

## VATLY NEWSLETTER

### VATLY IN A NUTSHELL

VATLY is the name of a cosmic ray laboratory located in Hanoi (Vietnam) in the premises of the Institute for Nuclear Science and Technology (INST), an institute of the Vietnam Atomic Energy Commission (VAEC) headed by Dr Vo Van Thuan.

VATLY means “physics” in vietnamese but stands also for “Vietnam Auger Training LaboratorY”, an acronym that summarizes its main features.

*Vietnam* underlines our determination to play a role – however modest it may be – in the development of fundamental research in the country and in the national effort to fight the heavy brain drain that Vietnam is suffering.

*Auger*, for the Pierre Auger Observatory that studies cosmic rays at extreme energies and of which a first site is currently under construction in Argentina, defines the frame in which, and the aim toward which, we are working. Presently observers in the Auger Collaboration, we hope to gain sufficient knowledge and expertise to become full members in a not too distant future.

*Training* is the main purpose of VATLY, training through research of young physicists from undergraduate to postdoc levels, requiring the establishment of close relations with the vietnamese universities and physics institutes.

And finally *Laboratory* describes precisely what we are trying to build, with what this implies in terms of scientific environment, facilities and instrumentation.

### WHY THIS NEWSLETTER?

Our motivation in writing such a Newsletter is to provide our friends with some information on our progress. We owe our continued existence to the interest and support of those who are helping us today, or have been helping us in the past, in financial, moral or other forms, whether as private persons or as representing an institution. We felt it was only fair to keep them informed of how we are doing and we thought that such a Newsletter might be a way to express our gratitude to them.

Our intention is to issue it quarterly.

Your comments and advice will be highly welcome.

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*The photograph was taken this summer on the roof of the laboratory when the shed was lifted up on a crane to remove the telescope. The telescope and a part of the Auger Cherenkov tank (on the left) are visible. From left to right: **Dinh** (Standing), **Diep, Pierre, Thao, Nhung**, and **Thieu**. The photograph was taken by **Duong**.*

### MEASUREMENTS OF THE COSMIC MUON FLUX IN HANOI

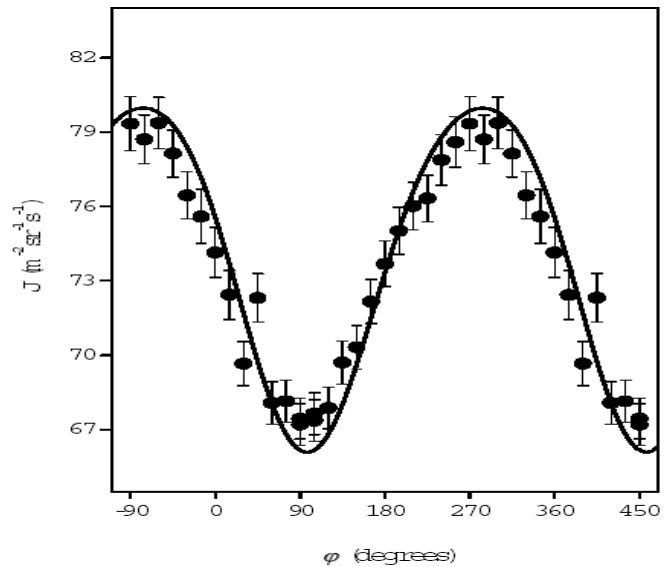
Hanoi is located on the geomagnetic equator at a place where the rigidity cut-off is maximum (17 GV compared to 14 GV at the geomagnetic antipode and typically 4 GV in most western laboratories, whether in Europe or in the United States). This makes it an interesting place

where to measure the cosmic muon flux. As the mean muon momentum is 4.8 GeV/c, well above its value in most western laboratories, such data are of special interest to those who elaborate detailed simulations of the development of cosmic showers in the earth atmosphere. This is the case of *M. Honda*, from Tokyo University, who has developed such a model in relation with the analysis of the atmospheric neutrino data of the SuperKamiokande Collaboration, and who has kindly provided us with files of the muon flux in Hanoi as predicted by his model.

