MEETING REPORT

Physics training and talent search programme*

A Physics Training and Talent Search (PTTS) programme for final year B Sc students from all over India was held last year. The aim was to identify college students who are motivated to study physics, train them and nurture their academic growth. The relationship with the students, we hope, will continue on a long-term basis so that we help in fulfilling their aspirations. We hope to create a stream of talented students opting for research in universities and institutes, while those who become teachers turn out to be of high standards. Furthermore, by developing and sharing better techniques for teaching physics, we hope to enhance the quality of physics education in theory and experiments across India.

The programme was motivated by the Mathematics Training and Talent Search (MTTS), and other similar physics programmes in India.

Distinctive features of PTTS are as follows.

(a) Teaching methodology: Classes are not in conventional chalk-and-talk style, but are interactive in nature. Students are asked questions and are also encouraged to ask questions in the lectures. They are asked to come to the blackboard to solve a problem or explain a concept during tutorials. The experimental physics course is structured so as to make students think of how to propose and design an experiment, and to identify errors in obtaining and interpreting the data. In particular, they are not given a pre-designed experiment with instructions. We believe that this teaching methodology, in the theory courses and especially in the experimental course, will have a larger impact on physics education in India.

(b) Emphasis on fundamental concepts: We believe that students must have a sound understanding of the fundamental concepts of physics and must know how to apply them. We focus on those concepts which they are expected to know as a part of their regular college curriculum.

(c) Talent search from smaller places: First priority will be given to students from smaller colleges, universities and rural background. Students from IISERs, IITs and Central Universities will be given lower priority.

A poster outlining the programme was sent across India to about 2500 colleges and universities in September 2015. About 250 applications were received. We selected 50 students for the planned capacity of 35 students. However, 49 students accepted and it was decided to accommodate all in the programme. Ultimately 47 students participated in the programme.

The selection criteria were: participation in science-related activities, performance in national tests like NTSE (National Talent Search Examination), NGPE (National Graduate Physics Examination), INSPIRE fellowships, reference letters by teachers, a 250-word essay on 'Why I want to attend this programme' by the students, and academic performance. Efforts were made to give adequate representation across states, rural/urban background, and gender. There were 28 female students and 19 male students, and 20 rural students and 27 urban students.

There were 12 lectures and 6 tutorials, each of 1.5 and 2 h respectively, for the theory courses. The experimental sessions were for 2 h daily, but the students often continued to work on the experiments for much longer.

There were special lectures delivered by R. Rangarajan on 'Cosmology – the story of our universe' and by G. Rajasekaran on 'A hundred years of fundamental physics and the discovery of the Higgs boson'. In addition, Rangarajan delivered a lecture on 'A career in physics'.

There were two sections of about 25 students each. While one section did mechanics tutorials the other section did quantum mechanics. During the tutorials the students were divided into groups of 5–6 members each. Problem sheets were distributed to the students and those within the same groups were asked to discuss among themselves as to how to start and proceed. There was healthy competition between the groups as to which one could solve a problem first. Since the tutor would ask any member of the group for the solution, the group had to ensure that all members understood the solution.

On the first day students were asked to choose an experiment by lottery, and groups of students doing the same experiment were formed. Efforts were made to ensure that students from the same college or state did not belong to the same group, so that they would interact with new students. Conversing in a common language, English, was emphasized.

Each student received only a statement on what he/she had to study. They were, for example, 'Without using a simple pendulum measure the acceleration due to gravity'; 'Does interference depend upon the polarization of the input light?' Details of the experiments are provided in the final report uploaded at the PTTS website (https://sites.google.com/site/ptts2015/).

The following instructions were given by the teacher on the first day: (a) First 2–3 days each group must discuss among themselves and with others on how to go about proposing to prove/study/investigate an experiment. (b) No equipment or kits will be given. The students have to come up with what they need to do the experiment. Each student received a polarized sheet. Groups with optics experiments received a laser pointer. (c) Most importantly, the cost of the equipment/apparatus should not exceed Rs 150 for each student. This was not due to any budgetary constraint. It was a conscious part of the training, to force students to think out of box and come up with alternatives and make things on their own. (This element had the greatest impact.) (d) Discussion among the students in a group is allowed and encouraged. But it was clearly mentioned that each student has to prepare his/her own experimental set-up. (e) There will be a review of the progress at the end of the first week of each group. On the last date there will be a presentation by each group. The teacher will choose who will give the presentation.

We found that for the first few days, students were completely lost and some

*A report on the 'Physics Training and Talent Search Programme' held at Kuvempu University, Karnataka from 18 to 30 December 2015 and funded by some national research institutions and the Science Education Panel of the National Science Academies.

were apprehensive as to whether they could rise up to the required level. They were counselled by the teachers and co-ordinators. Later all students got excited by the experiments and were in the laboratory much beyond the scheduled time for the laboratory sessions. There were 12 laboratory sessions, including presentations.

Students were given feedback forms on the last day. The feedback was overwhelmingly positive. The teachers found that at least 13 students were excellent and showed great promise.

