MATHEMATICAL ANALYSIS OF THE DIMENSIONAL SCALING METHOD IN CHEMICAL PHYSICS

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Abstract: The dimensional scaling (D-scaling) method is an effective asymptotic method in chemical physics, where one uses the spatial dimension D as a parameter by embedding the Schrödinger equation with a Coulomb potential into a general D-dimensional space and by letting D tend to infinity. For the hydrogen atom, by the proper scaling of D of Dudley Herschbach (Nobel laureate in chemistry 1986), one can obtain the exact value of the ground state. As D tends to infinity, one obtains a singularly perturbed differential equation which shows the condensation phenomenon that the wave functions condense into a classical particle at the unit Bohr radius. Recently, the speaker and his collaborators (Drs. Zhonghai Ding, Chang-Shou Lin, Dudley Herschbach, and Marlan Scully) have analysed the D-scaling technique and the corresponding theory of calculus of variations in order to put D-scaling on a solid mathematical foundation. The rigorous mathematical procedures will be outlined, and some recent progress will be surveyed.