Chemical and physical processes such as reaction dynamics and the transport of molecular excitations have been occurring on earth for the last few billions of years. In time, reactive processes led to the appearance of life through the formation of amino acids, nucleic acids and eventually, proteins, RNA and DNA. Photosynthetic bacteria, the first recorded forms of life on earth, have evolved biologically over the last three billion years. During this evolution, photosynthetic complexes were optimized to balance e.g. stability upon folding and light transport in the form of excitons.

In this context, I will begin by discussing the theoretical reconstruction of the gene sequence and three-dimensional structure of an ancestral photosynthetic protein complex, the Fenna-Matthews-Olson complex. Then, I will compare quantum coherence in the exciton transport of the ancestor to that of the current day complex and show that quantum coherence was not specifically selected for during evolution.

In prebiotic times, enzymes were absent and thus organic chemists have devised a network of non-enzymatic reactions which could have led to the formation of amino acids, sugars and nucleic acids.

The chemical environment surrounding reactants and products is unknown. Further, the mechanism of each of these reactions remains to be understood. I will thus discuss the kinetics of two reactions which would have led to the formation of precursors of valine and leucine. From the computed kinetics, I will show the reaction mechanism and how it changes when the solvent is included explicitly. I will also emphasize the importance of describing multiple reactive pathways to obtain an accurate picture of reactivity.