The New Space Race

China vs. the United States

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Preface

OUTLINE OF THE CHAPTERS

This book examines the civil and military space programs as the two sources of competition in the impending space race between China and the US. The book is organized into four sections. Section I characterizes China's long march into space and provides an insight into the space policies of the US and China. Chapter 1 focuses in particular on the impetus behind China's nascent space program before examining the history that led to China becoming a tier-one spacefaring nation. Chapter 2 provides an outline of Washington's and Beijing's civil and military space policies, focusing on policy goals and objectives.

Following the political groundwork, Section II provides an insight into how an arms race in space may evolve. Chapter 3 shows how the space warfare doctrine of the US is designed to achieve full-spectrum dominance, whereas the doctrine of China is to develop a preemptive strategy with the goal of defeating the US asymmetrically. Chapter 4 assesses the space weapon capabilities of the two countries and how these weapon systems might be employed in a future conflict. Next, Chapter 5 describes the concept of *space dominance* and how the US plans to ensure space superiority by seizing hold of the future of war. This chapter then assesses the asymmetric advantage and vulnerability that the US enjoys and suggests ways in which China may react by developing counterspace capabilities. The final part of Chapter 5 describes two hypothetical scenarios in which China could win and lose a space war with the US. At the conclusion of Section II, it is posited that although the extent of Beijing's pursuit of space weapon technology is uncertain, a new arms race in space is not unthinkable. Such an aggressive stance is proposed because China's statements purporting to use space for peaceful purposes are nothing more than empty rhetoric designed to disguise its real intentions to deploy its own space weapons.

The focus of Section III is the second component of a future space race. Whereas the first space race was characterized by the Soviet Union and the US racing to the

Moon, the objective of the new space race is nothing less than leadership in space. Chapter 6 provides an insight into China's and the US's space exploration programs. Whereas NASA's Vision for Space Exploration is funded to the tune of several billion dollars a year, China's entire annual budget is barely two billion, yet both programs have the same goal. This chapter explains how China is able to achieve so much with so little. Chapter 7 reveals details of China's space technology and how it compares with NASA's hardware designed to return astronauts to the Moon by 2020. This chapter also explains how China may be able to compete with NASA by skipping generations of technologies by buying and absorbing foreign expertise. Chapter 8 focuses on the question of whether China, a neophyte in the world of manned spaceflight, can hope to compete with the US, which routinely chalks up more manned spaceflight experience in a week than the cumulative total of all China's missions.

Finally, Section IV analyzes the factors described in the previous sections and asks how a space race may be avoided. Chapter 9 considers the case for and against collaboration with China and suggests that any attempt at cooperation is doomed to failure in light of the strong anti-China undercurrent in present American conservative politics. Chapter 10 concludes that Beijing cannot be trusted with regards to spaceflight or geostrategic intentions and, given the prominent challenge represented by China, the strategic landscape of the new space era is about to be forever altered by a contest in space.

THEMES AND OVERALL ARGUMENT

This book argues that there is compelling evidence for an impending space race between China and the US. Driven by ambitions to place astronauts on the Moon and driven by fears about national security, the new space race will undoubtedly be fought on two fronts, the first being in the manned spaceflight arena and the second in the strategic dimension. To that end, Beijing has read the playbook of NASA's space program and has decided to pursue manned spaceflight for many of the reasons that the Americans do, such as enhancing international prestige and advancing science and technology. China has also taken note of the US's effort to militarize space and to establish unilateral hegemony and its avowed intention to ensure unrivaled superiority in space, as evidenced by its provocative demonstration of ballistic efficiency when destroying one of its own derelict satellites in January, 2007. Additionally, China's anti-satellite (ASAT) test not only signaled that China had become the challenger to the US, but that space had become the new territory for military competition.

On October 15th, 2003, China became the third nation to independently launch an astronaut into Earth orbit, four decades after the Soviet Union and the US first sent men into space. While the event that matched the feats of the Soviet Union and the US was noted by many as a milestone in human history, China's first manned spaceflight may, in due course, be remembered as the event that launched a new space race. But, whereas the first space race was characterized by the goal of a "flags

and footprints'' mission to Earth's closest neighbor, the prize in the imminent Sino–US competition is nothing less than total military domination of the space environment.

The first space race began on October 4th, 1957, when the Soviet Union launched *Sputnik I*, the world's first artificial satellite, a feat that forced the US to accelerate its fledgling space program. On January 31st, 1958, the US launched *Explorer I* – an event signaling the beginning of a decades-long competition in low Earth orbit and beyond. Three years later, on 12th April, 1961, the Soviet Union put the first man into space, when cosmonaut Yuri Gagarin orbited the Earth – an accomplishment that was followed by the US sending Alan Shepard on a suborbital trip. Less than 50 years later, the two major space powers have been joined by a third, which has declared its intentions of not only establishing a space station, but also landing its astronauts on the Moon and eventually embarking upon a manned mission to Mars.

