

Quantum Physics

Metric deformation and boundary value problems in 2D

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A new analytical formulation is prescribed to solve the Helmholtz equation in 2D with arbitrary boundary. A suitable diffeomorphism is used to annul the asymmetries in the boundary by mapping it into an equivalent circle. This results in a modification of the metric in the interior of the region and manifests itself in the appearance of new source terms in the original homogeneous equation. The modified equation is then solved perturbatively. At each order the general solution is written in a closed form irrespective of boundary conditions. This method allows one to retain the simple form of the boundary condition at the cost of complicating the original equation. When compared with numerical results the formulation is seen to work reasonably well even for boundaries with large deviations from a circle. The Fourier representation of the boundary ensures the convergence of the perturbation series.

Comments: 15 pages, 5 figures, 1 table. (New figures showing the wave functions and energy levels added. Formalism applied to both Dirichlet and Neumann boundary conditions)

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