Do-It-Yourself Geiger Mueller Smart Detector
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Abstract
Both the Health Physics Society and American Nuclear Society have longstanding programs providing continuing educational workshops, lesson plans, posters, newsletters, and other educational materials for K-12 science teachers. These materials are designed to promote science literacy relating to radiation, but also serve the purpose of interesting students in science, technology, engineering and math (STEM) careers. Experimental kits with radiation detectors are available for loan to teachers, but expense precludes these becoming permanent part of the curriculum. Another professional outreach program to students involves the functional restoration of 1960s-1970s era fallout shelter detectors, typically through the replacement of a capacitor with a shelf life limited to only a couple decades. The distribution of such detectors, while both functional and of nostalgic interest, does little to promote careers in the radiation sciences as exciting ones involving impressive state-of-the-art equipment and cutting edge technology. Student experience with measuring ambient radiation with such antique detectors is also typically a limited one restricted to a single device available during the class period. To overcome these shortcomings, an affordable do-it-yourself radiation detector was designed that students would construct for themselves and be able to keep afterwards. The system is built around Geiger-Muller tubes salvaged from surplus fallout shelter detectors, thus avoiding the expense of the basic detector component. Basic circuit elements will be provided to the students who solder them to a supplied printed circuit board. The radiation detection system is controlled by a Raspberry Pi computer while voltage is increased to the necessary levels with an Arduino micro-controller. A smartphone, communicating using Bluetooth to the Raspberry Pi, will eventually serve as the display. An appropriate application will be created to allow collection of both GPS data and radiation measurements for creating radiation maps. A case, incorporating the detector, cellphone and electronics, will be 3D printed by the students. At the end of the exercise, students will have their own working radiation detection, and will have accumulated experience with practical radiation measurements, Raspberry Pi computers, Arduino micro-controllers, circuit design, 3D printing, and mapping.