While the international media's attention to China's space program has been sporadic and sometimes patronizing, such indifference risks overlooking the long-term consequences of China as a growing space power and, more ominously, the possible confrontation of the US and Chinese interests in space. The recent successful manned spaceflights by Beijing and the bold predictions made by China have prompted some Western observers to wonder whether China's achievements signal the beginning of the end of the American dominance in manned spaceflight, while other analysts suggest that the rise of China's space program may represent the ''Sputnik shock'' all over again.

Perhaps more worrying than a race to the Moon are the potential political and militaristic implications of China's space ambitions. These aspirations are fuelled by aggrieved nationalism deeply ingrained in the Chinese psyche and a mindset dictating that China must develop economic wealth and military power so that it can exact retribution from the foreign powers that have humiliated China since the Opium War more than a century ago. Perhaps Beijing's pursuit of a robust and long-term space program is a rational decision to not only pay homage to this obsessive Chinese nationalism, but also to garner political and military benefits.

Against this background, the aim of this book is first to provide an overview of China's and the US's military and manned spaceflight capabilities. The second aim of the book is to consider the reality that the world faces a very different space race from the one pursued by the Soviet Union and the US in the late 1950s and 1960s. The final goal of the book is to consider the geostrategic implications of a new international rivalry that seeks to control the final frontier and how the capabilities of the adversaries may affect the outcome.

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Once again, no acknowledgment would be complete without special mention of our cats, Jasper and MiniMach, who provided endless welcome distraction and entertainment.

About the author

Erik Seedhouse is an aerospace scientist with ambitions to become an astronaut. After completing his first degree in Sport Science at Northumbria University, the author joined the 2nd Battalion the Parachute Regiment, the world's most elite airborne regiment and greatest fighting force. During his time in the "Para's", Erik spent six months in Belize, where he was trained in the art of jungle warfare and conducted several border patrols along the Belize–Guatamala border. Later, he spent several months learning the intricacies of desert warfare on the Akamas Range in Cyprus. He made more than 30 jumps from a Hercules C130 aircraft, was certified in the art of helicopter abseiling, and fired more light anti-tank weapons than he cares to remember!

Upon returning to academia, the author embarked upon a Master's degree in Medical Science at Sheffield University. While studying for his Master's degree, he earned extra money by winning prize money in 100-km ultradistance running races. Shortly after placing third in the World 100-km Championships in 1992 and setting the North American 100-km record, the author turned to ultradistance triathlon, winning the World Endurance Triathlon Championships in 1995 and 1996. For good measure, he also won the inaugural World Double Ironman Championships in 1995 and the Decatriathlon, the world's longest triathlon – an event requiring competitors to swim 38 km, cycle 1,800 km, and run 422 km. Non-stop! Returning to academia once again in 1996, Erik pursued his Ph.D. at the German Space Agency's Institute for Space Medicine. While conducting his Ph.D studies, he still found time to win Ultraman Hawaii and the European Ultraman Championships as well as completing the Race Across America bike race. In 1997, *GQ Magazine* nominated the author as the "Fittest Man in the World".

Deciding it was time to get a real job, Erik retired from being a professional triathlete in August, 1999, and started work on his post-doctoral studies at Vancouver's Simon Fraser University's School of Kinesiology. While living in Vancouver, Erik gained his pilot's license, started climbing mountains, and took up sky-diving to relax in his spare time. In 2005, Erik worked as an astronaut-training consultant for Bigelow Aerospace in Las Vegas and wrote "Tourists in Space", the training manual for spaceflight participants. He is a Fellow of the British

Interplanetary Society and a member of the Aerospace Medical Association. Recently, he was one of the final 30 candidates of the Canadian Space Agency's Astronaut Recruitment Campaign. Erik currently works as a manned spaceflight consultant and author. He plans to travel into space with one of the private spaceflight companies. As well as being a triathlete, skydiver, pilot, and author, Erik is an avid scuba diver. Erik spends as much time as possible in Kona on the Big Island of Hawaii and at his real home in Sandefjord, Norway. Erik lives with his wife and two cats on the Niagara Escarpment in Canada.

