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Quantum Black Holes, Modular Forms and Mock Modular Forms

In the quantum theory of black holes in superstring theory, the physical problem of counting the number of quarter-BPS dyonic states of a given charge has led to the study of Fourier coefficients of certain meromorphic Siegel modular forms and to the question of the modular nature of the corresponding generating functions. These Fourier coefficients have a wall-crossing behavior which seems to destroy modularity. In this mini-course I shall explain that these generating functions belong to a class of functions called mock modular forms. I shall discuss the physical consequences of this statement, and interesting mathematical examples that arise from this construction. This is based on joint work with Atish Dabholkar and Don Zagier.