International school for radiation measurements in Asia

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***Abstract*—Radiation measurement is a key technology for various sciences. The education of radiation science is demanding in Southeast Asian countries. We are collaborating with Universities in Southeast Asia. Hands-on exercise is important. However, it was not so easy to provide enough number of setups. Recent developments change the situation. The granularity of detectors in particle physics and medical apparatus is increasing. It means detector unit becomes smaller and less expensive. We are developing setups for radiation measurement exercises based on those new developments. Those system is portable to carry. In Osaka University, we are organizing schools for radiation measurements inviting Southeast Asian students. In addition, we are organizing schools in Southeast Asia. Compact system helps us to carry.**

***Index Terms*—International school, radiation measurements**

I. Introduction

Demands on Radiation Science increases in South East Asian countries. Interests in medical application is also glowing. We are collaborating to organizing school for radiation measurements. How to use instruments is not in our scope. We want educate the people so as to understand the instruments. Hands-on experience is very much important for students. The school provides not only lectures but also laboratory exercises. The goal of the school is,

- To train young students in the area of radiation detectors and its applications.
- To stimulate the development of real-time system in South East Asia.
- To promote the participation of young scientists in radiation measurements and related fields.

Our activites and Lessons-and-Learned are described.

II. Activities

A. JSPS school in Osaka

The school held in Osaka University with the budget of the Japan Society for the Promotion of Science (JSPS). We organized "A primer course of experimental particle and nuclear physics, Advanced Technology Training Program for Radiation Measurements in Osaka University". The school was organized three times.

- 20 February 2013 21 March 2009
- 12 July-10 August 2010

	Morning (10:40–12:00)	Afternoon (13:30–14:50)	Afternoon (15:10–16:30)	Evening
7/12	Arrive in Osaka	Arrive in Osaka		
7/13	Guidance	Lecture	Japanese culture	Welcome Reception
7/14	Lecture	Lecture	Lecture	
7/15	Lecture	Lecture	Lecture	
7/16	Spring-8 Tour (TBC)	Spring-8 Tour (TBC)	Spring-8 Tour (TBC)	
7/17				
7/18				
7/19				Holyday in Japan
7/20	Lecture	RCNP/ILE Visit (TBC)		Get-together party
7/21	Lecture	Guidance (Experiment)	Guidance (Experiment)	
7/22	Experiment (1)	Experiment (1)	Experiment (1)	
7/23	Experiment (1)	Experiment (1)	Experiment (1)	
7/24				
7/25				
7/26	Experiment (1)	Experiment (1)	Experiment (1)	
7/27	Lecture	Experiment (1)	Experiment (1)	
7/28	Lecture	Experiment (1)	Experiment (1)	
7/29	Lecture	Experiment (1)	Experiment (1)	
7/30	Lecture	Experiment (2)	Experiment (2)	
7/31				
8/1				
8/2	Lecture	Experiment (2)	Experiment (2)	
8/3	Lecture	Experiment (2)	Experiment (2)	
8/4	Experiment (2)	Experiment (2)	Experiment (2)	
8/5	Experiment (2)	Experiment (2)	Experiment (2)	
8/6	Experiment (2)	Experiment (2)	Experiment (2)	
8/7				
8/8				
8/9	presentation	presentation	presentation	Farewell party
8/10	Leave from Osaka			

Fig. 1. Schedule in 2010.

- 8 September -3 October 2011

The school ran for one month as shown in Fig. 1. The number of students invited were 21∼24. The list of countries are in the table I. Students are graduate school students.

TABLE I
THE NUMBER OF PARTICIPANTS

Country	2009 school	2010 school	2011 school
Vietnam	13	11	8
Chine	11		7
Malaysia		5	7
Indonesia		2	
Philippine		2	
Myanmar		1	

Participants are selected by interview. The interview was done at their Universities.

The setups of the exercises are those for undergraduate exercises in physics department in Osaka University.

B. Mini-school

The number of students we can invite to Japan is limited. In order to have more students, we also did Min-schools in Asian countries. Because of limited budget, we were not

able to bring large setups. However, thanks to the recent developments of electronics, we can use compact equipments. We measured speed-of-light. Laser modulated by the signal from USB function generator was measured by a photo sensor with USB oscilloscope. The school was 2-3 days as shown in Fig. 2. The schools were held as follows.

- Da Nang, 20-21 September 2010
- Can Tho 22 - 25, Sept 2010
- Ho Chi Minh city, 14-15, March 2011
- Beijing, 19-20 April 2011
- Da Nang, 1-3 December 2011
- Qui Nhon 26 July - 3 August 2012
- Kuala Lumpur 14-16 February 2013

The number of students in the exercises were about 20. The number of students in the lectures were about 20∼50. The students invited to Osaka help the school as teaching assistants.

1-Dec		2-Dec		3-Dec	
		9:00	Lecture (Tokita)	9:00	Lecture (Kishimoto)
		10:20		10:20	
		10:40	Lecture (Itahashi)	10:40	Lecture (Itahashi)
		11:30	Accelerators for applied work and their requirements	11:30	Accelerators for applied work and their requirements
13:30	Lecture (Ogawa)	13:30	Experiments	13:50	Experiments
	Physics of Excitons		1) speed of light		1) speed of light
14:50			2) Radioactivity in our environment		2) Radioactivity in our environment
15:10	Lecture (Kuno)				
	Introduction to Osaka University				
16:30	Muon Science and MuSIC@Osaka	16:30		16:30	

Fig. 2. Schedule of DaNang school in 2011

C. JST SAKURA Science program

The school held in Osaka with the budget of Japan Science Technology Agency (JST), Sakura Science Plan. We organized ”International school for Radiation Measurements in Osaka University”. The school was organized five times and will be held also in 2019.