In the future, we plan to have, like MTTS, three stages of the programme: for the first and second year B Sc and first year M Sc students. The course will have regular topics of their curriculum. Experimental physics will always be one of the courses. The duration of the programme should also extend to four weeks. Since the number of potential students is large, restricting to one centre may not be adequate. Having two or more centres in different regions is part of the plan. Regions where physics education at undergraduate level are weak can be given particular attention, for example, by having a Mini-PTTS only for those students for a shorter duration.

If teachers in colleges and universities can benefit by this redefined pedagogy, it will go a long way in improving physics education in India. One way will be to identify teachers who are doing research and teaching in colleges and universities and to involve them as teachers and tutors. The other is to invite some interested teachers to attend the programme as observers. But to sustain this activity and fulfil our larger vision, we need unstinted financial support and encouragement. We hope that the academic community and funding institutions will fulfil the same.

Raghavan Rangarajan, Physical Research Laboratory, Ahmedabad 380 009, India, **G. Rajasekaran,** CMI, Institute of Mathematical Sciences, Chennai 600 113, India; **S. V. M. Satyanarayana,** Pondichery University, Puducherry 605 014, India; **M. Sivakumar*,** University of Hyderabad, Hyderabad 500 046, India; **Sudha Shenoy,** Kuvempu University, Shankaraghatta 577 451, India.
*e-mail: msivakumar.m@gmail.com

Predhiman Krishan Kaw bags the 2015 Subrahmanyan Chandrasekhar Prize of Plasma Physics

The Division of Plasma Physics (DPP) under Association of Asia Pacific Physical Societies (AAPPS) has selected Predhiman Krishan Kaw of the Institute for Plasma Research as the 2015 Laureate of 'Subrahmanyan Chandrasekhar Prize of Plasma Physics'. The citation reads, 'For his seminal contributions in the areas of laser–plasma interactions, strongly coupled dusty plasmas, and turbulence, nonlinear effects in magnetic fusion devices'. The prize was founded in 2014 by the AAPPS-DPP and is awarded annually for seminal contribution in the field of plasma physics and is named in honour of the Nobel Laureate Subrahmanyan Chandrasekhar[1]. Setsuo Ichimaru of the University of Tokyo was the first laureate (in 2014) for his contributions to the establishment of the theoretical basis of the science of strongly coupled plasmas and their applications[2]. Kaw is the second laureate (in 2015). Donald Blair Melrose of the University of Sydney is the third Laureate (in 2016) for his sustained original contributions to the theory of coherent emission processes in astrophysical and space plasmas, and for his seminal contributions to the theory of quantum plasmas[1]. The award ceremonies for the three Laureates are scheduled to take place during the 13th Asia-Pacific Physics Conference in Brisbane, Australia during 4–8 December 2016 (this series of Conferences is held once in three years, http://www.aip-appc2016.org.au/).

Kaw is an internationally recognized plasma physicist, well-known for his outstanding contributions in several areas of plasma physics, especially nonlinear laser–plasma interactions; strong coupling effects in dusty plasmas; and turbulence and nonlinear effects in magnetically confined plasmas. He was born on 15 January 1948. He completed Ph D from the Indian Institute of Technology (IIT), Delhi in 1966 at a young age of eighteen! He is the first doctoral student from the IIT. Kaw spent several years (1967–1971 and 1975–1982) at the Princeton Plasma Physics Laboratory, USA and then returned to India in 1982. He was at the Physical Research Laboratory (PRL), Ahmedabad from 1971-1975. From 1982 to 1986, Kaw was again at PRL. Kaw and colleagues at PRL succeeded in persuading the Department of Science and Technology (DST), Government of India, to set up a major programme of plasma physics at PRL. In 1986, Kaw established the Institute for Plasma Research (IPR) at Bhat on the outskirts of Ahmedabad[3]. IPR was funded by DST till 1996. In 1996, IPR was taken over by the Department of Atomic Energy with a considerable up-scaling of the experimental efforts on thermonuclear fusion[4–7]. Kaw served as the IPR's founding director till 2012. Under the leadership of Kaw, IPR successfully spearheaded India's case for participation in the prestigious ITER experiment (International Thermonuclear Experimental Reactor and Latin for 'the way'). Currently, there are seven parties participating in the ITER programme and IPR is now the nodal domestic agency looking after this participation. Kaw has received several prestigious awards including the Padma Shri (1985) and Shanti Swarup Bhatnagar Prize (1986). Kaw is the fellow of the American Physical Society and recipient of the TWAS Prize in Physics.

1. Website of the Division of Plasma Physics, AAPPS; http://aappsdpp.org/AAPPSDPPF/index.html
2. Kikuchi, M. and Namkung, W., *AAPPPS Bull.*, 2015, **25**(1), 51–52; http://aapps-bulletin.org/
3. Institute of Plasma Research, http://www.ipr.res.in/
4. Kaw, P. K., *Curr. Sci.*, 1993, **65**(1), 20–25.
5. Sen, A. and Saxena, Y. C., *Curr. Sci.*, 1993, **65**(1), 25–36.
6. Kaw, P. K., *Curr. Sci.*, 1993, **65**(1), 36–48.
7. John, P. I., *Curr. Sci.*, 1993, **65**(1), 48–56.

Sameen Ahmed Khan, Department of Mathematics and Sciences, College of Arts and Applied Sciences, Dhofar University, Salalah, Sultanate of Oman
e-mail: rohelakhan@yahoo.com