Three successive measurements have been performed, the results of which have been reported<sup>1</sup> in Nuclear Physics B. The first measurement was of the vertical muon flux and used a fixed scintillator hodoscope. The second and third measurements were of the zenith angle and azimuthal distributions respectively and used an orientable scintillator telescope (see photograph) that was entirely built by us using very primitive material and methods... but that nevertheless made it possible to maintain systematic uncertainties at the percent level typically. In all cases electrons and hadrons were found to account for less than 10% of the total charged particle flux and were easily rejected using standard methods (absorbers and radiators). All measurements were in quite good agreement with the predictions of the Honda model, however revealing some small but significant differences such as in the amplitude of the azimuthal oscillation (the observed amplitude being slightly smaller than the predicted amplitude, see figure). Two versions of the Honda model, one- and three-dimensional respectively, have been compared with our data that slightly favour the one-dimensional version (although the three-dimensional version is supposed to be more accurate).

The data have also been used by *Diep* and *Nhung* who made their diplom work (end of the university fourth year) on the dependence of the muon flux on atmospheric pressure and ground temperature. Their analysis reveals a small dependence on atmospheric pressure (at the level of a permil per millibar) consistent with what can be expected from the associated variation of the atmospheric density. The dependence on ground

temperature is essentially accounted for by the correlation that is seen to relate this quantity to the atmospheric pressure in Hanoi. These results have been submitted for publication in Communication in Physics (Vietnam).



*Azimuthal distribution of muon flux at zenith angle  $\theta = 50^\circ$ .*

Taking advantage of the strong east-west asymmetry, *Duong* has studied the design and performance of a simple, but accurate and reliable asymmetry monitor that uses three fixed scintillator pairs. Having made essential contributions to all steps of that small experiment, design, assembly, running-in, data taking, acceptance calculation and data analysis, he made it the subject of his master thesis that he has just been successfully defending in his home university at Ho Chi Minh City.

The telescope has now been dismantled (see photograph) and the scintillators have been rearranged to study the response to muons of our Auger Cherenkov counter. The shed on the roof of the laboratory is now housing a small water Cherenkov counter that will be used to measure the coincidence rate with the larger Auger counter. Progress on both measurements will be reported in later issues.

### ASTRONOMY AND ASTROPHYSICS IN VIETNAM

Four members (*NTT*, *NHD*, *PND* and *PTTN*) of VATLY interviewed professor *Phan Van Dong*, the dean of the astrophysics department of Hanoi University of Education, the general secretary of Astronomical Society of Vietnam, and

<sup>1</sup> P.N. Dinh *et al.*, Nucl. Phys. B627 (2002) 23.  
 P.N. Dinh *et al.*, Nucl. Phys. B661 (2003) 3.  
 P.N. Diep *et al.*, accepted for publication in Nucl. Phys. B.

asked him about what exists in Vietnam as far as astronomy and astrophysics are concerned.

**VATLY:** Professor, could you tell us about the astrophysics researchers and lecturers in our country?

**Prof Dong:** I have to tell the truth that the staff of astrophysics researchers and lecturers is very thin. All together, there are a few people trained regularly in astrophysics in Russia and Poland. Nowadays, only one person who was trained regularly in astrophysics at the Moscow University is *Nguyen Dinh Huan*, the principal of Vinh University, a member of the International Astronomical Union. Some others are now retired or moved to other fields. Almost all astrophysics lecturers are physics lecturers who moved to astrophysics. They study by themselves and learn by themselves.

**VATLY:** Professor, which equipment do you have in Vietnam?

**Prof Dong:** From 1994, the International Astronomical Union, in the framework of the TAD program, supported the Astronomical Society of Vietnam with some documents and equipment for training and popularising astrophysics. Therefore, Hanoi University of Education, Vinh University of Education and Ho Chi Minh University of Education are equipped with some small astronomical telescopes. In 1996, the Japanese Government sponsored Vietnam to construct a Planetarium in *Vinh*. In 1995, on the occasion of observing the solar eclipse in *Phan Thiet*, the astronomers of Paris University and Tokyo Observatory offered some small telescopes for observing the sun. Especially, professor *Y. Kozai* offered Hanoi University of Education one telescope LX-200 with a diameter of 40 cm together with a CCD camera and image processing software. In 2001, Gunma Observatory offered Ho Chi Minh University of Education some smaller telescopes, CX-200 with a diameter of 20 cm, with attached digital cameras, enabling the transfer of the data into a computer. With our current equipment, we essentially do training and popularisation of the knowledge of astronomy but we have not been able to deeply do research yet.

