A Novel Chiroptical Spectroscopy Technique

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In nanophotonics, electromagnetic helicity is the most commonly used chiral entity to unveil molecular chirality. Circular Dichroism (CD) spectroscopy remains the most utilized technique to detect molecular chirality using helicity [1]. In a conventional CD setup, the molecular solution is sequentially illuminated with fields of opposite helicities, and the transmitted power is recorded for each case. The CD signal is then defined as the difference between these power measurements. Despite its widespread use, CD has significant drawbacks. For instance, if CD = 0 at a certain frequency of the electromagnetic field, it becomes indeterminate whether the molecular solution is chiral or not, since CD provides only partial information about molecular chirality. To overcome this limitation, optical rotation (OR), which quantifies the rotation of linearly polarized light as it propagates through a chiral medium, is typically measured. However, both CD and OR are measured in the forward direction, where a dominant achiral background hinders accuracy and reliability. Moreover, CD and OR depend on molecular concentration and optical path length, meaning their signatures not universal for a given enantiomer of a chiral molecule. **In this work**, we introduce a novel spectroscopy technique (see Figure 1) for characterizing the chirality of dipolar objects based on measuring the Stokes parameters at non-forward angles [2][3]. The method, avoids achiral background, and is independent of concentration and path length. Additionally, when both enantiomers are present, this technique can determine which enantiomer is dominant [4]. Moreover, the robustness of this approach can be verified experimentally in-situ by measuring the Stokes vector at two different non-forward angles of choice.

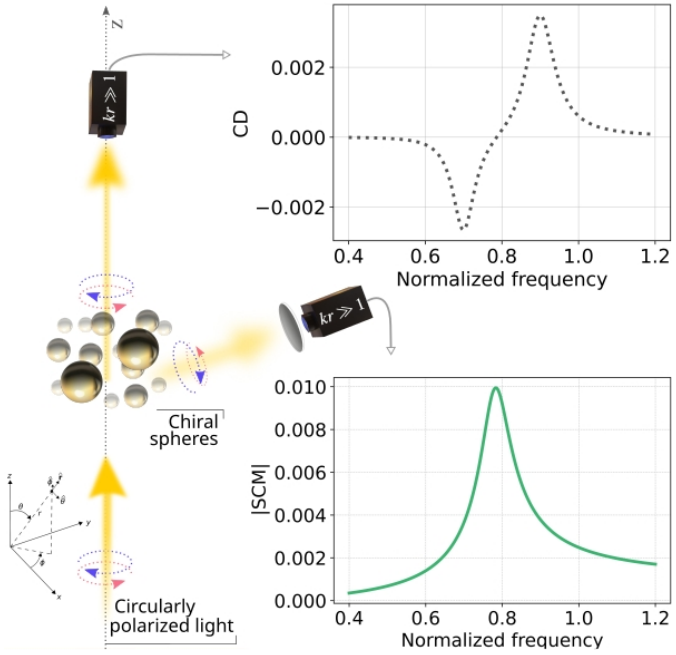

Figure 1: Chiral sphere sequentially illuminated by electromagnetic fields of opposite helicities. Two chiral observables are recorded: CD and the Stokes Chirality Measure (SCM) using a Stokes vector measurement.

References

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[4] J. Olmos Trigo, Sanz-Fernández, C., & Fernandez-Corbaton, I, arXiv: 2509.18006 **(2025)**