

CHINA'S BIG SCIENCE FACILITIES

PROBING INTO THE WORLD OF NUCLEI

HEAVY ION RESEARCH FACILITY IN LANZHOU

Genming Jin
Guoqing Xiao *Editors*

China's Big Science Facilities

“Big science” facilities are major elements of science and technology infrastructure, and important symbols of China’s scientific and technological development. This popular science book series presents the background, history and achievements of the Chinese Academy of Sciences in terms of constructing and operating big scientific facilities over the past few decades.

The series highlights the major scientific facilities constructed in China for pioneering research in science and technology, and uses straightforward language to describe the facilities, e.g. the fully superconducting Tokamak fusion test device (EAST), the National Protein Science Research Facility, Lanzhou Heavy Ion Accelerator, Five-hundred-meter Aperture Spherical Telescope (FAST), etc. It addresses the respective facilities’ research fields, scientific backgrounds, technological achievements, and strategic and fundamental contributions to science, while also discussing how they will improve the development of the national economy. Supplementing the main text with a wealth of images and linked videos, the book offers extensive information for members of the general public who are interested in scientific facilities and related technologies.

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Editors

Probing into the World of Nuclei

Heavy Ion Research Facility in Lanzhou



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Series Foreword

As a new round of technological revolution is burgeoning, it will exert a direct impact on the survival of a country whether or not it can gain insight into the future technological trends and grasp new opportunities from the revolution. In the face of the major opportunities in the twenty-first century, China is intensively formulating the innovation-driven development strategy and building an innovation-based country in this critical era to achieve a moderately prosperous society in an all-round way.

Scientific and technological innovation and popularization remain two wings for innovation-driven development of a nation. In particular, popular science affects the awareness of the general public for science and technology as well as social and economic development. Scientific education is thus highly practical for implementing the innovation-driven strategy. Contemporary science pays more attention to public experience and engagement. The word “public” covers various social groups that exclude those in scientific research institutions and departments. The “public” also includes decision-makers and management personnel in government agencies and enterprises, media workers, entrepreneurs, science and technology adopters, etc. Barriers that impede the innovation-driven strategy will emerge if any group falls behind this new revolution; avoiding and removing the possible barriers will strategically improve the quality of human resources, enhance mass entrepreneurship and innovation and build a moderately prosperous society in an all-round way.

Science workers are primary creators of scientific knowledge who undertake the mission and responsibility for science popularization. As a national strategic power in science and technology, Chinese Academy of Sciences (CAS) has always attached equal importance to this mission in addition to scientific innovation and incorporated the mission into key measures of the “Pioneering Action” Plan. CAS enjoys rich and high-end technological resources, such as the high-caliber experts represented by CAS members, advanced research facilities and achievements represented by the Big Science Project, excellent scientific popularization base represented by the national scientific research and popularization base. With these resources in place, CAS implements the “High-level Scientific Resource Popularization” Plan to transform the resources into popular facilities, products and talents to benefit trillions of

the public. Meanwhile, CAS launches the “Science and China” program, a scientific education plan, to mobilize more effectively the “popularized high-end scientific research resources” for scientific education targeted at the public and the integration of science and education.

Scientific education requires not only the dissemination of scientific knowledge, approaches and spirit to enhance overall scientific literacy of the country but also the creation of scientific environment to enable scientific innovation to lead sustainable and sound social development. For this reason, CAS cooperates with Zhejiang Education Publishing House to launch the CAS Scientific and Cultural Project. This is a large-scale scientific and cultural communication project on the basis of CAS research findings and expert teams to improve the scientific and cultural quality of the Chinese citizen in an all-round manner and to serve for the national strategy of rejuvenation by advancing science and technology. On the basis of the target group, the project is categorized into two series, i.e. the Adolescent Scientific Education and the Public Scientific Awareness, respectively, for the adolescent and the general public.

The Adolescent Scientific Education series aims to create a series of publications that draw on latest scientific research findings and introduce the status quo of scientific development in China, to cultivate the adolescents’ interest in science study, to educate them about basic scientific research approaches and to inspire them to develop rational scientific way of thinking.