Figures

Tables

Panels

Abbreviations

AAAS	American Association for the Advancement of Science
ABM	Anti-Ballistic Missile
ACS	Attitude Control System
AFRL	Air Force Research Laboratory
AFSPC	Air Force Space Command
AI	Artificial Intelligence
APSCO	Asia–Pacific Space Cooperation Organization
ASAT	Anti-satellite
ATB	Astronaut Training Base
ATCO	Ambient Temperature Catalytic-Oxidation
ATSP	Apollo Soyuz Test Project
ATV	Automated Transfer Vehicle
BACC	Beijing Aerospace Command and Control Center
BMD	Ballistic Missile Defense
BMDS	Ballistic Missile Defense System
BPC	Boost Protective Cover
C&C	Command and Control
C3	Command, Control, and Communications
C3PO	Commercial Crew and Cargo Program
CAIB	Columbia Accident Investigation Board
CALT	China Academy of Launch Vehicle Technology
CaLV	Cargo Launch Vehicle
CAST	China Academy of Space Technology
CAT	COTS Advisory Team
CAV	Common Aero Vehicle
CCB	Common Core Booster
CCDH	Command, Control, and Data Handling
CCP	Chinese Communist Party
CCS	Counter Communications System
CDMA	Code Division Multiple Access

CDV	Cargo Delivery Vehicle
CENTCOM	Central Command
CEV	Crew Exploration Vehicle
CIA	Central Intelligence Agency
CLV	Crew Launch Vehicle
CM	Crew Module
CMC	Central Military Commission
CMRS	Carbon Dioxide and Moisture Removal System
CNP	Comprehensive National Power
CNSA	China National Space Administration
CONUS	Continental United States
COSPAR	Committee on Space Research
COSTIND	Commission on Science, Technology, and Industry for National Defense
COTS	Commercial Orbital Transportation Services
CSA	Canadian Space Agency
CSSS	Constellation Space Suit System
CTU	Central Terminal Unit
CVO	Cargo Variant of Orion
DARPA	Defense Advanced Research Project Agency
DDTC	Directorate of Defense Trade Controls
DFH	Dongfanghong
DMSP	Defense Meteorological Satellite Program
DNI	Directorate of National Intelligence
DoD	Department of Defense
DRM	Design Reference Mission
DSCS	Defense Satellite Communications System
DSP	Defense Support Program
EAFB	Edwards Air Force Base
EAGLE	Evolutionary Aerospace Global Laser Engagement
ECLSS	Environmental Control Life Support System
EDS	Earth Departure Stage
EELV	Evolved Expendable Launch Vehicle
EKV	Exoatmospheric Kill Vehicle
ELINT	Electronic Intelligence
ELV	Expendable Launch Vehicle
EPIRB	Emergency Position Indicating Radio Beacon
EPS	Electrical Power System
ERS	Earth Remote Sensing
ESA	European Space Agency
ESAS	Exploration Systems Architecture Study
ESMD	Exploration Systems Mission Directorate
ET	External Tank
EVA	Extravehicular Activity

FALCON	Force Application and Launch from the Continental United States
FoS	Factor of Safety
FTV	Flight Test Vehicle
GBI	Ground-Based Interceptor
GOX	Gaseous Oxygen
GPS	Global Positioning System
GR&A	Ground Rules and Assumptions
GTO	Geostationary Transfer Orbit
HCV	Hypersonic Cruise Vehicle
HEMP	High Altitude Electromagnetic Pulse
HEO	Highly Elliptical Orbit
HPB	Horizontal Processing Building
HPUC	Hydraulic Power Unit Controller
HST	Hubble Space Telescope
IAF	International Astronautical Federation
IASS	International Association for the Advancement of Space Safety
IHPRPT	Integrated High Payoff Rocket Propulsion Technology
IMU	Inertial Measurement Unit
INS	Inertial Navigation System
IRD	Interface Requirements Document
ISC2	Integrated Space Command and Control
ISR	Intelligence, Surveillance, and Reconnaissance
ISRD	ISS Service Requirements Document
ISS	International Space Station
ITAR	International Trade in Arms Regulations
IUA	Instrument Unit Avionics
IVA	Intravehicular Activity
JAXA	Japanese Aerospace Exploration Agency
JPL	Jet Propulsion Laboratory
JSC	Johnson Space Center
JSLC	Jiuquan Satellite Launch Center
KEASAT	Kinetic Energy Anti-Satellite
KEW	Kinetic Energy Weapon
KKV	Kinetic Kill Vehicle
KSC	Kennedy Space Center
LADAR	Laser Detection and Ranging
LAS	Launch Abort System
LCH4	Liquid Methane
LEO	Low Earth Orbit
LES	Launch Escape System
LLO	Low Lunar Orbit
LM	Long March
LSAM	Lunar Surface Access Module

