

# Report of the Visiting Review Committee for the Physics Department of IIT-B

The review committee visited the Physics department of the Indian Institute of Technology, Bombay on February 26 and 27, 2014. The members of the review committee were:

- 1) Prof. Chandan Dasgupta, Department of Physics, IISc, Bangalore,
- 2) Prof. Rohini M. Godbole, Centre for High Energy Physics, IISc, Bangalore,
- 3) Prof. Dipankar Das Sarma, Solid State and Structural Chemistry Unit, IISc, Bangalore,
- 4) Prof. Spenta R. Wadia, International Centre for Theoretical Sciences, TIFR, Bangalore

## The Review Process

The head of the department, Prof. P. P. Singh made a short presentation to start the review process. Subsequently, the review committee members listened to several presentations giving detailed information about the research activities in the different groups in the department and met with the members of each group separately. The committee also met with different groups of students associated with the department: research students, M.Sc. students as well as students of the integrated M Tech program and the Engineering Physics program. In addition, the committee had a discussion session with the staff. They visited both the teaching laboratories and the research laboratories along with the central facilities that the Physics department is managing and which are also used by members of other departments of the Institute. The report below starts with a few general comments which are followed by observations of the committee about the research and teaching programs in the department.

### **General preparedness for this review was somewhat lacking:**

- Material relevant to the review should have been sent to the committee in advance.
- We had expected a meeting with the Institute authorities to specify the charge of the committee.
- The department was not duly prepared for the review:  
The original schedule was unsuitable and the committee intervened to revise it.  
The entire evaluation was supposed to have been finished in one day! In fact, we had to struggle to complete the evaluation in two days.

An executive summary of the achievements, needs and projections from all the groups was not provided to the committee. It would have greatly helped the review process if such information were available in advance.

# **The report**

## **General comments:**

The review committee was favorably impressed with the teaching programs of the department including the teaching labs. The level of research achievement was found to differ (sometimes quite strongly) from one group to another. While some of the groups have been performing very well, the research contributions of other groups leave a lot of room for improvement. The committee was also concerned about the lack of “peaks” in the research profile of the department, representing outstanding achievements of faculty members that have been recognized by the community in the form of awards, fellowships etc. It was difficult to identify members of the faculty who have established themselves as leaders in their fields of research at the national/international level. This aspect calls for some improvement.

Many faculty members emphasized the need for setting up a vigorous postdoctoral program. The real need of the hour seems to be administrative help on issues such as housing for the postdoctoral community and attractive salaries. The committee endorses the views of the faculty on this issue.

All members of the department (faculty, staff and students) pointed out that there is a severe shortage of space which prevents the department from functioning properly. No space is available for essential activities such as creation of labs for new faculty, expansion of existing research and teaching labs and providing office space for new faculty and postdoctoral fellows and working space for students. The committee believes that this problem must be addressed by Institute authorities as soon as possible.

Another common concern of faculty members is the time spent in teaching. The increased teaching load is mainly due to an increase in student strength at the UG level. The main issue here is not the number of contact hours but the lack of adequate teaching support. Increasing the number of teaching assistants (e.g. by allowing advanced undergraduate students to work as TAs for introductory courses) would help in alleviating this problem.

## **Research groups:**

In the following we give detailed comments on the research activities in each of the groups.

### **1. Experimental nuclear and particle physics (EHEP):**

This group has been developing well and is making an impact in ALICE and FAIR experiments. Members of this group were responsible for different analyses that have resulted in important publications for the collaboration.

It was perceived that there is a general lack of appreciation for such large collaborative activities in the department. However, it is the opinion of the review committee that such activities are important and should be encouraged. We also note that to address the concerns regarding contributions of individuals in big collaborations, there are well-established modalities to evaluate the contribution of individual members in such collaborations.

For the near future, the review committee appreciates the group's projection for getting involved in projects other than LHC physics. The collaboration between other experimental groups in the physics department and the members of the EHEP group for developing future detectors and accelerator related research is noteworthy. Such activities should be encouraged. The intentions of some of the group members of getting involved in ILC (International Linear Collider) detector development can also be supported.

Future programs: The proposal for "accelerator science program" and development of a small accelerator appears promising and should be taken forward through a suitable review process. The group wishes to apply for financial support to agencies such as DAE/DST. For this a strong Institutional backing will go a long way. IIT (B) MOU with KEK was mentioned during the review process; this will contribute to this exercise as well.

## **2. Theoretical physics (HEP):**

Most of the members of the group are publishing in high profile journals at a competitive level. The work done by some of the members is very good. The committee would like to make the following suggestions for improvement.

