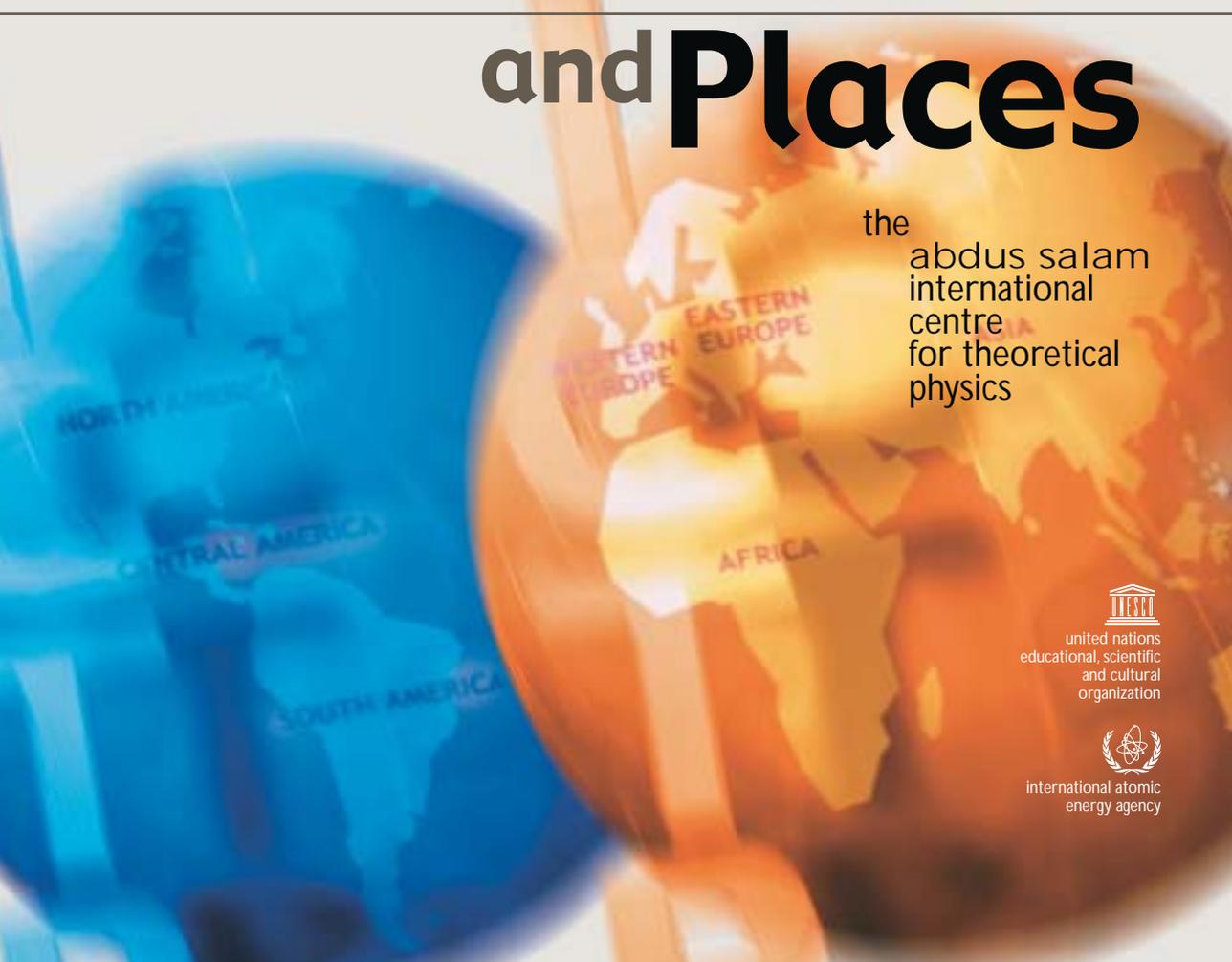




People and Places



the
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international
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and cultural
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international atomic
energy agency

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abdus salam
international centre for theoretical physics

People and Places



People and Places

Since its creation in 1964, more than 80,000 scientists have come to the Abdus Salam International Centre for Theoretical Physics (ICTP) to participate in the Centre's training and research activities.

While ICTP often focusses its attention on the many Nobel Laureates who come to the Centre to lecture at our workshops and conferences (some 50 Nobel Laureates have visited over the past three decades), we are equally proud of the thousands of young and mid-career researchers from the developing world who have come here as well.

Many of these scientists, who often consider ICTP their second home, have established distinguished careers in their own countries as scientists, administrators, and political officials.

Over the past several years, the ICTP Public Information Office has had the opportunity to interview a number of visiting scientists who are hoping to follow in the footsteps of their predecessors and to use their experience at ICTP as a springboard for future success.

What follows is their story largely in their own words—expressions of great optimism tinged with hints of anxiety for both themselves and the countries in which they were born.

These stories of people and places, written over the past five years, provide a rich tapestry of the human dimensions of the Centre. The presence of this men and women, a continual source of enrichment for the Centre, has helped make ICTP one of the world's most unique and valuable institutions for scientific research and training.

Lucero Alvarez Miño

► Physics on the Move

Colombia

Less than a decade ago, Lucero Alvarez Miño was finishing high school in Bogota, Colombia. Today, she's studying condensed matter at the Abdus Salam International Centre for Theoretical Physics.



November 1997. Lucero Alvarez Miño first encountered physics in 1985 when she was a junior in high school. "My interest in physics was evident during the first few classes. I was fascinated by the mind-puzzling problems that physics presented. I knew in high school that's what I wanted to do."

In early 1987, Alvarez entered Colombia's National University in her home town of Bogota. She had every reason to believe that she would be spending the next five years commuting between home and campus earning a degree in physics.

But Alvarez's life took a sharp turn to the east six months later, when she learned that she had received a fellowship to study at the University of Kharkov in Ukraine, then part of the Soviet Union.

"I had never crossed the borders of Colombia. Now, I was given an opportunity to travel more than 10,000 kilometres from home. I didn't know the language, I didn't know the culture. I didn't even know what the weather was like. But I knew I had to go. So, I packed my suitcase, had a long good-bye with my parents and sister, and off I went."

When she arrived at Kharkov, an industrial city of two million people, Alvarez learned that the University's physics department was welcoming some 80 new students—71 from the Soviet Union, two from Colombia, three from Cuba, and one each from Ethiopia, India, Spain and Sri Lanka.

"It was a cultural shock. But physics provided a foundation for all the foreign students. It was a way of communicating in an environment where other forms of communication were difficult."

Within a year, Alvarez had acquired a working knowledge of Russian and had narrowed her fields of interest in physics to condensed matter. She settled into a relatively comfortable life as a foreign exchange student.

Then, in 1991, the Soviet Union collapsed and Ukraine emerged as an independent nation for the first time in more than 70 years.

"The fall of communism had a tumultuous impact on science throughout the former Soviet Union. The Department of Physics at the University of Kharkov was by no means exempt from these historic events. Professors often found themselves working without pay."

"Students also had a rough time. Under communism, all graduates with advanced science degrees were guaranteed jobs. After the fall of the Soviet Union, students were told they would have to fend for themselves—and there were simply no jobs."

"I thought about leaving. But I had put in three years at the university. I was afraid that I would lose credit for all of that time if I quit and went home. Besides I loved the people. The multiculturalism that made it difficult for the Soviet Union to stay together also made it an interesting place to live."

So, Alvarez stuck it out—a young Latin American physics student living in exile in Ukraine during a period of revolutionary change. Only in 1994, with her degree in hand, did she return to Colombia.

Now, after spending the last two years teaching physics to prospective engineers in her home country, she's on the road again. The setting is different but the goal remains the same: to earn a doctorate in physics that would give

her an opportunity to teach full-time at a university.

Alvarez will graduate from ICTP's Diploma Course next October. She will then be off to a university—perhaps in the United States—to earn a doctorate in physics.

"A doctorate in physics has been a dream of mine since high school," says Alvarez, "and I've been fortunate enough to pursue that dream in some unusual places."

"Who knows what's next. I'm certain, however, that I will eventually return to Colombia as a full-time physics professor at the National University. I've seen the world, but I hope to spend most of my career in the country of my birth."

Lucero Alvarez Miño with fellow student at University of Kharkov, Ukraine

Titilayo Adelaja Kuku

→ TRIL-ing Experience

Nigeria

Titilayo Adelaja Kuku's career in science and engineering likely would have been short-circuited if not for the help of others. Today, Kuku continues to expand his career horizons through his participation in the Centre's Training and Research in Italian Laboratories (TRIL) programme.



April 1998. The journey from a remote school house in western Africa to a distinguished career in science and engineering has not been easy for Titilayo Adelaja Kuku, an associate professor in the Department of Electronic and Electrical Engineering at the Obafemi Awolowo University in Ile-Ife, Nigeria.

Since completing his schooling, Kuku has travelled to northern Italy on five different occasions to conduct research at the universities of Trieste, Parma and Pavia. While in each of the institutions, he has enjoyed access to excellent research facilities as part of the ICTP's Training and Research in Italian Laboratories (TRIL) programme. When Kuku comes to Italy, he has the added opportunity of visiting his older brother, Aderemi, a mathematics professor and researcher in ICTP's Mathematics group, who has played an instrumental role in his career.

Both Titilayo and Aderemi grew up in Ijebu Ode, a town of several hundred thousand people located about 100 kilometres from the Atlantic coast. Ijebu Ode serves as the capital city for the Ijebu language group.

"Nigeria has about 120 million people; only about 3 million are Ijebus. Yet, a large number of Nigeria's industrialists, business people and academics trace their roots to this small group," Kuku notes.

At 13, Kuku entered a five-year secondary school in Ibadan, a town some 80 kilometres from his home. State scholarships deferred some of the expense but his older brother also provided critical financial support.

Kuku's talents in science and engineering, first displayed at the secondary school, blossomed at the University of Ife (now Obafemi Awolowo University) in the early 1970s. That's where he received his undergraduate degree in chemistry. From there, Kuku left his native country to study in England at the University of Southampton,

where he received a master's degree in electronics, and then at Imperial College, where he was awarded a doctorate in electrical engineering.

"From the earliest days of my university education," Kuku explains, "I've always tried to straddle the worlds of basic and applied research. At the same time, I've always desired to apply my skills and talents in Nigeria."

Today, Kuku, who advises Nigeria's Energy Commission on issues related to photovoltaics, is seeking to establish photovoltaic production facilities in Nigeria through joint ventures with several Italian companies.

