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ON THE DESIGN POSSIBILITIES OF A NON-TRADITIONAL NUCLEAR DEVICE FOR PLANETARY DEFENSE

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UN Outer Space Treaty: The placement of nuclear weapons in outer space is banned under international law. It would require a vote by the UN Security Council to authorize such a mission.

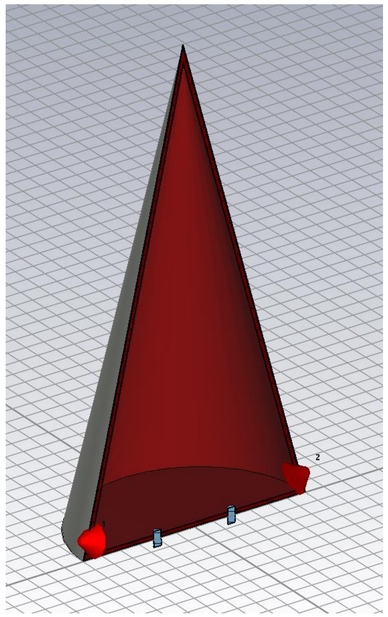
If we reconsider what we think a nuclear explosive device (NED) has to look like, this opens up the design space, and some engineering challenges become easier.

Motivation: the primary purpose of this study is to consider NED designs tailored to the PD mission, and that would fail by design if used in a re-entry setting. We find that, rather than paying a design cost for this, we **recover margin** for the radar.

One important radar figure of merit is **ringdown**: how long does it take for signal emitted by a powerful transmitter to fall low enough so the receiver may be turned on?

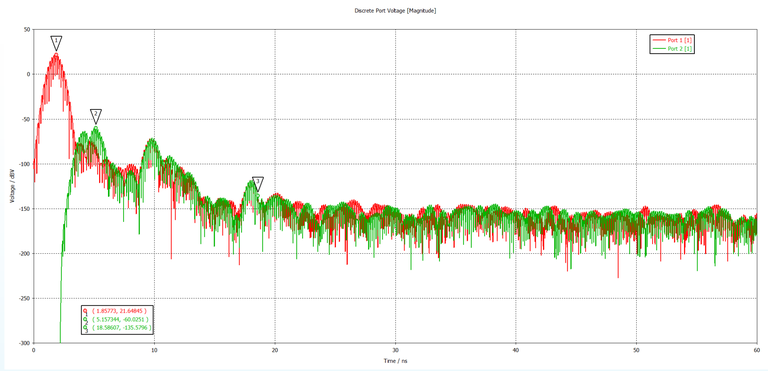
We can use full-wave EM simulation to estimate how long this takes for conventional and novel geometries.

The goal here is not to obviate international controls, but rather, to make it easier for diplomats to get to a "yes."

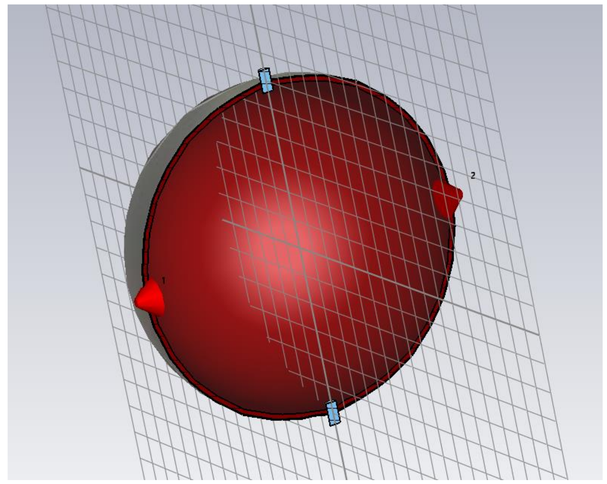


This conventional design features Tx/Rx antennas on opposite sides with damping material (red) within. Entry/exit ports (blue) allow EM inside.

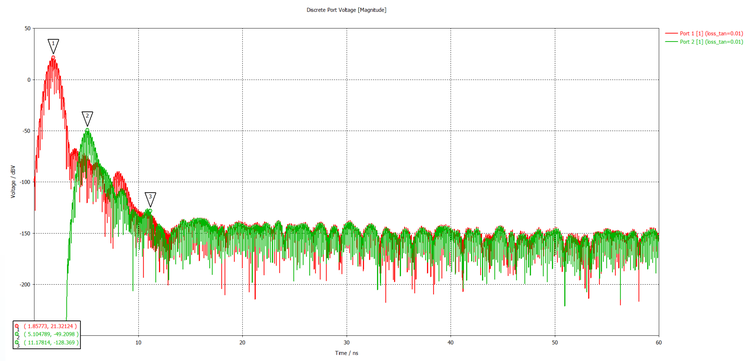
Red cones indicate monopole antennas which connect to the exterior conductive material as a chassis ground.



We achieve nominal ringdown (-150 dB) at 16.7 ns.



We choose a sphere as a new delivery concept because it would be deliberately terrible if used in re-entry (think Sputnik).



A spherical device achieves the same ringdown at only 9.3ns. With $c \approx 1$ ft/ns, this allows us to get much closer to the asteroid, if needed.

NB: there is more to ringdown than just the fields on the chassis. The internal radar circuitry should also be considered. But for now, one can assume such contributions to be similar for the same circuitry in different enclosures.

U.S. DEPARTMENT OF ENERGY
National Nuclear Security Administration

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SAND2025-04539C

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