The Public Scientific Awareness series aims to educate the general public about basic scientific approaches and the social significance of science and encourage the public to engage in scientific affairs, thus the project will enhance the capacity the public of conscientiously applying science to their life and production activities, improve efficiency and promote social harmony. In the near future, publication series of CAS Scientific and Cultural Project will constantly come out. I hope that these publications will be welcomed by the reader and that through coordination among CAS science workers, science icons such as Qian Xuesen, Hua Luogeng, Chen Jingrun and Jiang Zhuying will be more familiar to the public. As a result, the truth-pursuing spirit, rational thinking and scientific ethics will be fully promoted, and the spirit of science workers in courageous exploration and innovation stands eternally in the history of human civilization.



Chunli Bai

President of Chinese Academy of Sciences
Secretary of Leading Party Members’ Group

July 2016

Preface

My dear friends, do you know what is the smallest particle that makes up all substances in the world? You may say it is the atom. Then what is the atom made up of? What is the substance that constitutes an atom? What does it look like? How can we use the atom? If you are not sure of the answers, just check this book.

An atom is like a fort. Its wall consists of electrons, although not that compact and strong. Each castle only has one inhabitant—a dwarf (nucleus). In the world of dwarfs, there are nearly 3,500 different inhabitants. They draw their own map in the blue ocean. Like our world, their world also has many rules and disciplines. Every dwarf voluntarily abides by the rule with which an orderly world is built. Yet in this world, every dwarf has its own characteristics and will try to play their roles.

To know the origin of the dwarf, create more dwarfs and make them to do things for us, we must first of all mobilize them and make them a fighting force. To this end, scientists have created various dwarf force training bases—accelerators. From this book, you can know the internal situation of these bases and how to train the dwarf force.

Where do the dwarfs come from? A few were born in the initial chaotic state of the universe. More were produced during the evolution process of the stars from birth to death. However, there are not many—only 287 kinds of dwarfs—left for us to use and research. Over 3,000 of them have been created and carefully studied by scientists in a laboratory over the past seven or eight decades. The dwarf force can help us to kill tumors, improve crops and flowers, Chinese herbal medicine, as well as microorganisms so that they are better used for humanity. The dwarf force can also provide important assistance for the safety of artificial earth satellites, the moon-lander “Chang’e”, explorers to Mars, and astronauts!

For more details, please check and read this book. If you have any opinion and advice, please inform us and we will revise it based on your feedback.

Come and visit the Institute of Modern Physics (IMP) of the Chinese Academy of Sciences—a renowned nuclear physics institute in China—if you want to know more stories about dwarfs, training bases and training process of the dwarf force, and achievements of the dwarf force.

A handwritten signature in black ink, consisting of stylized Chinese characters, likely '靳明根' (Jin Minggen), which is the name of Genming Jin.

Lanzhou, China
July 2017

Genming Jin

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Visiting the Dwarfs in the Atomic Castles



Genming Jin and Guoqing Xiao

Go to the atomic castles and look for their owners. Learn more about the castle owners and their family members. Watch the dwarfs' sports games and their acrobatic performance.

1 Visiting the Dwarfs in the Atomic Castles

(1) Flying Through the Walls of the Atomic Castles

Nowadays, many people travel around during their holidays. On weekends, they may drive somewhere near their home to have fun; during long vacations, they may travel long distances on highways, airplanes or trains, to name just a few. Some like walking on a beach, enjoying gentle breezes and the charming blue sea. They may also jump into the sea for a joyful swim. Some prefer mountains for breathtaking landscapes. Have you, then, ever dreamed of turning yourself into a tiny little person, boarding a latest micro helicopter to travel around the microscopic universe for the fantastic landscapes? If you have such a wish and the gut, just go ahead! (Fig. 1).

Turn smaller! A fragrant breeze reached me, and I fell asleep. I did not know how long it took before I heard a gentle voice calling: "Open your eyes, we are arriving at the airport!" I rubbed my eyes and looked around to see who was talking, only to find mountains floating in the air. It seemed like I had landed on the planet of avatars. Though covered with no trees or grass, the mountains were all shining with bright light. I took a closer look at the ground below and found rolling hills with cracks. Beside me landed a helicopter, whose propeller was spinning around. "Maybe it's waiting for me to get on board", I thought (Fig. 2).

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