Despite these initiatives, Kuku has often been disappointed by events in his home country over the past 15 years. "Nigeria has been torn apart by political instability and undermined by severe economic difficulties. Both universities

and researchers have found it extremely difficult to receive sufficient funding."

"The University of Ife was founded in 1962," Kuku notes. "As an undergraduate student in the early 1970s, I found it a youthful, energetic place. The atmosphere proved extremely conducive to learning and research."

"When I returned to Nigeria in the early 1980s after receiving my doctorate in England, much had changed. A few numbers tell the story. The laboratory budget for the Semiconductor Programme at Imperial College exceeded US\$5 million. At the University of Ife, the budget for a similar programme did not even reach US\$500,000."

That's why ICTP's TRIL programme has been so crucial to his career. "Because of the economic difficulties in Nigeria, it has been impossible to maintain the

university's facilities, let alone provide new ones. My research would have languished without the generous assistance provided by the Centre in co-operation with Italy's laboratories."

Beyond the key role that the Centre has played in his career, Kuku appreciates how the ICTP nurtures an atmosphere in which scientists from the developing world can share their experiences. "It's always rewarding to come to Italy and meet people with similar backgrounds and problems."

"The daily treks that I took each day between my home and school so long ago remain fresh in my mind," Kuku warmly recalls. "They remind me that with determination—and a helping hand—even a small boy from a small town in western Africa can follow his dream."



Hong Van Le

→ The Prize

Viet Nam

Since 1983, the first year of the ICTP Prize, only one woman has ever been honoured. She's Hong Van Le. Today, Hong Van Le lives and works in Germany, not only proud of what she has accomplished but thankful for the help that the Centre gave her.



June 1998. Vietnamese-born mathematician Hong Van Le was the first and—for now—the only one woman ever to be awarded the ICTP Prize. She received the prize—in mathematics—in 1991.

"I'll never forget the time I spent at ICTP," recalls Hong Van Le, who remained in Trieste for about eight months in 1991. "It was my first extended stay in Western Europe; the first time I enjoyed access to sophisticated computer equipment; and the first time I could take advantage of an outstanding library. I fondly remember Salam, his smile and encouragement, and the people of the Mathematics group—not to mention the beauty of Trieste."

Math in Viet Nam has a brief but intriguing history that didn't truly begin until 1945, when the nation proclaimed its independence from France. "Before World War II," Hong Van Le explains, "elementary mathematics was the only math taught in Viet Nam."

"In the years following the war," she notes, "Viet Nam had only one Vietnamese mathematician with a doctorate—Le Van Thiem. He graduated from the French institute *Ecole Normale Supérieure* and taught mathematics at the University of Zurich, in Switzerland, before leaving behind a promising career in Europe in 1948 to join the resistance movement in Viet Nam."

When Vietnamese nationals defeated the French army in 1954, the doors of Hanoi University re-opened. But the university suffered from an insufficient number of qualified faculty, especially scientists. Virtually all the professors, most of whom had been born in France, left war-torn Viet Nam for more tranquil settings. "Le Van Thiem alone continued to teach mathematics. And he gave his lectures in Vietnamese instead of French, a radical concept in a country where the native language had never been used either in universities or high schools," Hong Van Le explains. "I think it's fair to say that almost all teachers who taught mathematics to students from my generation were former students of Le Van Thiem."

"Despite 30 years of war and economic hardship," Hong Van Le says, "mathematics in Viet Nam evolved rapidly from the time independence was declared in the mid 1950s to the mid 1970s, when the war with the United States finally ended."

Hong Van Le notes, "I know almost no Vietnamese mathematician who has not studied abroad, usually in the former Soviet Union. At the same time, eminent mathematicians from many nations—both in the East and West—visited Viet Nam during this time."

Why did Hong Van Le become a mathematician? Her answer is simple: encouragement from her parents and teachers.

"I acquired my love for math from my parents. When I was 10 years old, they urged me to take part in a competition for children who showed promise in math. I did well and what followed was typical for many young Vietnamese students of my generation. In 1978, I went to Moscow State University, where I was a student of Anatolii Timofeevich Fomenko, who supervised my work in differential geometry and helped determine my career path."

After her stay at the ICTP in 1991 as a visiting mathematician, Hong Van Le went to the Max Planck Institute in Bonn, Germany. There, she married a German geneticist, Karsten Fritzsche, whom she had originally met in Moscow. Their first child was born in 1994; their second in 1998. Hong Van Le currently works at the University of Leipzig's Institute of Mathematics.

"I returned to ICTP in the summer of 1993 for a conference on differential geometry. Again, I was impressed by how the Centre nurtures professional exchanges among colleagues from around the world. ICTP is a truly international site, without the anti-foreigner sentiments I have often found in other countries in eastern and western Europe."

*Hong Van Le with
Professor Abdus Salam,
1991*



Peyman Khorsand

► Fields of Dreams

Iran

From soccer to science, after years of isolation, Iran is sending signals that it wants to rejoin the world community. A youthful ICTP Diploma Course student talks about the impact that these changes may have on his life and the lives of millions of other Iranians.



August 1998. People danced in the streets of Tehran all night long. Dancing is illegal in Iran, but the government did not interfere. For the first time in decades, people were allowed to enjoy themselves in public.

That's how Peyman Khorsand, an ICTP Diploma Course student in high energy physics, describes events in Iran's capital city following his soccer team's victory over the United States in the 1998 World Cup competition. For Khorsand, the image hints at the changes that he would like to see take place in the years ahead.

"Iranians are dedicated to their culture and religion. But they don't want to be isolated from the rest of the world and they certainly enjoy celebrating their accomplishments. What the majority of people want, I believe, is balance in their lives and now for the first time in a long time, there are some small signs that my nation is willing to move in new directions."

Change and balance have also been major themes in Khorsand's life since he arrived at the Centre in October 1997.

"I'd never been outside of Iran until then. It was both an exciting and difficult decision. My mother was particularly sad because it meant that one of her two sons was leaving her household and wouldn't be returning for a long time. But she knew it was something I had to do."

Khorsand's journey began about a decade earlier in secondary school when his talents in physics first surfaced. "I was not much of a student during my early schooling. I spent more time playing soccer than studying," Khorsand recalls. "But when I moved from primary to secondary school, I became fascinated with physics. Excellent teachers helped nurture my interest."

At 17, Khorsand became one of 40 teenagers nationwide—out of a pool of 12,000—honoured as top science students in the selection process for the Physics Olympiad. When the list was pared to 7 he was still on it. Only when it was reduced to the final 5 did he fail to make the cut.

"My teachers had always been encouraging, but I didn't think I was good enough to excel among students nationwide," says Khorsand. "The competition helped build my confidence and make me realise that I wanted to pursue a career in physics." Equally important, as one of Iran's top 7 science students, Khorsand was allowed to enter the university of his choice. He selected Sharif University of Technology in Tehran, which has the nation's best physics department.

"Iranian universities offer excellent teaching, especially for undergraduates," Khorsand explains. "There's often a small group of dedicated professors who spend a great deal of time with their students. Since travel is limited

and publication opportunities restricted, teaching takes precedence over research."

Yet, what works on the undergraduate level, carries serious liabilities for those seeking more advanced degrees. "Like the nation itself, scientists working in Iran are isolated from the rest of the world. Communication and interaction are the lifeblood of science. When these forces are short-circuited, research becomes impossible."

For these reasons, Khorsand was delighted to be accepted to ICTP's Diploma Course last autumn. "A poster about the programme had been tacked onto a university bulletin board and a friend of mine urged me to apply. Within a couple of months, I was on an aeroplane headed toward Trieste. No one was more surprised than me by the turn of events."

Khorsand has made good use of his time at ICTP. Seifallah Randjbar-Daemi, head of the Centre's High Energy group, says that he has been one the Diploma

Course's top students—in fact, the only student in his class to graduate with a straight 4.0 grade point average. Khorsand, who has completed a thesis on string theory, has been accepted to Northeastern University in the United States, where he plans to pursue a doctorate degree in physics beginning this autumn. "That's where I'll go, if visa arrangements can be worked out."

"Right now, more Iranian-born physicists with advanced degrees work in foreign countries than in their homeland," says Khorsand. "Most, I believe, would come back if they were assured of reasonable working conditions. That's what I would like to do when I complete my studies."

"Perhaps what happened on the World Cup soccer field in France and then the streets of Tehran this summer will mark the beginning of changes that will slowly ripple across Iran and allow people to pursue lives that don't require them to make uneasy choices between their families and careers. I know I echo the sentiments of many Iranians when I say that's the hope for the future."

Peyman Khorsand receiving the Diploma of ICTP



Wang Wei

→ Making the Grade

China

China's government recently launched new policies to strengthen scientific institutions and encourage young researchers to pursue their careers at home. For former ICTP post-doc Wang Wei, such initiatives mean new and exciting challenges.



March 1999. When the Chinese government speaks about providing a nurturing environment for its young scientists, physicist Wang Wei, 37, is undoubtedly the kind of person they have in mind.

Born in 1962 in Changsha, a city of some 3 million people that serves as the provincial capital of Hunan province in south China, Wang Wei graduated from middle school in 1978, just as China's Cultural Revolution was fading into history.

"During the Cultural Revolution, local educational offices selected students for universities located in their provinces," Wang Wei notes. "Moreover, at the beginning of the revolution, the national government cut the total number of university students in half."

Not surprisingly, these policies created a backlog of qualified students eager to begin their university studies. As a result, the government's nationwide competitive examinations in 1978 were taken by millions of young people—not only Wang Wei's fellow classmates but many others who had graduated during the previous 10 years. Despite the competition, Wang Wei did well enough on the examination to gain acceptance into Nanjing University (NU).

Since then, Wang Wei's career as a student, professor and researcher has been characterised by a steady rise in both skill and prominence. In 1982, he received an undergraduate degree in theoretical physics, and in 1985, a master's degree. During the mid 1980s, in addition to his studies, he also taught and lectured—all at NU.

In 1987, Wang Wei's talents were again rewarded when he was selected for a joint doctorate program in experimental physics at the University of Sussex in the United Kingdom. Upon his arrival at the university, however, the experimental equipment that was to serve as the basic tool for his experiments was not working. To fill his time, Wang Wei again turned his attention to theoretical physics—in his own words, "picking up where I had left off in China. I was not disappointed by this

turn of events because in truth I was more interested in theoretical physics than I was in experimental physics."

