MINIMIZING THE THREAT FROM SPACE DEBRIS

Dr. David Wright’s March 27, 2007 Visit to Ottawa, Canada

produced in partnership with Secure World Foundation
MINIMIZING THE THREAT FROM SPACE DEBRIS: Event Report on Dr. David Wright’s March 27, 2007 Visit to Ottawa

INTRODUCTION

2007 marks the 40th anniversary of the Outer Space Treaty (OST), providing a unique opportunity for much-needed action on space security. It is in this context, that the Rideau Institute, in conjunction with Secure World Foundation, was pleased to sponsor Dr. David Wright’s visit to Ottawa on March 27, 2007.

Dr. Wright is co-director of the U.S.-based Union of Concerned Scientists’ Global Security Program. Dr. Wright’s visit was part of the Rideau Institute’s ongoing program on space security and its collaborative efforts with the Secure World Foundation to educate and spur national debate about the dangers of space weapons and increasing space debris.

Canada has never had a comprehensive, coherent, overarching space policy. Instead of the current piecemeal approach, the Rideau Institute and Secure World Foundation, are working with parliamentarians and other decision makers to advance a national space policy for Canada, to be developed following public debate and consultation. This national policy should then govern and guide all future Canadian space activities.

The Rideau Institute is encouraging Canada to work with other like-minded countries towards international treaties on the prevention of an arms race in outer space and on the needed to address growing problems posed by increasing space debris, that threaten the viability of satellites.

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BIOGRAPHY IN BRIEF

Dr. Wright is an established expert on the technical aspects of arms control, particularly those related to missile defence systems, space weapons and missile proliferation. He has testified before Congress on arms control issues and is a frequently quoted source in the New York Times and on the U.S.A.’s National Public Radio (NPR). He has worked for many years on projects to help train technical arms control experts in other countries, especially Russia and China.

Currently a Research Affiliate in the Program on Science, Technology, and Society at Massachusetts Institute of Technology (MIT), Dr. Wright has authored numerous articles and reports on arms control and international security. He is a primary organizer of the International Summer Symposiums on Science and World Affairs. These symposiums help create an international community of scientists working on arms control and security issues. Wright was a co-recipient of the American Physical Society’s 2001 Joseph A. Burton Forum Award for his arms control research and his work with international scientists.

WRIGHT IN OTTAWA

Along with Rideau Institute Director Steven Staples and Senior Advisor Peggy Mason, Dr. Wright was interviewed on his first day by Embassy magazine journalist Brian Adeb. [The resulting article on the need for a ban on space weapons to curb space junk is attached in Appendix I.] Later in the morning, Dr. Wright, Ms. Mason and Rideau Institute Program Director Anthony Salloum held a press conference on Parliament Hill to draw attention to the urgent need for measures to ban anti-satellite weapons (ASATs) and control space debris to ensure the sustainable use of outer space. During the press conference, Dr. Wright presented his March 27, 2007 open letter to Prime Minister Harper, calling on Canada to take action to minimize space debris and safeguard the peaceful use of outer space [see UCS’s “Open Letter to Canadian Prime Minister Stephen Harper” in Appendix II].

Ensuring the peaceful use of outer space is crucial given many countries’ increasing dependence on satellites. Although the 40-year-old international Outer Space Treaty (OST) bans nuclear weapons from being deployed in space, the treaty does not address the threat ASAT weapons pose to communication and international security. Ensuring the peaceful use of outer space is crucial given many countries’ increasing dependence on satellites.

Dr. Wright’s visit was part of the Rideau Institute’s ongoing program on space security and its collaborative efforts with the Secure World Foundation to educate and spur national debate about the dangers of space weapons and increasing space debris.

BACKGROUND

On January 11, 2007, China destroyed one of its aging weather satellites using an anti-satellite (ASAT) weapon. This action was a wake-up call to the international community about the looming threat of a new arms race in space. Throughout the world — in the U.S.A., Europe, Russia, China and India — nations are spending tens of millions of dollars developing technology for space-based strike weapons (SBWs). The U.S.A., in particular, is aggressively pursuing development of SBWs and seek line military dominance of outer space.