**VATLY:** Professor, how good are the international relations of the Astronomical Society of Vietnam?

**Prof Dong:** We have relations with the International Astronomical Union, in particular with astronomers in France, Japan and Australia. The Hanoi University of Education and the Ho Chi Minh University of Education have close contacts with Gunma Observatory (Tokyo, Japan), this way we receive some special documents and financial support for training young astronomers of Vietnam in Japan. Gunma Observatory also delegated some experts to help us assemble and adjust the observing equipment. From 1993, the National Astronomical Union has given support to the Astronomical Society of Vietnam to send young astronomers to take part in ISYA (International School for Young Astronomers) held in some developing countries.

**VATLY:** Professor, which training is given in astronomy and astrophysics in Vietnam?

**Prof Dong:** Every year in my university, all physics students, about 150 students, learn general astrophysics. Then about 20 students continue to learn astrophysics (stellar physics, solar physics) as special subjects. Since, as I said before, the staff of astrophysics researchers and lecturers is very thin, the Ministry of Education has not given us permission to teach for master degree. If graduate students want to study more about astrophysics, they have to go abroad but the knowledge that they gained from the university is not enough to study, they have to start from the beginning again. Recently, there were three graduate students studying in France. Two of them successfully defended their doctor thesis and the other his master thesis, also successfully.

**VATLY:** Professor, astronomy and astrophysics in Vietnam are facing many difficulties, what are the main difficulties nowadays?

**Prof Dong:** According to me, the main difficulty for Vietnam's astronomy is the manpower problem. We lack people to really do research. Moreover, nearly all leading experts are retired or reach retirement age. We also have many difficulties with material facilities. Currently, we don't have any center really doing astronomy research, we have to work in universities or institutes where research in theoretical physics is supported (particle physics, neutrinos and dark matter...). These centers do not dare to accept more people. Graduate students usually have to move to

other fields. Some lucky students, who could be kept in the university, also meet many difficulties. They have to give private lessons or do some other jobs to earn their living. Therefore, it distracts their attention. Of course, we have a lot of valuable aid from foreign countries. But, apart from moral support, documentary and equipment, they can not do more. The reason is that we don't have any real astronomy research center where we could invite foreign astronomers. I can say "They help us because of feeling compassion not because of believing that we are able to do some thing".

**VATLY:** Professor, a final question for you, what is the direction and prospect of astronomy and astrophysics in Vietnam?

**Prof Dong:** In the future, with some major effort of our own and taking advantage of the help of foreign countries, we shall try to construct telescopes that are able to take photographs of the moon and of the planets of the solar system. So we can use these photographs in our lectures. We also should try to build up a team of tutors teaching the students how to take photographs, to train a group of amateur astronomers and to build a virtual observatory so we could send our requests to big observatories all over the world by network connection. Together with some observatories in the world, we could take photographs of some phenomena whose happening can be predicted. Such photographs provide major information about these phenomena. We can use small telescopes to take photographs of standard stars, of variable stars and from this collect information on the nature of the interstellar medium. And also we could measure the period of variable stars. About the prospect, we, the lecturers of Hanoi University of Education in particular and the Astronomical Society of Vietnam in general, are trying to transmit and popularize the knowledge of astronomy and to give younger generation sufficient knowledge and understanding of the situation, of where we stand today and of where we are heading towards. In the future, when graduate students will come back to Vietnam, I hope that the manpower problem will have been solved.

**VATLY:** Professor, thank you for this very interesting interview. We hope you will find the time to visit us at VATLY.

## **LIFE OF THE LABORATORY**

*Thieu*, for now two years, has taken the load of heading the VATLY group. Trained as a nuclear physicist he specialized in nuclear electronics. He is currently working on his PhD thesis about the muon flux in Hanoi, for which he has been awarded for three years a Rencontres du Vietnam fellowship.

*Duong* joined VATLY from Ho Chi Minh City University in January 2003 and made his master thesis on the east-west asymmetry. In November he went back home to defend his thesis and has now been awarded the degree of master of science.

