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Impact of China's Anti-Sat Weapon's Test Debris?

"It would not surprise me if it caused the destruction of at least one working satellite and maybe a couple. I would be surprised if it was bad enough to cause the destruction of many satellites."- Jonathan McDowell, Ph.D., Harvard Astrophysicist

Illustration of aging FengYun-1 weather satellite destroyed January 11, 2007, in Chinese anti-satellite weapon test, courtesy Earth Observation Resources.

January 19, 2007 Cambridge, Massachusetts - Craig Covault in *Aviation Week & Space Technology* online reported January 17, 2007, that "U. S. intelligence agencies believe China performed a successful anti-satellite (asat) weapons test at more than 500 miles altitude (new estimate is 530 miles up) on January 11, 2007, destroying an aging Chinese weather satellite target with a kinetic kill vehicle launched on board a ballistic missile.

"The Central Intelligence Agency, the National Security Agency, the Defense Intelligence Agency, NASA and other government organizations have a full court press underway to obtain data on the alleged test. If the test is verified it will signify a major new Chinese military capability." Previously, only the U. S. in the mid-1980s and Russia had successfully performed anti-satellite weapons tests.

In 1986, Jonathan McDowell graduated from Cambridge University in England with a Ph.D.-equivalent in Astrophysics. He has worked as a staff astrophysicist at Harvard University's Smithsonian Center for Astrophysics in Cambridge, Massachusetts, since 1992. In addition to his university work, he has become a space historian keeping logs on as many satellite launches from all countries as he can. In the process he has expressed concern as a scientist against the weaponization of space, which Dr. McDowell sees as a very de-stabilizing path for this planet.

On January 17, 2007, he began receiving phone calls at his Harvard office about an alleged anti-satellite weapons test by the Chinese at 10:30 p.M. Greenich Mean Time on January 11. He was surprised by the news because until now, the last publicly known anti-satellite weapons tests were carried out by the United States in 1986 during the "Star Wars" era.

Further, he was stunned to learn that the debris field after the missile attack extended from 100 miles to 2,000 miles above the Earth - essentially the entire satellite and International Space Station orbiting territory. The energy of the device that hit the Chinese weather satellite had to be enormous and hit from the side. The accuracy of the guidance system to make such an accurate hit at 530 miles above the Earth says the Chinese technology is at least on par with the United States and Russia. So far, China authorities have neither confirmed nor denied their weather satellite's destruction by an anti-satellite weapon.

Interview:

Jonathan McDowell, Ph.D., Astrophysicist, Harvard Smithsonian Center for Astrophysics, Cambridge, Massachusetts: "We've had twenty years of restraints, which this Chinese test has ended. My concern now is that this Chinese test will provide a trigger to move the United States and other countries to develop more anti-satellite weapons systems.

The event happened over South China. Their (weather) satellite happened to be over South China at the time. U. S. administration officials off-the-record have stated that we detected a medium range ballistic launched which could have caused this explosion on January 11, at about 10:30 p.m. Greenich Mean Time.

WHY WOULDN'T CHINA JUST SIMPLY GO ON THE RECORD ABOUT WHAT'S HAPPENING BECAUSE THEY ARE BECOMING SUCH A MAJOR WORLD PLAYER?

Well, that's an interesting question and that I haven't figured out. My best guess is that the civilian authorities in charge of making statements are not necessarily cleared to know what the Chinese military is doing. We found this in the old Soviet Union a number of times – the official spokesperson would make some confident statement that they truly believed and then a few months later, they would have to backtrack when they were actually cleared to know what their military had actually done.

So, I don't put much weight on the fact that the Chinese have neither confirmed nor denied the satellite destruction.

COULD YOU COMMENT IN THAT CONTEXT ABOUT THE ACCURACY THAT THIS TEST INDICATES ABOUT CHINESE TECHNOLOGY?

It's impressive. We knew their rocket technology was good. We didn't know their guidance technology was this good. So, the trick in pulling this test off was not just to get a rocket to the right height, but to know exactly where that satellite was going to be. To be able to guide the nose cone of their rocket to exactly the right place at the right time to hit the satellite.

