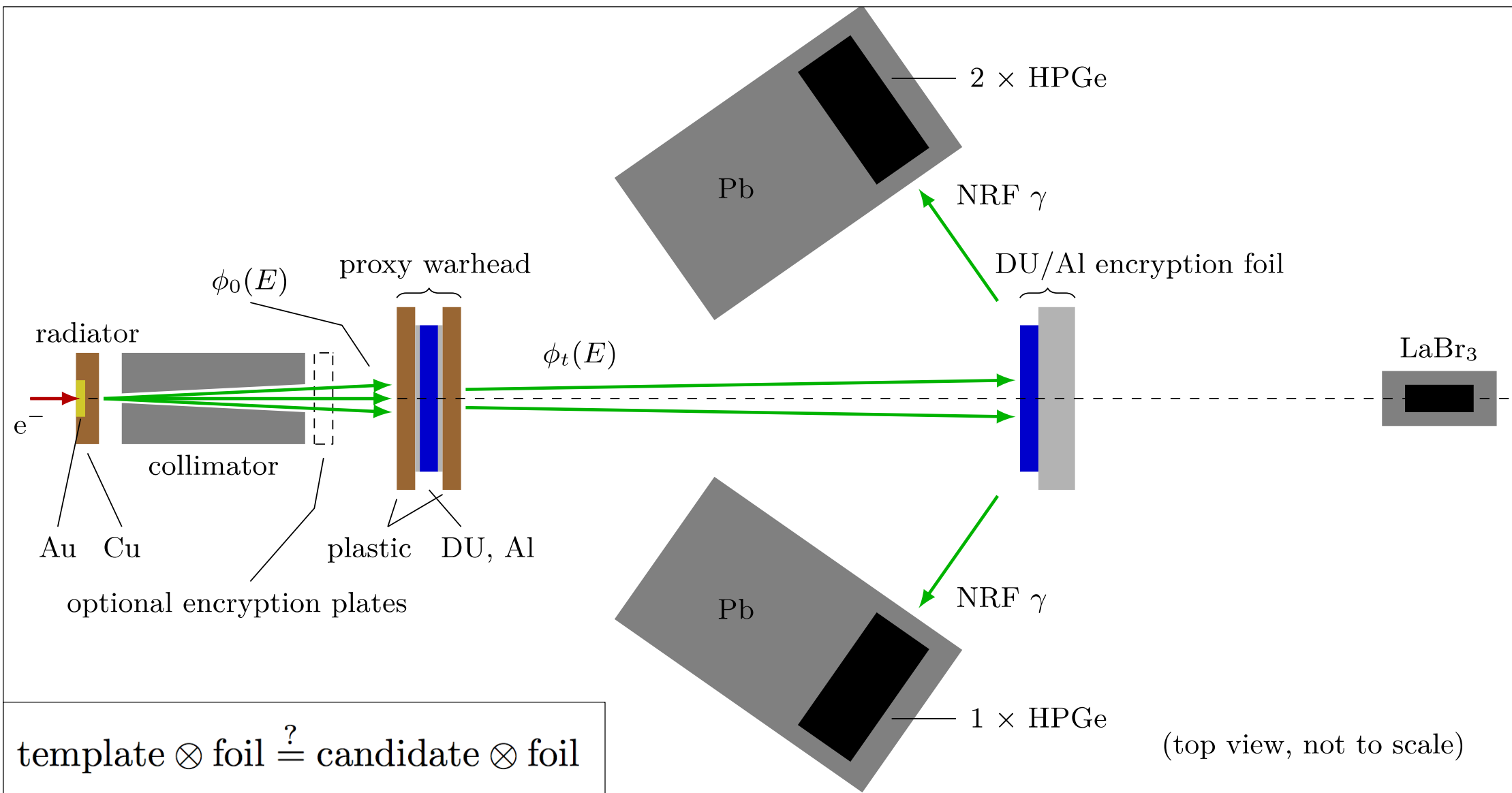


Warhead verification with NRF
Experimental demonstration

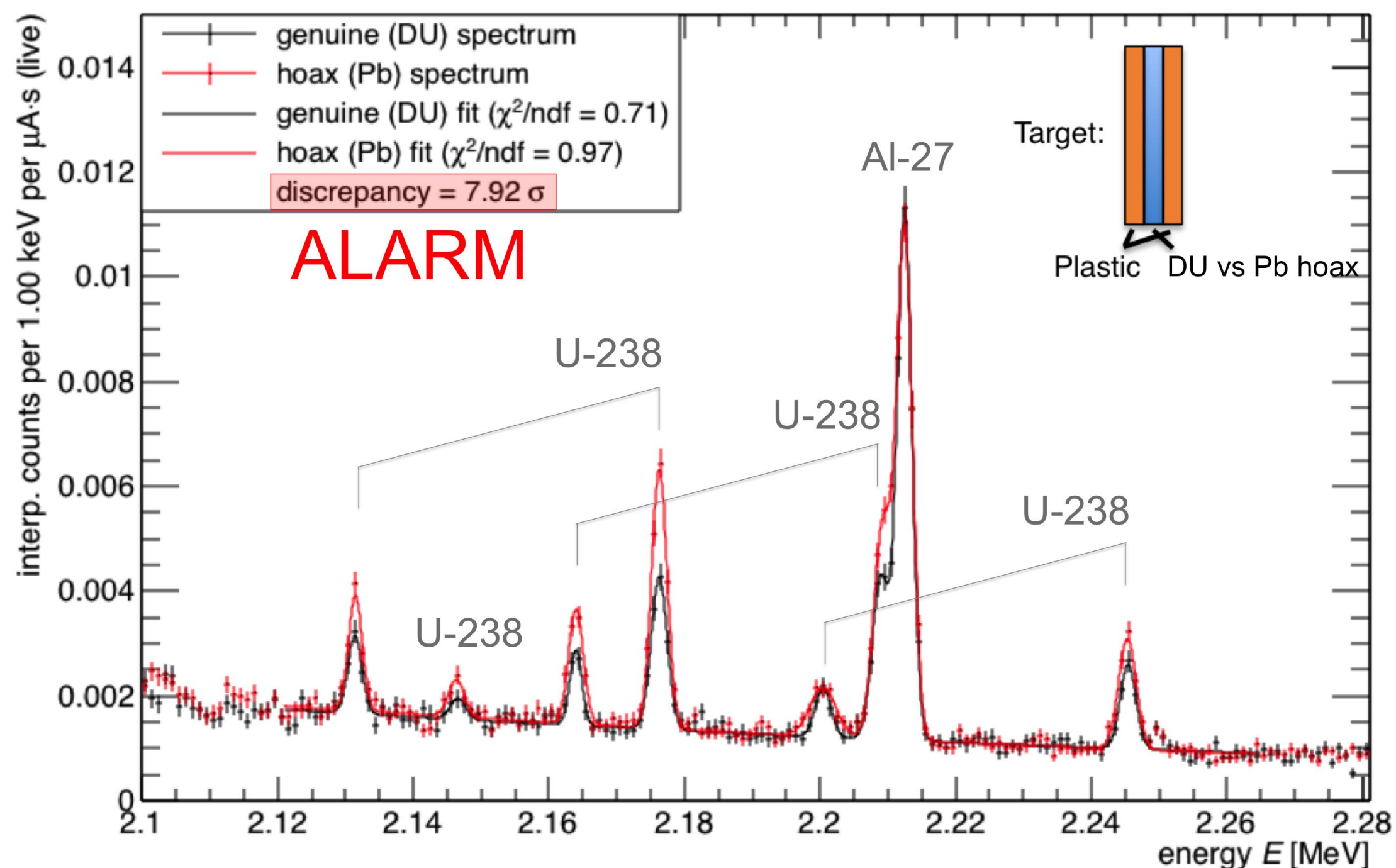


Background
How can we verify the authenticity of nuclear warheads without revealing sensitive information?

