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Quantum field correlations in the presence of a movable boundary

Tuesday 31 August 2021 12:00 (30 minutes)

We investigate the spatial correlations between quantum fields in two regions of space separated by a movable reflecting wall. Our system consists of two cavities separated by a movable reflecting mirror, that is bound to its average position by a harmonic potential. The two semi-spaces are occupied by a quantum massless scalar field, and the mirror acts as a moving boundary condition for the two scalar fields confined in the two cavities. In our approach, both the fields and the mirror are treated quantum-mechanically, and an effective interaction between the field modes in each semi-space, mediated by the reflecting wall, is present.
Using the time-independent perturbation theory in the effective field-mirror interaction, we first evaluate the vacuum spatial correlations between the field operators in the two semi-spaces and show that such correlations are zero. In contrast, correlations between the squared fields in the two cavities in the vacuum state give a nonvanishing term at the second order in the field-mirror effective coupling. This nonvanishing correlation indicates a mutual influence of the field fluctuations in the two cavities mediated by the movable reflecting wall. We also discuss the case of two infinite half-spaces separated by a single movable wall, obtained in the continuous limit when the fixed walls of the two cavities go to infinity, and evaluate the field correlation function on the opposite sides of the moving mirror. We show that the moving mirror gives rise to anticorrelations between the fields in the two semi-spaces and study the dependence of these spatial correlations as a function of the average distance from the moving wall. The observability of these effects is also discussed.

Is this abstract from experiment?

No

Name of experiment and experimental site

N/A

Is the speaker for that presentation defined?

Yes

Details

Roberto Passante, Prof., Università degli Studi di Palermo, Italy, www.unipa.it

Internet talk

Maybe

Primary authors: Dr ARMATA, Federico (Dipartimento di Fisica e Chimica - Emilio Segrè, Università degli Studi di Palermo); Dr MONTALBANO, Federico (Dipartimento di Fisica e Chimica - Emilio Segrè, Università degli Studi di Palermo); Dr RIZZUTO, Lucia (Dipartimento di Fisica e Chimica - Emilio Segrè, Università degli Studi di Palermo); Prof. PASSANTE, Roberto (Dipartimento di Fisica e Chimica - Emilio Segrè, Università degli Studi di Palermo)

Presenter: Prof. PASSANTE, Roberto (Dipartimento di Fisica e Chimica - Emilio Segrè, Università degli Studi di Palermo)

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