Contribution ID: **95** Type: **Invited talk**

The Twisting World of Chirality: A Molecular Perspective

Thursday 18 September 2025 09:15 (45 minutes)

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. How can we tell them apart?

In this talk, I will explore how modern spectroscopic techniques, in concert with theoretical modelling, enable us to probe chirality recognition, transfer, and amplification 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, 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.

Keywords

This abstract is submitted for....

HBond 2025 conference

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