Chirality Recognition, Transfer and Amplification: A Molecular Perspective

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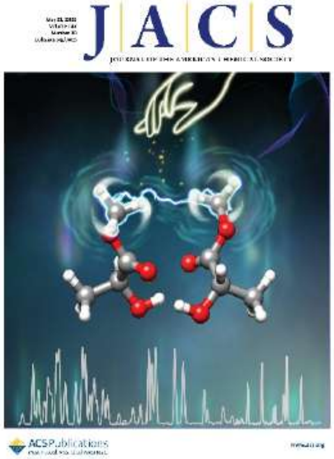
In 1848, French chemist Louis Pasteur made a groundbreaking discovery when he separated crystals of tartaric acid into two distinct mirror-image forms, marking the birth of molecular chirality. Since then, researchers have embraced the challenge of distinguishing left- and right-handed molecules, as their unique chiral non-covalent interactions can lead to vastly different biological and pharmaceutical effects.

In this talk, I will explore how modern spectroscopic techniques, in concert with theoretical modelling, enable us to probe chirality recognition, transfer, and amplification events at the molecular level. I will illustrate this through three case studies: a gas-phase rotational spectroscopic analysis of quantum tunneling effects in a chiral dimer;[1] a vibrational circular dichroism (VCD) study of a flexible salen ligand revealing drastic solvent effects; and a combined VCD and electronic circular dichroism (ECD) investigation of an atomically-precise chiral metal cluster,[2] showing how ligand conformation governs chiral spectroscopic response and drives chirality transfer and amplification. These examples highlight the central role of non-covalent interactions, advancing our fundamental understanding of chirality and its broad relevance.



References

[1] J. Ma, A. Insausti, W. Jäger, Y. Xu, Chirality-induced symmetry preferences in methyl lactate dimer: fingerprints of quantum tunneling, *J. Am. Chem. Soc.* **2025**, 147, 17002-17009.

[2] M. Alshalalfeh, X.-Y. Dong, S. Parshotam, G. Li, J. R. Cheeseman, S.-Q. Zang, Y. Xu, *Small*, **2025**, in press.