

## **Le Centre International pour la Physique Théorique (ICTP) de Trieste**

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*The International Centre for Theoretical Physics (ICTP) was created in 1964 by the Nobel Prize winner Pakistani scientist Abdus Salam. What was the intent at that time?*

The intent is best understood in terms of Salam's own experience. After getting his PhD from Cambridge, he returned to Pakistan and taught there for one or two years. But he found that he could not do much science because there was no good library, no peers to whom he could relate, and so forth, all of which choked his scientific productivity. If there were a way to stay connected to the world community, the situation might have been different. Salam was dedicated to his country but realised that, if he chose to stay there, it would be a scientific suicide. So he went back to Cambridge and, later, to Imperial College. Because of his experience, he worked to create an international centre to which scientists of all sorts from all parts of the world could come and work on frontier subjects; the centre would serve as a forum for exchange of a wide range of scientific ideas. In this way, no good scientist from a developing country would be cut off from scientific action. The centre could have been set up anywhere but the Trieste physicists such as Paolo Budinich joined force with Salam and got Italy to support the idea. The centre today is different from days of its infancy but the big picture has not changed.

*From where do the scientists at ICTP come? How long do they study and what topics?*

Scientists of many levels come to ICTP. Some come for brief visits to give a seminar and exchange ideas. A second category of scientists, called Associates, stay connected to ICTP for a period of ten years, roughly: They come every year, or every other year, and work here for a month or two depending on the total amount of time and money awarded to them. For some of them, the teaching in their countries is so heavy and available resources so few that they have little time to do research or write a paper; so they do that when they are at ICTP, either on their own or in collaboration with others at ICTP, Trieste, or Italy. The third category consists of post docs, whose functions are similar to those in any other research centre. The fourth category consists of participants in one of our programs. We run fifty to sixty programs every year, some of which are workshops at the frontiers of the field, some of which are pedagogical. For instance, we organize each year such a course on string theory to which students from all over the world come. Then we have the diploma students who are

chosen from the least developed countries according to the UN classification; they study for a year enriching their knowledge of physics and mathematics. We presently have three diploma's programs---in condensed matter physics, high energy physics and mathematics---and intend to start new ones in other areas soon. When the diploma students complete their work here, most of them are ready for graduate work in a good university. Another group of visitors is made up of Ph.D. students who are enrolled for their degrees in their own countries but come to ICTP for six months or so every year. They work with a co-adviser here and have access to scientists at the Centre and its visitors, as well as to other Trieste scientists, to our library, and so forth. About 50% of our visitors come from Europe and United States together and about 50% come from other parts of the world, but the total fraction of time spent at ICTP by scientists from developing countries is about 75%.

An important feature of the Centre is the mixing of people of different experiences, different levels of expertise and different levels of knowledge and accomplishment. They learn from each other as much as they learn from the scientists at the Centre. This is a centre where fledgling scientists as well as outstanding ones, scientists from poor countries as well as rich countries, come and interact. Some of the teachers in our programs are from industrialized countries but we make great efforts to find suitable teachers from other parts of the world as well. All our participants are chosen on the basis of merit. This commitment to diversity and excellence is really what makes ICTP unique. We do not ignore either of these two facets.

Altogether, the total number of visitors to the Centre exceeds 100,000 since 1964. Last year alone, we had about 6500 visitors in all. There is also another avenue for bringing in researchers from developing countries to work typically for a year and receive training in Italian Laboratories. The total number of such visitors is on the order of 1000 since the program began. We are thinking of expanding the scope of this program.

*What benefits are expected for the students from developing or underdeveloped countries from their studies at Trieste?*

In broad terms, visitors to ICTP enrich their scientific experience and prepare themselves better to build their own activities in their countries. The benefits for diploma students are obvious. They are intrinsically good students but are poorly prepared for a number of reasons, and the rigorous study that they undertake here prepares them graduate work. Although our business is not to supply graduate students to other countries, about half of them end up with PhD in Europe and United States in good universities. Yet, even those people stay connected to their countries. The other half of them go back to their countries

where they are often linked to our affiliate centres and keep doing science. Those that are working for their PhDs in their countries, spending part of the time here, receive their doctorates in their own country which helps them to remain connected to their countries. After their degree, they become researchers and teachers. Many of the post-docs end up taking faculty position in their country. While some do go to the western world, the record is not bad. Finally, students who participate in one of our programs can take the opportunity to enter a new area. There are new things happening all the time.

