Tata Institute of Fundamental Research
Survey No. 36/P, Gopanpally Village, Serilingampally, Ranga Reddy Dist., Hyderabad – 500 046

Internal Webinar

Enhanced chiral discrimination in mass spectrometry with Orbital Angular Momentum Beams

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Chirality is a fundamental geometric property that plays a critical role in determining chemical functionality and biological processes across all scales of matter, from the molecular to the macroscopic. Chiral molecules exist as non-superimposable mirror images, or enantiomers, whose distinction requires a chiral probe. Optical approaches exploit the spin angular momentum of light to selectively reveal these chiral molecular signatures. Recent developments in light–matter interaction suggest that twisted light beams carrying orbital angular momentum (OAM) – can enhance chiral selectivity. An experimental approach that combines both the orbital and spin angular momenta of femtosecond laser pulses with mass spectrometry is introduced, resulting in a fourfold amplification of the chiral response. Using S (−)- and R (+)- camphor enantiomers as test molecules, with laser pulses hundreds of femtoseconds long, and energies of a few hundreds of μJ, strong enantioselective ionisation and fragmentation behaviour is observed. Laser intensity and pulse width act as tuneable parameters affecting the chiral signal. The present method proposes a scalable pathway for resolving molecular handedness in complex chemical and biological systems.

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11:30 Hrs