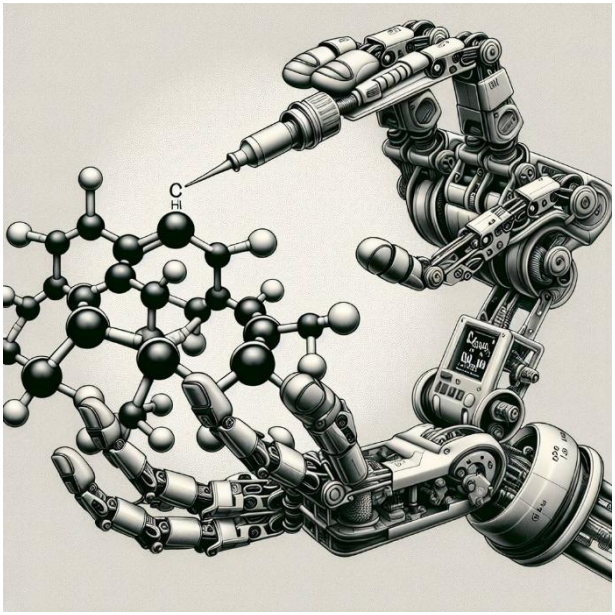
Popular science abstract

This research seeks to transform the field of organic synthesis by introducing a novel approach to selectively activating and modifying distal C-H bonds. These bonds, located far from functional groups within a molecule, pose a significant challenge due to their minimal structural differences. Traditional methods often rely on covalent directing groups, which require additional synthetic steps and generate waste. In contrast, this project focuses on harnessing dynamic, reversible non-covalent interactions, such as hydrogen bonding, metal coordination, and electrostatic forces, to guide chemical transformations with high efficiency and precision.



The innovative aspect of this research lies in the development of new catalytic systems that utilize these non-covalent interactions as temporary yet highly effective directing elements. Unlike covalent approaches, these dynamic interactions offer flexibility and adaptability, enabling the functionalization of a wider range of molecules while reducing environmental impact. A particular emphasis is placed on combining transient directing groups with hydrogen-bonding units to enhance molecular binding and reaction control. This dual strategy not only improves site selectivity but also facilitates the transfer of chirality, a critical feature in synthesizing biologically active compounds.

Through systematic optimization of reaction conditions, *the project aims to achieve unparalleled selectivity* and yield in C-H activation processes. Mechanistic studies will employ advanced spectroscopic and computational techniques to provide a deeper understanding of how these non-covalent interactions influence the reactions. The methodologies developed will be applied to synthesize structurally complex and biologically relevant molecules, as well as to modify frameworks useful in cutting-edge technologies, such as inducing chirality in spin-selective materials or creating circularly polarized light.

The outcomes of this research are expected to significantly advance the field of organic chemistry. By providing new catalytic tools and methodologies, it will streamline the synthesis of complex organic molecules, including pharmaceuticals and natural products, making these processes more efficient and environmentally friendly. The insights gained will also deepen our understanding of the role of non-covalent interactions in molecular design, laying the groundwork for further innovation.

Ultimately, this project represents a paradigm shift in C-H activation, offering a sustainable and versatile alternative to traditional methods and opening new possibilities for applications across medicine, materials science, and beyond.