The development of new theoretical methods capable of describing chemical reactions at a fundamental level is a research area which receives immense attention. Development of good, reliable yet fast methods for in silico prediction of reactivity could potentially revolutionize many disciplines within chemistry and biology, such as discovery of new catalysts, catalyst optimization, discovery of new pharmaceuticals\textsuperscript{1,2} etc.. While current state-of-the-art methods, which often relies on density functional theory (DFT), are accurate enough to perform these tasks in many applications, they must be several orders of magnitude faster than they are now to reach their full potential. In order to solve this problem, the Goddard group at the Materials Process and Simulation Center at the California Institute of Technology (MSC, Caltech) has developed a so-called “reactive force-field”, ReaxFF,\textsuperscript{3} which is capable of describing chemical reactions.

![Diagram of a catalytic cycle for a generic proline-catalyzed aldol reaction.](image)

Figure 1. Proposed catalytic cycle for a generic proline-catalyzed aldol reaction.

Hydrogen bonds are of crucial importance for the observed selectivity in the emerging field of organocatalysis, as exemplified by the family of proline catalyzed reactions discovered by the groups of Jørgensen,\textsuperscript{4} Barbas,\textsuperscript{5} and Macmillan\textsuperscript{6} among others (Figure 1). However, several unanswered challenges remain, such as reaction pathway for modified catalysts (e.g. the imazolidine family), induction of diastereo- and enantioselectivity and the possibilities to develop multicomponent domino reactions. Addressing these issues requires both a detailed understanding of the mechanism, and the ability to quickly screen a multitude of substrates and catalysts. For this purpose we intend to parameterize the ReaxFF to describe organocatalysis with good accuracy, which will enable us to perform rapid virtual screening of new catalysts and explore the reaction pathway in detail.

\textsuperscript{1)} Kuntz, I. D. \textit{Science} \textbf{1992}, 257, 1078
\textsuperscript{2)} Jørgensen, W. L. \textit{Science} \textbf{2003}, 303, 1813.