In 1990, Wang Wei returned to NU to resume his teaching and research responsibilities. As an associate professor, he quickly advanced through the ranks of academia before reaching his thirtieth birthday. Then, in 1991, Wang Wei attended ICTP's Summer Workshop on Condensed Matter Physics.

One of the organisers there was ICTP staff scientist Hilda Cerdeira, who encouraged Wang Wei to apply for a post-doc position at the Centre, which he was awarded in 1992.

While a post-doc at ICTP, Wang Wei also published an article on the dynamical behaviour of neurons in *Physical Review E*. "At the time," he says, "the article was outside my main research area, but the effort drew my attention to the field of biophysics. Little did I know then that it would lay the

groundwork for a career change just a few years down the road."

Wang Wei again returned to China in 1994, where he resumed his teaching and research responsibilities at NU. In 1995, Wang Wei's experience at ICTP and, more specifically, the article on neurons that he had published several years before proved major factors in his appointment to lead a new university group involved in biophysics.

"The initiative," he acknowledges, "posed major risks. Not only did researchers in my group have to shift fields but we had to teach ourselves about biology while maintaining our teaching and research responsibilities. In effect, we had to learn new material and apply it simultaneously."

The group, which now consists of four full-time researchers plus eight undergraduate and 15 graduate students, has proven worthy of the challenge. "Since our inception three years ago," Wang Wei observes, "we

have graduated two classes in biophysics. Some of our students are now at New York University and the University of Kansas in the United States, earning master's and doctorate degrees."

With his new group gaining both presence and strength, and two recent grants from China's National Natural Science Foundation worth some US\$120,000 in hand, Wang Wei notes that "the future looks good." Although conditions have improved, he quickly adds that "China's researchers still need outside help if they hope to continue to make progress."

"That's where institutions like ICTP come into play," he says. "Such institutions offer sound training and a stimulating research environment, encouraging people like me to pursue careers in science that are both personally rewarding and of long-term value to our home countries."



Rula Tabbash

→ Energy and Commitment

Syria

Rula Tabbash first learned about physics as a young child growing up in Syria. Two decades later, Tabbash is expanding her knowledge of physics with help from ICTP and the International School for Advanced Studies (SISSA).



June 1999. Throughout her education and travels, Rula Tabbash has maintained a childlike fascination with the physical world in which we live. Such enduring interest has taken her from her hometown, Aleppo, Syria, where she studied physics at Aleppo University, to Trieste, Italy, first as a student in ICTP's Diploma Course in high energy physics and now as a doctoral student in elementary particle physics at the International School for Advanced Studies (SISSA).

When it came to physics, Tabbash excelled within her own country. Yet, her performance at school, which won her many accolades at home, tended to leave her somewhat behind when she arrived in Trieste in 1995 to begin her year-long studies in ICTP's Diploma Course.

"Texts used by students in Syria," Tabbash explains, "were often out of date and the teaching not on par with the instruction that other Diploma Course students had received."

As a result, Tabbash adds, "I found myself at a disadvantage during the early weeks and months of ICTP's Diploma Course."

Luckily for Tabbash, the Diploma Course recognises that incoming students will possess different levels of knowledge and skills, largely as a result of the previous schooling they have received. For this reason, the first few months of the course are devoted to 'levelling the playing field' to ensure that all students—regardless of their backgrounds—can keep pace during the second half of the course when the instruction picks up steam and delves into new subject areas that none of the students have learned before.

"I really took advantage of the first few months of the Diploma Course to build a strong foundation in university-level physics that has served me well ever since. The doors of the professors teaching the courses were always open and I was not shy about asking for assistance. Antonio Masiero, Seifallah Randjbar-Daemi and George Thompson were particularly helpful. I don't think I would have been able to make it through without their guidance."

"Despite the competition, the students offered support to one another both inside and outside the classroom," Tabbash adds. "Through our study groups and after-study activities, we nurtured a sense of community that has led many members of the class to stay in touch despite the vast distances now separating us. Weekly e-mails among my friends in Brazil, Germany, the Netherlands, and the United States are not uncommon, and I suspect that they will continue as our careers and lives unfold."

After successfully completing the ICTP's Diploma Course, Tabbash was accepted to doctoral programmes at both the National Institute for Nuclear Physics and High Energy (NIKHEF) in Amsterdam, the Netherlands, and *Scuola Normale Superiore* in Pisa, Italy.

"I decided to turn down those offers when I learned that I was accepted to SISSA's doctoral programme," she says. "The close interaction between SISSA, ICTP and the University of Trieste's Department of Theoretical Physics creates a unique learning environment that I don't think is replicated in many other places."

Tabbash was only one of four students (out of nearly 40 who had applied) to be accepted into SISSA doctoral programme in physics in 1998—testimony to the progress she had made since her arrival in Trieste two years earlier. Her field of study at SISSA is elementary particle physics and her supervisor is Antonio Masiero, her former Diploma Course professor.

"I'm convinced," Tabbash says, "that there's a direct link between childhood fascination in physics and my current

studies at ICTP and SISSA. It's all part of a life of learning that never begins too soon and never ends."

"After completing my studies in Trieste and a postdoc either in Europe or the United States, I hope to convey some of the joy of learning that I have experienced here when I return to Syria. Giving something back to the scientific community in my country is the least I could do to express my appreciation for what so many others have done for me."



Hem Raj Sharma

▶ Thinking Ahead

Nepal

Hem Raj Sharma, from Nepal, not only hopes to excel as a physicist but to raise the importance of physics in the country of his birth. His association with ICTP has enabled him to get off to a promising start on both fronts.



August 1999. Like many other young Nepalese students, Hem Raj Sharma's first ambitions in high school leaned towards medicine or engineering, which are regarded as secure career options with good earning potential.

Despite excellent grades in his high school graduation exams in 1989, Sharma didn't quite make it into either of these extremely competitive areas. He opted instead to study physics at Nepal's Tribhuvan University, the only university in the country to offer a master of science degree. Physics, Sharma thought, would allow him to switch to engineering at some point in the future.

A redirection in career plans was not the only major change he had to make when he arrived at the university in the bustling capital city of Kathmandu. Sharma comes from a remote rural district without electricity or running water and he was taught in Nepalese, not English, at his state high school. Within a few weeks, Sharma had to get used to a relatively new subject, a very different way of life and an unfamiliar language.

He withstood the challenge. In fact, changing culture, country and language seemed to have become mainstays of his still early career as he moved from rural to urban Nepal and then Japan and Italy.

Once he arrived at Tribhuvan University, it became obvious that he and physics were going to get along just fine. In his first year, he was the top student in his class and the next year the top student in the entire college—a position he maintained, winning the gold medal for physics when he graduated with a master in science degree majoring in solid state physics. His record made him the obvious choice to represent his university on a one-year student exchange with Rikkyo University in Japan, where he studied photoemissions. The exchange took place in 1997.

In Japan, Sharma was impressed by his colleagues' autonomy and depth of knowledge—they were left to study on their own more than he was used to in Nepal and had access to a wider range of equipment and published material. The latter, however, proved difficult for Sharma who did not read Japanese and often had to wait weeks for English-language versions of manuals to arrive. Typically, he started to learn the new language and, by the end of his stay, he could get by, despite a few problems with hard-to-translate technical terms.

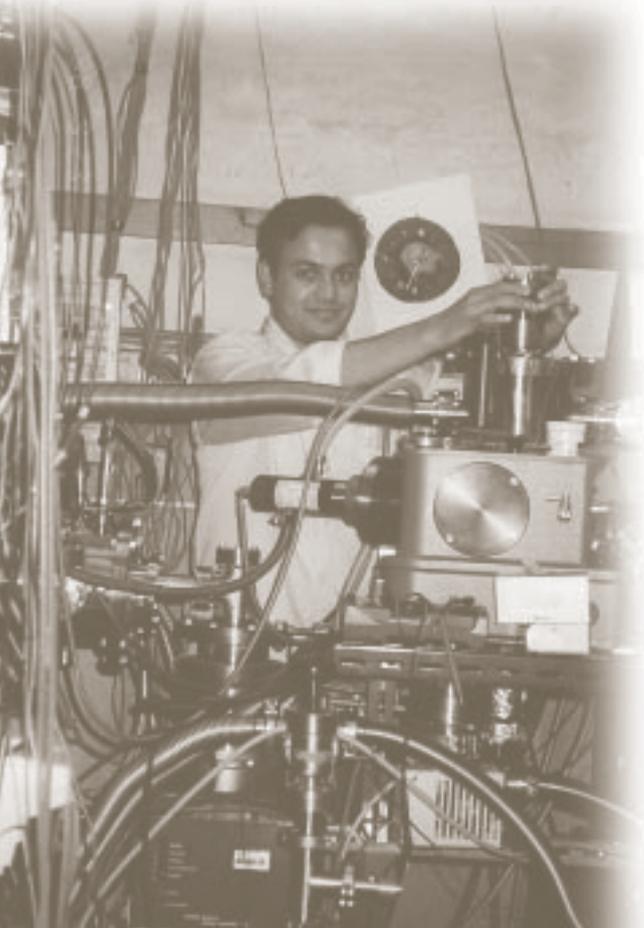
Once back in Nepal, he would have been qualified to select engineering, but chose to stay with physics. His next move was to ICTP as a Diploma Course student in condensed matter physics. That proved one of the most decisive moves of his career. Not only did it allow him to see that he was on the right track both scientifically and professionally, but it brought him in contact with scientists from all over the world and helped him to formulate and realise new plans and ambitions.

Sharma managed to combine his studies with participation in an INFM-TASC's (Italian National Institute for the Physics of Matter-Laboratory of Advanced Technologies, Surfaces and Catalysis) research project on photoemissions. This experience, he believes, helped him win a place in a Ph.D. programme at *Freie Universität Berlin* in Germany in 1999, where he will spend the next three years pursuing research on helium atom scattering and surface physics.

Sharma would then like to return to Nepal to help establish physics as a valid and valuable field of research in his native country. At the moment, there are few career options for physicists other than teaching and, as the son of a social sciences teacher, he has seen first hand why the underpaid and overworked life of a teacher may not be enough to encourage young Nepalese to continue their study of physics beyond their first degree.

Sharma would like to change that by creating research opportunities in Nepal. He does, however, realise that such a change will likely take place only gradually in a country where government spending priorities must focus on such critical areas as food security.

Sharma, who has been in contact with several like-minded Nepalese colleagues, hopes to get something going within the next few years, possibly starting with research related to computational science before branching into other areas. In the meantime, he plans to continue his research abroad, preparing himself to bring home as much physics learning as possible when the right moment arrives.



