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Boundary-induced quantum effects in the hyperbolic vacuum of dS spacetime

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The vacuum expectation values (VEVs) of the field squared and energy-momentum tensor for a massive scalar field with general curvature coupling parameter are investigated inside and outside a spherical shell in background of de Sitter (dS) spacetime. It is assumed that the field is prepared in the hyperbolic vacuum state. The latter differs from the maximally symmetric Bunch-Davies vacuum state and is realized by the mode functions corresponding to the foliation of dS spacetime by spatial sections having a constant negative curvature. In the flat spacetime limit the hyperbolic vacuum is reduced to the conformal vacuum in the Milne universe. The sphere-induced contributions in the VEVs are extracted explicitly and their behavior in various asymptotic regions of the parameters are investigated. The vacuum energy-momentum tensor has a nonzero off-diagonal component that describes the energy flux in the radial direction. The latter is a purely boundary-induced effect and is absent in the boundary-free geometry.

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