OPTIMAL FRAMES FOR POLARIZATION STATE RECONSTRUCTION

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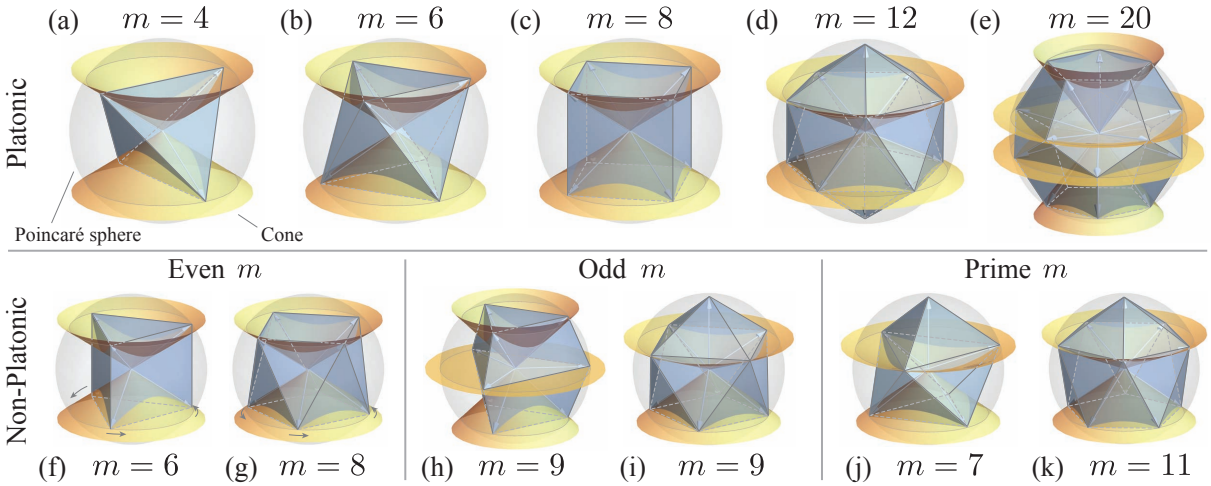
Measurement of the polarisation state of light is a common problem in many branches of fundamental and applied science including biological imaging and remote sensing. Accurate and robust measurements are essential in all such applications. Recently, interest has grown in determining higher order polarisation properties, as these can play a key role in nonlinear microscopy as well as quantum processes. Whilst polarisation dependent optical nonlinear processes can provide important insights into crystal and molecular structure, higher order properties described through a multipolar expansion of the polarisation matrix can contain hidden polarisation correlations, which are of interest both in a quantum and in a classical context.

Optimisation of linear polarisation measurements is well studied, however, the problem of optimally reconstructing higher order polarisation properties has to date remained unsolved. We present our recent work in which we derive an analytic solution to this problem using an arbitrary number of measurements. Our analysis hence generalises existing results in the linear domain which have been predominately confined to minimal measurement sets, however, critically we present optimal measurement strategies for higher order problems. Our method employs the elegant mathematical framework of spherical t-designs, thereby the derived optimal measurement sets constitute a powerful generalisation of the concept of mutually unbiased bases.



[1] M. R. Foreman, A. Favaro and A. Aiello, Phys. Rev. Lett. 115, 263901 (2015).