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ABSTRACT FOR
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DIRECTED ENERGY FOR STAND-OFF ACTIVE-INTERROGATION: DETECTION OF TERRORIST NUKES IN A MARITIME CONTEXT

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It is a matter of public concern that if terrorists obtain or improvise a nuclear weapon, they would attempt to use it against the United States causing extreme psychological, political and economic distress. We may readily imagine an attempt to bring a nuclear device to America by sea. A craft capable of negotiating a significant ocean voyage can also have sufficient capacity to carry adequate amounts of nuclear material and shielding. With excellent intelligence information, the problem is one of locating a particular ship somewhere along its route and then confirming the existence of Special Nuclear Materials (SNM). If, however, intel is limited to some indication of passage during a broad time window, we cannot identify *a priori* which of a large number of boats and ships could be carrying a weapon. The use of boarding parties to search a vessel is a time-consuming and sometimes dangerous procedure. We have focused our efforts on exploring techniques whereby we can scan a ship at sea from some allowable stand-off distance. Various particles may be useful for such scanning depending on the size of the target-ship, including photons (e.g., bremsstrahlung) for smaller ships and high-energy protons or negative muons for larger ships. The requirement for scanning tends to imply that we do not have adequate information merely to intercept and board the target-ship, so we have to allow that people aboard the vessel under consideration may be innocent. We cannot expose the public to an arbitrarily high dose of ionizing radiation. While the exact value of allowable dose is a matter of ongoing discussion, and might be expected to vary with rules-of-engagement, policy and imminence of threat, we should expect that the particle fluence (i.e., the number of probe-particles per cm^2) will be constrained. The product of this fluence, the area of the SNM and various factors (e.g., structure and shielding) diminishing the probe particle fluence and the output of radiations induced from the SNM, determines the maximum number of counts that could be received at a detector. Such output will typically be isotropic, so the number of received counts depends on the detector area compared to an area that increases with the square of the distance between the SNM and the detector. In addition to the desired signal, we have to deal with radiations induced by the high-energy probe particles even if no SNM is present.

We have examined probing with mono-energetic gammas, bremsstrahlung photons, neutrons, protons and negative-muons. Detailed simulations with the MCNP/X

code have examined complex scenes, including fishing-trawlers, ocean-going yachts and fast-boats. These simulations indicate the necessary beam energies and thus the required high-energy accelerator technologies. Such technologies, their siting aboard naval vessels and operation in a maritime environment closely relate to some issues for directed energy weapons, e.g., FEL. Stand-off active-interrogation represents a more imminent requirement and perhaps nearer term application of directed energy technology. We provide an overview of critical issues and a summary of some technical activities at LANL.

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Prefer oral session

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Proposed Focus Session: Directed Energy Technologies; Novel Directed Energy Concepts and Technologies.
Session on directed energy technologies for counter-terrorism, (especially countering terrorist nukes).