



Contribution ID: 256

Type: **Talk**

Gravitational wave imprints on spontaneous emission

Wednesday 25 June 2025 15:25 (15 minutes)

Gravitational wave studies and detection efforts have traditionally focused on their effects on test masses and geodesic deviation. In contrast, we show that gravitational waves can nontrivially influence spontaneous emission from point-like atoms, inducing directionality in the emission pattern and generating sidebands in the spectrum. We examine how much information about the gravitational wave amplitude is encoded in the quantum state of the combined atom–field system, analyzing both the classical Fisher information associated with photon number measurements and the quantum Fisher information. Our results suggest that the requirements for gravitational wave detection via this mechanism are not prohibitive.

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Session Classification: Wednesday Parallel Session C