- 18 January - 27 January 2015 10 participants
- 9 November -18 November 2015 10 participants
- 24 November - 3 December 2016 18 participants
- 8 November - 17 November 2017 18 participants
- 31 October -9 November 2018 18 participants

The school ran for 10 days as shown in the schedule. Students invited were from Hanoi, DaNang, Dalat, Ho Chi Minh City, Kuala Lumpur, Jakarta, Bandung. Students are master course students and last year in undergraduate.

Since the there is not enough time to do full course of exercise, just introductory ones were provided. Activation experiments by AVF cyclotron beam were provided. In addition, we did pulse shape analysis and time of flight measurements.

D. IEEE/NPSS school

We collaborate with IEEE/NPSS for ”Real time school”. Thanks to distinguish lectures of IEEE/NPSS, we had lectures

	Morning	Afternoon	Evening
10/31 (Wed)	Arrive in Osaka	Guidance RCNP visit	
11/1 (Thu)	Lecture	Experiment (preparation)	
11/2 (Fri)	Experiment (preparation)	Experiment (Measurement)	
11/3 (Sat)	Experiment (Measurement)	Experiment (Measurement)	
11/4 (Sun)	Free		
11/5 (Mon)	Visit (Osaka – Shirakawa Gou – Toyama)		
11/6 (Tue)	Visit (Kamioka - Osaka)		
11/7 (Wed)	Lecture	Analysis	
11/8 (Thu)	Analysis	Presentation	
11/9 (Fri)	Leave from Osaka		

Fig. 3. Schedule in 2018 SAKURA Science plan.

and exercises by top level researchers from international laboratories. So far, we organized three times. Osaka University hosted the school in Osaka and co-hosted the school in Vietnam.

- 2-7 June, 2014, Osaka
- 18-26 July, 2016, Ho Chi Minh city
- 7-17 July, 2018, Cape Town

The schedule of the school in Ho Chi Minh city is shown in Fig. 4

July 2016	18 Mon.	19 Tue.	20 Wed.	21 Thu.	22 Fri.	23 Sat.	24 Sun.	25 Mon.	26 Tue.
Morning 9:00 ~10:20		Orientation	Lecture A-2	Exercise-1	Lecture C-2	Exercise-2	Excursion	Lecture D-2	Students Presentation
Morning 10:40 ~12:00		Lecture A-1	Lecture B-2	Exercise-1	Lecture D-1	Exercise-2		Lecture E	
		Lunch	Lunch	Lunch	Lunch	Lunch		Lunch	
Afternoon 13:30 ~14:50		Lecture B-1	Exercise-1	Exercise-1	Exercise-2	Exercise-2		Analysis	
Afternoon 15:10 ~16:30	Registration	Lecture C-1	Exercise-1	Exercise-1	Exercise-2	Exercise-2			Farewell Party
Evening		Welcome Party				Move to downtown			
	University Guest house					Hotel in down town			

Fig. 4. Schedule of Ho Chi Minh city school in 2016.

The exercises use Raspberry-Pi [1] and DRS-4 [2] evaluation module. Data acquisition on Raspberry Pi is studied. FPGA programing is also studied.

III. Lessons and Learned

A. Setups of the exercises

We used rather cheap setups for the exercises. It saves our budget or makes possible to have more setups. In addition, affordable price means the Universities of participants can buy to repeat after the school. Cheap does not mean poor performance. Thanks to recent developments in HEP, Medical etc., Price-per-Channel is dramatically decreasing, High

performance evaluation boards are available such as DRS-4 [2], Raspberry Pi [1] etc. Recent developments also make downsizing. Our setup fits in our luggages. We don't need to carry or send heavy and legacy CAMAC crates for exercises.

B. Hands on exercises

So as all students can do hands-on experiences, we use one setup for 2$\sim$3 students. Cheaper setup allows us to prepare enough number of the setups.

At the end of the school, students make presentation. Not only follow the procedure written in the text, students prepare and discuss the presentation to explain what they did. It is very useful to understand what they did.

We asked young scientists in South East Asian countries to participate as a teaching assistant. We can show them how to do exercises. We expent they repeat the exercises at home institute. It may motivate the future collaboration. We also hire PhD students as a teaching assistant. It should be a good experience in their carrier.

C. Interview

Selection of participants are important. We selected students with interview. Interview was useful to find motivated students We also were able to know the level of students and what they want. The level of school (lectures / exercises) must fit to participants. We need to adjust the level to the students. Interview with local professors was useful to show what kind of students were selected. In addition, Inviting professors, we show the school to them. It is important to continue the collaboration.

The interview were done at the University which has candidates. SKYPE connection was also applyed. Face to face interview at their University was valuable for the collaboration involving young scientist.

REFERENCES

[1] https://www.raspberrypi.org
[2] https://www.psi.ch/en/drs/evaluation-board