



Contribution ID: 591

Type: Poster

Beyond the plane-wave transitions by wave packets: anomalous kinetic effect in quarkonium decays

Thursday 15 December 2022 14:00 (1 hour)

The profile of a particle in quantum theory is usually formulated as an eigenstate of momentum using plane waves. This is a straightforward and widely used prescription, but it is inadequate because the energy localisation of the particles is completely indescribable.

Due to this spatial non-normalizability, in plane-wave calculations, the frequency of quantum transitions can only be calculated as an averaged physical quantity with dimension, averaged in time (and volume). In contrast, with wave packets, including the effects of particle localisation, a complete quantum transition can be described as a pure (dimensionless) probability quantity.

Now, whether wave packet-specific effects - beyond the “averaging” described above - can be observed experimentally.

In this talk, I will focus on several decay processes of quarkoniums occurring near the kinetic threshold and show that the experimental results, which were difficult to understand by plane-wave calculations, can be explained by wave packet calculations. The talk will also cover the fundamentals of calculation methods using wave packets.

Session

Beyond the Standard Model

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