

Performance of an Optical Readout Gas Chamber for Charged Particle Track

Authors : Jing Hu, Xiaoping Ouyang

Abstract : We develop an optical readout gas chamber based on avalanche-induced scintillation for energetic charged particles track. The gas chamber is equipped with a Single Anode Wires (SAW) structure to produce intensive electric field when the measured particles are of low yield or even single. In the presence of an intensive electric field around the single anode, primary electrons, resulting from the incident charged particles when depositing the energy along the track, accelerate to the anode effectively and rapidly. For scintillation gasses, this avalanche of electrons induces multiplying photons comparing with the primary scintillation excited directly from particle energy loss. The electric field distribution for different shape of the SAW structure is analyzed, and finally, an optimal one is used to study the optical readout performance. Using CF₄ gas and its mixture with the noble gas, the results indicate that the optical readout characteristics of the chamber are attractive for imaging. Moreover, images of particles track including single particle track from 5.485MeV alpha particles are successfully acquired. The track resolution is quite well for the reason that the electrons undergo less diffusion in the intensive electric field. With the simple and ingenious design, the optical readout gas chamber has a high sensitivity. Since neutrons can be converted to charged particles when scattering, this optical readout gas chamber can be applied to neutron measurement for dark matter, fusion research, and others.

Keywords : optical readout, gas chamber, charged particle track, avalanche-induced scintillation, neutron measurement

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