Developing space science satellite series is the postprint of the "Two Bombs, One Satellite" mission in the new era.

Authors: Wu Ji

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Abstract

For a considerable period, a recurring question within China's scientific and technological community has been how to propose major scientific and technological projects comparable to the "Two Bombs, One Satellite" mission of the 1960s, hoping thereby to once again propel the nation' s rapid scientific and technological advancement. However, despite numerous major scientific and technological missions having been proposed over the past decade, they have consistently been perceived as unable to match the "Two Bombs, One Satellite" mission, which at the time transformed China' s political, defense, and scientific-technological standing. The brilliant achievements of the "Two Bombs, One Satellite" mission continue to shine in our collective memory, and no form of major project can substitute for its luster. This article examines the evolution of national strategic needs from the 1960s to the new era as its point of departure, analyzes what China' s most pressing scientific and technological requirements are in the quest to build a world-leading science and technology power, and subsequently identifies the irreplaceable role that developing a space science satellite series can fulfill in this endeavor, thereby concluding that the development of a space science satellite series represents the "Two Bombs, One Satellite" mission of the new era.

Full Text

Abstract

For decades, China' s scientific community has engaged in ongoing discussions about how to propose major scientific and technological programs comparable to the historic "Two Bombs, One Satellite" mission of the 1960s, hoping to replicate its transformative impact on national development. Yet despite numerous initiatives proposed over the past ten years, none appear to match the profound influence of that mission, which fundamentally altered China' s political standing, national defense capabilities, and technological status. The brilliance of the "Two Bombs, One Satellite" achievement continues to resonate, and no contemporary program seems capable of replacing its legacy. This paper examines the evolution of China' s national strategic demands from the 1960s to the present era, analyzes the nation' s most pressing scientific and technological needs in the quest to become a world-leading science and technology power, and demonstrates the irreplaceable role that a space science satellite series could fulfill. The central argument is that developing such a series represents the modern-day equivalent of the 1960s "Two Bombs, One Satellite" mission.

Keywords: space science, space science satellites, key national program, sustainable development, breakthroughs in fundamental sciences

Introduction

The years 2017, 2019, and 2021 mark significant milestones: the 90th anniversary of the People' s Liberation Army, the 70th anniversary of the People' s Republic of China, and the 100th anniversary of the Communist Party of China, respectively. By these dates, China will have eradicated poverty and achieved a moderately prosperous society, bringing the nation closer to realizing the great rejuvenation of the Chinese nation. In May 2016, the Central Committee of the Communist Party of China and the State Council issued the "National Innovation-Driven Development Strategy Outline,"establishing a three-step goal: entering the ranks of innovative countries by 2020, becoming a front-runner among innovative countries by 2030, and building a world-leading science and technology power by 2050 [1]. On May 30, 2016, President Xi Jinping solemnly announced these three-step objectives at the National Conference on Science and Technology Innovation, the Academicians'Conference of the Chinese Academy of Sciences and Chinese Academy of Engineering, and the Ninth National Congress of the China Association for Science and Technology, providing clear direction and sounding the call to action for our future work [2].

While achieving rapid enhancement of scientific and technological innovation capacity to join the ranks of innovative nations represents our immediate task, contemplating the national goals for 2030 and 2050—how to become a world science and technology power—is even more critical. Any ambitious objective requires long-term, sustained, and unremitting effort to achieve. With only 33 years remaining until 2050, failure to think ahead and plan early may cause us to miss opportunities, creating unnecessary obstacles that could compromise the quality of our goals or even delay their realization. The foundation for economic sustainability, social stability, and national security lies in continuous reform and technological innovation. Compared with 50-60 years ago, China's international position has fundamentally changed. Today, China holds greater influence in economic, political, diplomatic, and international affairs. However, sustainable development places unprecedented demands on science and technology, which is precisely why the three-step strategy focuses on technological innovation. This shift guides our analysis of evolving national demands, which we discuss in the following section.

To achieve this transformation in national strategic needs, we must analyze the means to satisfy these new demands and the strategic pathways to realize new objectives. The role that space science satellite series can play in this context forms the core content of this paper, leading to the clear conclusion that developing such a series constitutes a major national scientific and technological task comparable to the "Two Bombs, One Satellite" mission of the 1960s. This paper concludes with policy recommendations for implementing this major undertaking.

The Strategic Shift in National Demands for the New Era

In the early years of the People's Republic, the new nation faced numerous challenges. National security was severely threatened by economic underdevelopment, international political isolation, external aggression, and particularly the nuclear weapons of superpowers. The most critical national security need of that period was evident: defense construction, with the most important lever being the independent development of atomic bombs, guided missiles, and artificial satellites—the "Two Bombs, One Satellite" program. As Deng Xiaoping stated in the 1980s: "If China had not developed the atomic and hydrogen bombs and launched satellites since the 1960s, it could not be called a major influential country, nor would it have its current international status. These achievements reflect a nation's capability and serve as a symbol of a nation's and country's prosperity" [3].

