The Radiation Shielding Competition

Sponsored by:

The American Nuclear Society (ANS) and Women in Nuclear (WiN)

Introduction:

A radiation shield is anything that blocks radiation from an intended target. It does this by absorbing the energy from the radiation. As unstable elements decay, they typically release some sort of radiation. These can be in the form of particles (alpha, beta, etc.) or in the form of photons (gamma rays, etc.). See http://www.epa. gov/rpdweb00/understand/protection_basics.html for a few basics.

In this competition, we consider gamma radiation from a laboratory source. Gamma rays are high energy photons speeding through matter until they collide with it. When a gamma ray collides, it deposits energy into the matter. Because gamma rays are so penetrating, it's possible to detect them through other matter (walls, floors, etc.). By using a detector (a device that recognizes incident radiation) we can tell where radiation is coming from.

This has a very large impact on nuclear security. When radioactive materials are transported across our borders or into our country, they release this radiation and that allows us to find them. But what happens when they are shielded from our detectors? To understand how to detect shielded materials, we must first understand how they might be shielded.

Objective:

The objective of our competition is to introduce high school students to one field of nuclear engineering: radiation shielding. Staying with our theme of the 14 Grand Challenges, we aim to tackle "Prevent nuclear terror." Understanding how to shield radiation is the key to learning how to detect shielded radiation sources.

Procedure:

Student teams will submit their shields (made before coming to campus for the competition) to the competition moderating team. These shields must be no larger than 6" x 6" x 1" (they can be smaller but they must be supported by the stand) and must have a minimum weight of 15 grams. The team will take the shields, weigh them, and test them using a Sodium-Iodide detector and a lab radiation source (Cobalt – 60). The Cobalt source will emit gamma rays (in very safe amounts!), and the Sodium-Iodide counter will count the number of emissions that are not stopped by the shield. We will start by recording the counts without the shield, and then take three different counts with the shield. The source will be moved up against the shield and the detector will be moved 2" from the other side of the shield. Both the source and the detector will be centered about 3" off of the table. The resulting average number of counts will then be divided by the counts without the shield, and then multiplied by the weight of the shield (measured in grams) in order to open the competition to more variations of shield material. The group with the lowest score wins.

Hint: Elements with a high atomic number block gamma rays best (but watch the weight)!

If you have any questions about the competition or need help getting started, please email Katy Worrell, ANS President (kworrell@vols.utk.edu), Annie Berens, WiN President (aberens@vols.utk.edu), or the

ANS officers (ans@utk.edu).