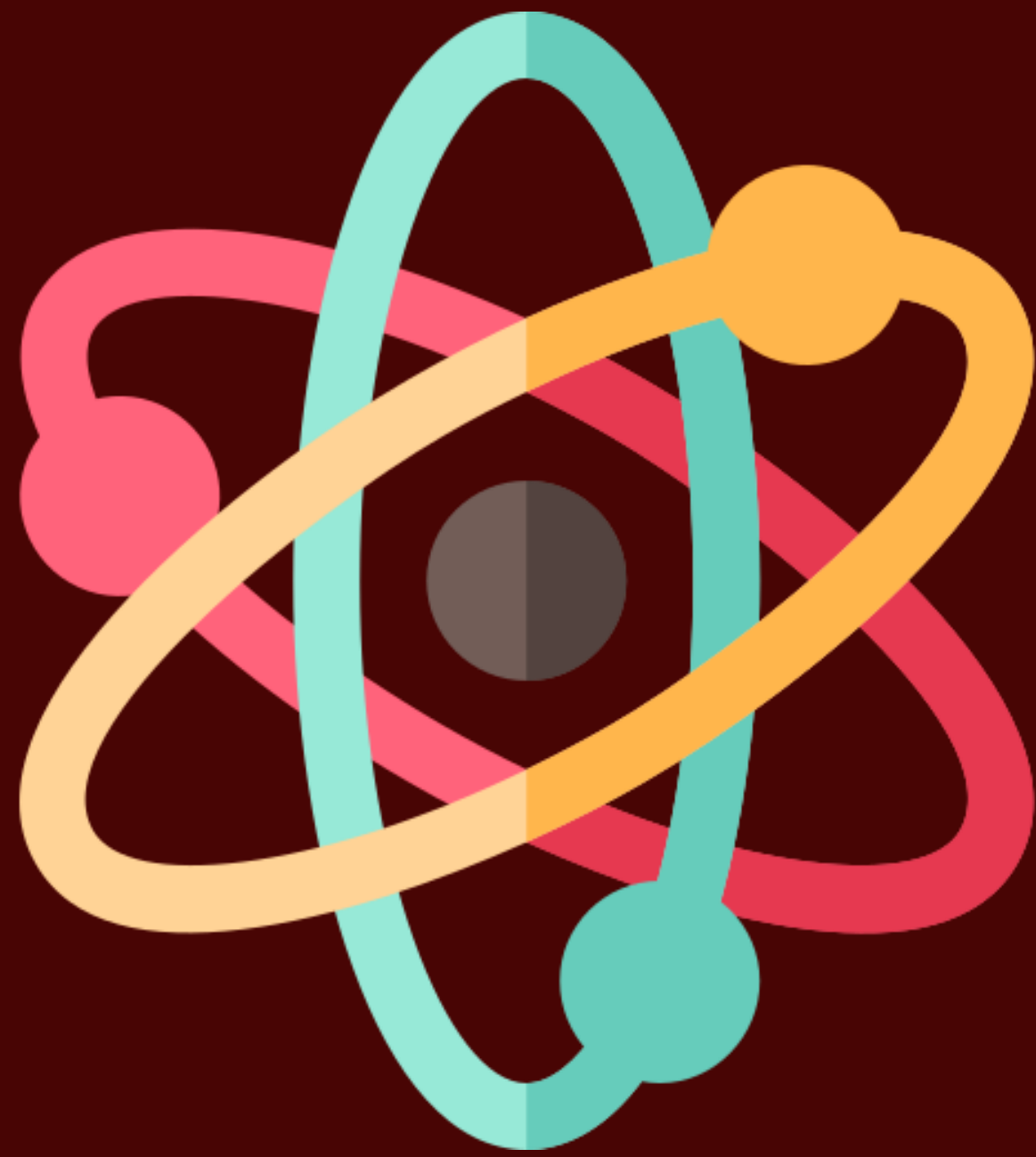
- Methods**
1. Irradiated (proxy) genuine and hoax warheads with high-energy photon beam
 2. Measured each object's induced nuclear resonance fluorescence (NRF) photon signature in U-238 and Al-27
 3. Compared NRF results to distinguish hoaxes from genuine warheads