Today, we face new national development goals and strategies: achieving the great rejuvenation of the Chinese nation through scientific and technological innovation. This new strategy has been formulated in response to a fundamental shift in national demands. China's current primary security threats stem from employment and social stability, environmental carrying capacity, regional security situations, and extremism and terrorism [4]. Among these, employment and social stability depend on sustainable economic development, and the solution to this challenge lies in continuous reform and technological innovation. After 60 years of development, our national needs have become fundamentally different from those of 60 years ago. Therefore, when contemplating new major scientific and technological tasks comparable to "Two Bombs, One Satellite," we must address the needs of the new era rather than those of six decades past.

We can conduct further analysis. Does scientific and technological innovation refer only to scientific and technological tasks? The answer is no. In fact, the core of scientific and technological innovation is not "science and technology" but "innovation." Innovation is not follow-up research; it is humanity's first attempt, leading-edge research. Therefore, any scientific and technological task that involves tracking—repeating what others have already done—cannot become the new era' s "Two Bombs, One Satellite" mission, as it fails to meet the nation' s new demands. In this new era, if China can only follow but not innovate, it cannot attain the international status and voice commensurate with a major power. Tracking and imitation are insufficient to reflect our nation' s capabilities or serve as symbols of our prosperity. This represents a fundamental difference from the early period of the Republic.

What, then, constitutes the symbol of national capability and prosperity in the new era? The answer is: achieving major breakthroughs in frontier fields of basic science, representing humanity in obtaining major original innovative achievements. Reviewing the history of human civilization, particularly modern scientific development, the names of scientific giants—from Copernicus, Galileo, and Newton to Maxwell, Darwin, and Einstein—all come from the West. China is one of the world' s oldest countries, and Chinese civilization is the only ancient civilization that has continued uninterrupted to the present day. China is now the world' s most populous country and the second-largest economy. In the next 10–20 years, barring major disruptions and assuming sustained economic development, we will surpass the United States to become the world' s largest economy. Given the superiority of our social system, China will become the world' s largest "superpower" in terms of both strength and capability. However, if such a country remains content with knowledge created by others—focusing only on applied research directly related to economic benefits while neglecting basic research; if we continue to use others' past to decorate our future, implementing only follow-up development without creating new market models and application fields—we will be like a wealthy person without knowledge, undeserving of respect.

President Xi Jinping has emphasized that basic research is the source of the entire scientific system, the master switch for all technical problems, and the driving force for weapons and equipment development [5]. Only by pioneering new fields that lead global scientific and technological trends, creating original innovative theories with profound influence and broad application, and producing on our own soil a group of Chinese scientific giants who can represent human scientific development (such as multiple Nobel laureates in natural sciences) can we gain widespread recognition and respect from the international community. This need represents the most critical component of national demands in the new era and the core content of building a world science and technology power. Without this, building such a power would be empty talk, and China' s overall national security could not be fundamentally resolved.

Pathways to Major Breakthroughs in Frontier Basic Science

The history of modern scientific development over the past several centuries reveals that early breakthroughs in frontier basic science primarily depended on individual scientists' contributions—from Copernicus to Einstein—representing spontaneous, self-directed research where individual genius played a decisive role. However, since the mid-20th century, particularly after World War II, organized, directed basic research and major scientific breakthroughs representing national will have gradually become the primary means for frontier basic science breakthroughs. Major advances in information technology, space technology, life sciences, and artificial intelligence technology grown from highly developed information technology cannot succeed without massive national investment in large computers, high-end and independently developed large-scale scientific instruments, and facilities. This is why governments worldwide have established national laboratories with clear objectives, rushed to invest in large ground-based scientific infrastructure, and actively sustained support for scientific satellite programs. These government actions, evolving over decades, have formed two types of institutions: one is national laboratories relying on ground-based large scientific facilities; the other is national space agencies that rely on space technology for scientific exploration goals, such as NASA in the United States and the European Space Agency (ESA), which comprises over 20 European countries.

Since the beginning of the new century, from 2000 to 2014, NASA launched 84 space science satellites and ESA launched 34, achieving hundreds of major breakthroughs in frontier basic science, with nearly ten scientists fortunate enough to receive Nobel Prizes (Table).

Table Statistics of Nobel Prizes Awarded Based on Space Science Satellites Since 2000

Laureate	Year	Satellite/Program	Contribution
Raymond Davis Jr.	2002	Homestake/Aerobee	Pioneering contributions to astrophysics, particularly the detection of cosmic neutrinos
Masatoshi Koshiba	2002	Kamiokande	Pioneering contributions to astrophysics, particularly the detection of cosmic neutrinos

Laureate	Year	Satellite/Program	Contribution
John C. Mather, George F. Smoot	2006	COBE	Discovery of the blackbody form and anisotropy of cosmic microwave background radiation, further confirming the Big Bang theory and revealing the distribution of matter and energy in the early universe
Saul Perlmutter, Brian P. Schmidt, Adam G. Riess	2011	Supernova Cosmology Project/High-z Supernova Search Team	Discovery of the accelerating expansion of the universe through observations of distant supernovae
Arthur B. McDonald	2015	SNO	Discovery of neutrino oscillations, showing that neutrinos have mass

Data source: http://www.nobelprize.org/

Space Science Satellite Series as the New Era's "Two Bombs, One Satellite" Mission

Space science is the discipline that uses space vehicles as primary platforms to study physical, astronomical, chemical, and life phenomena and their laws occurring in Earth, Sun-Earth space, interplanetary space, and the entire universe. Space science research covers both the macroscopic cosmos and the microscopic physical world, including the origins of life and dark matter particles. Any important breakthrough in these areas represents a major achievement at the frontier of basic science. Space science is not only an important field for achieving original scientific innovation but also a primary vehicle for organized, directed major basic research by national governments.