*Dinh* has been working in VATLY from the very first days and has specialized in computing. After a stay of three months in Malargue he returned to Hanoi and installed the software that makes it possible for us to acquire and analyse Auger events. He is our linkman with the IN2P3 centre in Lyon. He created and maintains the VATLY website.

*Phuong*, a nuclear electronician that had joined VATLY from the beginning and went to Malargue with *Dinh* has now left to work in a private computer company.

*Diep* and *Nhung* completed their fourth year in Hanoi national university in academic year 2002-2003 and joined VATLY for their diplom work, for which they were awarded *Odon Vallet* fellowships. They are now working toward their master degree. One thesis will be on the response of the Auger Cherenkov counter to muons, the other on the time structure of the shower front in Auger events, but both will work on both subjects.

*Thao* studied theoretical physics in the Hanoi national university and completed her fourth year in academic year 2001-2002. She joined VATLY in November 2002 with the motivation of being trained in experimental physics and has been making contributions in various area.

*Alan Watson* visited us for three days in July 2003 and gave a colloquium downtown. His visit was an important event for us as it coincided with a phase transition in the life of the laboratory: from a period dominated by the measurement of the cosmic muon flux in Hanoi to a new era dominated by our growing implication in Auger. It gave us an opportunity to learn from him about the

analysis of Auger events and discuss with him how we might most efficiently acquire some expertise and start making some small contributions. He also helped us with documentation of various kinds that has proven to be extremely helpful.

Among other recent prestigious visitors to the laboratory we may mention Professor Ryoji Noyori, President of the RIKEN Laboratory, in October 2003, Professor *K. Igi* from Tokyo university, Professor *Toshikazu Ebisuzaki* from RIKEN, Professor *G. Ripka* from Saclay.

A major event occurred in the life of the laboratory in November 2003 when we received a subvention from CNRS-IN2P3, via *Rencontres du Vietnam*, that will help us support research in VATLY for nearly two more years.

Various lectures have been organized in the Institute in 2003 for academic training: Elementary particles and their interactions (*Pierre Darriulat*), Neutron Physics (*Vo Van Thuan*), Nuclear structure (*Dao Tien Khoa*), Fifth VAEC-JAERI training course on radiation measurement (*H. Matsuzuru* and team). Moreover we organize lectures inside the group including introductory lectures following *Alan Watson's* lectures (*PD*) and lectures on

astrophysics, each of us reporting in turn on a specific subject.

In November 2003, *Thuan* presented VATLY and its future needs to the bilateral Vietnam-USA science development programme in the hope to obtain some support.

The whole group will attend the tenth Vietnam School of Physics (VSOP10) that will take place in Hue from 29<sup>th</sup> December 2003 to 9<sup>th</sup> January 2004.

## **IN FUTURE ISSUES**

*VSOP10 School in Hue.*

*The response to muons of the Auger Cherenkov counter.*

*The front shell of Auger showers.*

*Coincidence rate between two nearby Cherenkov counters.*

*INST, its main activities (VV Thuan).*

*Particle physics in Vietnam.*

*A stay in Malargue (PN Dinh).*

*The INST Computing Centre.*

*Student's Club of Astronomy.*

***Distribution:*** *Patrick Aurenche, Jean Pierre Bibring, Murat Boratav, Georges Charpak, Jim W. Cronin, Toshikazu Ebisuzaki, Minh Ha Pham-Delègue, Luigi Di Lella, Phan Van Dong, John Ellis, Alberto Etchegoyen, Bernard Frois, Marcelo Gilardoni, Jacques Haïssinski, Nguyen Van Hieu, Morihiro Honda, Pham Quoc Hung, Stavros Katsanevas, Marc Lachièze-Rey, Luciano Maiani, Livio Mapelli, Akira Masaïke, Peter Mazur, Jap Panman, Eliane Perret, Bruno Paing, Philippe Quentin, Jean-Michel Rieubland, Dieter Schlatter, Peter Schlein, Michel Spiro, Jack Steinberger, Christine Sutton, Dick Taylor, Samuel C.C. Ting, Isao Tanihata, Odon Vallet, Jean Tran Thanh Van, Jean-Pierre Vanuxem, Sylvie Vauclair, Alan Watson, Atsushi Yoshida.*