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Laser calibration & electron drift property analysis for NEWS-G

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As part of the ongoing search for dark matter, the NEWS-G collaboration uses a spherical proportional counter to detect WIMP interaction. The detector consists of a grounded spherical vessel filled with gas. A positive voltage is applied on a central anode, inducing a radial electric field. Energy deposited by a WIMP can cause ionization. Under the influence of the electric field, primary electrons drift towards the central anode. Within a few hundred μm around the anode, where the electric field is strong enough, primary electrons acquire sufficient kinetic energy to ionize other gas atoms, producing a large quantity of secondary ion-electron pairs by Townsend avalanche. The time taken for the primary electrons to drift from the sphere's volume to the central anode is constantly being calibrated by a laser using the photoelectric effect. However, that drift time varies significantly depending on the field conditions. Moreover, it has been found to fluctuate substantially with time and is strongly correlated to other events happening inside the sphere that modify the charges distribution and the electric field. The purpose of this talk is to discuss laser calibration of the detector, causes and consequences of the drift time fluctuations, how it can influence the pulse formations and the overall data analysis as well as how problems arising from this effect can be mitigated.

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