It's something that even our own American tests, if you have followed the sub-orbital anti-missile tests that have happened in the Pacific over the past few years, we've had some embarrassing failures, as well as some successes. So, this is not a trivial thing to do that guidance. It's a lot easier, I might add, when your target satellite is your own satellite, so you can have it transmit a signal that says, 'Here I am! Here I am!'

It's a lot harder to do this against an uncooperative satellite that belongs to someone else. That's the one caveat I would say about the level of capability the Chinese have shown – you don't know whether the Chinese made use of looking up the answer in the back of their own weather satellite to help them. Until you know if they did that, or made use of any of that information, and just pretended it was someone else's satellite – that makes the difference in how convincing a capability it is.

Weather Satellite Exploded In All Directions

DID THE MISSILE HIT THE SATELLITE FROM BEHIND?

It came from the side, but imparted a lot of energy that was somehow – and this is what I personally don't understand about the physics of this collision. It basically added momentum in all directions. So, the energy of the explosion in the disintegration of the satellite was randomized in the collision. It put a lot of energy into this satellite and pieces came flying off in all directions, but with enough speed to change the orbit of those pieces.

WHAT WOULD YOU SPECULATE COULD CAUSE THAT?

You have a fairly large missile with a lot of kinetic energy hitting the satellite. Then the amount of energy needed to create what you see is certainly there. Then the details of how that energy gets changed into the exact form of the disintegration of the satellite is not something I have thought through.

"Hitting Brick with A Brick At High Speed"

BUT THE STRONG DEBRIS FIELD IMMEDIATELY SAYS THAT THEY WERE SO ACCURATE THAT THEY HIT THE WHOLE SATELLITE WITH A LOT OF ENERGY?

Right. This new generation of anti-satellite weapons – the idea is that they don't have a bomb onboard. There is no explosive involved. It's just that you are hitting the target at 18,000 mph. A head on direct collision is not good!

SO THIS MISSILE DID NOT HAVE A NUCLEAR OR EXPLOSIVE WARHEAD?

That is correct. It certainly did not have a nuclear warhead and it probably did not have an explosive warhead.

WHY WOULD THAT BE?

The energy from an explosion – suppose you put a ton of high explosive in this warhead. The energy released by a ton of high explosive is much less than the energy of just hitting something at 18,000 mph, right? So, you add maybe 10% by putting a high explosive onboard. Why bother?

So if you have the clever guidance system that lets your non-explosive missile hit the target, then there is no advantage to adding high explosives. There is more energy in racing down the freeway and smashing into something.

Nuclear Anti-Satellite Warheads Would "Wipe Out Half the Satellites in Earth Orbit"

YOU DON'T NEED TO ADD THAT WEIGHT TO YOUR MISSILE.

Right. Now, a nuclear warhead is a different matter. But with a nuclear warhead, what happens is you pretty much wipe out half the satellites in Earth orbit. The electromagnetic pulse from a nuclear explosion will zap everything. You'll create a new radiation belt around the Earth. The U. S. did that in 1962. The U. S. exploded a nuke at 500 miles high and it created a new radiation belt that lasted for five years (until 1967), it took out all the lights in Hawaii for a day. It was a very major event. That's not something you do to take out one satellite. That's something you do to really start a war. It's not a good plan for an anti-satellite weapon.

So, hitting a brick with a brick at very high speeds is still one better way to do it, but it's still very bad because it creates all this debris. Some of the military in the U. S. have been thinking up more clever, but more benign ways to be space warriors like sidling slowly up to your target satellite and spraying its cameras with black paint. Stuff like that which would disable the satellite without creating hundreds of pieces of debris which is not only bad for your enemy, it's bad for you because you want to use your satellites in space.

WHAT YOU HAVE JUST OUTLINED IS THAT IT WOULD BE ALMOST IMPOSSIBLE FOR ANY RATIONAL COUNTRY TO DO ANYTHING THAT WOULD EXPLODE IN SATELLITE ORBITING TERRITORY BECAUSE THEY WOULD END UP DAMAGING THEIR OWN SATELLITES?

That's right. The only thing that's been suggested is a Third World player like Iraq before the invasion, which did not use space for its own purposes and would be happy to make space inaccessible to everybody else. North Korea is another possibility.

