Nguyen Dinh Dang

Embracing art and science

A Vietnamese nuclear physicist at RIKEN is also an accomplished painter

Art has always been important to Nguyen Dinh Dang. He began learning to draw at just five years old and soon became an outstanding student. Blessed with artistic talent and an unfaltering passion, Dang could have become a professional painter. However, restrictions on artistic work and the difficulty in making a living as a painter in the war-time Vietnam led him to pursue a career in science. But, art remained a lifelong interest. Even the Vietnam War and a lack of materials didn't dampen this native of Hanoi's passion for painting.

"Many people claim themselves painters, but the most difficult and beautiful thing is the mystery of the universe. Only few people can comprehend this," says Dang, who is now an Accelerator Research Scientist at RIKEN's Nishina Center for Accelerator-Based Science in Wako.

Good at mathematics and physics, Dang was among the students who topped the entrance exams to Vietnam's national universities in 1975, and got the state scholarship to study abroad. He chose to enroll in 1976 in one of the world's best institutions for studying basic sciences — the Moscow State University.

Dang recalls he visited excellent fine-art museums, and devoted himself to painting on vacations during his time in Moscow. Academically, he earned two doctoral degrees: a PhD and a Doctor of Physics and Mathematics Sciences at the Moscow State University.

Dang spent his postdoc in Germany and Italy in the early 1990s. While in Italy, Dang was surprised to receive a letter asking him to apply for a scholarship in Japan. He realized later that this was the result of a recommendation by his former PhD supervisor Vadim Soloviev, a renowned physicist at the Joint Institute for Nuclear Research in Dubna, Russia.

Returning home from Italy, Dang organized Vietnam's first large-scale international conference in nuclear physics in spring 1994. There he met Akito Arima, the then president of RIKEN and prominent nuclear theorist. "Dang is multi-lingual, presents opinions clearly and has a firm grasp of physics," Arima recalls.

Studying the behaviors of nature's building blocks

Many physicists, including Dang, are investigating how atomic nuclei behave under unusual conditions. A nucleus consists of protons and neutrons, and forms the core of an atom. Nuclei are stable when protons and neutrons have the right balance. But nuclei easily become unstable when they have large deformations, or many more neutrons than protons. They even heat up at high excitation energies. Although the properties of stable nuclei have been well-studied, those of nuclei under extreme conditions largely remain a mystery. Further unveiling the structure of these nuclei could provide a better understanding of how the universe was created.

One of the important features of nuclei is 'giant resonance'. It is an oscillation, which involves many nucleons, at a certain frequency around the equilibrium shape of the nucleus. Depending on the type of oscillations, the status of giant resonances differs. "By studying these properties we can learn a lot about nuclei," Dang says.

The most prominent giant resonance is a collective oscillation of all protons against all neutrons in a nucleus. This type of resonance, called 'giant dipole resonance' (GDR), was discovered about 70 years ago in photonuclear reactions. Dang has been studying nuclear GDR since the early 1980s and building his expertise in different countries.

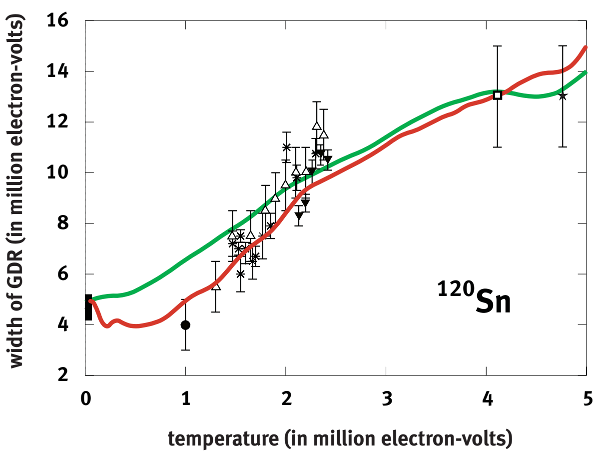

Figure 1: The photoabsorption cross section of GDR has a typical bell shape, whose width depends on temperature. In 2003, compared to their 1998 predictions (green line), Dang and Arima achieved theoretical results (red) much closer to experimental systematic (data points) for the GDR width.

Helping end a three-decade debate

Arriving in Japan in 1994, Dang took up a 10-month fellowship at Tokyo University's Institute for Nuclear Study. Meanwhile, Arima asked him to work at RIKEN, where he moved in 1995, to tackle a controversial issue related to a giant resonance called the Gamow-Teller resonance. This resonance is created by neutrons that spin upwards (or downwards) as they oscillate against protons that spin downwards (or upwards), and plays a key role in neutrino physics and astrophysics since it affects the initial dynamics of a collapsing supernova.

