beyond the construction of the Pierre Auger Observatory (PAO): the interaction of ultra-high energy cosmic rays (UHECR) with the cosmic microwave background (CMB) and the identification of the sites where UHECR are accelerated.

The interaction of UHECR with the CMB is the interaction of photons with protons or nuclei. Above a threshold at UHECR scale (say $\sim 10^{20}$ eV), called the GZK threshold from the names of the physicists who were first to mention the effect [2], inelastic reactions can take place such as photoproduction of pions or of N* resonances. In intergalactic regions this implies an interaction length at the 10 Mpc scale: UHECR having energies above the GZK threshold and coming from more than, say, 100 Mpc from us, will interact with the CMB before having a chance to reach us and will accordingly loose energy. As a result we expect the energy dependence of the UHECR flux to be significantly damped above the GZK threshold. For the first time, the statistics collected by the PAO allow for a clear observation of the predicted effect (see figure). To the extent that there were suggestions, before the PAO results, that the GZK threshold might be violated, this is a very important result.

The identification of the sites where UHECR are produced is an even more important issue. Obvious considerations [3] on the necessary



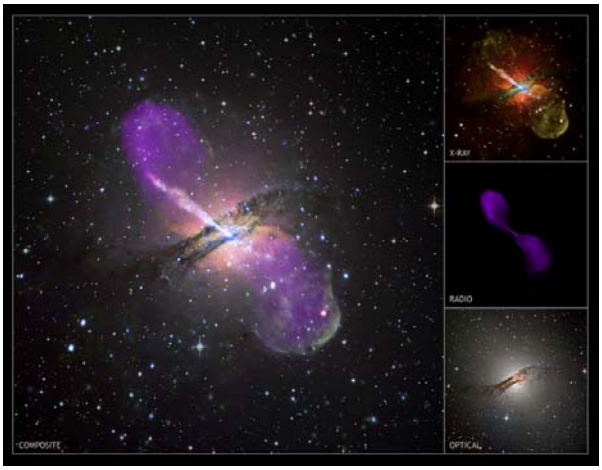
Ratio of the measured energy dependence of the UHECR flux to a power law of index –2.6

confinement of cosmic rays during acceleration in regions where there exist magnetic fields allow to place a lower limit at the scale of a few $\mu G \times kpc$ on the product *field×size* of possible UHECR sources. Essentially, the only celestial objects known today to approach such sizes are active galactic nuclei (AGN) made of a very massive black hole (billions of solar masses) in the centre of a galaxy. Depending on their orientation and mass, such AGNs may appear under different forms – quasars, radio sources such as Seyfert galaxies, blazars, BL Lac, etc... A general feature is a very bright accretion disk with two jets on its axis and a large dust torus all around. It was not clear, a priori, that the PAO would be able to point to the sources of the UHECRs that it detects. Not because of the experimental pointing precision – which is excellent, at the degree level – but because of the uncertainties on the magnetic fields that UHECRs have to traverse on their journey to Earth, in particular those associated with the Milky Way (the magnetic fields that are closer to the Earth are the more harmful). An essential test of the ability of the PAO to understand the origin of UHECRs was therefore to see whether those detected do point toward known celestial objects or do not. It is important at this stage to be aware of the strong anisotropy of our galactic environment at the few 10 Mpc scale: most galaxies around us are in fact confined to a plane, the supergalactic plane, and more generally the Universe is known, on that scale, to include gigantic voids. The planes are called walls and the regions where they meet are very rich in large and dense galaxy clusters. Essentially, the study presented by the Pierre Auger Collaboration is a search for correlations between the places in the sky to which the detected UHECRs are pointing and known celestial objects. Qualitatively, the results may be summarized in three statements: 1) The detected UHECRs are anisotropic and display a clear correlation with our galactic environment (in particular with the supergalactic plane); 2) An even better match is obtained when restricting our galactic environment to known AGNs; 3) Strong correlations require very high energies (in agreement with the expected energy dependence of the effect of magnetic fields on the pointing accuracy) and not too large distances (in agreement with the GZK argument).