Santos Asin Lares

→ Math Mission

Mexico

To Mexican mathematician Santos Asin Lares, his fascination with the elegance of numbers and theorems all adds up to a life of intellectual freedom.



September 1999. If you have the image of mathematicians as dry, crusty characters shut away in their studies, you should meet the sociable Asin Lares, who'll soon show you math's more human side. Even his first encounter with the subject was the result of light-hearted chatting with friends. In fact, he claims that, like many of his fellow high school students, physics and math captured his imagination when the television series *Cosmos* was first shown in his native Mexico in the early 1980s. Although biology had been his forte until then, he soon found that his true passion was for pure mathematics, which he decided to study as an undergraduate at the *Universidad Complutense* in Madrid, Spain.

The move abroad so early in his career was more the result of the situation in Mexico than of any conscious decision on Asin Lares' part. In the late 1980s, a strike at the National University of Mexico, the country's most prestigious institution of higher education, meant that no undergraduates were being admitted. Rather than risk starting a course at a private university, where facilities for math and physics are limited and there are constant threats of sudden closure due to financial problems or dwindling student numbers, he decided to go straight to Madrid. From there, he went to the University of Warwick in the United Kingdom for a master's and doctorate degrees in pure mathematics. Then in 1999-2000, he spent a year at ICTP as a long-term fellow, involved in post-doctorate research in differential geometry.

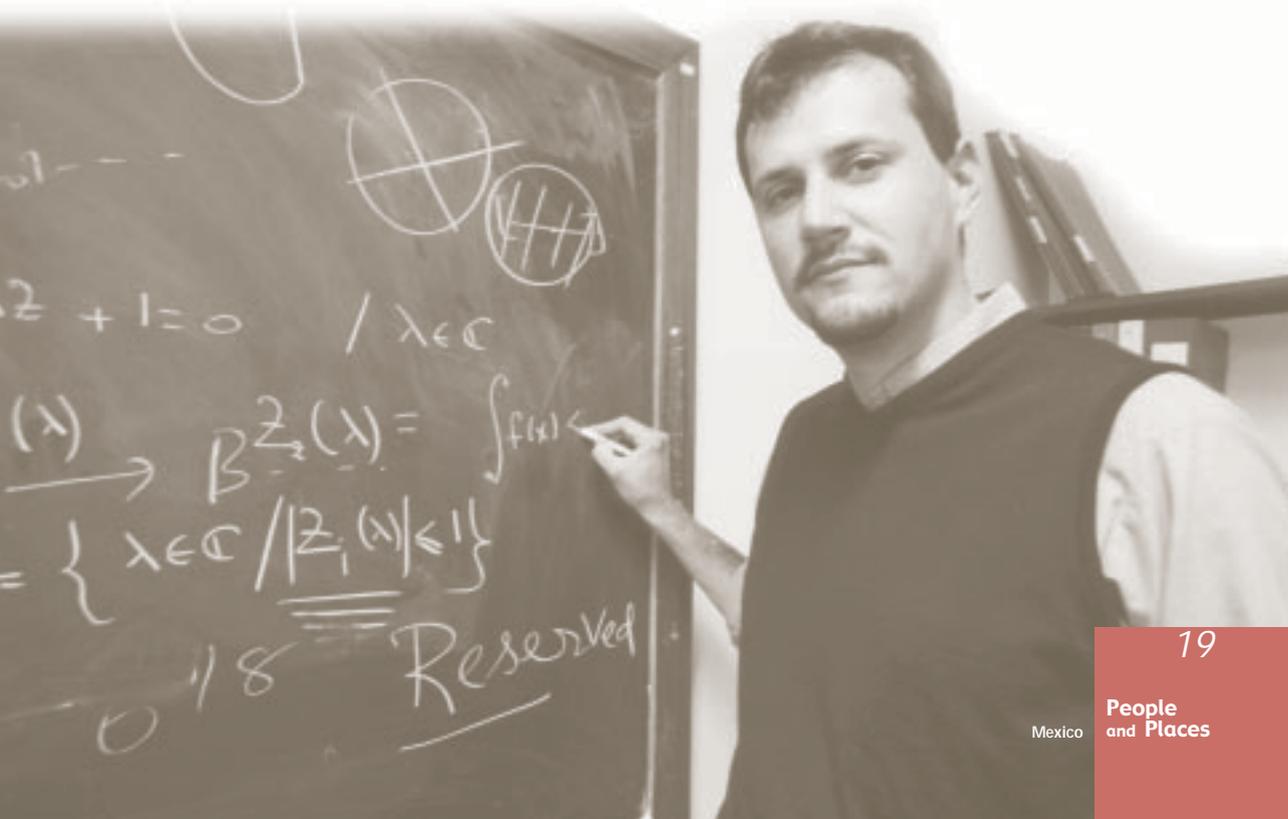
Asin Lares' pure enthusiasm for pure math is always on display. From the start, he was drawn by math's universality, seeing it as the language that codifies a massive range of phenomena from the movement of planets to the cutting of a cake. He particularly likes that what he works on each day often ends up having all sorts of surprising applications in the future.

Originally, however, he followed the school of thought that believes math is a 'romantic' subject for thinkers and dreamers who prefer to deal with theories, not reality. While at Warwick, he first came to understand how abstract mathematical principles can be applied to very practical areas. He also started to see how marketable his math skills were in terms of possible career options.

This didn't make him waver in his dedication to research and he was not tempted by the lucrative posts that many of his colleagues pursued in banking and commerce. In his view, the lower salaries that research attracts are a small price to pay for the privilege of spending his working hours doing something he feels passionate about—and he'd rather pay that price than find himself dreading Monday mornings, which some of his better-paid friends do.

Not that math research is the only thing that makes Asin Lares tick. He's a great conversationalist. If you want a simplified explanation of a complicated mathematical theory, he's the right person to ask. He'll pause for a few seconds before putting it into everyday terms, illustrated with easily grasped examples that even the least mathematically minded can understand.

For the foreseeable future, he plans to do research. However, like both his parents, who have changed careers and occupations frequently to adapt to changing circumstances, he retains a flexible attitude to the future. Exactly where he's going next is an open question. It may well be back to Mexico to join another research project with some colleagues he's met in Europe. But he's not making any hasty decisions for several reasons. The most important is that his Turkish girlfriend, who he met in the United Kingdom where she is working towards a Ph.D. in law. In the meantime, whatever and wherever the future brings him, he's enjoying the ICTP experience and the stimulation of being free to work on what interests him with a group of new like-minded colleagues from all over the world.



Maria Liz Crespo

→ True Compass

Argentina

Argentinean computer scientist Maria Liz Crespo calculates a bright future based in part on the experience she's acquired in ICTP's Microprocessor Laboratory.



December 1999. Maria Liz Crespo loves the flash of inspired enlightenment that comes from mulling over concrete, practical problems that have concrete, practical solutions. At high school in Argentina, this drew her towards certain branches of science and, although computer science was neither a major part of her school curriculum nor a particular passion at the time, she realized that it could offer exactly the challenges she was looking for.

That's the subject she opted to study for her master of science degree at the National University of Argentina in San Luis. Since then, her belief has been confirmed, and she continues to enjoy exploring the ever-growing list of increasingly sophisticated applications to which computers can be put.

Her mother and father, who has his own business in La Pampa, encouraged both their daughters to follow their career plans and Crespo's sister is a chemist at the National University.

After her degree, Crespo continued at the National University as an assistant professor in the microprocessing laboratory where she's been for the last five years devoting about half her time to teaching and half to research. It's a combination she enjoys, although, at least for the next year or so, she will be concentrating on research while on sabbatical to ICTP's Microprocessor Laboratory where she's involved in the Geneva-based COMPASS research project in high energy physics. Her contribution to the project is in developing methods and techniques for using computers to process vast amounts of data in a short time—a particularly useful tool for those who base their research on broad surveys, for example. Crespo's work, in short, will be used by other computer scientists to design programmes and software that make new applications more readily available to computer users.

Crespo's first visit to ICTP took place in 1997. A senior professor at the microprocessor laboratory where she works in Argentina suggested she accompany him on this visit and she quickly took advantage of the invitation to join the prestigious COMPASS project.

Computer science is a growth area in Argentina which, like other more advanced developing countries, is rapidly establishing a national and international industry in the field. As a result, compared with young scientists from other parts of the world, Crespo does not feel that her studies have suffered from a lack of funds and resources at home. All the same, there aren't many projects worldwide on the vast scale such as the one she's working on now.

While her first visit here marked her first time abroad, she hasn't experienced the culture shock that other colleagues often do when they arrive in Trieste. Her open and easy-going personality helped. Culturally, too, she feels at home in Italy, where even the language is similar to her native Spanish. Integration has probably been made even easier by the Italian boyfriend she met here.

Argentinean scientists are encouraged to study abroad throughout their careers so that they can expand their horizons and bring home experience and knowledge gained from institutions and projects in other parts of the world. Crespo sees her future in Argentina, but she expects to be making other trips abroad in to take part in more research projects.

In the meantime, while the research she's doing remains particularly rewarding, she misses teaching which she finds stimulating and helpful to her own research. She also likes the close contact with others that teaching provides and often finds herself thinking about the students she has taught, wondering how they are getting on with their studies and research projects. Doubtlessly, they'll tell her when she returns.



George Nkrumah

→ Physics Pioneer

Ghana

After learning first-hand how difficult it is to make up for inadequate training during the early school years, George Nkrumah is determined not to let that happen to younger Ghanaian physicists who follow in his footsteps.



February 2000. Throughout his high school years in his native Ghana, George Nkrumah excelled at biology. As a consequence, it looked as though his future lay in medicine—his father is a health official who, having retired from the public sector, now runs his own clinic. However, when it came to university entrance, Nkrumah didn't make the grade for this popular and demanding area. So he shifted to physics and math, gaining a bachelor of science degree from the University of Ghana at Accra.

Physics and math captured Nkrumah's imagination, as he began to understand the wide range of applications to which it could be put. He sees physics as having the potential to explain virtually everything that we can see and capable of solving a host of practical problems through a combination of theory and experimentation. He'd like to help his country make the most of this potential and, although he also enjoys research (his main areas of interest include polarons, superlattices and electronic structure calculations), he sees a teaching career as one of the best ways to achieve this aim.

He has wasted no time in working towards his goal. Immediately after graduation he began to teach physics and general science at a girls' high school and a junior secondary school. He remained there for a few years, before returning to the university as a teaching assistant in the physics department, while also working towards a master's degree in theoretical solid state physics. He then spent a year as a Diploma Course students in condensed matter physics at ICTP in 1998-1999 before returning home to continue putting his longer-term career plans into action.

