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Peace Through Science



Kim Douglass

The Abdus Salam International Centre for Theoretical Physics (ICTP) in Trieste, Italy, is celebrating its 40th anniversary this year. During the Cold War, the center offered a rare vehicle for scientists from all corners of the world to meet and share knowledge. Today, its focus tends to be on facilitating scientific collaboration between the developed and the developing world through a range of programs, including an annual college in optics. For some young optical scientists, involvement with the center has been a life-changing experience.



**“Scientific thought is
our common heritage.”**

— *Abdus Salam, co-founder of ICTP*



Courtesy ICTP Photo Archives



Imrana Ashraf Zahid and Revati N. Kulkarni come from the same part of the world. Both women are professors of physics. Both were intrigued by problem solving early on; Zahid, thanks to a grandfather who took pleasure in helping her tackle complex mathematical equations, and Kulkarni, thanks to a backyard telescope that never quite gave her a perfectly clear image of the sky.

The two have at least one other thing in common: each was awarded the 2004 optics prize from the International Commission for Optics (ICO) and the Abdus Salam International Centre for Theoretical Physics (ICTP). The award honors outstanding optics research by young scientists from the developing world.

Zahid and Kulkarni traveled to Trieste in February to receive their awards as part of the ICTP winter college in optics, an annual program that lasts several weeks and features lectures and seminars on a range of optics topics. Zahid, who comes from Islamabad, Pakistan, spoke of her research on the role of pump-phase fluctuations in micromasers. Kulkarni came from Pune, India, and spoke about adaptive optics.

The two had never met; the fact that they come from nations that have traditionally been adversaries seemed irrelevant to them. “Science isn’t about all of that,” Kulkarni said, and she held Zahid’s hand as the two were introduced to their peers on the ICTP auditorium stage during the award presentation.

“It’s a sign of what we want to achieve,” said Gallieno Denardo, a longtime ICTP faculty member. “Peace through science.”

(Background) Aerial view of ICTP, Trieste. *(Facing page)* Abdus Salam (1926-1996), Nobel laureate and co-founder of ICTP, in 1990 during a visit to the center’s laser laboratory on the occasion of a week-long college on physics, lasers and optical fibers. *(Above)* Imrana Ashraf Zahid (left) and Revati N. Kulkarni each won the 2004 optics prize from ICO and ICTP. They traveled to Trieste in February to accept the honor.



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Courtesy ICTP Photo Archives

In 1960, Paolo Budinich (*front row, standing third from right*) invited Abdus Salam (*front row, standing second from right*) to attend a small seminar in Trieste. The group, pictured above, met at a small castle on the grounds of the castle of Miramare (*left*). The meeting served as the starting point for the establishment of ICTP.

The origins of ICTP

This scene no doubt would have pleased Abdus Salam: the Nobel laureate, co-founder and longtime director of ICTP often said, "Scientific thought is our common heritage." This sentiment has been at the heart of the center's mission since its creation.

It is hard to separate Salam's story from that of the center he helped create in a handful of buildings on a hill alongside the Adriatic Sea. He was born in 1926 in a small town in the province of Punjab, India, which is now part of Pakistan. "When he cycled home from Lahore, at the age of 14, after gaining the highest marks ever recorded for the matriculation examination at the University of the Punjab, the whole town turned out to welcome him," according to The Nobel Foundation's biography of Salam.

He was educated in the United Kingdom, receiving a bachelor's degree in mathematics and physics from St. John's College in Cambridge and a doctoral degree from Cambridge University.

He held a one-year fellowship at Princeton University before returning to Pakistan in 1951, where he was appointed head of the Department of Mathematics at the Government College in Lahore and the University of Punjab. "The environment he found there was quite different from that of Cambridge or Princeton," A.M. Hamende wrote in *A Guide to the Early History of the Abdus Salam*



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Gallieno Denardo spent most of his career working alongside Abdus Salam (*pictured in poster*) at ICTP. Today, Denardo is a consultant for the center, helping to manage its optics programs.

