**Daine L. Danielson**

*University of California at Davis*

Applied Antineutrino Physics 2018

**Directionally Accelerated Detection of a Second, Unknown Reactor with Antineutrinos for Mid-Field Nonproliferation Monitoring**

In reactor antineutrino monitoring, one must discriminate known background reactor fluxes from reactor signals under investigation. To quantify this discrimination, we find the confidence to reject the (null) hypothesis of a single proximal reactor, by exploiting directional antineutrino signals in the presence of a second, unknown reactor. In particular, we simulate the inverse beta decay (IBD) response of a detector filled with a 1 kT fiducial mass of Gadolinium doped liquid scintillator in mineral oil. We base the detector geometry on that of WATCHMAN, an upcoming antineutrino monitoring experiment soon to be deployed at the Boulby mine in the United Kingdom, whose design and deployment will be detailed in a forthcoming white paper. Naturally occurring site-specific backgrounds are neglected, so that this result establishes a baseline of performance for the experimental and analytical techniques developed here. From this simulation, we construct an analytical model of the IBD event distribution for the case of one 4 GWt±2% reactor 25 km away from the detector site, and for the case of an additional unknown 35 MWt reactor 3 to 5 km away. Applying this model, we predict 3σ confidence to detect the presence of an unknown reactor within five weeks, for standoffs of 3 km or nearer. For more distant unknown reactor standoffs, the 3σ detection time increases significantly. The relative significance of directional sensitivity also increases, however, providing up to an eight week speedup to detect an unknown reactor at a 5 km standoff in the opposite direction from the known reactor.