The life of a physicist is not easy in Ghana, where Nkrumah feels that science in general, and physics in particular, do not attract the government support and funding they deserve. While studying for his degree, he saw how much his often overstretched teachers must work to make up for a severe lack of resources and up-to-date literature.

His first few months at ICTP were particularly difficult as he had to study overtime to catch up on certain aspects of the subject that were already familiar to colleagues from other countries. Another of the side-effects of having overworked professors at home was that he had been left largely to his own devices and free to set his own pace for learning. For this reason, when he arrived in Trieste, he had to adjust to working under closer supervision and at a speed that was not always his own.

In Ghana, there are only limited opportunities for advanced study and research in physics. Nkrumah himself had to move from the university campus at Accra to Cape Coast to find the facilities necessary for his master's studies that were missing in the capital. There are also few openings for qualified physicists other than teaching, which is a poorly paid and unattractive field for ambitious young scientists.

Nkrumah wants to change this negative image, and he's already done enough teaching to know that it's an area he finds particularly rewarding. He has the right combination of communication and listening skills to allow him to enjoy the exchange of ideas while deriving great personal and professional satisfaction from clarifying aspects of physics that he had to struggle to grasp by himself. Having gone through his own trying moments, he wants to do all he can to help other people appreciate physics as much as he does, motivating them to carry their studies further and bringing the subject the recognition it deserves at the national level.

Not surprisingly, he's received the enthusiastic support from his professors and senior colleagues who seem to value him as much as he values them. They know the importance of dedicated physicists and teachers like Nkrumah, and it was they who encouraged him to move to Cape Coast for his master's, and then to come to ICTP. They are now ready to welcome him home to Ghana and backing his next step—earning a Ph.D.



Ivane Murusidze

► Tradition and Transition

Georgia

ICTP Associate Ivane Murusidze remains optimistic that his native Georgia can regain its footing in science after a difficult period of transition.



March 2000. When ICTP Associate Ivane Murusidze leaves Trieste to return to his home in Tbilisi, Georgia, in early May, it will mark the end of his third visit to ICTP during the past six years. Murusidze, who is trained as a plasma physicist, is thankful for the opportunities that the Centre has provided him during a period of unprecedented change for both scientists and scientific institutions in his home country.

Georgia is one of the 'newly independent states,' located between the Black and Caspian seas in the Caucasus, that re-emerged after the collapse of the U.S.S.R. in 1991. "Our problems," Murusidze notes, "are similar to the problems faced by other republics that belonged to the Soviet Union. Economically, we now resemble a developing country, but scientifically we do not."

In fact, Georgia has a long tradition of excellence not only in science but in other fields of inquiry—for example, history, philosophy and the arts—that date back to the 12th century. "Our culture has a deep and abiding respect for education," he notes, "and that respect has found expression in the accomplishments of our teachers, humanitarians, artists and scientists."

Murusidze cites the work of Elever Andronikashvili, who served as the director of the Georgian Academy of Science's Institute of Physics between 1950 and 1988, as a prime example of his country's enviable history of scientific excellence. Andronikashvili is considered to have been one of the world's foremost condensed matter physicists.

"Under communism," Murusidze says, "scientific institutions were part of a large, politically powerful network able to secure sufficient resources to sustain high-level research in physics and many other fields."

"Today, however, we are in a period of transition. Our ties to the Soviet system of science have been severed and we have yet to develop a fully functioning market economy." As a result, funding for scientific institutions has declined dramatically. "In the late 1980s," Murusidze notes, "about 200 physicists worked at the Georgian

Academy of Science's Institute of Physics." Some former employees have retired, some have moved to the West and some have migrated to other fields, notably computer science and business. Despite the exodus, the scientists who remain continue to do excellent work.

Murusidze acknowledges that the benefits he derives from his association with ICTP "may be different from the benefits derived by his younger colleagues from other parts of the world where scientific institutions have not been strong."

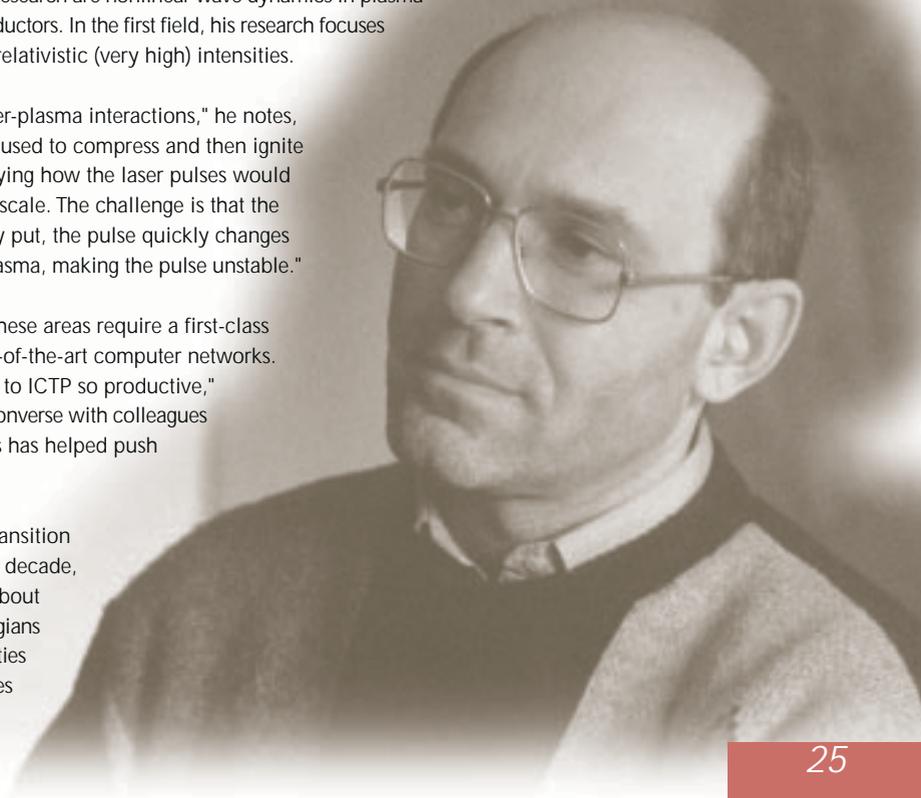
At the same time, he maintains that the benefits he has received from his ties to the Centre are no less valuable. ICTP is a "unique place that has enabled me to remain in contact with colleagues who share my research interests. The Centre's library and computer facilities have also proven invaluable. No other single library in Europe houses as comprehensive a collection of journals and monographs in physics and mathematics. Meanwhile, the capacity and speed of the Centre's computer network has facilitated my efforts in model building and simulations, which has proven indispensable to my research. I owe a particular sense of gratitude to Swadesh Mahajan, who has been course director of the College in Plasma Physics for many years."

Murusidze's two major fields of research are nonlinear wave dynamics in plasma and nonlinear optics in semiconductors. In the first field, his research focuses on laser-plasma interactions at relativistic (very high) intensities.

"Small-scale experiments in laser-plasma interactions," he notes, "have proven that lasers can be used to compress and then ignite plasma. Scientists are now studying how the laser pulses would interact with plasma on a large scale. The challenge is that the relationship is nonlinear. Simply put, the pulse quickly changes the material properties of the plasma, making the pulse unstable."

Theoretical investigations into these areas require a first-class research environment and state-of-the-art computer networks. "That's why I've found my visits to ICTP so productive," Murusidze says. "Being able to converse with colleagues and utilise the Centre's facilities has helped push my research forward."

Despite the difficult period of transition Georgia has faced over the past decade, Murusidze remains optimistic about his country's future. "Young Georgians continue to come to our universities to learn science and their families continue to value science as a noble endeavour. These are encouraging signs for my country."



Marie-Claudine Andriamampianina

→ Islands of Information

Madagascar

ICTP Associate Marie-Claudine Andriamampianina has altered her field of study to take advantage of the opportunities presented by ICTP's Weather and Climate Group.



June 2000. A geophysicist by training, ICTP Associate Marie-Claudine Andriamampianina has recently shifted the focus of her research to the physics of weather and climate. The reason: Although surrounded by water, her native country of Madagascar has been increasingly plagued by drought and spreading desertification, especially the southern third of this island nation. While other island nations worry about the erosive impact of rising sea levels on the integrity of their shorelines (some nations even fret about eventually being swallowed up by sea water), Malagasy scientists fear that alterations in the environment will accelerate evaporative processes and create even drier conditions in regions of their country that already thirst for more water.

"The problem," explains Andriamampianina, "is due to two factors. First, unwise land use practices—notably, widespread careless cutting of forests and burning of underbrush—have reduced the soil's water-retaining qualities. Second, the regional effects of global warming have made southern Madagascar a bit warmer and drier."

Studying trends in the regional climate of Madagascar, Andriamampianina explains, could help her nation better understand the forces at work and thus become a critical factor in devising effective solutions—or, perhaps more realistically, adjustments—to climate-related problems that threaten the future environmental well-being of a third of Madagascar's land mass.

"We are a relatively small country with a sparse population," notes Andriamampianina. "Our per capita income is less than US\$300 a year; our economy is largely resource-based (coffee, cloves, vanilla beans and rice constitute our major crops); and, despite a lush humid corridor along the east coast and fertile valleys in the central plateau, the fact is that less than 5 percent of the land is arable. All these factors mean that we can ill-afford to ignore the potential adverse impacts of a drier, more arid, climate."

While Andriamampianina is convinced that her new research focus can make a difference for her nation, she realises that Madagascar's isolation (another consequence of geography), combined with its limited resources, make it impossible for her to study regional climate patterns at home. "We have internet access," she says, "but the connections are slow and prohibitively expensive to use. That's why when I come to ICTP, I download and print as much information as possible. I then

take the printed copies home with me to use as source material both for my research and teaching."

But it's not just the data that she finds valuable; it's also the training she receives at ICTP that has helped place her research and teaching on a firm footing. Andriamampianina was selected as an ICTP Associate in 1997 and visited Trieste for the first time in 1998 to attend the Colloquium on the Physics of Weather and Climate: The

Effect of Topography on the Atmospheric Circulation. She has returned this summer for the Colloquium on Chemistry-Climate Interactions.

