Measurement of Chiral Enantiomeric Excess by Photoelectron Circular Dichroism

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Results:

The work performed during this STSM will form a major part of my PhD thesis, which is aimed at distinguishing gas-phase chiral molecules with multi-photon processes. During my research visit to the group of Prof. Jacinto Sa in Uppsala University, the following tasks were performed:

- Installation and setup of our chiral detection instrument in the laser laboratory. This involved installing laser optics to measure and produce high quality circularly polarised laser light, a necessary pre-requisite for measuring photoelectron circular dichroism (PECD).
- Measured PECD in two benchmark chiral molecules (Fenchone & Camphor), and successfully distinguished the two enantiomers of each molecule manifested through a sign change in the asymmetry of the photoelectron emission.
- Provided the first steps to validating our instrument as a means of determining enantiomer excess by showing a reduction in the magnitude of the photoelectron asymmetry for a series of (non-racemic) mixtures of R/S-Camphor enantiomers. Furthermore, a racemic (50%-R/50%-S) mixture was shown to reveal no asymmetry, as expected from the equal and opposite contributions of each enantiomer.

Conclusions/Outlook:

Over the course of this short STSM, our collaboration has provided significant and promising results for this new instrument to be exploited as a means of detecting and distinguishing chiral molecules. Moreover, the ability to measure mixtures of enantiomers has been demonstrated. The results, which will be published in due course, have provided me with a firm foundation for preparing my thesis, and would not have been possible without the support of the MOLIM COST Action.

Future tests will include chiral detection of non-volatile species and to use different wavelengths. These tests will verify the potential of the instrument to be applied for enantiomer identification, but also to the used as a powerful tool for the study of ultrafast molecular dynamics which is the focus of MOLIM's Working Group 2 – "Time Resolved Method Developments". As structural changes in chiral molecules introduce changes in PECD asymmetry, the instrument will be capable of tracking these changes on femtosecond timescales.

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I certify that Jordan Miles performed the stated work in my laboratory
Jacinto Sa