



Ronald E. Hatcher
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***ZERO-KNOWLEDGE ARMS CONTROL: PROVING A
WARHEAD IS REAL WHILE LEARNING NOTHING ABOUT IT***

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ABSTRACT:

Since the end of the Cold War, the U.S. and Russia have made major strides in nuclear disarmament. However many thousands of nuclear warheads remain perched on intercontinental ballistic missiles and in active storage. Each of these weapons is capable of instantly killing hundreds of thousands of human beings. Arms control agreements to date have depended on limiting delivery systems for weapons, but in the future we will also need to verify that individual warheads removed from storage and slated for dismantlement are true warheads, not clever spoofs.

The verification of nuclear warheads, however, involves a fundamental paradox: international inspectors need to gain very high confidence in the authenticity of all submitted items – while at the same time, learning nothing about them. Otherwise arms control procedures could lead to widespread proliferation of advanced nuclear weapons technologies.

We are exploring a fundamentally new approach to this problem that incorporates a “Zero Knowledge Protocol”, which originated in the cyber-security world. In this approach we measure no properties of the submitted items, but only differences between submitted items. If warheads removed from storage are found to be no different from those randomly removed from active delivery systems, they are considered validated as true warheads for dismantlement. Meanwhile no information is revealed by null measurements of differences. Proof-of-principle experiments, based on probing test objects with energetic neutrons, have now begun at PPPL.

BIOGRAPHY:

Rob Goldston is a professor in Princeton’s Astrophysics Department. He is a leading researcher in plasma physics and fusion energy and was director of the Princeton Plasma Physics Laboratory, 1997 – 2009. He is author of over 250 technical publications, co-author of the textbook “Introduction to Plasma Physics”, and received the APS Award for Excellence in Plasma Physics. Goldston has published on the tradeoff between climate change mitigation by nuclear energy and nuclear proliferation risks. Recently he has collaborated with Professor Alex Glaser of Princeton’s Woodrow Wilson School and Boaz Barak of Microsoft Research, New England, on a “Zero-Knowledge Protocol” for warhead verification, published in Nature magazine. The authors were named “Leading Global Thinkers of 2014” by Foreign Policy magazine for this work. Goldston and Glaser, in collaboration with Francesco d’Errico of Yale University, are constructing facilities at PPPL to test this technique experimentally.