MCS	Mission Control Station
MCTR	Missile Technology Control Regime
MIT	Massachusetts Institute of Technology
MKV	Multiple Kill Vehicle
MNF	Multinational Force
MOL	Manned Orbiting Laboratory
MPSS	Main Parachute Support System
NDC	National Defense Complex
NDIO	National Defense Industry Office
NMCC	National Military Command Center
NMD	National Missile Defense
NOAA	National Oceanic and Atmospheric Administration
NPR	Nuclear Posture Review
NPR	NASA Procedural Requirements
NRC	Nuclear Regulatory Commission
NSB	National Science Board
NSIRA	National Security Intelligence Reform Act
OMS	Orbital Maneuvering System
OST	Outer Space Treaty
OTV	Orbital Test Vehicle
PAEC	Pakistan Atomic Energy Commission
PAROS	Prevention of an Arms Race in Outer Space
PBAN	Polybutadiene Acrylonitrite
PCU	Power Control Unit
PLA	People's Liberation Army
PLAAF	Peoples Liberation Army Air Force
PMAD	Power Management and Distribution
PNT	Positioning, Navigation, and Timing
PV	Photovoltaic
R&D	Research and Development
RCS	Reaction Control System
RFS	Radio Frequency Spectrum
RMS	Remote Manipulator System
ROE	Rules of Engagement
RSB	Reusable Solid Rocket Booster
RSM	Reactive Satellite Maneouvre
RSS	Rotating Service Structure
S&T	Science and Technology
SA	Spacecraft Adapter
SAA	Space Acts Agreement
SAFER	Simplified Aid For EVA Rescue
SAGES	Shuttle and Apollo Generation Expert Services
SBIRS	Space-Based Infrared System
SBL	Space-Based Laser
SCA	Spacecraft Adapter System

SDI	Strategic Defense Initiative
SEI	Space Exploration Initiative
SIGINT	Signals Intelligence
SLF	Shuttle Landing Facility
SLV	Small Launch Vehicle
SM	Service Module
SM-3	Standard Missile-3
SMP	Strategic Master Plan
SMSC	Space and Missile Systems Center
SPAS	Shuttle Pallet Satellite
SRB	Solid Rocket Booster
SRBM	Short-Range Ballistic Missile
SRM	Solid Rocket Motor
SROE	Standing Rules of Engagement
SSA	Space Situational Awareness
SSC	Stennis Space Center
SSME	Space Shuttle Main Engine
SSN	Space Surveillance Network
SSO	Sun Synchronous Orbit
STEC	Science, Technology and Equipment Commission
STSS	Space Tracking and Surveillance System
TLI	Trans-Lunar Insertion
TPS	Thermal Protection System
TSLC	Taiyuan Satellite Launch Center
TT&C	Telemetry, Tracking and Control
UN COPUOS	United Nations Committee on the Peaceful Uses of Outer Space
UNIDIR	United Nations Institute for Disarmament Research
USAF	United States Air Force
USSTRATCOM	US Strategic Command
UV	Ultraviolet
VAB	Vehicle Assembly Building
VDC	Volt Direct Current
VPB	Vertical Processing Building
VSE	Vision for Space Exploration
WSLC	Wenchang Satellite Launch Center
XSCC	Xi'an Satellite Control Center
XSLC	Xichang Satellite Launch Center
XSS	Experimental Spacecraft System

Section I

High Frontier Politics

Following its third manned spaceflight in 2008, China now stands at the pinnacle of the international space hierarchy, alongside Russia and the US. But, while the flights of Yang Liwei and his fellow taikonauts have received much media attention, what is less well known is the military dimension of its space program. Here, in Chapter 1, the broader historical and political contexts within which the Chinese civil and military space programs have developed are explored and in Chapter 2, Chinese space policy is examined against the policies of the US, China's rival in the new space race.

1

Rising dragon

THE *WHY* AND *HOW* OF CHINA'S LONG MARCH INTO SPACE

In October 2003, a Long March 2-F (LM-2F) rocket launched Shenzhou 5 (Figure 1.1) and China's first taikonaut, Yang Liwei, into low Earth orbit (LEO). Although the flight lasted only one day, and decades separated China's first manned mission from those of the Russians and Americans, the event was significant, as it heralded China as only the third nation ever to develop an independent manned spaceflight capability.

Despite being a poor developing country with a per capita income of only $1,293, China has indicated its intention to launch a space station, to land its taikonauts on the Moon, and eventually to embark upon a manned mission to Mars – ambitions it characterizes as a "long march" into space. In common with China's historic Long March, in which Mao Zedong's retreating forces created an epic propaganda coup, Beijing intends to ensure that the "long march" into space will, in addition to setting the tone for China's future, be seen as another grand project, on a par with the Great Wall. But how did China, whose space ambitions had often been denigrated by the Western media before Liwei's historic flight, accomplish a technological feat previously achieved by only two other nations, and what are the forces driving the red dragon's ascent into space? The answers to these questions are presented in this chapter, which first examines the impetus behind China's nascent space program, before describing the events leading to China's arrival on the threshold of attaining the status of a space power.

THE WHY

Manned spaceflight is open to all nations willing to pay the financial and technological price of admission (Panel 1.1). An activity that is perhaps the most difficult and most prestigious of all human endeavors – manned spaceflight – confers