

Rencontres Du Vietnam Vietnam School on Neutrino (VSoN) 2018

KEK 素粒子原子核研究所

Son Cao

cvson@post.kek.jp

京都大学理学研究科

小田川 高大

odagawa.takahiro.57w@st.kyoto-u.ac.jp

横浜国立大学工学研究院

Pintaudi Giorgio

giorgio-pintaudi-kx@ynu.jp

2018年9月24日

1 Introduction

Vietnam school on Neutrino, organized by Rencontres Du Vietnam and Neutrino Group, Institute For Interdisciplinary Research in Science and Education (IFIRSE) and Japanese professors, was held at the International Center for Interdisciplinary Science and Education (ICISE) [1], Quy Nhon, Binh Dinh, VN from July 8th–20th 2018. Purpose of the school is to train and attract generations of students and young physicists to the neutrino physics, especially the neutrino experiments. The school is expected to support the development of neutrino physics in Vietnam. The school webpage can be found at [2].

Special theme for the school is neutrino, which was proposed by Pauli in 1930, but has kept physicists astonished since then and continue to be one of main streams for exploring the physics beyond the description of the Standard Model of elementary particles. In 2017, a group for neutrino physics was newly launched at the ICISE center under a Memorandum of Understanding [3] signed by four Japanese professors (Prof. Tsuyoshi Nakaya

(Kyoto University), Prof. Yuichi Oyama (IPNS, KEK), Prof. Makoto Miura (ICRR, The University of Tokyo), and Prof. Atsumu Suzuki (Kobe University)) and the Rencontres du Vietnam, in order to carry out the neutrino research in the international collaborations in Vietnam. For development of the group, one of the most important things is to locally build human resource and the Vietnam school on Neutrino started for this purpose in 2017. 19 students participated in total, including 10 Vietnamese, 6 Japanese, 1 Indian, 1 Singaporean and 1 Indonesian in this year. They were



Figure 1: Vietnam School on Neutrino, a group photo.



Figure 2: Training session for software (top) and hardware (bottom).

educated and trained under supervision by 12 lecturers. Five students were female. The most of students had already received B.Sc in Physics. The school principal was Prof. Yuichi Oyama.

2 School program

The program contained a set of introductory lectures covering backgrounds of the elementary particle physics and the neutrino phenomenology. Other lectures introduced neutrino experiments and methods to detect neutrinos. Tools and methods of data analyses used in the neutrino experiments were also introduced. Finally, some selective topics were introduced to students by special guests from the participants of the international conference which has being held at the same time as the school. Hardware and software training sessions were also included for more practical approach. To encourage the students to learn actively, exercise and final presentation on given topics were included. For these activities, the students were divided into four groups for better connection and exchange.

2.1 Lectures

The school started with an introductory lecture on the neutrino physics for the first 50 years (1930-1980) given by Prof. Yuichi Oyama in order to give a broad picture of the history of the neutrino physics. An introduction to Standard Model of the elementary particles, including the zero-mass of neutrino predicted by this model, was given by Prof. Nguyen Anh Ky (IOP). One of the main topics of this school, the neutrino oscillation, which indicates that the neutrinos have mass and mixing as the lab-based evidence beyond the description of the Standard Model, was delivered by Prof. Boris Kayser (Fermilab). To be prepared for the lectures of the neutrino experiments, an introduction to main concepts in the neutrino experimental physics was delivered by Dr. Son Cao (IPNS, KEK). Prof. Yuichi Oyama introduced neutrino experiments from Kamioka to T2K, one of the most seamless and successful neutrino programs in the world. Prof. Karol Lang (The University of Texas at Austin) gave a lecture on “Radiation and Particle Detectors” to help the students understand what happens with a particle passing through the detector and how we can detect and identify neutrino events in the detector. Future neutrino experiments including Hyper-Kamiokande, DUNE, JUNO, etc., were introduced by Prof. Atsumu Suzuki. Selective neutrino topics were introduced by special guests: “Solar neutrino experiments” by Dr. Guillaume Pronost (ICRR, The University of Tokyo); “Ultra-high energy neutrinos” by Prof. Phuoc Ha (Towson University); and “Short baseline neutrino experiments” by Prof. Rachel Carr (MIT).

