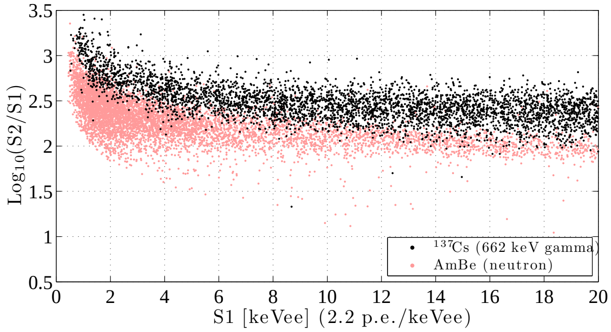

FIG. 31: (Color online) The electronic and nuclear recoil bands shown in Log_{10}(S2/S1) vs. S1 space.

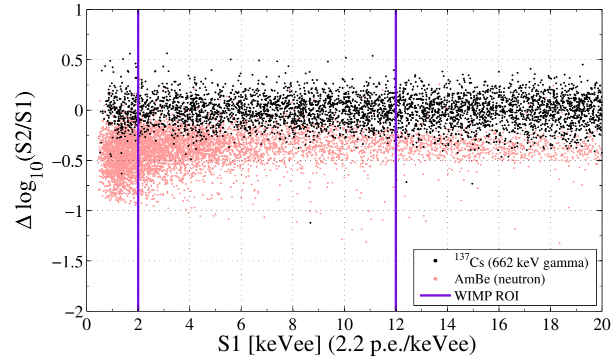

FIG. 32: (Color online)The bands in figure 31 have been transformed to show the distance in Log_{10}(S2/S1) space from the ER band center, giving the new discrimination parameter, $\Delta\mathrm{Log}_{10}$(S2/S1). The vertical lines indicate the WIMP region of interest (ROI).

this range are dominated by recombination fluctuations, until the lowest energies where uncorrelated statistical fluctuations take over. The width of the electronic recoil band is very important for gamma rejection because the two bands overlap. Due mainly to the non-uniform S1 response at different locations in the fiducial region, applying spatially-dependent corrections to S1 based on the ^{131m}Xe calibration (see section VI A 3) improves the overall S1 resolution and thus helps to reduce the variance of the bands. Data with the AmBe neutron source were taken on December 1, 2006 for approximately 12 hours, accumulating a total of about 260,000 events. The energy dependence of both bands makes it difficult to precisely measure the discrimination power in the absence of extraordinarily large calibration datasets. In an effort to remove this energy-dependence, a one-dimensional transformation that "flattens" the ER band is applied to all data. The ER band is broken up into 1 keVee-wide, vertical slices in S1. For each, a Gauss fit is applied to the Log_{10}(S2/S1) spectrum. The mean of each fit now represents the center of the ER band in that particular bin. A high-order polynomial is fit to the Gauss means, which provides an analytic form for the ER band centroid as a function of S1, and is subtracted from every data point in both bands. This procedure flattens the ER band (and to a large extent, the NR band as well), and introduces a new parameter, $\Delta\mathrm{Log}_{10}$(S2/S1), which represents the distance from the ER centroid in Log_{10}(S2/S1) space. Figure 32 shows the bands in $\Delta\mathrm{Log}_{10}$(S2/S1) space.

Although the energy dependence of the ER band centroid has been removed, the NR band centroid and width still change with energy. Again, the flattened bands are broken up into vertical S1 slices, only this time more coarse binning is used—seven bins in the WIMP energy region of interest (ROI)—in order to maximize the statistics in each slice, and a Gauss fit is applied to the $\Delta\mathrm{Log}_{10}$(S2/S1) spectrum of both bands. One such slice is shown in Figure 33, for the range 13.4–17.2 keVr (1 keVr = 1.1 pe, according to [11]) of nuclear recoil energy. The WIMP acceptance window is defined to lie in the range $(\mu - 3\sigma) < \Delta\mathrm{Log}_{10}(\mathrm{S2/S1}) < \mu$, where μ and σ are the mean and sigma from the NR band Gauss fits, respectively. The Gauss fits were performed only to define the window bounds; the NR acceptance, A_{nr}, was calculated by counting the number of AmBe events that fall within this window, for each energy bin.

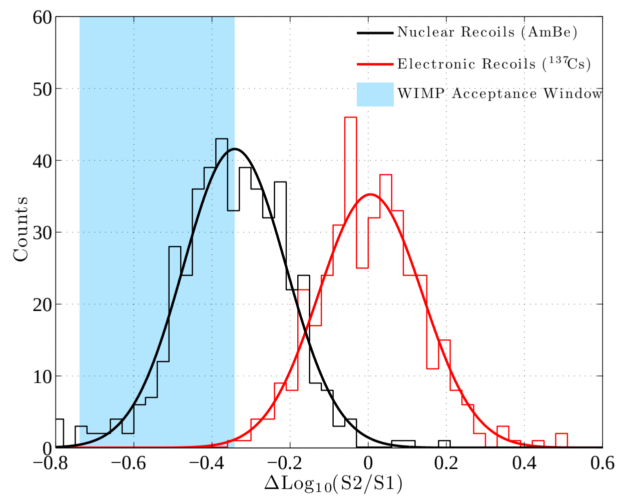

FIG. 33: (Color online) Distributions of $\Delta\mathrm{Log}_{10}$(S2/S1) for nuclear and electronic recoils in the range 13.4–17.2 keVr. The WIMP acceptance window in this particular energy range is defined by the blue, shaded rectangle which is between μ and $\mu - 3\sigma$ of the NR band.

The shape of the $\Delta\mathrm{Log}_{10}$(S2/S1) fluctuations in the ER band are "empirically" Gaussian; that is, with the statistics available, they appear consistent with a Gaussian distribution. As previously stated, the $\Delta\mathrm{Log}_{10}$(S2/S1) spectrum is dominated by recombination fluctuations, which are poorly understood, and thus more cannot be said in the absence of a larger calibration dataset. We calculate the predicted ER rejection in