Nearly all those that have come to our Centre are working in their own countries or are students in their countries. One of our concerns is to keep active scientists engaged in their own countries. One of the great things about the Centre is that it does not directly contribute a lot to brain drain, which is one of the biggest banes in developing countries. There are exceptions, of course, but there is a sense of mission at the Centre that hooks people to the ideals it has espoused over time.

*What does the “Trieste system” mean?*

ICTP was based in Trieste with an orientation towards developing countries. In 1983, another institution called ICGEB, International Centre for Genetic Engineering and Biotechnology, was formed. It is also oriented towards science in developing countries. In 1988, the International Centre for Science and High Technology (ICS) was created, and so was SISSA (International School for Advanced Studies), which is next door to ICTP. Though SISSA is an Italian institution, it has some international aspects as well. The Academy of Sciences in the Developing World, whose acronym TWAS stands for its original name of the Third World Academy of Sciences, was created some 25 years ago. There is some interest in giving all these international institutions a common front, partly for reasons of visibility and partly for increasing their combined effectiveness and political clout. This is the “Trieste system”. It is a collection of international institutions oriented towards developing countries, but they have no common governance. Indeed, the specific mandates of our institutions are somewhat different because we are governed by different international bodies. For example, ICTP is administered by UNESCO and tied also to the International Atomic Energy Agency (IAEA) in Vienna.

*What are your connections with the Academy of Sciences for the Developing World (TWAS)?*

Abdus Salam also founded TWAS and was its President until his failing health made it impossible. During his time, the separation between the two institutions was undefined, and Salam did whatever seemed appropriate to him to achieve his goals. I myself view ICTP and TWAS as two sides of the same coin, and that

they will always remain connected because they are both interested in building scientific capacity in developing world (or, as far as I am concerned, wherever it is needed). The secretariat of TWAS is housed in ICTP's buildings, its staff members are formally part of ICTP, so we are intertwined in many direct ways. However, TWAS is an academy and ICTP a scientific centre, so there are difference in culture and functions. TWAS elects members and awards grants and fellowships, and its stated goal is to work for sustainable development. TWAS does not organise scientific meetings as ICTP does, nor does it have resident scientists. TWAS organises its annual meetings as do other academies. The last one was in Alexandria in the Library, and was great. The next one is going to be in Brazil. These meetings rotate from one place to another. TWAS hosts the Inter Academy Panel (IAP), the Inter Academy Medical Panel (IAMP), and other affiliate organizations.

*How is ICTP financed?*

We receive about 80% of our budget from the Italian government and I am grateful and pleased about this constancy of support. We get some funding from IAEA and UNESCO, and, for special programs, some also from SIDA and other foundations. One of my goals is to raise money from other countries. ICTP does many things that should interest many people. For instance, we wish to establish a formal connection with the French Academy of Sciences.

*The importance of science in the developing world was underlined recently by a conference on "Physics and Sustainable Development" in Durban. What can we expect from the themes examined by the Conference?*

ICTP was a co-organiser of the Conference (October 31 – November 2 2005). There were four main themes: physics education, energy and environment, physics and health, physics and economic development. The proposals from the meeting are available in draft form but are not yet finalized.

An important proposal adopted was that the educational material available worldwide should have a common depository and should be electronically accessible. It was suggested that ICTP could be a place for it. ICTP will, however, not be engaged in educational philosophy or in creating methodology. In the field of economic development, where physics does make an important contribution, it was decided that supporting entrepreneurship was essential. Many people in science do not know how to transfer their knowledge into wealth creation, this being a part of the problem in developing countries. If countries do not know how to transfer their scientific knowledge to wealth, they may think science is of little value, just the activity of some strange people interested in strange things! Science receives better support in countries where

the connection between science and wealth creation is good. They are stronger in France, for instance, than in Italy; the connection is certainly weak in many parts of the world. So we are going to set up at ICTP a course, in co-operation with the Institute of Physics in UK, on such aspects as patenting intellectual property. ICTP will host this joint activity this year. In the field of physics and health, the importance of creating a network of training centres in physics of radiation therapy was underlined. There were also some concrete suggestions in the area of energy, and so forth.

