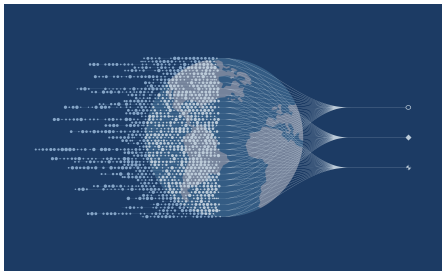

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technologies for the zero-yield standard

The zero-yield standard prohibits explosive experiments involving a supercritical fission chain reaction while permitting subcritical experiments. The latter are still conducted by certain nuclear weapon states today to ensure the performance and safety of their nuclear arsenals. However, there have been growing tensions between these states as they suspect each other of violating the zero-yield standard by conducting supercritical explosive experiments at very low yields. Since the International Monitoring Systems cannot detect very low-yield experiments let alone distinguish a supercritical from a subcritical experiment, there is an urgent need to develop verification technology and protocols that would make it possible to verify the zero-yield standard. This work presents various proofs-of-concept of scientific methods based on gamma spectroscopy to distinguish supercritical and subcritical experiments during an on-site inspection. These methods have been developed and tested via high-fidelity, physics-based computer simulations of very low-yield experiments and gamma detectors, including neutronics, isotopic evolutions, and photon transports. Demonstrating and deploying these methods would strengthen the verification regime of the CTBT, decrease suspicions of violations of the zero-yield standard, and reinforce adherence to the nuclear test ban.

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