PROPERTIES OF HIGH NA MUELLER-MATRIX CONFOCAL MICROSCOPES

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KEY WORDS: high aperture theory, numerical simulations, Mueller-matrix, polarimetry.

1 INTRODUCTION
Mueller-matrix polarimetry is used to determine the Mueller matrix of a sample. Such polarimeters have recently been employed in conjunction with confocal microscopes [1,2]. Mueller matrix confocal microscopes permit much information to be extracted from samples. There are however some important differences between polarimeters incorporated into confocal microscopes and those that are not.

2 MUELLER-MATRIX CONFOCAL MICROSCOPES
The presence of high NA objectives commonly used in confocal microscopes leads to depolarisation of the light incident upon a sample. Thus, the light interacting with the sample has a different and generally more complex polarisation state than the light incident upon the first principal focal plane of the lens. It is thus possible to consider the objective to be part of the sample in the sense that it too perturbs the polarisation of the incident and scattered light. The use of a confocal pinhole in detection mitigates the non-ideal depolarising effect of the objective in much the same way as it allows a theoretically infinite extinction ratio in polarised light confocal microscopy [3].

Consider for example the field distribution in the focal plane of the objective lens depicted in Figure 1. This figure depicts the field reflected by a slab of aluminium, collimated after focusing by an objective of NA .85. This is for a wavelength of 405nm where the refractive index of the aluminium is .41 + 3.96i.

Although horizontally polarised light was incident upon the focal plane, the reflected light is horizontally polarised only at particular locations within the exit pupil thus displaying the depolarising effect of the objective and reflection off aluminium.

In this talk we consider the role that depolarisation by the objective plays in a confocal Mueller-matrix. We also consider what effect the size of the confocal pinhole has upon the properties of a confocal Mueller-matrix polarimeter. Finally, we consider what additional information may be obtained by analysing the scattered light in novel ways.