

# Adventures in Theory

A Lecture Series in  
Theoretical and Mathematical Science

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*Modeling Crowding and Confinement:  
Towards an Understanding of Cellular Environments*

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150 Physics Building

Inside cells, proteins exist in very crowded and compartmentized environments. In contrast, most biophysical studies, both theoretical and experimental, have been limited to proteins under dilute conditions. We have undertaken several lines of research to model the crowded or confined conditions of proteins inside cellular environments. Statistical-thermodynamic models are developed to gain qualitative understanding of how macromolecular crowding and confinement influence the thermodynamics and kinetics of protein folding and binding. In particular, such models show that crowding increases the chemical potentials of both the folded and the unfolded states of a protein and predict a modest increase in folding stability. Experiments are carried out to test this and other predictions. Models with atomic details are also developed to more realistically capture various effects of macromolecular crowding. These complementary approaches are allowing us to reach a better understanding of the influences of cellular environments on biological processes.