"When people read about global warming, the first question they often ask is whether the world is getting warmer. But the most meaningful impacts are likely to take place on a regional scale, and depend largely on how global climate trends interact with environmental conditions that vary from one place to the next. The regional focus of ICTP's Weather and Climate Group, together with its emphasis on the developing world, make the group a particularly useful member of the climate change research community. As the potential impacts of global warming move to the top of the science agenda in nations like my own, there's a good chance that the Centre will be one of the places that we turn to both for access to the latest data and for high-quality training."



Joseph Várilly

► Cultures and Disciplines

Costa Rica

A new book recently published by ICTP Associate Joseph C. Várilly seeks to explain the principles of noncommutative geometry to both mathematicians and physicists.



July 2000. Newly appointed ICTP Associate Joseph C. Várilly has been a professor of mathematics at the University of Costa Rica for more than 20 years. But that hasn't thinned his Irish blood or softened his Irish character. Even when the lilt in his accent doesn't give him away, his easy-going story telling and self-deprecating humour does.

Várilly's journey from the isle of Ireland to the isthmus of Costa Rica began about 30 years ago in Dublin, where he earned his bachelor's degree in science from University College in 1973. Várilly was then accepted at the University of Rochester in the United States for graduate studies in mathematics. Gérard G. Emch was his major professor; quantum statistical mathematics his major research field.

While working towards his doctorate degree, which he earned in 1980, Várilly spent a year at the University of Campinas in Brazil. There he met a Costa Rican woman. "The rest," Várilly says, "is history." In 1979, he moved to his wife's native country, where he has been ever since.

Várilly's research has unfolded across a broad field of topics all related to quantum theory. In the late 1980s, he concentrated on phase-space methods in quantum mechanics; in the early 1990s, symmetries in quantum field theory; and for the past eight years, noncommutative geometry and its physical applications. Each of his specialised research areas has reached beyond mathematics to physics. As Várilly notes, "theoretical physicists have expressed as much interest in my work as my colleagues in mathematics."

In fact, the interest that theoretical physicists have shown towards noncommutative geometry has largely driven his latest project: a 'primer' on the subject written in part for theoretical physicists who would like to know more about the concept as a way to better understand quantum space-time.

As Várilly explains: "Less than a decade ago, the great French mathematician and Fields Medal winner Alain Connes almost single-handedly invented the subject of noncommutative geometry. The book he wrote, *Noncommutative Geometry*, remains the field's main reference. But it is a compilation of research papers, which

make for difficult reading even for colleagues in related fields. The book I have co-authored, which is descriptively titled *Elements of Noncommutative Geometry*," Várilly says, "is one that mathematicians and theoretical physicists should read before they read Connes' book."

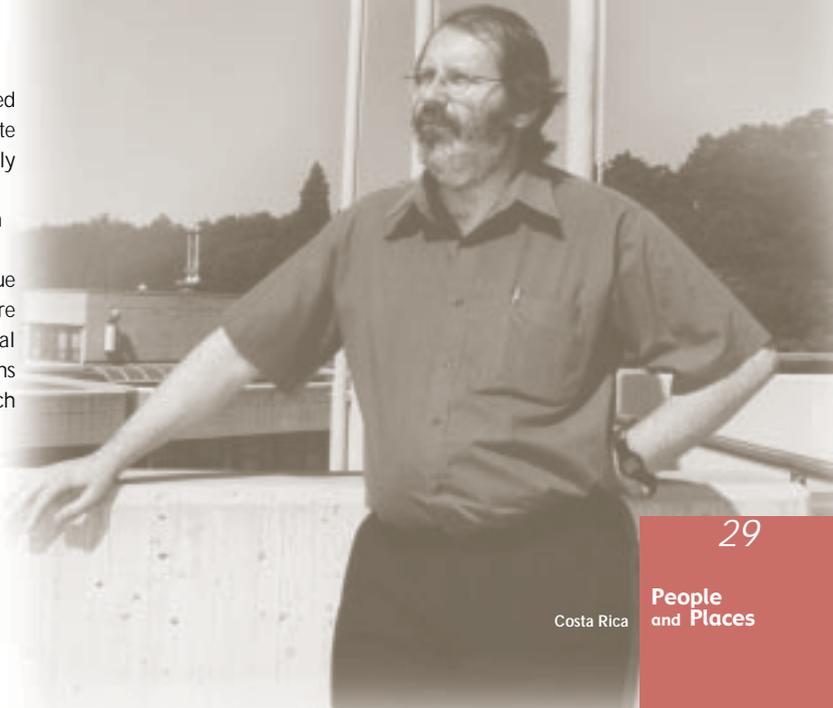
Elements of Noncommutative Geometry, scheduled to be published this fall by the well-respected science publisher Birkhäuser, will be distributed worldwide. Várilly and his co-authors, José M. Gracia-Bondía and Héctor Figueroa, who are his colleagues at the University of Costa Rica, hope to reach a wide range of scientists and mathematicians with their book. "Noncommutative geometry," the authors note in the book's preface, offers "a bouquet of applications related to analyses of the standard model, the quantum Hall effect, string theory and renormalisation."

Várilly says that it should be no surprise that many of his articles are written with other physicists, particularly his long-time colleague Gracia-Bondía. "Science has increasingly become a collaborative enterprise as the lines between disciplines, particularly mathematics and physics, continue to blur. Collaboration," he adds, "is particularly important to researchers from the developing world. Teamwork helps break our isolation and expands our range of contacts."

With his new book in press, Várilly, appointed an ICTP Associate in 1998, arrived in Trieste in June "to see what's next." He is particularly interested in exploring the interface of noncommutative geometry with quantum field theory, especially the role that Hopf algebras play in symmetries. "My new avenue of inquiry remains focussed on areas where mathematics can speak directly to physical phenomena. I hope that both mathematicians and physicists continue to find my research and writing useful."

"I first visited the Centre in 1985 to participate in the College on Representation Theory of Lie Groups and that really got me going as a researcher. Now with my appointment as an Associate, the Centre should serve as my research retreat for the next several years. I plan to put this opportunity to good use."

His visits to Trieste, Várilly says, will help energise and direct his research, which will continue to take place largely in Costa Rica. To confirm his commitment to his adopted homeland, Várilly quoted a saying often heard in Spain. "*Uno nace donde quiere*," he observes in his Irish-lilted Spanish, "*pero se muere en el pueblo de su mujer*." The English translation: "A man is born wherever he likes, but he always dies in his wife's village."



Bandara Karunaratne

→ Moulding the Future

Sri Lanka

ICTP Associate Bandara Karunaratne has spent much of his career putting physics to work to help boost the economy of his native country Sri Lanka.



November 2000. Sri Lanka is a small island-nation that lies like a tear-drop off the southern coast of India. Rich in cultural traditions and blessed with an abundance of natural resources, the tranquillity of this island-nation has been shattered by violent ethnic upheavals in the northern province of Tamil, which have left thousands of people dead and a once-pleasing landscape scarred and battered.

ICTP Regular Associate (1997-2002) Bandara Karunaratne, a Sri Lankan materials physicist, is determined to help put his native land, which the world has often associated with tea, coconuts and rubber, back on track by improving its capacity for scientific training and research. He has been particularly interested in investigating potential commercial applications of native materials.

"I received my undergraduate degree in physics in 1971 from the University of Peradeniya, Sri Lanka, and earned my doctorate in materials physics from the University of Warwick in the United Kingdom in 1980," explains Karunaratne. "Immediately following my graduation, I worked for a local timber firm, where I examined the physical properties of the harvested lumber to assess its durability after it was treated with borax, a preservative."

As a graduate student, Karunaratne broadened his materials research at the University of Warwick to encompass silicon nitride ceramics. "I wanted to investigate the microstructure and fracture properties of these materials when subjected to extremely high temperatures and pressures," he notes. "The ways in which the materials respond to these conditions tell us a lot about their durability. That, in turn, could have important implications for their use in motor engines or cutting tools."

While completing his doctorate, Karunaratne, in collaboration with the Lucas Research Group in the United Kingdom, conducted research helping to illustrate that silicon nitride could serve as a more efficient and longer lasting machine-cutting material than carbon- and steel-cutting materials then in use. The research eventually bore fruit in commercial applications under the trademark *syalon*, which has found widespread use in the cutting tool industry.

Karunaratne returned to Sri Lanka in 1980, assuming a teaching position in the department of physics at the University of Peradeniya. While attending to his teaching responsibilities, Karunaratne also developed an active research agenda. Drawing on his knowledge and previous training in materials physics, he devoted a great deal of time examining the structural integrity and durability of local ceramics—porcelains, bricks and tiles.

"My goal," Karunaratne notes, "has been to enhance the applicability of these ceramics in the manufacture of materials ranging from dinner plates to turbine blades." Most recently, he has investigated the potential for ceramic rotary seals to replace alumina seals in water pumps. "Since clay is much cheaper than alumina and since our testing suggests that the ceramic seals would be more durable, the research holds much promise for possible commercial applications."

A key to Karunaratne's success is explained by the ties he has established with other institutions. The International Programme in Physical Sciences (IPPS) at the University of Uppsala in Sweden offers both laboratory equipment and student fellowships, and the University of Warwick sends materials used in experiments and provides valuable lines of

communication with former teachers and colleagues. Meanwhile, his status as ICTP Associate has enabled him to spend seven weeks last fall in Trieste, where he has taken advantage of the Centre's library, internet facilities and proximity to other well-respected scientific institutions to "stock up on information that will undoubtedly prove invaluable to my research and development activities when I return home."

The Centre's close relationship with the University of Trieste has allowed Karunaratne to develop ties with Italian researchers as well as to take advantage of the university's electronmicroscopic facilities to conduct experiments that would be impossible to do back home. Trieste's scientific facilities have also opened a new world to Uthpala Dahanayake, a youthful Sri Lankan researcher who has accompanied Karunaratne as an 'ICTP young collaborator.' "Sergio Meriani and Valter Sergo, professors at the Materials Engineering Department of the University of Trieste, have been particularly helpful in strengthening the links among ICTP, their university and my institution. It's all part of a growing network of scientific interaction that would be impossible to build without the Centre's long-standing reputation both in Italy and abroad."



Saw-Wai Hla

→ Ultimate Reactions

Myanmar

Saw-Wai Hla recently garnered worldwide publicity for uncovering a technique that enables scientists to study chemical reactions molecule by molecule.



January 2001. Former ICTP Diploma Course students Saw-Wai Hla, currently a researcher at *Freie Universität Berlin*, Germany, is an accomplished young scientist whose pathbreaking work with scanning tunnelling microscopes has been discussed in virtually every major scientific publication. He is also an accomplished musician who once earned a living playing bass guitar in a 'boy band' that produced three albums and made a dozen appearances on national television in his native country of Myanmar (formerly Burma) in southeast Asia.