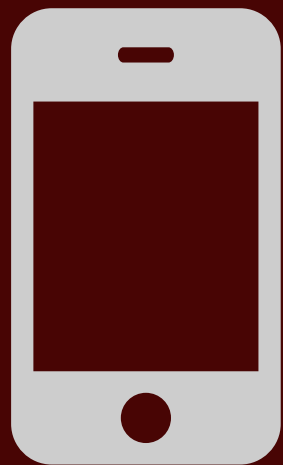
Results



Changes in U-238 NRF peaks catch diversions of nuclear material

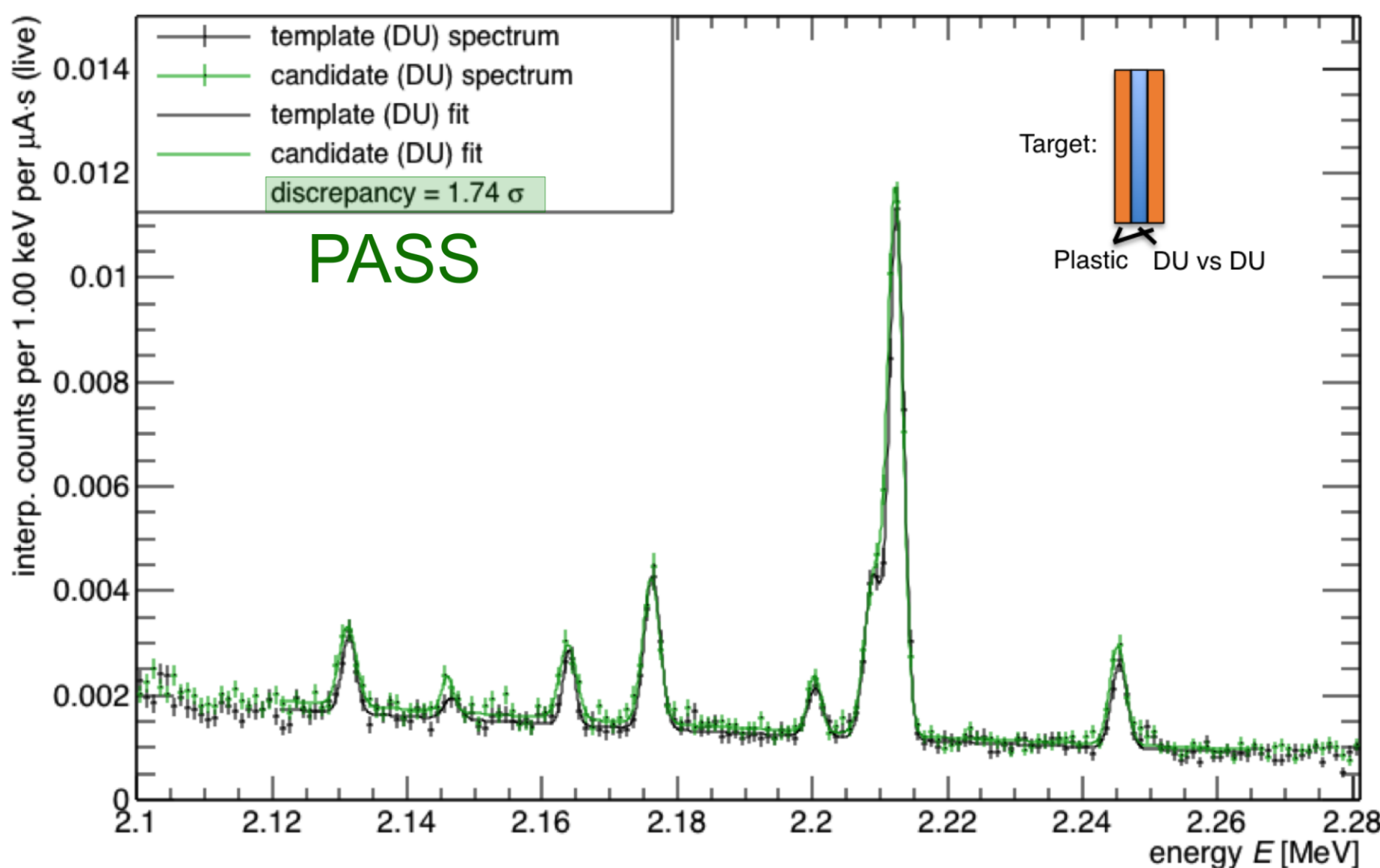


NRF provides an **isotope-** and **geometry-**sensitive test of a nuclear warhead's **authenticity** in an information-secure manner