The controversial issue was that experimental observations showed only about 60% of the strength of the resonance that was predicted theoretically. Researchers around the world were divided between two explanations for this discrepancy. Arima was a vocal supporter of the simpler explanation, which does not involve non-nucleonic degrees of freedom, but had a limited influence on the debate.

In 1997 researchers at the Research Center for Nuclear Physics in Osaka succeeded in producing definitive experimental results that supported Arima's theory. Concurrently, Dang proposed a new model that combined RIKEN's cutting-edge computer power with a microscopic approach. The results of his theoretical calculations neatly described the experimental data[1]. The three-decade debate was almost over, as Arima's group became closer to fully explaining the gap.

Dang then began to focus on his long-term interest in the GDR in nuclei that heat up as they are formed in heavy-ion fusion or other reactions. Scientists are puzzled because, while at moderate temperature the width of GDR extracted from these 'hot nuclei' increases with temperature, it stops expanding when the temperature reaches a certain value. Despite many attempts, physicists have failed to offer a consistent description of the phenomenon.

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In 1998, Dang and Arima proposed a new model to clearly explain the thermal behavior of GDR. The results of their calculations described well where the width expands and where it saturates[2] (Fig. 1). In 2003, they elaborated on their theory and became the first to show an important effect of the nuclear superconducting property that provided a more comprehensive explanation of the phenomenon[3]. Encouraged by the success in the study of hot nuclei and GDR, Dang has been applying the model to other types of resonances.

Blessed with an artistic life

In addition to enhancing his stellar scientific career, the move to Japan gave Dang great opportunities to hone his artistic skills. "Only in Japan I could establish a life that includes painting regularly," he says. In 1995, he resumed painting after a four-year break, and has since held a number of solo and joint exhibitions. He says once he gets an idea, he spends nights and weekends painting.

For the past two decades, Dang's painting has shifted from impressionism to surrealism, whose most eminent representative, Salvador Dali, remains one of Dang's favorite masters. "Surrealism is the way I can express my ability the best," he says. In one recent painting titled 'Winter Ocean', he painted himself along with his mother giving a piece of banana to his father (Fig. 2). The two couples in the background are also his parents in their Parisian student days. Dang was twice named as a 'Fine-Work Artist' at the exhibition of the Individual Artist Association held annually in Tokyo. In November, Dang plans to hold a group exhibition with 12 Japanese artists in Hanoi.

Dang says it's not important to explain the literal context of any artwork. But feeling matters everything. "In the creative process of both art and science, the most important thing is intuition. You feel something intuitively. You cannot explain how it comes to you," he says. ■

Figure 2: "In my mind, I am always a small child to my parents, who are old and weak but their love for me and each other is so immense that they are associated with the image of the ocean in winter," Dang says. He won the title 'Fine-Work Artist' at the 41st annual exhibition of the Individual Artist Association for this painting.

1. Dang, N. Dinh, Arima, A., Suzuki, T. & Yamaji, S. Spreading of Gamow-Teller resonance in ^{90}Nb and ^{208}Bi. *Physical Review Letters* **79,** 1638 (1997).
2. Dang, N. Dinh & Arima, A. Temperature dependence of quantal and thermal dampings of the hot giant dipole resonance. *Nuclear Physics A* **636,** 427 (1998).
3. Dang, N. Dinh & Arima, A. Pairing effect on the giant dipole resonance width at low temperature. *Physical Review C* **68,** 044303 (2003).

About the researcher

Nguyen Dinh Dang was born in 1958 in Hanoi, and graduated from the Moscow State University in 1982. He received his PhD in nuclear physics in 1985, and his doctor of physics and mathematics sciences in 1990 at the same university. He came to Japan in 1994 as a research fellow of the Nishina Memorial Foundation and joined RIKEN in 1995. Currently, he's an Accelerator Research Scientist at RIKEN's Heavy-Ion Nuclear Physics Laboratory, Nishina Center for Accelerator-Based Science. Dang is also serving as a senior scientist at the Institute for Nuclear Science and Techniques of the Vietnamese Atomic Energy Commission, where he got his permanent position in 1982. Dang is a member of the Fine-Arts Association of Vietnam and Japan's Individual-Artist Association. He also speaks fluently Vietnamese, English, Russian, and French. His personal website is http://rarfaxp.riken.go.jp/~dang/