Hla fervently believes that the talents and skills accounting for his success as a musician are the same ones that he has put to good use in his scientific endeavours.

"In science as in music," Hla explains, "it's not enough to master the techniques. You must know how to handle the instruments. You must also have an emotional attachment to your work."

"In music that means not just having the ability to play the correct notes and chords but the feeling to play those notes and chords in ways that touch and move your audience. In science that means not just having the ability to master your laboratory instruments but having an innate feeling of how to take your research in uncharted directions."

Hla describes how this feeling helped him take the well-known analytical power of scanning tunnelling microscopes to new heights by using the tip of the microscope to 'tease' single molecules through a complicated chemical process known as the Ullman reaction.

The Ullman reaction, which has been part of the tool kit of chemical laboratories for more than a century, creates multi-ring polymers by blending countless reacting molecules in large copper-laced vessels that provide the catalyst for the reaction. Hla and his colleagues at *Freie Universität Berlin* miniaturised the process by using electron flows from the tip of the microscope to break and then rejoin molecules one at a time. A process, previously characterised by a blur of chemical activity, was reduced to a step-by-step procedure that allows scientists to visualise the reaction as it's unfolding.

This breakthrough, which could effectively allow scientists to probe the most intimate details of chemical reactions molecule by molecule, also opens up the possibility of building human-made molecules in the future. "We are not there yet," says Hla, "but the discovery certainly makes a monomolecular construction process a possibility." If such a bottom-up molecular construction technique becomes a reality, it could have an enormous impact on atomic-scale chemistry and nanoscience and nanotechnology.

Chemical and Engineering News, the flagship publication of the American Chemical Society, billed Hla's "atom by atom reaction" as the 'top story' of the week in its 2 November 2000 edition, and this past fall *Nature*, *Science*, *Scientific American*, *Science News*, *Physics Today* and *Physics News* all gave extensive coverage to his work.

The press attention generated numerous requests for lectures by Hla, including presentations at international conferences in Canada, China, France and Sweden, and invited seminars at IBM's T.J. Watson Research Center and Clemson University in the United States, and the University of Freiburg in Germany. It also brought Hla back to Trieste to speak at the Workshop on Nanoscale Spectroscopy hosted by ICTP last December.

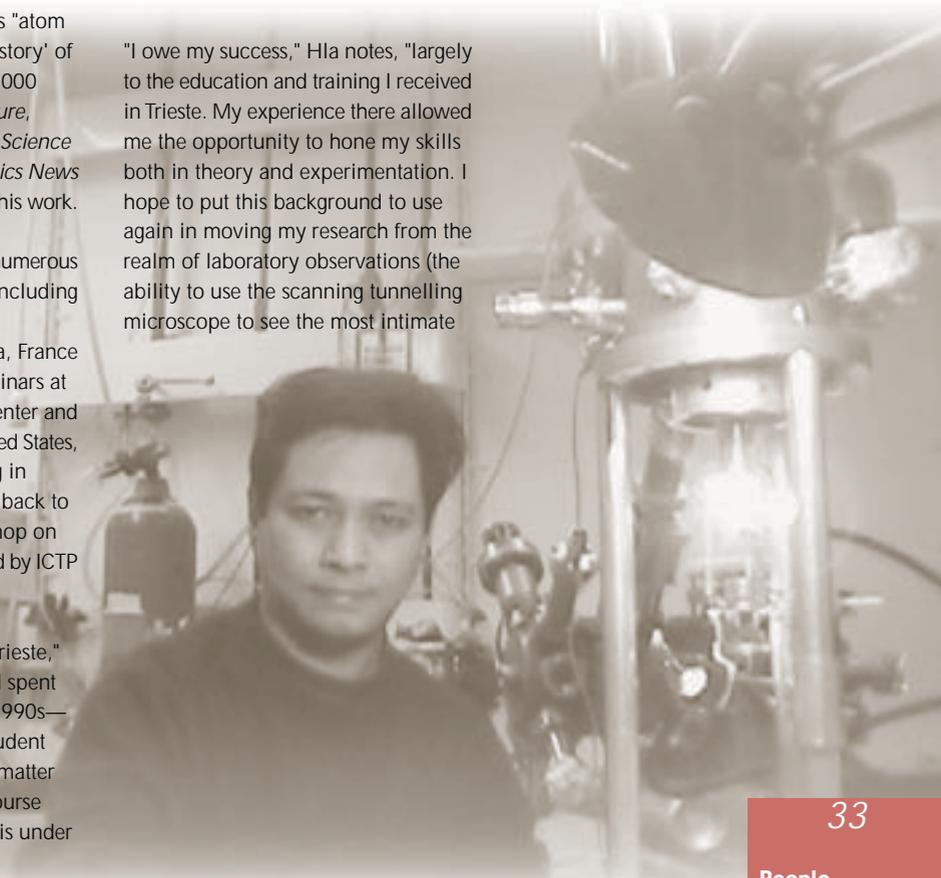
"I was delighted to return to Trieste," says Hla. That's where he had spent much of his time during the 1990s—first, from 1992-1993, as a student concentrating on condensed matter physics in ICTP's Diploma Course (where he completed his thesis under

the direction of Maria Peressi, professor at the University of Trieste's Department of Theoretical Physics); then from 1994-1997 as a doctoral student at the J. Stefan Institute (IJS) in Ljubljana, Slovenia, in a programme sponsored jointly by ICTP and IJS (where he earned a doctorate under Veljko Marinkovic and Albert Prodan, focussing his research on experimental surface science and thin film physics); and finally, from 1997-1998, as a fellow in ICTP's Training and Research in Italian Laboratories (TRIL) programme, working at the TASC laboratory at the *Elettra* synchrotron light facility in Area Science Park, Trieste, on experiments related to surface science.

"I owe my success," Hla notes, "largely to the education and training I received in Trieste. My experience there allowed me the opportunity to hone my skills both in theory and experimentation. I hope to put this background to use again in moving my research from the realm of laboratory observations (the ability to use the scanning tunnelling microscope to see the most intimate

details of chemical reactions) to the world of molecular manipulation and creation, which could spur the creation of novel chemical compounds that cannot be made through conventional means."

"I consider myself an alumnus of ICTP and, more generally, of the Trieste scientific community. There's no doubt that ICTP and the intricate network of scientific institutions in Trieste and the surrounding area are largely responsible for whatever success I have achieved to date and whatever success I might achieve in the future."



Qian Yun

Climate Changes

China

In his journey from China to Colorado, physicist Qian Yun has discovered that global climate is a topic of concern that attracts the attention both of citizens and scientists alike.



February 2001. Environmental issues are now understood to be at the heart of many worldwide problems, especially in the developing countries, and one of the aspects that Qian Yun likes most about his subject, the physics of weather and climate, is its potential to benefit humanity. He also enjoys the fact that it attracts so much public and media interest—and that's just as well, because it would be a pity for his excellent communication skills to go to waste. Qian can pitch his tone to anything from a learned journal or conference of experts to a layperson who wants to know a bit more about global warming, greenhouse gases or the ozone layer. He's aided by a finely tuned sense of humour that sparkles through everything he says without once distracting from it.

Qian was born in China in 1967, when the Cultural Revolution undermined opportunities and stifled the ambitions for an entire generation of intellectuals and researchers. Shortly after he began school a few years later, this period of China's history came to an end and was replaced by an environment of enthusiasm and hope as people sought to benefit from the re-opened universities and the re-established rewards of hard work and dedication. This was a good time to be growing up, and Qian took advantage of it, applying himself to his studies and gaining the grades necessary for university entrance.

His undergraduate and master's degrees in physics were followed by a Ph.D. from the Institute of Atmospheric Physics in Beijing and the National Center for Atmospheric Research in Boulder, Colorado. While in the United States, he met and worked with Filippo Giorgi. When Giorgi was asked to head the newly established Physics of Weather and Climate Group at ICTP in 1998, he invited Qian to come with him to Trieste. The two scientists had collaborated successfully on several projects, including one on the effects of sulphate aerosols on regional climate, a subject that is of particular relevance to the rapidly industrialising China. As friends, they both also share a passion for Italian soccer, avidly following *Serie A* (first division) matches on satellite TV.

This combination of professional and personal rapport with an exciting new career opportunity made it easy for Qian to accept a two-year post-doctorate focussing on issues related to regional climate change over China and East Asia.

Qian's decision to study abroad was prompted by several factors. First and foremost is the global nature of climate and climate change—weather systems must be examined at both regional and worldwide levels to construct an overview of what is happening and why. Even localised research findings frequently prove valuable to very distant countries and regions, while global trends are often dramatically broken by specific conditions in a certain region.

Another consideration prompting Qian's study abroad relates to the fact that China is one of the fastest developing countries in the world. Moreover, his nation is establishing itself as a world leader in certain aspects of scientific research. While the country is by no means ignoring environmental issues, the study of weather and climate

requires vast, sophisticated, multi-million dollar equipment that, at least until recently, was more readily available in countries where research priorities are different.

On a more personal note, Qian also felt that he is at the right age and stage to follow research opportunities as they open up around the globe. He observes that the Cultural Revolution has resulted in a dearth of academics who would now be in their forties and fifties. The result is that younger people are being promoted to responsible positions in China's universities and institutions, a trend that he sees as being both good and bad. While the influx of younger, fresh ideas can help to create a more dynamic atmosphere in which to learn, it also means that some of the best scientists are being put into

administrative roles in which they no longer have time to pursue their own research, and he doesn't yet feel ready for this.

He sees his longer-term future in China, however. It's home, and the place where he can put the knowledge and experience he is accumulating to the best use, encouraging gradual change and contributing to national and scientific development. And it won't just be research results that he takes home with him. He's also seeing the world. Both he and his wife enjoy travelling, spending their free time visiting different parts of Italy, a country they are happy in and whose emphasis on family and friendships reminds them of China.



Arbab Ibrahim Arbab

► Sudan Success

Sudan

Arbab Ibrahim Arbab, assistant professor of physics at Omdurman Ahlia University in Sudan, was a student in ICTP's first Diploma Course. His road to success began in Trieste.



June 2001. The year 1990 was not a good year for Arbab Ibrahim Arbab. Although he had graduated with a bachelor's degree from the University of Khartoum in his native Sudan a year before, he had spent much of his time since then in search of secure employment—first in the department of physics at his alma mater, where he had hoped to teach while earning a master's degree, and then in Libya, where he taught high school physics part-time.

