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Positronium discrimination in liquid scintillators

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Electron anti-neutrinos are commonly detected in liquid scintillator experiments via inverse beta decay, by looking at the coincidence between the reaction products, neutron and positron. Prior to positron annihilation, an electron-positron pair may form an orthopositronium (o-Ps) state, with a mean life of a few ns. Even if the o-Ps decay is speeded up by spin flip or pick off effects, it may introduce distortions in the photon emission time distribution, crucial for position reconstruction and pulse shape discrimination algorithms in anti-neutrino experiments. Reversing the problem, the o-Ps induced time distortion represents a new signature for tagging anti-neutrinos in liquid scintillator.

We report the results on the measurement of the o-Ps formation probability and lifetime for the most used solvents for organic liquid scintillators in neutrino physics and for scintillators doped with gadolinium, neodymium, and boron.

Primary author: Dr PERASSO, Stefano (APC)

Presenter: Dr PERASSO, Stefano (APC)

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