Particle Physics on the Plains 2024



Contribution ID: 37

Type: not specified

Modeling frequency instability in high-quality resonant experiments DarkSRF

Sunday 3 November 2024 11:56 (18 minutes)

In the pathfinder project of DarkSRF, the thermal jittering of the receiver cavity has been conservatively modeled with a constant mismatch, assuming the receiver is always off-resonant with the emitter. In this paper, we develop a more refined model by treating jittering as a random process, utilizing its power density spectrum. We derive the analytical solutions for the expectation value and variance of the power output and validate them with numerical simulations. Our results indicate significantly less power loss than previously predicted, leading to a substantial improvement in the existing bounds on dark photon mass and mixing strength.

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Session Classification: Astrophysical Probes