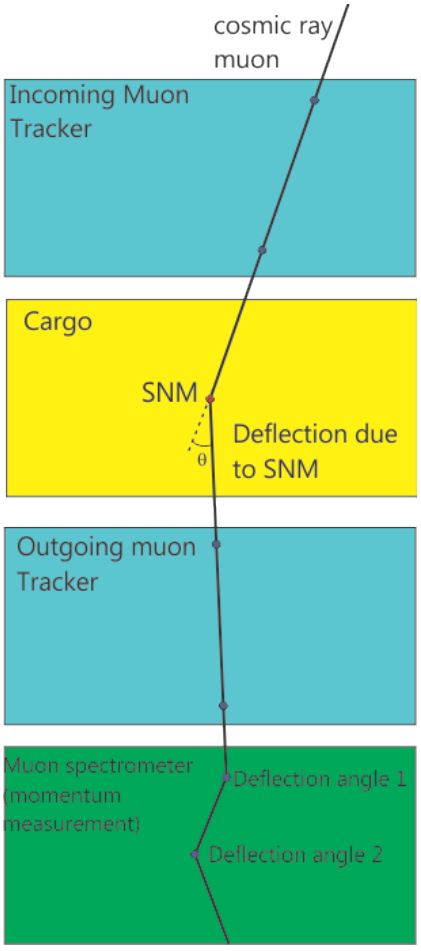
Cosmic Ray Inspection and Passive Tomography (CRIPT)

The smuggling of illegal nuclear material into Canada, into any country, is a major security concern. The Cosmic Ray Inspection and Passive Tomography (CRIPT) is a system that can detect smuggled nuclear materials (like uranium or plutonium). The detection of these materials is essential as they can be used to make weapons, and as such, pose a global threat with catastrophic consequences.

The CRIPT system records three-dimensional images of cargo using naturally-occurring, high energy radiation, called muons. The image construction process is related to medical imaging techniques like computed tomography (CT) with x-rays or positron emission tomography (PET). CRIPT's muon detectors make precise measurements of the track directions of individual muons entering and exiting large objects like shipping cargo containers, which are projected back to identify a POCA: Point Of Closest Approach. This is where the incoming muon track crosses closest to the outgoing track. At this point, the angle between the incoming and exiting tracks forms the scattering angle, a measure of how much the muon has been scattered or deflected. Muons are highly penetrating and can pass through metres of steel; however, when they pass through very dense materials like uranium, plutonium or lead, they are deflected by relatively large amounts, when muons pass through less dense materials they are deflected through smaller angles. CRIPT's detectors measure these deflections very precisely (to better than three millimetres) in order to detect nuclear materials. X-ray machines and other commercially-available scanning systems have difficulties identifying the difference between nuclear material and less dense material like steel. In contrast, muon tomography systems, like CRIPT, have the potential to detect nuclear material smuggling. The construction of CRIPT was completed in September 2012. Since then, CRIPT has been successfully scanning a variety of objects, including an air cargo container, to test its performance.



The collaborators who built CRIPT represent federal government departments and agencies, industry and academia. This project was funded through the Chemical, Biological, Radiological-Nuclear and Explosives (CBRNE) Research and Technology Initiative (CRTI), a former federal program led by Defence Research and Development Canada (DRDC) on behalf of the federal science and technology community. DRDC manages the project and oversees all of its scientific aspects. Other collaborators include: Atomic Energy of Canada Limited (AECL) who developed the software to detect nuclear material; Canada Border Services Agency (CBSA) who provides real-world advice on scanning cargo at Canada's ports; Health Canada who is investigating advanced computer algorithms for detecting nuclear material; Advanced Applied Physics

Solutions of Vancouver designed the muon detectors and developed their specialized electronics; Carleton University's Department of Physics who built and operate the muon detection system; and International Safety Research of Ottawa who provide project management and radiation detection expertise.

Having successfully commissioned the detector, in the spring of 2013 it was then dismantled and shipped to AECL's Chalk River Laboratories. Here it will be easier to test the detector's response to realistically configured nuclear materials.