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Columnar Recombination Study in High Pressure Xenon Gas for Direction-sensitive Dark Matter Search

Columnar recombination is a phenomenon that recombination is promoted when a direction of electric field and that of an ionizing particle track are aligned.
If this phenomenon occurs for low energy nuclear track, direction-sensitive dark matter search with large target mass and spin-independent sensitivity can be realized.
We report on the measurement of columnar recombination in a high pressure gas detector filled with 8 atm xenon using 5.4 MeV alpha particle.
We measured both scintillation and ionization to study columnar recombination.
Since the recombination photons are emitted several microseconds after de-excitation emission, we divided the scintillation photons into fast and slow components.
The fast component did not show angular dependence, on the other hand, the slow component increased when the angle of alpha particle is aligned with the electric field.
The result indicates that the track angle relative to the electric field can be reconstructed from scintillation time profile.

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