Low Likelihood, High Impact:

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Upon first glance, the idea of nuclear weapons in space sounds completely outside our realm of possibility to be of any real concern. In February 2024, however, Republican U.S. Congressman Mike Turner warned Congress against just that: according to the Chair of the House Intelligence Committee, Russia is seeking to deploy nuclear weapons to space.

A Russian nuclear missile in space could have significant consequences for the US domestic security policy, as historical tests revealed that space nuclear weapons have the capacity to destroy satellites and other communication technology located in space. Using similar amounts of explosive material, the power of the explosion is magnified at higher latitudes. Tests like the Starfish Prime experiment in 1962, where the explosion of a nuclear fusion bomb caused power outages and blackouts in the experiment's location, Hawaii, showcased that space explosions may even have a direct impact on Earth.

While some voices in politics and academia thereby call for deterrence in response to the potential Russian threat, others warn against the consequences of a renewed nuclear space race. In the following we therefore want to look at the question of how this conflict can be addressed, examining the stakeholders, interests and potential consequences.

The appeal of deploying nuclear weapons in space lies in their ability to create Electromagnetic Pulses (EMP) upon detonating, as showcased by the Starfish Prime test. As powerful bursts of energy, EMPs can silence radar systems, disrupt communications and disable satellites. Since satellite systems are essential to the functions of a country for communication, navigation and Earth observation purposes, targeting such satellites could pose a security threat. Moreover, directing an EMP towards a specific target is impossible, therefore using nuclear weapons in space would have global and indiscriminate effects on both military and civilian systems of every nation. Lastly, the duration of an EMP's impact on affected systems remains uncertain.

Following the destructive effects of the nuclear bombs deployed in Hiroshima and Nagasaki and the concerning results of nuclear testing in space and in the atmosphere, Article IV of the Outer Space Treaty (OST,

1967) bans nuclear weapons in space, and specifically forbids the placement of nuclear weapons in orbit or on celestial bodies.

While space nuclear weapons have been of concern in the international environment for over 50 years, US sources speculating that Moscow may be considering the development or deployment of such weapons could lead to serious consequences depending on how diplomats and journalists handle the situation. Thus, it is important to carefully dissect these allegations. First, the Kremlin has expressed no interest in violating the OTS, to which it is a signatory. In fact, President Putin has publicly opposed the use of nuclear weapons in space.

Since space-based nuclear attacks are indiscriminate and global in nature, Russia could damage its own infrastructure as much as that of its opponents if it decided to deploy and potentially detonate a nuclear weapon in space. Additionally, Moscow would face significant diplomatic costs, as any (further) breach of international law weakens Russia's position within the international community. Lastly, the deployment of a nuclear warhead to space could potentially trigger a collective response, following the cold-war logic of deterrence.

Thereby is it fair to assume that the likelihood of an actual use of nuclear weapons in space is currently low. However, the legal ambiguity surrounding their deployment and the potential for covert operations make this threat strategically compelling. Currently, space law lacks verification mechanisms, and certain technologies, such as Nuclear Power Sources (NPS), remain legal under the Outer Space Treaty despite raising similar concerns.

Unlike nuclear weapons, NPS are not designed for destruction but rather for long-duration, reliable energy supply in environments where solar power is insufficient or impractical. However, their launch or use is not immediately distinguishable from a nuclear weapon, creating an opportunity for strategic manipulation: while the OST bans putting nuclear weapons in orbit, it permits the launch of NPS systems, as long as they are reported and undergo proper review. Actors like the International Atomic Energy Agency (IAEA), the US's Department of Energy (DOE) and military intelligence services closely monitor these procedures. Given the different legal status of NPS systems, it is theoretically possible to disguise a nuclear weapon as an NPS systems, allowing an actor to obscure the deployment of a nuclear weapon to space.

While employing a nuclear detonation and accepting the associated EMP risks mentioned above seems unlikely, so-called Radio Jamming could be a more likely space warfare method, encountering little or no legal boundaries. Jamming consists of using satellites equipped with NPS to create interference by enhancing radio signals. This way, naturally existing interference can be increased, blocking and distorting communication between other satellites and ground stations. This method is not only compliant with OTS, but it is also deniable, reversible, and non-destructive. Therefore, by

leveraging on legal grey zones, it presents a more approachable avenue for offensive or coercive operations in space.

Even if nuclear weapons are unlikely to be detonated in the outer space, they may still serve a purpose as a deterrent or bargaining coin. Although this does not involve the deployment of nuclear weapons in space, China's 2007 ASAT (anti-satellite) test can be seen as an example of how the mere mention of nuclear capabilities in space may act as a tool to shape diplomatic outcomes. In fact, the largest effect of this test was underlining the urgency of regulating space arms control, especially in the eyes of the US. This point of concern was reiterated one year later, in 2008, when Russia and China presented to the UN the draft of the Prevention of the placement of weapons in Outer Space Treaty.

In this light, the threat of using nuclear weapon in space is integrated in a broader strategy of ambiguity and coercion as a rhetorical weapon. Since nuclear payloads are hard to verify prior to detonation and that transparency is a non-enforced invitation, the risk of miscalculation or pre-emptive action is high. The security dilemma is now presented in a space fashion: one actor's defensive measure may be perceived as a threat, prompting escalation from others.

In conclusion, while at first glance the idea of nuclear weapons in space seems far-fetched, we have shown the possibility that they can pose a complex and multifaceted challenge to international security. While the likelihood of actual deployment remains low due to legal constraints, self-damaging consequences, and high diplomatic costs, the strategic ambiguity surrounding nuclear weapons in space keeps the topic relevant. The possibility of using Nuclear Power Sources systems or radio jamming demonstrates how space can still be militarized in ways that do not directly violate the Outer Space Treaty.

Today, the deployment of nuclear weapons in space can be seen as a tool of deterrence, echoing Cold War-era strategies that are transported into present-day conflicts over security and territory. This highlights the relevance of space in the realm of International Relations, as it is an area of crucial importance for negotiating security that often remains overlooked.