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A Projection-Based Framework for Chemical Kinetics, Thermodynamics, and Molecular Organization

ABSTRACT

Chemical kinetics, thermodynamics, and biochemical organization are traditionally treated as distinct layers of chemical science, each described using its own set of empirical laws and models. While these approaches are highly successful, a unified conceptual framework connecting microscopic molecular dynamics to observable chemical behavior remains incomplete.

In this work, I propose a projection-based framework for chemical and biochemical systems, in which observable quantities such as reaction rates, activation barriers, free energy, and equilibrium states are interpreted as context-dependent manifestations of underlying molecular processes. Within this perspective, reaction rates correspond to effective fluxes between observable states, activation barriers reflect constraints on accessible pathways, and thermodynamic quantities describe the structure of accessible configurations under given environmental and experimental conditions.

The framework provides a unified interpretation of classical chemical concepts, including Arrhenius and non-Arrhenius kinetics, transition state theory, tunneling effects, enzyme catalysis, stochastic kinetics, master equation approaches, diffusion, solvent effects, and nonequilibrium irreversibility, without modifying established physical laws. Reaction networks are described as reduced representations of molecular dynamics, and entropy production is associated with changes in accessible configurations under nonequilibrium conditions.

This approach extends naturally to biochemical systems, where metabolic pathways, protein folding, membrane formation, and genetic stability emerge as structured outcomes of coupled kinetic and thermodynamic constraints. By linking chemical reactivity, transport, and biological organization within a single conceptual structure, the framework offers a coherent perspective on how complex chemical systems arise from underlying molecular processes.

The results suggest new directions for interpreting reaction mechanisms, guiding chemical design, and understanding the transition from chemistry to biology.

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BIOGRAPHY

Abhishek Bansal is an independent consultant, researcher, and amateur scholar whose recent work reflects over 20 years of fully self-funded, self-directed research. He has proposed novel B-Equations and related engineering frameworks for impedance analysis, transformers, inverters, generators, pumps, solar systems, machinery, turbines, batteries, SMPS, and short-circuit analysis. In biomedical science, he has formally claimed Novel Bansal-NonLinear Theory and Novel Bansal-Biology Theory with nine frameworks, including B-Phy, B-Chem, B-Disease, B-Pharma, B-AI, and B-Prosthetics. He has developed free BVidAL Clinical Software Suite(beta version) and BVidAL RTOS (Real Time Operating System) for biomedical analysis, simulation, imaging, signals, and medical-device research.