*How does basic physics participate in balancing development and sustainability?*

Many people think that “basic physics” has little to do with development. But who could have expected the internet to emerge from a high energy research centre, or bar codes from research on optics, or the intercontinental optical fibre networks from research on solitons? There are many areas in which physics has helped. Materials science comes to mind, as does medical physics. More directly for sustainable development, climate modelling is important, and we run several courses on this topic at ICTP. Many people are killed in Iran every year because of earthquakes, and physics of earthquakes, monitoring seismic activity and, eventually, inventing prediction schemes are worthwhile endeavours. The same is true for the monsoon activity in south Asia. Nanotechnologies may provide solutions for water purification, which remains a big need in three quarters of the globe. Physics is a part of an interdisciplinary inquiry. My hope is that anyone who learns any one branch of physics well will be able to transfer the rigor of thinking from one area to another area, and solve problems which interest them and their countries.

*At ICTP, do you run experiments or studies on physics related to the environment or the climate issues?*

We do not run many experimental programs, although my own group does experiments on hydrodynamics and there are several small hardware-oriented programs on optics, communication and instrumentation. We have a group of people who work on environmental issues (broadly speaking), but they are modellers and consider issues such as regional climate modelling, land-ocean coupling, etc. This type of interest has been present at ICTP for some ten or fifteen years, and the future of energy, for instance, has been of great interest to us from day one! The first conference that was held at ICTP was on plasma fusion as a source of energy. That was 40 years ago! We are still interested in fusion, especially in the context of the new program, ITER, to be headquartered in France. We can play an important role there, especially in training and forging ties with scientists in developing countries.

*To what extent does the ICTP participate in co-operations with international institutions or national governments? On which type of programs?*

We are closely connected with several international organizations, especially with our parent institutions, UNESCO and IAEA. With IAEA, we jointly run several courses on nuclear data management, nuclear knowledge preservation, and the role of isotopes. You know that nuclear scientists are disappearing from many parts of the industrialized world, and they will have to borrow people and knowledge from France one of these days! There is a big worry in IAEA that this kind of knowledge is disappearing. A synchrotron facility is being set up in Jordan under the umbrella of UNESCO. We train people using the ELETTRA synchrotron facility in Trieste. We shall also be running a course on carbon economy jointly with UNESCO. We collaborate with ICSU, which has a special program for development. We are running a new course with IIASA in 2006 on coastal upwelling.

With respect to working with governments and national level, we have recently set up collaboration between the South Africans and the rest of African scientists on nanotechnologies. ICTP and South Africa share expenses. With Pakistan, for instance, we are lending a hand in establishing the national centre for theoretical physics, which we hope will become a first-rate institution. I have been working with the Sri Lankan government and expatriate scientists to raise the science infrastructure there. We have special agreement with Iranians on earthquake studies, and with Romanians and Belarusians on theoretical physics. We are working with the government of Korea to start a new institute. There are many such instances and I have just given you a sample. We have now established agreements with Brazil, China and India for cost-shared collaborative programs of regional character. We take every opportunity to do something to raise the scientific level in each country, often by being a catalyst. For instance, during my recent visit to Egypt, we discussed a new mathematics centre in Cairo. The issues in front of us are so immense that we cannot afford to lose any occasion. Efforts are being made to develop mathematics and optics in the MAGREB countries, in which we would be delighted to have the French collaboration.

*What do you expect for the future?*

I am optimistic about ICTP but am worried on many fronts. One, of course, concerns the level of resource for the Centre and its continued effectiveness. What worries me even more is the following: ICTP has supported many good people both on its premises and at their home institutions. Some of them have done remarkably well under adverse circumstances but not many have been able to build institutions around them, and enlarge the ICTP effect. If we support

50,000, or even 100,000, people in 40 years, well, that is not enough. Some of them should have created lasting institutions themselves. We will continue to identify and support first-rate individual scientists because nothing happens without good individuals, and science by and large is an individual activity. But these scientists must also engage themselves in the extraordinarily important task of institution building. ICTP should thus function a little bit differently. Many people do not even know how to foster a research group because they have no experience on how to articulate and realize a vision, or even how to write a proposal or raise money. These are the kinds of things that must improve to make a lasting impact.

For forty years, the Centre has been battling to tide negativity about science in developing countries; we have to make positive things happen.