International Centre for Theoretical Physics. "No one encouraged him in pursuing his research, the library was poor and possibilities for travel were almost nil. ... It soon became obvious to him that remaining in Lahore meant a farewell to physics."

After three years, Salam returned to the United Kingdom. His career as a theoretical physicist developed nicely, but the price he paid was high. "He had left his country, his family, his friends and his cultural environment," Hamende wrote,

adding that this was not uncommon for scientists from developing nations who had been educated in Europe or the United States.

Salam worried not only about the quality and development of science programs in less developed nations, but also about mounting Cold War tensions which threatened to divide and alienate scientists from different parts of the world. He participated in various United Nations-sponsored conferences on peaceful uses of atomic energy. He envisioned a place where scientists from all nations could exchange ideas.

Another scientist a continent away had a similar idea.

Paolo Budinich grew up in Trieste. He served in the Italian navy during World War II and was a prisoner of war in England and in the United States. When he returned to Trieste, he taught rational mechanics at the local university before being named director of the school's new Department of Physics in 1954.

Ten years ago, Budinich described in an article how post-war Trieste sat dangerously close to the Iron Curtain in northeastern Italy. He wrote that the border "could have easily strangled the city to death, cutting it off from its natural hinterland and generating poisonous nationalisms. For us at the Department of Physics of the newly born university, one of the few possible remedies to that disaster was to establish cultural links



Courtesy ICTP Photo Archives

Abdus Salam lecturing to a group of students in 1962 as part of an international seminar on theoretical physics that was held inside the stables of Trieste's Miramare Castle.



Courtesy ICTP Photo Archives

A group photo from the first Edward Bouchet International Conference on Physics and Technology (1988). The event was organized by Abdus Salam to unite African and African-American scientists. It honored the first African-American to receive a doctoral degree in physics.

and collaborations, especially in science, which by its nature is international and does not recognize borders of any kind.”

In 1960, Budinich invited Salam to attend a seminar in Trieste on elementary particle interactions. The group met at a small castle on the grounds of the castle of Miramare, which sits in a lush park on a cliff overlooking the Adriatic. The meeting led to the creation of ICTP.

The Italian government agreed to sponsor the center; today it funds about 85 percent of ICTP's total annual budget of approximately 20 million Euros. Italy made the commitment because of the war trauma Trieste had endured, said Minister Giancarlo Riccio of Italy's Ministry of Foreign Affairs. “The city always had a history of great culture,” he said. “It's a city where the business class reads, where everybody knows three and four languages. The government said, ‘We will give you jobs in the scientific field,’ to help Trieste rebuild.

Gallieno Denardo remembers those days. Denardo was raised in Trieste and he has spent his career there, serving now as a consultant for the center and a kind of manager of its optics programs. “Trieste lost everything with the First and Second World Wars,” he said. “It was going to become a really useless town. The industries moved away.” American soldiers were stationed in Trieste through 1954 and much of Denardo's childhood; he learned English from the son of an



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Katepalli R. Sreenivasan has served as the director of ICTP since March 2003.

American GI who lived in his family's apartment building.

The center not only gave Denardo and other local scientists a professional home, it helped reinvigorate Trieste's rich, knowledge-based culture. The city now is also home to the International Centre for Genetic Engineering and Biotechnology, the Third World Academy of Sciences and the International Centre for Sciences and High Technology, among other scientific programs. Italy has submitted Trieste to the International Bureau of Exhibitions as a possible candidate for the 2008 International Exposition, given its history as a crossroads between cultures and its reputation as a place where knowledge is exchanged through places such as ICTP, Riccio said.

ICTP's current director is Katepalli R. Sreenivasan, a scientist whose work in fluid dynamics and problems of turbulence has gained him world recognition. The center and its staff “create friends for Italy all across the world,” Riccio said. “We are not going to give it up. It is part of our contribution [to developing nations].”

Salam's connections with the United Nations led to that organization's sponsorship of the center as well.