The importance of this result is clear: the ability of the PAO to do cosmic ray astronomy has been demonstrated. It is the first time that a probe other than photons has been proven to be usable in astronomy (neutrinos are another potential candidate for the future). In this sense the PAO can be said to have opened a new chapter of astrophysics.

These results guarantee a long and rich future for the PAO. One will now have to understand, with increased statistics, why such an object – galaxy, AGN, or else – is a source and why such another is not. This will obviously shed much light on the details of the acceleration mechanism and hopefully will clarify it completely. It will also contribute to a better understanding of the nature of the sources. Moreover a new tool is now available to probe magnetic fields at galactic and intergalactic distances.

A few more lines, just for the pleasure of contemplating fascinating recent astrophysical observations. Among the sources identified in this early PAO exploration one finds the region of Centaurus A, a picture of which is shown in the figure below. It is believed to be the result of the interaction between two galaxies, a large elliptical one and a smaller spiral. Recently several interacting galaxies (one speaks of galaxy collisions but the name is somewhat misleading) have been identified and studied. They are the seat of very violent events. They suggest that many of the present galaxies have in fact been formed by the earlier merging of smaller galaxies at a time when the Universe was denser than it is today.



A combined view [5] of X-ray, optical and radio images of Centaurus A, the closest AGN, 11 Mly away. Both radio and X-ray telescopes trace a jet of high-energy particles streaming from the galaxy's core over 13 kly. The central black hole is 200 million solar masses.

The interested reader may find beautiful pictures of such colliding galaxies in many internet sites [4].

[1] J. Abraham et al., Pierre Auger Collaboration, Science 318, 939 (2007).
M. Roth (for the Auger Collaboration), presented at the ICRC30, 2007, arxiv.org/abs/0706.2096v1
[2] K. Greisen, Phys. Rev. Lett. 16, 748 (1966).
G.T. Zatsepin and V.A. Kuz'min, JETP Lett. 4, 78 (1966).
[3] A. M. Hillas, Ann. Rev. Astron. Astrophys. 22 (1984) 425.
[4] A good start is http://rst.gsfc.nasa.gov/Sect20/A4.html.
See also http://csep10.phys.utk.edu/astr162/lect/galaxies/colliding.html
[5] Credit: X-ray, Chandra, NASA, CXC, R. Kraft (CfA) et al.; Radio, VLA, M Hardcastle (U Hertfordshire) et al.; Optical, ESO, M. Rejkuba (Garching) et al.

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http://www.inst.gov.vn/inst/English/About/VATLY/Vatly.htm

- PHOTO ALBUM -

A group of Vietnamese BCSPIN students on Tien An Men. Nhung and Diep are flying in the back.

Diep and his two-month son

From left to right: Diep, Nhung, Natalia (a friend from Cuba) and Dong at Van Mieu

Students and lecturers at the Hanoi astrophysics summer school

Two young and charming smiles at the astrophysics summer school: a student and Michèle Gerbaldi

John Earnshow surrounded by students of the astrophysics summer school. The second on the left is The who made her graduation thesis with us.

Thao and friends after her master thesis. From left to right: Giang, Thao, Hang and Thuy

After Thao's master thesis with her referees. From left to right: Nguyen Trung Tinh, Truong Bien, Vo Van Thuan, Thao, Nguyen Mau Chung and Pierre

Dinner at ISPUN07 (Diep is third from left) with Japanese and Chinese participants (on the right)

Ed Guinan with two students at the astrophysics summer school, Thao on the right

On the roof of the laboratory: the large Auger tank on the right and two of the three trigger tanks (the third one is hidden behind the hut)

At the occasion of the Hoi An conference Pierre had the honour to meet Ms Nguyen Thi Binh, former Vice-Prime Minister, with whom he shared views on higher education in Vietnam

ISPUN07: Diep is through with his talk, one minute and 20 seconds are left for questions...

ISPUN07: Khoa is standing in the front and his student Cuong, who just finished his talk, in the back.

Pierre Billoir in front of a shop of the Hanoi Old Town

Pierre Billoir at Diep's place with Nhung on his right and Dong, Diep and Khoi on his left

Pierre Billoir shopping in Hanoi's Old Town, together with Nhung

After Thao's master thesis, Thao and Pierre