

# A Novel Algorithm for Alpha Discrimination in PICO Bubble Chambers

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A new comprehensive algorithm is presented for acoustic analysis of the complete exposure of the PICO-60 dark matter detector. The PICO-60 detector is a bubble chamber filled with 52 kg of  $C_3F_8$  operated at the SNOLAB underground laboratory. The bubble chamber experiments run by PICO have been some of the leading experiments in direct detection of spin-dependent WIMP-proton interactions; the complete exposure of the PICO-60 detector sets an upper bound on the cross-section of these interactions at  $2.5 \times 10^{-41} \text{ cm}^2$  for a 25 GeV WIMP (Amole et. al, 2019). One advantage the PICO bubble chambers have is the Acoustic Parameter (AP) used for rejection of alpha decays of  $^{222}\text{Rn}$ . Using the AP for alpha discrimination of the WIMP search produced 3 events which could not be classified as either alphas or nuclear recoils, called “mid-AP” events. Using this new algorithm to find optimal frequency bands in the acoustic power spectra, the “Signal to Noise Ratio” (SNR) was able to be calculated to replace the AP, and Machine Learning Algorithms were used to supplement the SNR. Using the SNR, all 3 “mid-AP” events from PICO-60 were able to be classified as alphas or nuclear recoils. Furthermore, this algorithm can be applied to any other PICO bubble chamber, or any other bubble chamber with acoustic alpha discrimination.

## email address

q.trayling@queensu.ca

## Please select: Experiment or Theory

Experiment

**Primary author(s)** : Mr TRAYLING, Quintin (Queen’s University)

**Presenter(s)** : Mr TRAYLING, Quintin (Queen’s University)