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Title: Large bandwidth mesh half-wave plates for millimetre and THz wave astronomy

Author: G. Pisano, P. Ade, C. Tucker and M.W Ng

Abstract:

Millimetre and sub-millimetre astronomical polarimeters have traditionally been based on birefringent Half Wave Plates (HWPs) used as polarisation modulating elements. Although moderate bandwidth can be achieved using the Pancharatnam designs there are limitations in terms of diameters, weights and associated losses. In addition, the rapid advance in array detector technology at these wavelengths has created a pressing need for large diameter HWPs which exceed those possible with crystalline materials.

The first metamaterial HWP was developed using an air-gap mesh filter technology, which demonstrated the feasibility. This was subsequently replaced by a more robust dielectrically embedded version which can be fabricated in much larger diameters than are available to crystalline plates and being basically a plastic material is also much lighter. The present development in this area is focussed on achieving large bandwidths (over 100%), large diameters (500mm or larger) and low losses (<1% at cryogenic temperatures). Here we review different approaches to the design and show how a trade-off of the different HWP parameters (transmissions, differential phase-shift, cross-polarisation, absorptions) can lead to optimal performances for specific instrument configurations.