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Characterizing and Removing ER Background Events in the DEAP-3600 Experiment

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DEAP-3600 searches for dark matter via the coherent scattering of argon nuclei by dark matter particles as they traverse the detector. The detector is located at SNOLAB, and uses 255 photomultiplier tubes (PMTs) viewing ~3300 kg of liquid atmospheric argon (AAr) in a spherical acrylic vessel. The use of liquid argon as a target allows the powerful discrimination of nuclear recoils (NR) (produced in DM collisions or from background interactions) from beta and gamma electronic recoil (ER) backgrounds. Due to the fraction of Argon-39 naturally present within the AAr, with activity ~0.95 Bq per kg of AAr, ER events form the dominant component of the backgrounds. The discrimination is only possible due to the large difference in the scintillation live times between the triplet (predominantly produced in ER interactions) and singlet (predominantly produced in NR interactions) states of Ar.

As the scintillation spectrum of Argon peaks at 128 nm, it needs to be shifted to a wavelength where the PMTs are sensitive, this is achieved by coating the inner surface of the acrylic vessel with TPB wavelength shifter. The fluorescence time profile of the TPB, and other detector effects need to be taken into account when developing a model for the detector response. This presentation will cover the development and components of a model for the response of the detector to Argon-39 decays and the application of the Argon-39 ER band to develop a region of interest for the dark matter search.

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Please select: Experiment or Theory

Experiment

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