Space science satellite programs possess three main characteristics:

1. **Scientific objectives target frontiers of basic science** at macroscopic or microscopic levels. Once breakthroughs are achieved, they will realize

major original innovations with significant international impact, enabling Chinese scientists to make contributions to human development history.

2. **Space science programs require large investment and involve high risks.** Different programs share commonalities, making them suitable for implementation by governments or government-commissioned agencies. They represent typical organized, directed basic research.

3. **Implementation drives development of related high technologies**, providing an optimal platform for military-civilian integration. This role is irreplaceable by other missions.

Based on these characteristics, we believe that space science programs, under new historical conditions and in the process of building a world science and technology power, will produce an impact as significant as the "Two Bombs, One Satellite" mission did in the 1960s. Therefore, we conclude that developing a space science satellite series is the "Two Bombs, One Satellite" task for the new era.

Policy Recommendations for Smooth Development of Space Science Satellite Series

The sole criterion for measuring the success of a space science program is whether it achieves major scientific breakthroughs. To ensure this, two critical tasks must be completed before project approval:

1. **Organize scientific teams to conduct strategic research on space science development** to identify major frontier fields and directions, and find new entry points where Chinese scientists have advantages, providing guidance for project proposal solicitation [8].

2. **Organize bottom-up scientific mission proposals from research teams** and conduct open, fair project selection. This step is crucial as it establishes the foundation for rapid scientific output after launch. Protecting and leveraging the enthusiasm of the principal research entities—the scientific teams—is the most important prerequisite for a mission' s success.

Conversely, if project management authorities designate missions and set scientific objectives on behalf of scientific teams, preventing them from independently arranging scientific payload configurations, the result may be scientific instruments whose specifications deviate from research requirements. Even if a science team leader is appointed later, without systematic thinking and organization, that leader cannot adjust instrument specifications and can only conduct makeshift analysis and mining of scientific data. The initiative and enthusiasm will be far inferior to that of projects proposed autonomously by scientific teams, significantly reducing scientific output and losing opportunities for major breakthroughs.

China' s investment in space science remains in its infancy. During the entire 12th Five-Year Plan period, China' s investment in space science satellites amounted to only the cost of a medium-scale ground accelerator—merely one-tenth of U.S. annual investment in this field [9]. This is completely disproportionate to our goal of building a world science and technology power. Therefore, we recommend:

1. **Elevate the space science satellite series program** (the Strategic Priority Program on Space Science) currently implemented by the Chinese Academy of Sciences to a national "Science and Technology Innovation 2030—Major Project," implementing a "Space Science 2030 Plan." The goal should be to achieve multiple Nobel Prize-level scientific results in major frontier basic science fields before 2030.

2. **Establish a National Space Science Laboratory**, with direct central oversight of major breakthroughs in space science and a separate annual budget line. After several years of rolling implementation, this would ensure several new scientific satellite programs are selected each year and several new satellites are launched annually. By 2030, China should strive to reach the current U.S. level of support for space science satellite programs.

Achieving President Xi Jinping' s three-step strategic goal of building a world science and technology power is the historical mission and responsibility of the entire Party, the nation, and particularly the scientific and technological community. In this new historical period, proposing and implementing major scientific and technological tasks similar to "Two Bombs, One Satellite" remains a hotly debated issue among scientists and engineers without a clear conclusion. This paper analyzes the differences between current national needs and those of 60 years ago from a historical development perspective, arguing that achieving major breakthroughs in frontier basic science has become the most important and core national demand of the new era. Focusing on this argument, we discuss the specific pathway to meeting this demand: implementing organized, directed major basic research programs. This paper further demonstrates that the space science satellite series is precisely such a program, capable of satisfying these major national needs. In short, developing a space science satellite series is the "Two Bombs, One Satellite" task under new historical conditions.

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Author Biography

Wu Ji is Director General of the National Space Science Center (NSSC), Chinese Academy of Sciences; President of the Chinese Society of Space Research; Vice President of the Committee on Space Research (COSPAR); Member of the International Academy of Astronautics (IAA); IEEE Fellow; and Chief Scientist of the CAS Strategic Priority Program on Space Science. He previously served as Chief Designer of the Ground Application System for the Double Star Program, Chief Scientist of the YH-1 Mars Probe, and Chief Commander of the Scientific Payload Subsystem for CE-1, CE-2, and CE-3. His main research areas include distributed space exploration technology, microwave radiometric interferometric imaging technology, and strategic and policy research on space science and technology development. E-mail: wuji@nssc.ac.cn

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Figures

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Figure 1: Figure 1