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Diffusion on a Sphere with Localized Traps: Mean First Passage Time, Eigenvalue Asymptotics, and Fekete Points

A common scenario in cellular signal transduction is that a diffusing surface-bound molecule must arrive at a localized signaling region on the cell membrane before the signaling cascade can be completed. In order to determine the time-scale for this process, we calculate asymptotic results for the mean first passage time for a diffusing particle confined to the surface of a sphere in the presence of multiple partially absorbing traps of small radii. In addition, asymptotic results are given for the related problem of calculating the mean first passage time for a diffusing particle inside a sphere with small traps on an otherwise reflecting boundary condition. The asymptotic analysis relies on detailed properties of certain Green's functions related to the sphere. The asymptotic results are shown to compare favorably with full numerical results.

Joint work with Dan Coombs (UBC), Ronny Straube (Max Planck Institute, Magdeburg).