300,000 Debris Pieces Now Orbiting with World's Satellites and ISS

TODAY THERE ARE REPORTS THAT COMPUTER MODELERS ESTIMATE 300,000 PIECES OF DEBRIS RESULTED FROM THE WEATHER SATELLITE'S DESTRUCTION.

Right. Obviously it's a matter of choice how small a piece you count in your computer models. I think recent computer model standards have improved and they probably just run it and it goes down to a particular size and down to that size, the answer is 300,000. It's kind of a wild guess.

I would say, even down to that size, the real objects could be 100,000 or 500,000. It's not a very accurate calculation (computer models). But certainly we will see many hundreds, perhaps even a couple thousand, pieces of debris that are an inch or so across that would be very damaging to any satellite that they hit.

DO YOU THINK CHINA MIGHT BE QUIET BECAUSE THEY ARE EMBARRASSED THAT THEY CREATED SO MUCH DAMAGE?

That's possible. I doubt it. But it may be that something happened they didn't expect or they created more damage than they expected and they are still assessing how to spin that.

Destroyed Satellite Debris Now Orbiting Between 100 to 2000 Miles Above Earth

The interesting thing that I haven't seen discussed in the media yet is that the U. S. Space Command has released data for the first 32 (debris objects). Of those 32, what is surprising about them is that they are at a very wide range of heights. So, the original weather

satellite was about 500 miles high (850 kilometers). The debris cloud we are seeing ranges all the way from 100 miles, just skimming the atmosphere, to 2,000 miles high. So, it covers the entire range of what we call low Earth orbit – including the range where the astronauts on the International Space Station are orbiting, including the range in which the Hubble Space Telescope is orbiting; and where a lot of the low orbit weather satellites are.

Adding a significant amount of debris to that altitude range – and I haven't done the detailed calculations – but it corresponds to an increase in the amount of debris at that height of anything from 25% to a factor of 2. At the higher altitudes, the debris will stay up for decades at least.

There was an anti-satellite test the U. S. did in 1985 and the last piece of debris from that test re-entered in 1999, almost fifteen years later.

WHY WOULD THERE BE SUCH A WIDE DEGREE OF SPACE DEBRIS DISTRIBUTION?

It's partly to do with the angle in which the satellite was hit and the energy of the collision. Depending upon the amount of kinetic energy and momentum that you add to the satellite as it disintegrates, you can predict how high an orbit is going to end up.

So, what happens if you have a satellite in an orbit that's 500 kilometers circular, if you add a couple hundred miles an hour to its speed by kicking it in the rear, that changes its orbit to a low point of 500 kilometers and a high point of 2,000 kilometers.

If you kick it in the face at a couple hundred miles per hour, that slows down the high point, so it ends up in an orbit where the high point is still 500, but the low point is only 100.

It all has to do with the orbital mechanics of how these things go. The low and high points of your orbit are determined by how high you start off and how fast you are going. So, if you change how fast you are going, you end up in a different orbit.

WHAT ABOUT THOSE 32 PIECES THAT HAVE BEEN OFFICIALLY ACKNOWLEDGED BY SPACE COMMAND? WHAT SIZES WERE THEY?

We don't know yet. They will be at least a few inches across. My guess is because the first few they catalogued are probably the bigger ones, so they might be even a foot across or so. But we don't know that yet. Things are changing very quickly in this story. And what we'll see over the next couple of weeks – what happens is that after this happened, the USAF radars were littered with many, many little radar tracks of many pieces. It's not initially obvious that this track over here is the same or different track of that one over there, or here or wherever.

So, that's why it takes several weeks to put together the jigsaw puzzle of how many pieces they are actually tracking. You might think it's a new one, but it's the one you saw yesterday and you just didn't calculate its orbit quite right. So, they had to put it all together. What you will typically see over the next few weeks is that maybe a week from now, they will catalogue another hundred and then two weeks after that, they will catalogue another 100. Eventually, they'll catalogue all the ones that are bigger than a few inches across.

Any Other Satellites Yet Threated by Satellite Debris?

YOU AND I ARE SPEAKING ON JANUARY 19, 2007, WHICH IS EIGHT DAYS AFTER THE INITIAL EXPLOSION. HAS THERE BEEN ANY REPORT, OFFICIALLY OR UNOFFICIALLY, OF ANY KIND OF DAMAGE TO ANY SATELLITES SO FAR?