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Canada has a long history of activity in outer space. In 1962, Canada became the third country in the world to design and build its own satellite, when it launched the Alouette I research satellite. Also first in the world was the Canadian operational satellite ANIK, which was launched into the geostationary orbit in order to provide domestic telecommunications and TV transmissions throughout Canada. Canada's space program has been designed primarily to serve specific domestic needs in this vast, relatively sparsely populated country. Canadian space programs are an important economic activity and have become indispensable for national security and environmental protection.

To date, Canada has played an important role in informing international debate and dialogue on space security through the Space Security Index. This annual index is the product of the collaborative research of Spacesecurity.org — a consortium of academic, governmental, and non-governmental organizations, such as Secure World Foundation. The federal government has provided funding for this consortium since 2003. Using primary, open source research, the Space Security Index provides a policy-neutral fact base of trends and developments in space security to inform a debate that has become unnecessarily polarized. Building on the consortium's work, the Department of Foreign Affairs published a consultative working paper on a “space security index” in 2004 with the aim of establishing an agreed body of knowledge from which to commence negotiations on an arms control treaty for outer space.

RECOMMENDED ACTION FOR CANADA

Since debris cannot be effectively removed from orbit, controlling the production of debris is essential if we are to preserve the long-term use of space. “Banning the testing and use of destructive anti-satellite weapons should be an urgent priority for the international community,” said David Wright. Banning ASAT weapons would also improve international security by preventing satellite failures from being erroneously interpreted as resulting from deliberate attacks by enemy states.

Although there are currently no weapons in outer space, Dr. Wright fears that, in the absence of decisive action, the recent ASAT test could lead to an arms race in space. While the Department of Foreign Affairs has called for an immediate moratorium on the use of ASATS, further action is required. In his letter to Prime Minister Harper, Dr. Wright urged Canada to use its international moral suasion to lead an international campaign to ban the testing and use of ASAT weapons.

The ASAT ban is one component of a broader international treaty on the prevention of an arms race in outer space (PAROS) that is required to ensure the peaceful long-term use of outer space. This treaty also needs to include guidelines governing the launch and retirement of satellites to minimize the production of additional space debris.

Given Canada’s international reputation for promoting disarmament and space security, Canada is in an excellent position to lead the way in supporting initiatives for the drafting and ratification of a PAROS treaty and an ASAT weapons ban. The Rideau Institute has been advocating for Canadian leadership on both the PAROS treaty and an ASAT weapons ban. To date, Canada has played an important role in increasing dialogue on space security through the Space Security Index. However, the time has come for Canada to do more — namely, openly declare its support for the negotiation of a PAROS treaty. There is no better time to do this than the 40th anniversary of the Outer Space Treaty.

This is urgent. As Nobel Peace Prize-nominated peace activist Helen Caldicott puts it, “We must act today if we are to avoid a war in heaven tomorrow.”

FOR MORE INFORMATION: please refer to The Rideau Institute’s Blue Note Briefing Paper Increased Threat to Space Underscores Need for New Space Treaty.
U.S. Scientist Says Weapons Ban Would Curb Space Junk

David Wright wants a ban on weapons in space based on worries about debris from old satellites affecting communications on Earth.

By Brian Adams

A scientist with the U.S.-based Union of Concerned Scientists in Ottawa to use its position to encourage the creation of a global security program. Even if countries don’t start cutting weapons in space, the arms could be used to destroy satellites, which are vital to humans’ communication needs. Thus there are urgent reasons for a global security program, he said.

Wright believes the destruction of an aging satellite like the Chinese early that your goal is a disarming prevention for our country because the threat has the potential of spurning an arms race in space.

In addition, he said that there is a direct link between those belonging to enemy states, which could lead to an increase in the amount of debris floating in space. He said some satellites are being shot down larger than the satellites themselves. He said there are fewer debris in space if there are destroyed.

Mr. Wright visited Ottawa last week as part of a campaign by the Bulletin of Atomic Scientists and the Union of Concerned Scientists to encourage citizens and politicians about the dangers of space weapons.

