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Overview of Some New Techniques for Inspection: Using 1950's Physics to Solve Modern Problems

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The goal of any inspection technique is to non-intrusively determine the presence of such materials in a manner which is consistent with not interrupting the normal scheme of commerce and which, at the same time, exhibits a high probability of detection and a low probability of false alarms. A great deal of work has been reported in the literature on neutron based techniques for the detection of explosives with by far the largest impetus coming from the requirements of the commercial aviation industry for the inspection of luggage and, to a lesser extent, cargo; for baggage, the major techniques are either x-ray based or are chemical trace detection methods which look for small traces of explosive residues. Nuclear techniques have been proposed for the detection of explosives and contraband for a number of years due to their ability to penetrate shielding and to identify the elemental composition of materials, thus leading to enhanced detection probability and lower false alarm rates. Nuclear techniques are virtually the only method which can both detect and identify the presence of fissile materials, either in the form of bulk material or assembled weapons. Some examples of current work in nuclear based systems currently under development will be discussed such as nuclear resonance radiography, nuclear resonance fluorescence, pulsed fast neutron analysis and pulsed photonuclear detection. The physical basis of these techniques is well known, the physics having been studied in the 1950's, but there remain limitations on current technology with respect to e.g. radiation sources and detectors and data acquisition methods. Accelerator-based systems often are large and are often not well suited for field use; radiation detectors often suffer from limited count rate ability, low sensitivity and poor energy resolution and data acquisition and analysis methods usually rely on analog techniques which are not always stable in field operation. Current research in basic physics has resulted in the development of new accelerators, radiation detectors and data acquisition electronics which may help to overcome these limitations.