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**A Field Theory Approach to Roughness Corrections for Casimir Energies**[1] HUA-YAO WU[2], MARTIN SCHADEN, Rutgers University — We present a systematic approach to the interaction of a massless scalar field with stochastically rough parallel plates by deriving an effective brane-like field theory in which a massless scalar field living in four-dimensional Euclidean space-time couples to a scalar (roughness) field restricted to one of the two-dimensional plates. The model is described by the interaction $V_{int} = \frac{1}{2}\varphi^2(\tau, z, x_\perp)[g_1\delta(z-a-h(x_\perp))+g_2\delta(z)]$ with prescribed (measured) correlations for the roughness field $h(x_\perp)$ summarized by a generating functional. Counterterms ensure that the correlations of the roughness-field $h(x_\perp)$ do not depend on the separation $a$ of the plates. We in particular demand that$\langle h(x_\perp)\rangle = 0$ and $\langle h(x_\perp)h(y_\perp)\rangle = \sigma^2\exp(-(x_\perp - y_\perp)^2/\ell^2)$. Here $\sigma^2$ and $\ell$ are parameters related to the variance and correlation distance of the surface roughness. The leading roughness correction to the Casimir energy is given by a two-loop contribution to the free energy. Our results are compared with those of other perturbative methods for taking stochastic roughness into account. We use renormalization group methods to examine the strong coupling (Dirichlet) limit of this model.

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