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Fluctuation-induced forces in strongly anisotropic critical systems M. BURGSMÜLLER, H.W. DIEHL, Fakultät für Physik, Universität Duisburg-Essen, 47048 Duisburg, Germany, M.A. SHPOT, Institute for Condensed Matter Physics, 79011 Lviv, Ukraine — Strongly anisotropic critical systems have two (or more) correlation lengths ξ_α and ξ_β that diverge as nontrivial powers $\xi_\alpha \sim \xi_\beta^\theta \to \infty$ upon approaching criticality. We investigate the effective (Casimir-like) forces that are induced between two confining parallel boundary planes at a distance L by fluctuations in such systems at bulk criticality. Two fundamentally distinct orientations of boundary planes must be distinguished: parallel, for which the planes are parallel to all of the available $1 \le m < d$ α-directions, and perpendicular, for which they are perpendicular to an α-direction, but parallel to all other α- and β-directions. Using a RG approach, we show that universal Casimir amplitudes $\Delta_{\parallel,\perp}^{BC}$, depending on both the large-scale boundary condition (BC) at both plates and the type of surface plane orientation, can be introduced to characterize the asymptotic L-dependence of the critical fluctuation-induced force. This varies as $\mathcal{F} \sim -(\partial/\partial\mathcal{L})\,\Delta_{\parallel,\perp}^{BC}\,L^{-\zeta_{\parallel,\perp}}$, where the proportionality constant is nonuniversal. To corroborate these findings, $O(n)$ ϕ^4 models with m-axial Lifshitz points are investigated below their upper critical dimension $d = 4 + m/2$. Explicit one- and two-loop results for $\Delta_{\parallel,\perp}^{BC}$ are presented for both orientations and periodic or Dirichlet-like boundary conditions, along with large-n results.

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