Zeta regularization and Casimir effect for a scalar field with singular background

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Abstract We consider a free scalar field living on Minkowski spacetime, in presence of delta-like background potentials supported on hyper-surfaces of low co-dimension. We describe this type of settings in terms of singular perturbations of the free Laplacian, giving rise to the Klein-Gordon equation for the field, and use standard resolvent techniques to determine explicit expressions for the correspond- ing resolvent operators. To make connection with the Casimir effect, we introduce a zeta-regularized Wightman field in the framework of canonical quantization, using complex powers of the mentioned perturbed Laplacian. This field generates an algebra of polynomial observables, whose (vacuum) expectation values are analytic functions of the regulating parameter; their analytic continuation is constructed using integer powers of the resolvent operator corresponding to the perturbed Lapla- cian. This allows to attain renormalization in the spirit of zeta approach. (Based on joint works with Claudio Cacciapuoti, Livio Pizzocchero and Andrea Posilicano.)