XE DOPING STATUS

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REFERENCES

- These slides are based on results from

1. McFadden et al, *Large-Scale, Precision Xenon Doping of Liquid Argon*, 2020
2. Vogl et al, *Scintillation and optical properties of xenon-doped liquid argon, 2021*
3. Akimov et al, *Fast component re-emission in Xe-doped liquid argon*, 2019

CHANGES TO DETECTOR PARAMETERS DUE TO XE DOPING

- As showed last time, many of the detector/simulation parameters remain unchanged
- Based on these references, the main parameters that need adjustment are
    - Scintillation wavelength (discussed last time)
    - Scintillation time structure
    - Attenuation length

TIME STRUCTURE

- Currently, scintillation light output is described by

$$I(t) = I_f e^{-t/\tau_f} + I_s e^{-t/\tau_s}$$

- According to references, this should at least be adjusted to

$$I(t) = I_f e^{-t/\tau_f} + I_s e^{-t/\tau_s} - I_d e^{-t/\tau_d}$$

  where τ_d describes the time for energy to transfer between Ar and Xe excimers

TIME CONSTANT VALUES

- $\tau_f = 6$ ns is not influenced by Xe doping
- $\tau_s = 1300$ ns for undoped LAr, $\mathcal{O}(100\ \mathbf{ns})$ for Xe doped LAr
- $\tau_d = \mathcal{O}(100\ \mathbf{ns})$ for Xe doped LAr, not applicable for undoped LAr

ATTENUATION LENGTH

- This is currently set to 20 m for all wavelengths in `cenns10geant4`
- Reference 2 measures 42 cm for undoped LAr, increasing to 650 cm at 300 ppm Xe concentration
- Another reference from 1997 quotes 66 cm for undoped LAr and around 150 cm for 3% Xe concentration

TO-DO

- Create GDML files specifying one or more Xe concentrations
- Implement handling of the τ_d time constant
- Think about adjusting F90 parameter to look at a smaller time window
- Think about shortening pulse lengths
- Run simulations with Xe doping vs no Xe doping