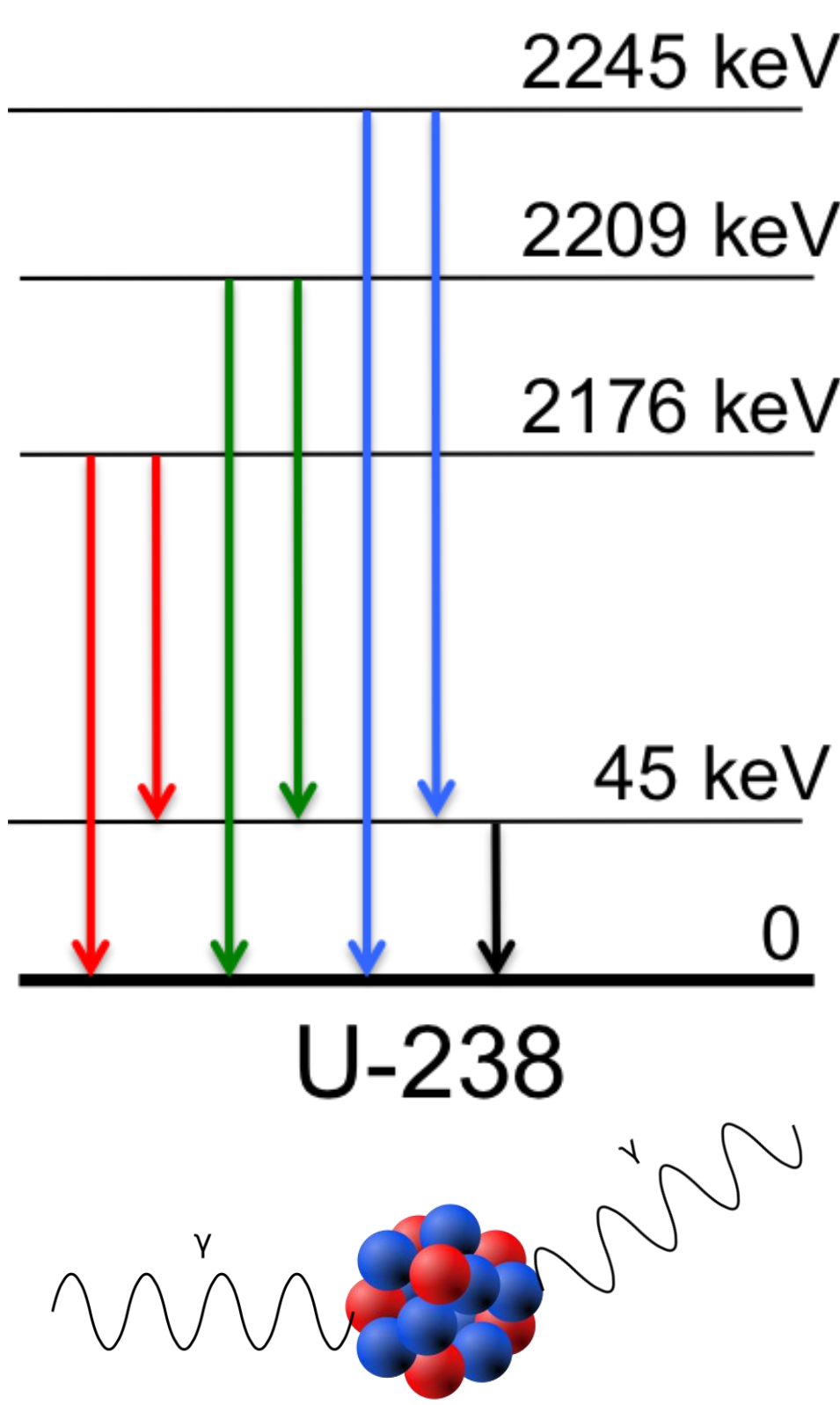


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Genuine vs genuine



Nuclear resonance fluorescence (NRF)



Sharp emission peaks at γ energies fixed by isotopic structure

Unambiguous, one-to-one signature for:

- U, Pu fuel isotopes
- Fe, Al structure
- C, N, O in explosives

Related work:
pnas.org/content/113/31/8618 (initial concept)
arxiv.org/abs/1807.01701 (verification)
arxiv.org/abs/1807.02596 (validation)

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