Not as far as I'm aware. And I wouldn't expect there to be. The risk is not immediate. Remember, that even though you're talking about a lot of debris pieces, space is really big. If you imagine the volume of space that covers the surface of the Earth out to 1,000 miles out. That's a huge volume in which you are putting many thousands of tiny pieces of debris and a few thousand satellites. So, the typical distance between them at any one time is hundreds of miles. You have one piece of debris and satellite every hundred miles. But they are all traveling very fast.

Eventually things are going to start hitting each other, but it's on a time scale of months to years. Things aren't going to start being hit in the next day or so. That's not how it works.

HOW SERIOUS DO YOU THINK DAMAGE COULD BE A CONSEQUENCE FROM THIS ONE EXPLOSION OF THE WEATHER SATELLITE EVENTUALLY?

It would not surprise me if it caused the destruction of at least one working satellite and maybe a couple. I would be surprised if it was bad enough to cause the destruction of many satellites. So, I'm more concerned – it could also cause some damage to the International Space Station. I'm more concerned about the implications when you start having multiple events of this kind.

THERE IS A LOT OF COMPETITION THAT SEEMS TO BE EMERGING BETWEEN CHINA AND INDIA AND JAPAN, SAY GOING TO THE MOON.

Right.

International Space Competition

THIS RIGHT NOW WOULD REPRESENT A PAWN MOVE BY CHINA THAT APPARENTLY HAS SURPRISED EVERYONE?

I think that's right. It's clear that U. S. intelligence was aware of this (Chinese anti-satellite) program and was waiting for the test. There are indications we have of that. But in the rest of the world, I think it did come as a surprise. Certainly to those of us who are not privy to U. S. secrets, we were all surprised by this. We had not realized that China was going this route.

It's also surprising because it's a strange route for them to be going. I suspect that it will not in the end give them a lot of advantage. But clearly it's part of the scenario that China is acting as a super power. I don't think this is directed at India and Japan, even though some of China's other space activities are. India and Japan don't really pose a surveillance threat to China. There is no reason for China to go after those countries' satellites. I think this is very much a defensive, or a move, against the United States. I think it's the concern that the U. S. has said it might in some circumstances have to take out other countries' satellites. China wants to be able to respond in kind and take out our spy satellites.

The fear on the U. S. side is that China wants this capability because it wants to make an aggressive move against Taiwan. The scenario is that the day before China invades Taiwan, it would take out all the American spy satellites so we could not see what was going on.

Future Consequences - Worst Case?

WHAT DO YOU THINK IS THE WORST CASE CONSEQUENCE GOING FORWARD - REALIZING THAT RUSSIA, THE UNITED STATES AND CHINA ALL HAVE THE ABILITY TO LAUNCH ANTI-SATELLITE MISSILES AND THAT POLITICS ARE MOVING OUT INTO SPACE?

Right. I think the worst case scenario is that the United States and Russia, which had retired their anti-satellite programs and not deployed the new ones they have been working on will change their agenda and move more aggressively to develop space weapons and really start an arms race in outer space. I think that would be bad for the planet. It would certainly be bad for the civilian use of space. It would be bad for the space environment in general for the foreseeable future."

More Information:

For further information about space weapon issues, please see the **Earthfiles Archives** below:

• 04/28/2006 -- Modern Warfare Applied to Extra-Terrestrial Invasion• 05/19/2005 -- USAF Wants Space Weapons Program
• 06/18/2004 -- German Scientist Werner von Braun Anticipated Terrorists, Asteroids and ETs on American "Enemy's List"
• 04/21/2004 -- At the X-Conference, Former Naval Intelligence Officer, C. B. Scott Jones
• 11/09/2002 -- UPDATED: Majestic-12 Documents with Ryan Wood About Extraterrestrial Technologies

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Websites:

Union of Concerned Scientists: **http://www.ucsusa.org/**

UCS Comment on China Test:

http://www.ucsusa.org/news/press_release/china-tests.html

Jonathan McDowell's Satellite Log Updates: **http://www.planet4589.org/jsr.html**

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