Building bridges across the world

The Abdus Salam International Centre for Theoretical Physics in Italy has an ambitious dual purpose: to carry out world-class research and to nurture science in the developing world. **Edwin Cartlidge** visited the centre ahead of its 40th anniversary this month

Located in the north-east corner of Italy on the coast of the Adriatic, the city of Trieste has long been a crossroads. An important trading post during the Roman Empire and the sole sea port of the Austro-Hungarian Empire, Trieste was also a destination for many scientists from behind the Iron Curtain after the Second World War. It was as a bridge between east and west that the city also became home to the International Centre for Theoretical Physics (ICTP) in 1964.

The physicists who created the centre – future Nobel laureate Abdus Salam and Paolo Budinich, who grew up in Trieste – envisaged the centre not only helping to ease the tensions of the Cold War but also stimulating co-operation between scientists in the northern and southern hemispheres. Some 40 years on, the ICTP remains true to the mission of its founders. Each year it plays host to about 5000 scientists from 120 countries, both in the developing and developed world, who attend training courses or carry out research in particle physics, condensed matter, mathematics and related fields.

Built on a hill overlooking the sea a few kilometres outside Trieste, the ICTP provides the time and space for scientists to get up to speed with the latest research in their field. It gives them access to library facilities, computing infrastructure and, most importantly, other researchers in their fields – three basic requirements for research that are often in short supply in their own countries.

The idea is that scientists from the developing world can take advantage of these opportunities without having to leave their home countries on a permanent basis. As well as setting up research centres at home, ICTP alumni have, over the years, also become members of parliament (Nepal and Vietnam), government ministers (Pakistan, Bangladesh, Kuwait and the Ivory Coast), and presidential science advisors (Argentina and Chile).

"Building and sustaining a world-class intellectual infrastructure in developing countries is an ongoing challenge," says Indian-born Katepalli Sreenivasan, who became director of the centre in March 2003 after moving from the University of Maryland. "In the long term we have to inspire budding scientists to emulate successful scientists living in their home countries, rather than expatriates."

But why should people from developing countries be interested in theoretical physics and mathematics when they could be doing something more practical? "The point is that it does not matter so much what people do, but that what they do, they do well," says Sreenivasan, an experimental physicist whose interests include complex fluids and turbulence. "It is so important to give people a sense of achievement."

ICTP

A helping hand – the ICTP provides training for hundreds of scientists from the developing world each year.

A multinational meeting place

The origins of the ICTP are closely tied to the career of Abdus Salam, who was the director between 1964 and 1993. Born in 1926 in what is now Pakistan, he graduated from Punjab University in Lahore in 1946, and went on to receive a further degree and a PhD from Cambridge University. He spent a year at Princeton before returning to Lahore, but became frustrated with the difficulty of finding collaborators, as well as the poor library facilities and the lack of opportunities for travel. Salam returned to Cambridge and then became professor of theoretical physics at Imperial College in London in 1957 at the age of 31. However, he was unhappy at having to leave his homeland and, more generally, concerned that countries in the developing world were being left behind scientifically.

In 1960, at a seminar on particle physics in Trieste, Salam and Budinich discussed the possibility of building a place where scientists of all nationalities could exchange ideas. Four years later the ICTP was born with funding from the International Atomic Energy Agency (IAEA) and the Italian government, who were keen to redevelop a city that had experienced industrial decline in the 1950s following the withdrawal of Allied troops. In the meantime, Trieste has become home to a number of other international science organizations, including the International School for Advanced Studies (SISSA) and the Third World Academy of Sciences.

Since its inception the ICTP has been visited by almost 100 000 scientists, about half of whom have come from the developing world. Administered by the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the IAEA, it now employs about 30 permanent scientific staff and 100 general staff, with the Italian government providing about €18.5m of its annual €21m budget. The centre also has a well stocked library and a high-speed computer network with some 500 workstations.

Central to the ICTP's efforts to support scientists in the developing world is its associates programme. Each year the centre selects between 100 and 150 new associates, who are given the opportunity to visit the centre three times over a six-year period. The centre also picks about 100 scientists a year to spend up to 12 months at Italian laboratories as part of its TRIL programme, while an intensive one-year diploma course

provides about 30 graduates annually with the grounding needed to take a PhD at a Western university. The ICTP also provides support for research and training activities at centres within the developing world.

Although other organizations provide support for scientists from the developing world, Le Dung Trang, head of the mathematics section at the ICTP, believes that the Trieste centre has unique expertise, which ensures that it can spend money where it is needed most. "We can see things at the global level," he says. "For example, we can compare someone from Africa with someone from China. These people have different abilities, a different kind of training and have different needs."

Arbab Ibrahim Arbab, from Sudan, is one of more than 300 students who have participated in the ICTP's diploma programme. After obtaining a physics degree from the University of Khartoum in 1989, he had hoped to teach at the university while earning a master's degree, but an exodus of staff and political instability made this impossible. Arbab says that on the diploma course he picked up new knowledge, problem-solving skills and the confidence to be a good teacher. He is now an assistant professor at Omdurman Ahlia University, one of Sudan's leading higher-education institutions.

