PUTTING THE GENIE BACK IN THE BOTTLE: THE SCIENCE OF NUCLEAR NON-PROLIFERATION. Gerard P. Gilfoyle, Dept. of Physics, University of Richmond, Richmond, VA 23173. Nuclear non-proliferation, the efforts to limit the use and spread of nuclear weapons, began with the first development of the atomic bomb in 1945. The methods to detect, monitor, and verify the construction, movement, and testing of nuclear weapons has evolved as both the technology and the international landscape (and the threat) changed over the last seventy years. In this talk I will develop the technical features of these devices that drive many of the non-proliferation efforts around the world. Next, I will focus on two central issues. (1) I will discuss the methods used to detect and characterize a nuclear explosion anywhere in the world by the International Monitoring System (IMS) of the Comprehensive Test Ban Treaty organization. Attention will be focused on the series of tests performed by North Korea since 2006 and the performance of the IMS. (2) I will then examine the illicit trade in nuclear materials and the technical challenges faced when transnational groups (i.e. terrorists) pursue the construction of a nuclear bomb. Assessments of the threat will be presented and some of the ways that threat is mitigated will be explored. I will spend some time at the end talking about the relationship between science and our society and draw some conclusions.