EXPERIMENTAL RESULTS FROM A REACTOR MONITORING EXPERIMENT WITH A CUBIC METER SCALE ANTINEUTRINO DETECTOR

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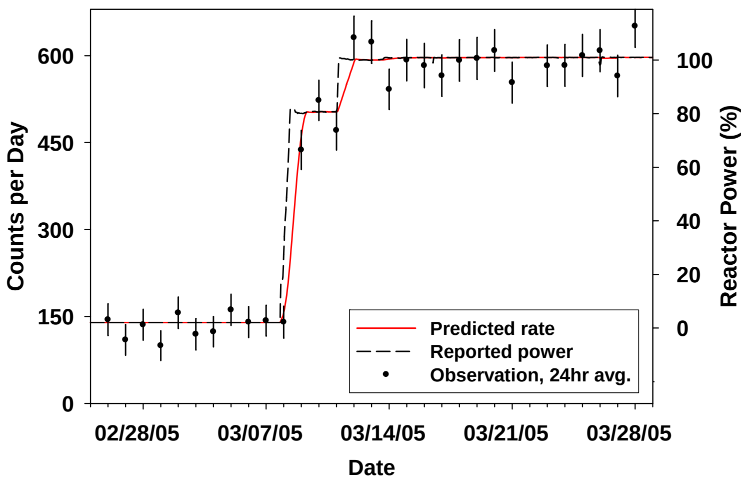
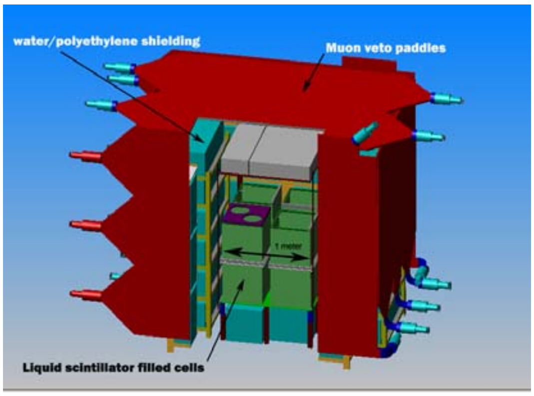
ABSTRACT

Cubic meter scale antineutrino detectors can stably and no intrusively monitor both plutonium content and reactor power at the few percent level, at a standoff of a few tens of meters. Our Lawrence Livermore National Laboratory/Sandia National Laboratories collaboration has deployed a detector to demonstrate this capability at a 3 GWt pressurized water reactor in Southern California, operating 25 meters from the core center, and acquiring data over an approximate one year period. Such monitoring may be useful for tracking power output and plutonium buildup in nuclear reactors, constraining the fissile content and providing the earliest possible measurement of the amount of plutonium in the reactor core. We present our antineutrino event sample, and show that the observed change in antineutrino rate recorded in our detector over the reactor cycle correlates with plutonium ingrowth according to predictions. We present our current precision and estimate the attainable precision of the method, and discuss the benefits this technology may have for the International Atomic Energy Agency (IAEA) or other safeguards regimes.



This figure shows the antineutrino data through a reactor turn-on, including a few day period of operation at 80% power. The left axis is the antineutrino rate; the right axis is the measured reactor power. A single overall normalization constant has been applied.



This figure shows LLNL/SNL detector, including the central liquid scintillator filled cells, the passive water shield and the muon.