1) Having two or three people working in overlapping areas would be good. The older members (Uma Sankar and Urjit Yagnik) have such an overlap. For the younger members, having more people working in related areas will be more productive.

Hiring of new faculty in the group may be done keeping in mind the desirability of facilitating collaborative activities not just within the members of the group, but perhaps also with the members of the EHEP group.

2) While hiring new members, keeping in mind the directions in which theoretical high energy physics is developing, the committee would like to recommend the following broad areas for consideration:

i) LHC phenomenology and QGP phenomenology

The latter is desired by the experimental EHEP group who are doing a good job. Having an in-house theorist will help them increase their impact as well.

ii) String theory

iii) Astro-particle physics and Cosmology

### **3. Experimental condensed matter physics:**

The experimental condensed matter physics group has a few major directions of research, namely magnetism, semiconductors, and nanostructured materials; some of the activities combine more than one of these aspects, for example studies of interesting magnetic properties in nanomaterials and novel optical properties in thin film materials. The academic performance of this group, as a whole, is good, with publications in good quality journals at a competitive level, though some components of this group are certainly doing better compared to some of the other components. It is to their credit that the group has been able to put together a range of sophisticated instruments that suffice their own purpose as well as serve the Institute community very efficiently.

### **4. Photonics:**

This group has put together an impressive suite of optical spectroscopy related facilities. It also consists of several young faculty members with promise. We look forward to seeing important work coming out of this group.

### **5. Statistical Physics and Physics of Soft Matter:**

This group has performed quite well in recent years, with several publications in high-impact journals. The committee appreciated the fact that members of this group have established active collaborations with colleagues from various other departments, such as the departments of biology, chemical engineering and mechanical engineering. This kind of interdisciplinary research should be strongly encouraged. The latest hiring is expected to add significantly to the activities of this group. The committee believes that with some institutional support for improving computational facilities (e.g. institutional backing of a proposal from the group for acquiring high-performance computers) and recruiting good postdoctoral researchers, this group can become a leading one in this area of research.

### **6. Condensed matter theory:**

In view of the departure of some senior members over the last several years, the group requires injection of new blood, activating modern areas of interest, such as strongly correlated systems, quantum information, and cold atomic systems.

## Teaching programs:

Below we first give a summary of our impressions from discussions with the students and then provide a list of issues that need attention.

### PhD Scholars

The present course structure consists of 4 3-credit courses + 1 Seminar in the 1<sup>st</sup> year (compulsory). The students uniformly feel that more choices should be given.

Some of the specific courses were particularly criticized for well-founded reasons. For example, subjects that individually require a full semester to be taught and also are not strongly interconnected are often clubbed together in a one-semester single course. Examples are Classical + EM and QM + Stat Mech. It was generally felt that such courses do not serve any purpose, being sub-critical for both components.

Also, the students criticized courses on Fortran and Electronics quite uniformly.

The committee noted with concern that there is no system of a comprehensive examination to confirm the candidacy of the students in this program; the only requirement seems to be that the student must score a minimum of 6.5/10 in the course work.

### EP students

Students of this program appear to be generally happy with the course structure and teaching. The committee got the impression that this program is running well. A few problems mentioned by the students are listed below.

Lab courses should have feedback from the students. At present, there is no feedback mechanism in place for lab courses.

Activities in the labs do not correlate with theory classes.

Better planning of the sequence of courses would be very useful. For example the condensed matter course should not be given in the 4<sup>th</sup> year.

The compulsory electives are too specialized.

Students prefer blackboard teaching over the use of ppt slides.

Some of the course contents are particularly disliked by the students and need to be looked into. These are:

- Optics
- Complex analysis – Mech.
- Energy

Dual degree program:

- 5 year – M Tech. It should not be tied to Nanoscience alone; the choices available should be broadened.
- Engineering electives should be allowed.

### **MSc. Students**

- 2<sup>nd</sup> year project – Not enough attention from the guide.
- Too little experience in computation is imparted in the course on computation.
- 1<sup>st</sup> year courses are too easy and have too much overlap with UG courses.

### **Issues mentioned by technical staff:**

The following issues were mentioned by the staff in their meeting with the committee.

Technical staff members have serious concerns about their career prospects and growth. Enhancement of qualification is possible, but not an enhancement of position. Promotion of junior lab assistants is often delayed.

Safety issues in the labs should be taken more seriously.

A training program for technical staff involved with experiments would be useful.

The availability of modest funding for designing new experiments would be appreciated.