2.2 Hardware and software training sessions

A hardware training on a concept for neutrino detector was delivered by Dr. Nguyen Minh Truong (Da Nang University of Technology). The setup for the training included plastic scintillators, wavelength shifting fibers and silicon photodetectors named Multi-Pixel Photon Counters (MPPCs). For the first section of the training session, the students learned how to measure MPPC properties such as breakdown voltage, dark noise, cross talk, etc. For the second section of training, students were guided to measure the cosmic muon rate.

We had two software trainings sessions: one with Super-Kamiokande software for classifying muon-like Cherenkov ring and e-like ring and one with a neutrino event generator. The former was supervised by Prof. Makoto Miura. To support the students for this training, an overview lecture on Super-Kamioka, for its detector and software, was given. The students connected to a computing machine of Super-Kamiokande to scan the simulated neutrino events by eyes and compare them to the truth. The latter part of the software training session was for a neutrino event generator, called NEUT, guided by Prof. Nguyen Thi Hong Van (IOP & IFIRSE). The special and unique role of the neutrino event generator was introduced and the students accessed to a computing machine at IOP to generate neutrino events with a given flux and an interaction model. They practiced an analysis with the MC sample at the end of the session.

2.3 Exercise and final presentation

Different topics were assigned to four groups at the very beginning of the school. The students worked on these topics during the school under supervision by the lecturers. On the last day of the school, all groups presented their results. A special award from Prof. Takaaki Kajita (ICRR, The University of Tokyo), 2015 Nobel Laureate in Physics, was given to a student group with the most outstanding presentation.



Figure 3: Life & culture experience for students.

2.4 Auditing an international neutrino conference

In the second week of the school, the students were allowed to audit the International Symposium on Neutrino Frontiers held at the ICISE center from July 16th–19th 2018. The symposium, chaired by Prof. Tsuyoshi Nakaya, covered the current landscape and vision of the future development of the neutrino physics, with the fundamental impacts in particle physics, astrophysics, cosmology and nuclear physics. This was a good chance for the students to have a broad view on the neutrino physics, exchange ideas and get advices for their career path.

3 Life experience in Vietnam

Vietnam has a long history and unique culture. As many places in Vietnam, Quy Nhon is in a great pace of development and modernization. Dynamics, energetics, and spirit for self-improvement are burning in blood of the young generation of Vietnam and it is not difficult for foreign students to realize this. It may be good for students from other countries to have experiences in such environment.

4 Future prospects & Acknowledgement

We plan to continue this school series for the next couple of years to enhance the contents.

We thank Rencontres Du Vietnam for the foundation. We also thank KEK, Japan for donating the equipment for the hardware training session and Japanese neutrino physicists for the continuous supports.

5 Report from participants #1 (小田川)

5.1 はじめに

7月8日から20日まで Vietnam School on Neutrinos (VSoN) に参加した。これはベトナムの Qui Nhon 市内にある International Center for Interdisciplinary Science and Education (ICISE) で行われる学校で、ベトナムを中心としたアジア各国からニュートリノ物理に関心を持つ学生が集まる。この活動に参加した感想を報告する。

5.2 活動について

講義

学校ではニュートリノに関する講義が行われた。講義は「標準模型」のような理論に関するものから「ニュートリノ実験の基礎」や「検出器」といった実験に関するものまで多岐にわたった。特に実験の講義は様々な実験の具体的な内容にまで踏み込んだものが多く、これからニュートリノ実験の世界に踏みこむ自分にとっては、分野全体を広く深く理解する上で役立った。

学校の後半では同じく ICISE で開催された International Symposium on Neutrino Frontiers に参加する機会もあった。現在進められている研究についての発表は講義の内容についての理解を確認し発展させるよい機会であった。

