Position reconstruction with the XENON100 TPC based on least-squares fitting

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— The determination of interaction locations is a key feature of dual-phase Time Projection Chambers (TPCs) for Dark Matter search. XENON100 is a liquid/gas xenon TPC, searching for Weakly Interacting Massive Particles at the Gran Sasso National Laboratory. While the z-coordinate of an event is determined by the drift time of electrons with regard to a scintillation light trigger, the x/y position is reconstructed using the distribution of proportional light on the top PMT array. Previously for the relatively small TPC of Xenon10, a exhaustive search procedure was developed to perform the least-squares fitting. However, for the larger TPC of current detector Xenon100, the very procedure becomes unpractically slow. In this work, we present the development of a new procedure which searches the minimum of $\chi^2$ between real signal and simulated data efficiently. The procedure performed on a Monte Carlo generated data-set yields millimeter resolution of x-y position. The performance on real signals employing proper uncertainties from various sources is also discussed.

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