Unlike Arbab, plasma physicists Ivane Murusidze from the former Soviet republic of Georgia – a country with a proud scientific tradition but limited resources – had no need for basic training. However, his visits to the ICTP as an associate scientist between 1994 and 2000 allowed him to remain in contact with colleagues working on simulations of laser–plasma interactions. "Being able to converse with colleagues and use the centre's library and computing facilities has helped push my research forward," he says.

Maintaining standards

The ICTP is not just about training and support, however. More than 80 Nobel laureates have visited the centre and every year a significant number of the world's leading physicists visit Trieste to give lectures or carry out their own research. And since 1985 the centre has awarded an annual medal in honour of Paul Dirac to scientists who have made significant contributions to theoretical physics and mathematics.

In addition to Salam's own contributions to particle theory, ICTP researchers have made a number of other important breakthroughs. For instance, in 1998, while working at the ICTP, Gia Dvali and co-workers in France and the US published the first of a series of papers that suggested that the extra dimensions in theories of quantum gravity might be "large" enough to observe in experiments. These papers have been some of the most cited in theoretical physics over the past decade. Dvali, a Georgian, is now a professor at New York University.

ICTP

First-rate facilities – the Trieste centre has a well stocked library and high-speed computer network.

"There is an inspiring research atmosphere at the centre," says Alexei Smirnov, who is a staff member in the high-energy group and is also the "S" in the MSW theory of neutrino oscillations. "In the fields where we are expert, we can compete internationally."

The centre also contains a small group that has created a regional climate model that visitors can apply to their own countries when they return home. "The ICTP is a very good place to discuss scientific problems," says Xuejie Gao of the National Climate Centre in China. "I can take the knowledge learned here and use it to improve climate-change study in China."

Sreenivasan is convinced that the centre must carry out world-class research. "If we did not, why would people come?" he asks. "High-quality people do not just come to an arbitrary place. What we do not have, we cannot impart." He would like to attract more outstanding researchers to the centre but says that it is not easy to compete with places like Harvard and Cambridge.

The UNESCO-administered staff structure also makes it more difficult to attract the very best people, says Sreenivasan, because it tends to promote people on the basis of length of service rather than merit. "We currently cannot promote an outstanding scientist to the top level unless it is to an administrative post," he says.

The problem of Africa

Since the ICTP was formed, a number of countries in the developing world have improved their scientific capabilities considerably. These include China, which now produces over 5% of the world's scientific publications, India, Brazil and Argentina. A number of institutions in these countries are also approaching world-class status, such as the Tata Institute of Fundamental Research in India and the Institute for Pure and Applied Mathematics in Brazil.

However, the same cannot be said for Africa, with the scientific output of many African countries having decreased significantly over the last 40 years. "Somehow the money going into Africa from the ICTP and other organizations is not adding up," says Sreenivasan.

Part of the problem is personality, says Vladimir Kravtsov, head of the ICTP's condensed-matter group. "We invite the African scientists to Trieste," he explains, "and provide them with opportunities to improve their education and raise their level where they can do real research. But many of them take a while to adjust to their new surroundings."

To improve matters in Africa the ICTP plans to concentrate money in selected institutes and in particular fields, rather than spreading money too thinly, says Sreenivasan. Optics is one area that the ICTP is likely to focus on. He cites Paul Buah-Bassuah as an example of what can be achieved. Having received a physics degree from the University of Cape Coast in Ghana, Buah-Bassuah was a fellow on the TRIL programme and then did a PhD at the University of Florence. He subsequently returned to his alma mater to set up a laser and fibre-optics centre, which is used to develop agricultural techniques, monitor drinking water and atmospheric pollution.

More generally, the ICTP is likely to become active in new areas of research in the future. "We cannot remain oblivious to areas like biophysics and advances in medical physics," says Sreenivasan.

Another priority is to ensure continued funding for the future of the centre. In 1991 a financial crisis in Rome resulted in the government withholding funds from the centre, which were only reinstated after the ICTP received a loan from Iran. "This was a very difficult time for the centre," says Sreenivasan, who was a lecturer at ICTP at the time. "I got a note from Abdus Salam saying that the centre did not have the money to pay for lecturers but that my work had not gone unnoticed!"

To prevent this from happening again, it is necessary to make sure that Italy continues to see the value of the centre, says Sreenivasan. Moreover, the centre needs to persuade other nations to fund it. "We cannot keep saying that it is the moral responsibility of developed nations," he says. "We need to point out that having a centre like this is also in their self-interest. I believe that if part of the world lags behind too much it will bite you back."

Indeed, Sreenivasan believes that the ICTP will continue to have an important role to play in bridging the scientific communities of nations that have troubled diplomatic relations – such as the US and Iran – just as it served as a bridge between East and West during the Cold War. "The ICTP's primary purpose must be to develop good physics around the world, but in the process it can help promote mutual understanding among nations," he says. "The centre is, after all, part of the larger world, and it simply cannot ignore what divides and endangers humanity."

● www.ictp.trieste.it