Since the first satellite was launched 50 years ago, many more have been placed in space to provide weather conditions and military communications. The number is now over 9,000, with many more on the launchpad. About 50,000 pieces, contributing to a 15 percent increase in space

InSPACE

D. Wright said even though satellites have orbits, which can travel at a speed of 7 miles per second, they can be targeted to hit other orbits and even to be destroyed in orbit.

There is no way of removing debris from space and Mr. Wright said the best solution is not to put them out there.

It’s like global warming, once you put carbon dioxide to the atmosphere it’s there for a long time. For that reason, having the testing and use of destructive anti-satellite weapons should be an urgent priority for the international community,” said Mr. Wright in a speech at the University of Ottawa.

APPENDIX II

March 27, 2007
Open Letter to Canadian Prime Minister Stephen Harper

Rt. Hon. Stephen Harper
Office of the Prime Minister
80 Wellington Street
Ottawa ON K1A 0A2 Canada

Dear Prime Minister Harper,

I am writing to call your attention to a critical issue that requires the action of the international community: banning the testing and use of destructive anti-satellite (ASAT) weapons.

The testing or use of these weapons to destroy satellites creates dangerous amounts of space debris that can threaten the future use of space. The recent test of such an anti-satellite weapon by China has highlighted concerns about this issue.

Fifty years ago this October, humans put their first object into orbit with the Soviet Union’s launch of Sputnik. Since then, there have been more than 4,500 space launches. Today there are more than 800 active satellites in orbit, but human space activity has also placed in orbit more than a half million pieces of debris large enough to cause severe damage to a satellite in a collision.

Because of their very high speed in orbit, even relatively small pieces of orbiting debris can damage or destroy satellites. Since debris can stay in orbit for decades or longer, it accumulates with time as more is produced. As the amount grows, the risk of collisions with satellites also grows. If the amount of debris becomes sufficiently large, it can make parts of space unsuitable for use by satellites.

Since debris cannot be effectively removed from orbit, controlling its production is essential for preserving the long-term use of space.

A draft set of debris mitigation guidelines has been developed by the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS), and will be sent to the U.N. 4th Committee and then to the General Assembly for approval. Adoption of these guidelines is an important step for controlling the production of debris during routine space activities.

However, these guidelines do not go far enough; they do not specifically address the issue of banning destructive ASAT weapons, and they are not legally binding. Banning the destruction of satellites is crucial to preserving the sustainable use of space because of the tremendous amount of debris such destruction can create. Our calculations show that the destruction of a single large satellite, similar to many of the current military reconnaissance and surveillance satellites, could
have a significant impact on the space environment.

In particular, there are currently an estimated 200,000 pieces of debris with size greater than one centimeter throughout low earth orbit (i.e., at altitudes up to 2,000 kilometers), where over half of existing satellites operate. The destruction of a single 10-ton satellite in low earth orbit could create 250,000 additional pieces of debris of this size—more than doubling the total population of large debris in low earth orbit. Debris greater than one centimeter in size is particularly important because it can cause significant damage to satellites in a collision, and it cannot be effectively shielded against at such high speed.

This much debris would be equivalent to that generated in 70 to 80 years of space activity under a regime of strict debris mitigation measures of the kind currently being discussed internationally.

The January 2007 Chinese test was conducted against a relatively small, defunct weather satellite, and yet that test resulted in a 20 percent increase in low earth orbit debris with size greater than one centimeter. Because it was created at high altitude (850 kilometers), more than half of the debris created in that test will remain in orbit for several decades.

Banning destructive anti-satellite weapons would also have important implications for international security by reducing the chance that the failure of a satellite during a time of tension would be interpreted as a deliberate attack—an interpretation that could result in a further escalation of tensions or lead to retaliation.

Because many aspects of modern life—civil, economic, scientific, and military—rely heavily on satellites, ensuring the sustainable use of space must be a high international priority. One of the most important steps in this direction is developing a legal regime that bans the testing and use of debris-creating anti-satellite weapons. International leadership is urgently needed to put such a regime in place. Canada, with significant space assets to protect and an international reputation for promoting space security, is in an excellent position to provide such leadership.

