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The determinant on flat conic surfaces with excision of disks

Let (M,g) be a surface with a flat conical metric, and consider the surface M_ϵ obtained by removing disks of radius ϵ around any subset of the conical singularities. We investigate the asymptotic behavior of the determinant of the Laplacian on M_ϵ, with Dirichlet boundary conditions, as ϵ approaches zero. Such families of surfaces were first studied by Khuri in the context of the Osgood-Phillips-Sarnak approach to compactness of isospectral sets of metrics. In particular, Khuri used these surfaces to prove that the determinant is not a proper map on the moduli space of flat metrics on a surface of genus p with n disks removed when $np \geq 1$. Our goal is to analyze the determinant of the Laplacian more closely as a function on this moduli space. As a first step, we sharpen and generalize Khuri's results; our main formula is an asymptotic expansion for the determinant of the Laplacian on M_ϵ, with an error which vanishes as ϵ approaches zero. The proof uses determinant gluing formulas as well as an extension of an argument of Wentworth, which enables us to analyze the asymptotics of the Dirichlet-to-Neumann operator on M_ϵ.