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Neutral Bremsstrahlung scintillation emission in xenon optical TPCs

Xenon TPCs with optical readout are being increasingly applied to rare event detection, in the important fields of cosmology and particle physics, e.g. dark matter search or neutrino physics studies such as double-beta decay, double electron capture and neutrino detection.
Through the years, it was assumed that secondary scintillation in noble gases was solely due to VUV emission from excimers, created in a three-body collision of two neutral atoms and one excited atom produced by electron impact, being the Neutral Bremsstrahlung (NBrS) emission ignored. Recent studies have shown the presence of NBrS in argon.
We have measured, for the first time in pure xenon, non-excimer-based secondary scintillation, Neutral Bremsstrahlung, in a dedicated setup based on a Gas Proportional Scintillation Counter. We present an unambiguous identification of NBrS emission in xenon TPCs, and provide a quantitative assessment of the NBrS emission yield as a function of reduced electric field, sup-ported by a predictive theoretical model of this light-emission process. We have implemented a robust theoretical model describing the experimental data with accuracy. The relevance of xenon NBrS emission in the context of rare event experiments will be discussed.
The emission of NBrS by drifting electrons occurs even for electric field values below the gas excitation threshold. We have shown the presence of NBrS in the NEXT-White TPC, at present the largest optical HPXe-TPC in operation (~ 5 kg of xenon at 10 bar).
Moreover, for field values above 1 kV/cm/bar, as typically employed for electroluminescence (EL), there is consistent evidence that NBrS is present with an intensity about two orders of magnitude lower than conventional, excimer-based, EL.
Despite fainter than EL, in pure xenon, this "new"source of emission has to be accounted for in xenon optical TPCs and may play an important role in future single-phase LXe TPCs.

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