Today the International Atomic Energy Agency (IAEA) and the United Nations Educational, Scientific and Cultural Organization (UNESCO) also provide some support. The buildings are owned by the University of Trieste, which leases them to ICTP for a small fee. Special programs, such as the winter college in optics, are paid for through a patchwork of contributions. While ICTP is the main supporter of these colleges, OSA, SPIE and ICO also chip in to ensure that students with limited assets can travel to attend the program and that highly skilled teachers are on hand to lead the classes.

“It is not necessary for me to remind this distinguished audience of the basic role which theoretical physics, and theoretical physicists, have played in the development of atomic energy,” Salam said in his address to the General Conference of the IAEA in 1960. “The basic notion that atomic energy can be

released in the service of men was the brainchild of two of this century's theoretical physicists—Albert Einstein and Niels Bohr. Even more pertinent perhaps is the fact that the very first nuclear reactor was assembled and actually constructed by a theoretical physicist—Enrico Fermi. The time has perhaps come when the Agency, in its turn, might pay back the debt by considering if it might sponsor an International Institute for Theoretical Physics. ... Such an institute needs no laboratories and no costly apparatus. All that is necessary is a modest building, a library and a few blackboards.”

Who benefits?

About 80,000 people from 170 countries have visited ICTP over its 40-year history to research and discuss topics ranging from elementary particle physics to the physics of condensed matter and of weather and climate. They stay for anywhere from a few weeks to a few years. Most attend special two- and three-week conferences on specialized topics, such as optics. Three-quarters of those who attend come from developing nations, especially those in Africa, Asia and Europe.

For some young scientists, involvement with ICTP has been a life-changing experience. Paul Buah-Bassuah is from the West African nation of Ghana. In the mid-1980s, as a graduate student in physics at the University of Cape Coast, he spotted a poster for a program at ICTP. The program did not require a recommendation from his academic advisor, a factor Buah-Bassuah said was important. “Graduates [rarely] return home after their study abroad,” he said, and he was not convinced that his advisors would have supported him.

Buah-Bassuah was accepted into the program, and it was through ICTP that he met his professional mentors: Denardo, Fortunato Tito Arecchi and Giuseppe Furlan. All three encouraged him to stay in Italy and pursue a doctoral degree at the University of Florence, which he did.

Rather than stay away, Buah-Bassuah then returned to Ghana, where Denardo, along with scientists F. K. A. Allotey and S. K. Adjepong, helped him establish a



Courtesy of Elettra

The Elettra Synchrotron Light Laboratory opened in 1993 atop a mountain overlooking Trieste. Currently there are about 20 operating beam lines which offer an important tool to ICTP researchers. Also on site is a laser laboratory created in the late 1990s with donations from various individuals and organizations. Ali Javan, the inventor of the helium neon laser, donated the first laser.

laser and fiber optics center at his home university.

The Ghana program uses laser-induced fluorescence to study local agriculture issues and laser spectroscopy to monitor drinking water and atmospheric pollution. As the nation expands its optical communications networks, some scientists on Buah-Bassuah's team also want to learn about fiber optic communication. Among them is Joanna Nkrumah-Mills, a master's degree student from the city of Akosombo.

Nkrumah-Mills' mother is a nurse with the local health ministry and her father is a surgeon. Virtually everyone in her family is in the health business, but Nkrumah-Mills has taken an interest in fiber optics, in part because she would like to play a role in helping her country modernize.

“In Europe, if you ask the layman, he would be able to tell you how fiber works,” Buah-Bassuah said. “In Ghana, he might have heard of fiber, but the details and the technological benefits, he doesn't know. If a technology has an immediate

use, the government will say, ‘OK.’ But money for R&D? There's nothing there.”

Buah-Bassuah helped Nkrumah-Mills attend a three-month program at ICTP in 2002; she also attended the 2004 winter college in optics. “I saw things I had only read about in books,” she said. “I met people [whose names] I had read in journals.”

Among those she met was Anthony Johnson, OSA's 2002 president and a long-time participant in the center's winter optics colleges. Now, OSA is purchasing a fiber kit for the Ghana team, and this summer, Nkrumah-Mills has been learning about how the kit works at Italy's University of Padova.

“I am learning how to handle and use most of the fiber-optic components that form the basis of what is used in telecommunications, and how to take measurements to characterize these components,” she said.