実習講義

学校では software および hardware に関する実習も行われた。学生は4つの班に分かれ各班で協力して実習にあたった。

まず、software training は二日に分けて行われ、1日目は NEUT を用いて CCQE のシミュレーションを行った。2日目にはスーパーカミオカンデのデータを用いて電子ニュートリノとミューオンニュートリノの信号識別を行った。

次に、hardware training では NIM モジュールと MPPC を用いて crosstalk の簡易測定や宇宙線測定を行った。

参加者の中には理論物理専攻の学生も多く、解析や実験機器について多く質問されたが、つたない英語を駆使してなんとか意見を伝えることができた。

最終日の発表

実習の班にはそれぞれニュートリノに関する課題が与えられ、最終日にその発表が行われた。我々の班はニュートリノの混合行列 (PMNS 行列) についての発表を行った。準備を通してニュートリノ振動やユニタリ三角形に関してさまざまな知見を得られただけでなく、一つのテーマについていろいろな国の学生と協力して準備を進めるという貴重な経験を得ることができた。

5.3 終わりに

今回、VSoN に参加するにあたって多くの方々にお世話になりました。VSoN への参加を勧めくださった中家さん、Son さんをはじめとする VSoN の organizer の方々、講師の方々、そして旅費などの支援をしてくださった KEK, ICISE の関係者の皆様には感謝します。

また、日本からともに参加した Giorgio さん、岡本さん、栗林くん、羽田野くん、松下さん、さらに各国からの参加者の皆さんにこの場を借りてお礼申し上げます。ありがとうございました。



Figure 4: 最終日の発表後の集合写真。筆者(小田川)は後列左から二番目。同じく筆者の Pintaudi Giorgio は後列左から四番目。

6 Report from participants #2 (Pintaudi)

On our arrival at the Qui Nhon airport, we were greeted by some school organizers who took us to a very lively banquet at the Seagull Hotel. This was only the beginning of the Vietnam School on Neutrino, organized by both Vietnamese and Japanese professors at the ICISE center [1] with the aim of fostering the growth and development of the Vietnamese neutrino physics community.

The main purpose of the school was to gather some of the Vietnamese students who were most keen on physics and introduce them to the new and fascinating world of neutrino physics. With this goal six graduate school students coming from Japanese universities whose research subject lies within the boundaries of neutrino physics were selected to participate in the school (I count myself in that number even if I have Italian citizenship): the Japanese professors and the Japanese students would then help the Vietnamese students understand the basics of neutrino physics and make them “breathe” in the atmosphere of Japanese neutrino physics community.

This school was also very useful and stimulating even for us, the students from Japan. We learned a lot about many theoretical and experimental topics, ranging from the history of neutrino experiments to the future outlooks of the neutrino physics. I really acknowledge the efforts by the lecturers to make the lessons accessible to students from various levels and backgrounds. Actually, we were a very heterogeneous group with students from undergraduates to Ph.D. students like me, however the lecturers managed to teach every one of us something and, at least, arouse the interest towards the fascinating world of the neutrino physics.

The lecturers from all around the world were scientists at the top of their fields. The content of the lectures was never boring and full of interesting details. If there are any young Japanese students reading this article and considering going to VSoN next year, I really advise them to take a look at the web page of the school [2] where all the slides are available. While I feel the urge to warn the future students (both Japanese and Vietnamese) that the School purpose is not to teach the whole neutrino physics in two weeks (this would be impossible considering that many students had never even taken a proper course in Quantum Field Theory), but just give a glimpse of that world and say “This kind of interesting stuff exists. Consider going to graduate school or become a researcher if you want to know more!”

As a closing remark, I really would like to express my appreciation and gratitude to the Vietnamese students, organizers and ICISE staff. They welcomed us really warm-heartedly and treated us like kings. Especially the food (including the fruits) were mind-blowing tasty and delicious. I am looking forward to the next time that I can visit this marvelous country.

References

- [1] <http://www.icisequynhon.com/>
- [2] <http://ifirse.icise.vn/nugroup/vson/2018/>
- [3] <https://ifirse.icise.vn/nugroup/OpenMoU.html>