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Semi-empirical calculation of quenching factors for scintillators

Semi-empirical method of calculation of quenching factors for scintillators is described. It is based on classical Birks formula with the total stopping powers for electrons and ions which are calculated with the ESTAR and SRIM codes, respectively. Method has only one fitting parameter (the Birks factor kB) which can have different values for the same material in different conditions of measurements and data treatment. However, once obtained by fitting data for particles of one kind and in some energy region (e.g. for a few MeV α particles from internal contamination of a detector), it can be used to calculate quenching factors for particles of another kind and for another energies (e.g. for low energy nuclear recoils) if all data are measured in the same experimental conditions and are treated in the same way. Applicability of the method is demonstrated on many examples including materials with different mechanisms of scintillation: organic scintillators (solid C_8H_8, and liquid $C_{16}H_{18}$, C_9H_{12}); crystal scintillators (pure $CdWO_4$, $PbWO_4$, $ZnWO_4$, $CaWO_4$, CeF_3, and doped CaF_2(Eu), CsI(Tl), CsI(Na), NaI(Tl)); liquid noble gazes (LAr). Old and new (obtained during last 3 years) results are presented.

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