"I wanted to stay in Sudan to continue my education. While the University of Khartoum had shown some promise in the 1970s and 1980s, by the time I was ready to begin graduate school almost all the good people had left. Political uncertainties were making a difficult situation even worse."

"I was running out of options," Arbab recalls, "when my former professor at the University of Khartoum, Mohammed Saeed, suggested that I apply to the newly created Diploma Course at ICTP in Trieste, Italy. I didn't know anything about ICTP but Saeed was a frequent visitor to the Centre and he assured me that it would be a good place for me to be."

Arbab was accepted and, with 21 other young students from the developing world, he became a member of the inaugural class of the Diploma Course.

Arbab's first few months as a Diploma Course student were not easy. "The courses not only proved difficult in content," he explains, "but they required me to think and learn in entirely new ways. Previously I could excel by simply memorising information. Now I had to solve problems. I'll never forget that one of the first examinations in the Diploma Course was an open book test. That surprised me because having the text book in front of my eyes made me think I could look up the answers. Nothing could have been farther from the truth."

Arbab also credits the Diploma Course with teaching him how to teach. He notes that for the first time in his life, he was "required to make oral presentations and to defend his arguments before his peers," helping him acquire the organisational skills and gain the confidence that he needed to be a good teacher.

After adjusting to the rigours of his new environment, Arbab enjoyed a successful second semester and was among those who received ICTP's first Diplomas. "It was a proud moment for all of us. We had come from many different countries and cultures and had both competed and cooperated throughout the year to attain our goal. As members of the Centre's first Diploma Course, we enjoyed both a feeling of individual and collective achievement that made the moment special." Today some of the Diploma Course students with whom he graduated are among Arbab's friends, including Egyptian-born Shaaban Khalil, who is now a post doc at the University of Sussex in the UK, and West Indies-born Surujhdeo Seunarine, who is a post doc at Christchurch University in New Zealand.

Between 1993 and 2000, Arbab earned his Ph.D. in physics at the University of Khartoum, where he also taught undergraduate students first as a lecturer and then as an assistant professor. Insufficient resources, large class sizes and poor pay made life as a scientist difficult. "The department," he says, "lacked both the size and energy to be a dynamic centre for teaching and research." Reflecting a problem common to many university physics departments in Africa, Arbab noted that the next youngest faculty member in his university was more than 20 years older than him. He also observes that he had to teach four classes and 200 students each semester, leaving little time for research.

Things are now looking up for Arbab. Last year, he became an assistant professor at Omdurman Ahlia University

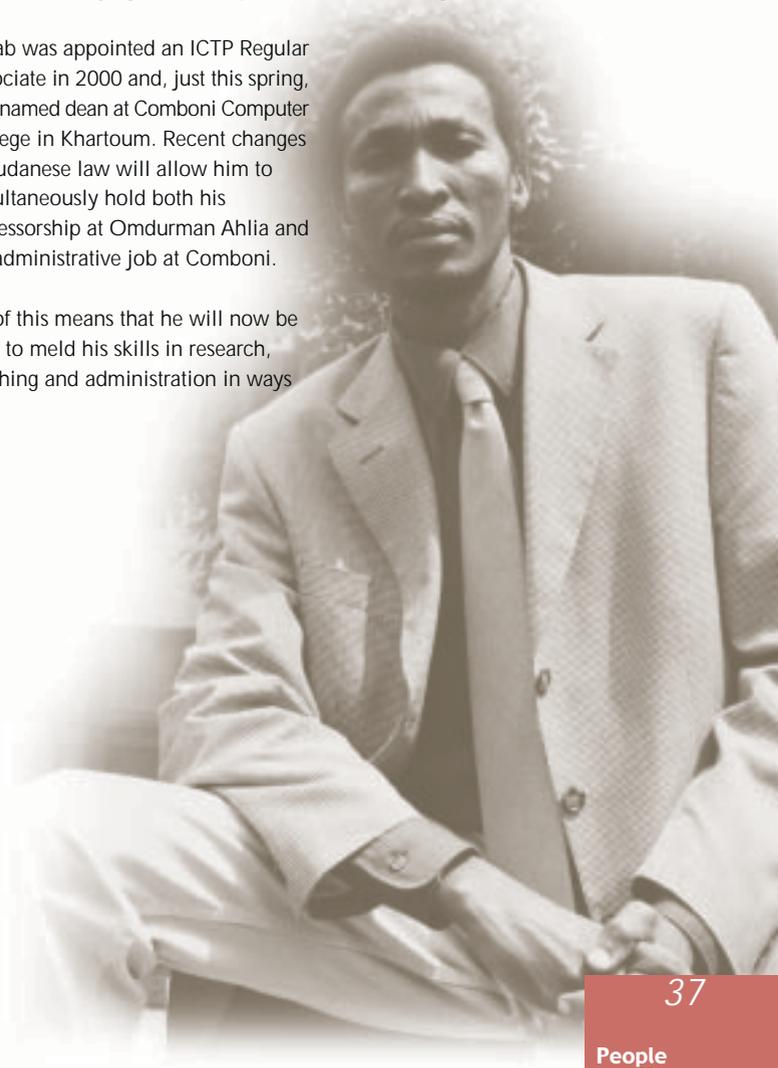
in Sudan, one of the best institutions of higher education in the country. "The teaching load is lighter and the facilities are better equipped." More importantly, he notes, "professors are given a greater sense of autonomy and are able to devise and pursue their own research agendas." In Arbab's case that means time to study and publish in the fields of cosmology and astrophysics with special attention to questions related to vacuum decaying and fluid repulsion.

Arbab was appointed an ICTP Regular Associate in 2000 and, just this spring, was named dean at Comboni Computer College in Khartoum. Recent changes in Sudanese law will allow him to simultaneously hold both his professorship at Omdurman Ahlia and his administrative job at Comboni.

All of this means that he will now be able to meld his skills in research, teaching and administration in ways

that professors in Northern universities take for granted.

There is no better testimony to the success of the ICTP Diploma Course than Arbab's current good fortune. Much of this has to do with Arbab's own skills and drive, but much also has to do with the strong foundation in analysis, research and teaching that the Diploma Course provided him with a decade ago.



Habtu Hailu Zegeye

→ Decisive Numbers

Ethiopia

Habtu Hailu Zegeye, a former ICTP Diploma Course student and now Junior Associate, is returning to Trieste as a Fellow of ICTP's Training and Research in Italian Laboratories programme.



July 2001. When Habtu Hailu Zegeye arrived in Trieste this July from his home country Ethiopia, he certainly didn't need a map to get around. After all, this marked the third time in the past six years that he would be spending a good deal of time in the Italian port city that hosts ICTP's secretariat.

His first visit, a one-year stay, took place in 1995-1996 when he was a student in the Centre's Diploma Course programme. He returned to ICTP in the summer of 1999 for a three-month stay and came back again in the summer of 2000, both times as an ICTP Junior Associate. His visits enabled him to take advantage of the Centre's facilities and busy summer-time curriculum to advance his own research agenda in mathematics, which focusses on nonlinear functional analysis and applications.

For the next 12 months, he will be living and working in Trieste as a Fellow of ICTP's Training and Research in Italian Laboratories (TRIL) programme under a cooperative arrangement between ICTP and the International School for Advanced Studies (SISSA), an Italian institution of higher education located next door to the Centre. Zegeye notes that he will be "spending much of his time doing research in his areas of expertise," which he anticipates "will lead to a series of publications in international journals." He also plans to attend courses at ICTP, SISSA and perhaps other research institutions in Italy.

Zegeye's periodic journeys to Trieste have proven instrumental in helping him achieve his most cherished career objective: To live and work in Ethiopia as a university teacher and researcher without being isolated from the global mathematics community.

He earned his undergraduate degree from Addis Ababa University in central Ethiopia in 1985. He concentrated primarily on mathematics and physics but also set aside time for education courses helping him acquire valuable pedagogical skills that would later serve him well as an instructor.

With his bachelor's degree in hand, Zegeye decided to continue his education at Addis Ababa University, taking courses from 1989 to 1991 after teaching mathematics

at Arba Minch high school. "The teaching methods at the university," he notes, "were largely based on lectures and the rote retention of information. Teachers," he adds, "did a commendable job under a difficult situation."

Poor facilities and a lack of course books or journals posed the most serious obstacles to learning. "Computer facilities were not available and recent books and journals were hard to come by," he notes. "As a result, lectures were usually the sole source of information."

Zegeye admits that he never really stopped seeking ways to continue his university training. "I realized that my need for financial aid and having earned both my bachelor's and master's degrees in Ethiopia would likely hinder my progress." Nevertheless, he enrolled in Addis Ababa University for a second master's degree, this time focusing exclusively on numerical analysis and algorithms. After completing this degree, Zegeye was appointed a lecturer at Bahir Dar University in Bahir Dar, Ethiopia.

Zegeye earnestly began his search for a Ph.D. programme in 1999, the same year that ICTP's Mathematics Group and Office of External Activities joined forces to launch a Ph.D. initiative targeted for students in sub-Saharan Africa. The ultimate goal of the initiative, designed in partnership with universities in sub-Saharan Africa, was to allow students to remain within the region while earning their degrees.

"The programme was an ideal fit for my circumstances," Zegeye notes. "I applied and was soon accepted for entrance into the mathematics doctorate programme at the University of Nigeria in Nsukka. With help from ICTP I could once again pursue my career ambitions."

This June, Zegeye's ongoing journey passed another milestone when he was awarded a doctorate in mathematics. Today he is back in Trieste advancing his knowledge and honing his skills even further.

"I'll be here for the next year," he notes, "and hopefully will return often to ICTP during my entire career. I expect to spend most of my time, however, at Bahir Dar University—instructing students, conducting my own research and perhaps laying the groundwork for a broad institutionally based research programme in nonlinear functional analysis and applications."

The programme he envisions would not only allow faculty members and students to stay abreast of the latest intellectual developments in the field but also enable them to use their skills to address some of their country's most intractable resource problems, including issues related to adequate water supplies and soil fertility.

Simply put, Zegeye would like nothing better than to have his extraordinary trips between Ethiopia and Italy to lead to nothing more than an ordinary existence at home where his professional responsibilities would be defined by the three pillars of university life worldwide: teaching, research and community service.





Nearly 80,000 scientists from more than 170 countries have visited the Abdus Salam International Centre for Theoretical Physics since its inception in 1964.

People and Places

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For detailed statistical information concerning ICTP activities, see *Facts and Figures* (Trieste, Italy; ICTP Public Information Office).

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People and Places



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