I appreciate your attention to this issue.

Respectfully,

David Wright, PhD
Co-Director and Senior Scientist
Global Security Program
Union of Concerned Scientists
Debris from China’s Kinetic Energy Anti-Satellite Test
Wang Ting and David Wright
March 23, 2007

On January 11, 2007 (U.S. time), China tested an anti-satellite (ASAT) weapon against a defunct Chinese weather satellite. The test used a kinetic energy ASAT weapon, which apparently destroyed the satellite by homing on it and colliding with it at very high speed.

The satellite, called Feng Yun 1-C (FY-1C) had a mass of just under one ton and was orbiting at roughly 850 km altitude when the collision occurred. The collision took place at a speed greater than 8 km/s and would be expected to completely break the satellite into fragments, the vast majority of which would orbit the earth as space debris. Because this breakup took place at a high altitude where the atmospheric density is very low, a large fraction of this debris will remain in orbit for decades.

Debris from the Chinese Test
Because of their high speed, even small pieces of orbiting debris can threaten satellites. Since high-altitude debris can stay in orbit for decades or longer the amount of debris grows with time, and there is no effective way to remove it. Controlling the production of debris is therefore essential for preserving the long-term use of space.

Using a NASA model developed to describe satellite breakups at high speeds, one can estimate the number of debris fragments with size greater than 1 mm that resulted from the FY-1C breakup (see table below). This debris represents a significant increase in the total estimated amount of debris of this size at all altitudes up to 2,000 km, i.e., throughout low earth orbit (LEO). By late March, the U.S. Space Surveillance Network had already catalogued more than 1,000 pieces of debris (presumably larger than 5 to 10 cm) from the Chinese test.

<table>
<thead>
<tr>
<th>Debris size</th>
<th>1 mm to 1 cm</th>
<th>1 cm to 10 cm</th>
<th>&gt; 10 cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total debris in LEO before Chinese test</td>
<td>140 million</td>
<td>180,000</td>
<td>9,700</td>
</tr>
<tr>
<td>Debris from the FY-1C breakup</td>
<td>2 million</td>
<td>40,000</td>
<td>800</td>
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</table>

Since the debris from this test is concentrated at altitudes near 850 km, it would double the density of debris larger than 1 cm in that region for at least five years.

Satellites cannot be shielded effectively against collisions at this speed with debris larger than about 1 cm. Moreover, debris smaller than about 10 cm cannot be reliably tracked from the ground to give warning of a possible collision.

Figure 1.

Using the NASA model, debris and atmosphere data, and orbit calculations, we can estimate how long the debris from this test will stay in orbit. Those calculations (Figure 1) show that more than 50% of the debris with size greater than 1 cm will remain in orbit for more than 20 years. The sections of the curves that show sharp declines in debris are due to the periodic maxima of solar activity, which cause the earth’s atmosphere to expand slightly, increasing the atmospheric drag on the debris.

Most of the debris from such a breakup will orbit at altitudes near the altitude at which the collision took place. Over time the debris will spread out in a shell around the earth, so that it places at risk all satellites that pass through that altitude (Figures 2 to 5).

Debris from Larger Satellites
The breakup of satellites larger than FY-1C will produce significantly more debris. Satellites that are considered likely targets of ASAT weapons, such as spy satellites, have masses ten times that of the FY-1C satellite. The breakup of a single large satellite with a mass of 10 tons would double the amount of debris in low earth orbit with size larger than 1 cm, and could increase the density of debris in altitudes near the breakup altitude by several hundred percent. The debris estimates for this case are shown in the table below.

<table>
<thead>
<tr>
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<th>&gt; 10 cm</th>
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<tr>
<td>Total debris in LEO before Chinese test</td>
<td>140 million</td>
<td>180,000</td>
<td>9,700</td>
</tr>
<tr>
<td>Debris from the breakup of a 10-ton satellite</td>
<td>14 million</td>
<td>250,000</td>
<td>5,000</td>
</tr>
</tbody>
</table>

For more information, contact: David Wright, Union of Concerned Scientists, 617-301-8060