It is much harder for scientists in developing countries to develop professionally when they have limited access to top-notch equipment, Buah-Bassuah said: one is less likely to innovate, and therefore less likely to be invited to present at important conferences to network with fellow researchers.

ICTP has value on many levels, he said. In addition to the practical knowledge one receives, the connections with researchers from the developed world can be invaluable. “[With ICTP], you're not left alone to decay,” he said.

Pakistan's Imrana Ashraf Zahid agrees. “It is unthinkable for a female graduate student sitting in a small room to be called one day in front of an audience of highly reputed scientists for appreciation,” she said, speaking of her recent honor. “Both of us, Revati and I, belong to a region where there is some discrimination towards women. ... I believe there is great potential [for] women of this region and that they just need a little bit of encouragement and chances to prove their abilities. ... [ICTP is] working hard to offer scientists from developing countries those chances they would hardly come across in their own countries.”

Kim Douglass (kdoug@osa.org) is assistant managing editor of *Optics & Photonics News*.

Courtesy ICTP Photo Archives



Anthony Johnson (*right*) has worked closely with ICTP for more than a decade, offering assistance and training to young researchers from the developing world. Johnson represents OSA on a new ICTP optics advisory group, organized by Gallieno Denardo (*left*).

Advanced Studies in Photonics Research at the University of Maryland, Baltimore County, understands the importance of establishing and maintaining professional connections across oceans. ICTP has helped make some of these connections possible for him. In addition to being a regular participant in the institute's annual optics college, Johnson in 1988 was invited to participate in a program created by Abdus Salam to unite African and African-American scientists. The Edward Bouchet Abdus Salam Institute sprang from this meeting; it honors Edward

Alexander Bouchet (1852-1918), the first African-American to receive a doctoral degree in physics (Yale University, 1876). Johnson has traveled to Africa as part of various Bouchet meetings, and he is currently mentoring a graduate student from the University of Cape Coast in Ghana.

"There is so much talent that is untapped in the developing world," Johnson said. "Governments are starving scientific enterprises in many of these countries. Not only can we help these young scientists find out about the latest work in their fields, but occasionally we can have real influence over these governments."

Wanted: Optics Mentors

The Trieste System Optical Sciences and Applications (TSOSA) advisory group is a new body created to help the Abdus Salam International Centre for Theoretical Physics (ICTP) promote optical sciences in the developing world. Anthony Johnson represents OSA in the group, which also includes representatives of SPIE, the International Commission for Optics (ICO), two United Nations Agencies—the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the International Atomic Energy Agency (IAEA)—and science programs across Europe.

In addition to advising the center's leaders about programs for the annual winter college in optics, the group offers a vehicle for sharing news from the center with the global optics community. For this year's meeting in February, organizer Gallieno Denardo told the group that what the center needs most now are mentors.

More and more young scientists from the developing world are taking an interest in optics, Denardo said. At home, however, many of their universities lack the equipment and expertise to help them advance. About 100 people apply each year to a training program for doctoral students; ICTP can only accept about 15 of these students, many of whom have an interest

in optics, in part because of a limited number of mentors, Denardo said

Denardo's vision calls for recruiting a number of scientists from the developed world who would be willing to serve as mentors. The students would receive degrees from their home countries, but would correspond with an international expert in their chosen fields. The mentors likely would need to travel to Trieste occasionally to meet with students.

"The importance of this constant involvement cannot be emphasized enough," ICTP Director Katepalli R. Sreenivasan told the advisory group in February. "It is difficult to imagine bringing students here, training them, and then expecting them to go back to their home countries without support. We cannot just give students equipment and then stop. I am extremely anxious to see such a program thrive and succeed."

Johnson, director of the Center for



Kim Douglass



Paul Buah-Bassuah (*top*) and Joanna Nkrumah-Mills traveled to Trieste from the University of Cape Coast in Ghana several times to learn more about optics.

To learn more about serving as a mentor through the International Centre for Theoretical Physics, contact Gallieno Denardo at denardo@ictp.trieste.it.