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Event Reconstruction in DEAP-3600 at SNOLAB

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DEAP-3600 is a low-background, single-phase liquid argon (LAr) direct detection experiment looking for nuclear recoils from WIMP dark matter, operating 2 km underground at SNOLAB (Sudbury, Canada). The detector consists of 3279 kg of LAr contained in a spherical acrylic vessel. LAr is an excellent scintillator, transparent to its own scintillation light. Photomultiplier tubes detect the scintillation light, and pulse shape discrimination is applied to differentiate between nuclear recoils and electromagnetic interactions (the most abundant backgrounds, which predominantly come from the beta-decay of Ar39). The 'Event Reconstruction' methodology used to analyse events in the DEAP-3600 detector, significantly utilizes a detector model based on detailed optical and DAQ simulation. DEAP-3600 data is converted to a set of times and charges for pulses in each PMT. From that information, we have algorithms that reconstruct the position. One algorithm is based on the spatial distribution of the integrated charge in PMTs; the second algorithm is based on the time of flight in the first 40 nanoseconds of an event. The algorithms will be described and the performance compared. The algorithms give very consistent result for light due to scintillation events in the main detector volume; but disagreement is used to reject events that arise from shadowed geometries. I will present an overview of the event reconstruction methodology and will discuss the recent improvements in the pulse shape analysis techniques as well as time based event reconstruction techniques.

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