

# Polarisation

## **Sensitivity to the polarisation of light**

"Write a short essay explaining the connection between Haidinger's brush, ellipsometry and the flight of the honey bee. Reference any sources you use".

Ellipsometry allows the surfaces of materials to be analysed (properties including thickness, roughness, optical anisotropy and composition) by measuring the effect of reflection (off the material surface) on the polarisation of the light<sup>A</sup>. By measuring the ratio of two orthogonal polarisations in the reflected beam, a reference value/material is not needed (no "absolute values" in the obtained data).

Haidinger's brush is the result of the blue cones in the retina being slightly sensitive to the polarisation of light<sup>B</sup>. This is due to the photosensitive molecules in these receptors having very anisotropic (rod) shapes and some orientational alignment, and consequently – the ability to respond differently to light of different polarisations<sup>C</sup>. This produces a very faint propeller-shaped pattern in the perceived image, with four alternating blue and yellow blades. The orientation of the blades indicates the direction of the polarisation and a steady rotation of this indicates circular polarisation.

The honeybee, on the other hand, can strongly sense polarisation and may use it to aid navigation due to the varying polarisation of light scattered in the sky with respect to the direction of the sun<sup>D</sup>.

All three rely on the ability to detect the polarisation of light.

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<sup>A</sup> "Ellipsometry", <http://www.uta.edu/optics/research/ellipsometry/ellipsometry.htm> obtained 09-03-2011

<sup>B</sup> "The polarization sense in human vision", Albert Le Floch, Guy Ropars, Jay Enoch, Vasudevan Lakshminarayanan, *Vision Research* 50 (2010) 2048–2054

<sup>C</sup> "Haidinger's brush: the unknown sense", <http://www.polarization.com/haidinger/haidinger.html> obtained 08-03-2011

<sup>D</sup> "Honeybee navigation: following routes using polarised light-cues", <http://rstb.royalsocietypublishing.org/content/366/1565/703.full> obtained 09-03-2011