The Reactor Evaluation Through Inspection of Nearfield Antineutrinos (RETINA) System

Matthew Dunbrack
Nuclear and Radiological Engineering Program, Georgia Institute of Technology

Abstract

Antineutrino detection systems show potential as a non-intrusive, tamper-proof monitoring tool for nuclear reactors. There remains a challenge, however, bridging the gap between current technological capabilities and future desired use cases. A flexible, high-fidelity modeling tool is needed to highlight the technical limitations for detector research and development as well as quantify the safeguardibility of these novel systems. The Reactor Evaluation Through Inspection of Near-field Antineutrinos (RETINA) system can be used for both efforts. The system is comprised of two components: spectra simulation and system sensitivity. The spectra simulation component allows for custom reactor and detector initialization along with specific scenario simulation to derive an expected antineutrino detection spectrum. With flexible component installation, researchers can adjust slight parameters and directly measure the expected spectrum deviation. The system sensitivity component includes a profile construction statistical analysis portion that can quickly quantify the detector collection period required to verify a null hypothesis rather than an alternative hypothesis. From this calculation, safeguards inspectors can determine if the system could timely detect a reactor misuse or diversion scenario of interest. The modular structure of the RETINA system allows researchers to explore current detector limitations and for inspectors to evaluate the potential utility of these evolving detection systems.