

## Opportunities for Imaging and Spectro-Polarimetry at *UKIRT*

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**Abstract.** Near-IR imaging and spectro-polarimetry are offered with the facility instruments *UIST* and *UFTI*. Both linear and circular polarimetry are possible, the former from 1-5 $\mu\text{m}$ , the latter from 1-2.5 $\mu\text{m}$ . The *IRPOL* polarimetry module utilises Wollaston prisms (installed cold inside each instrument) and achromatic (JHK) or compound zero-order (LM) wave plates. Pipeline data-reduction software is also available for all observing modes.

### 1. An Overview of Near-IR Polarimetry at *UKIRT*

Polarimetry with *IRPOL* has been available at *UKIRT* for over ten years. The instrumentation, supplied by the University of Hertfordshire, provides both imaging and spectro-polarimetry with the facility instruments *UIST*, our workhorse 1-5 $\mu\text{m}$  imager-spectrometer, and *UFTI*, a 1-2.5 $\mu\text{m}$  imager.

The wave plate module is located above the tertiary mirror, inside the instrument support unit beneath the *UKIRT* primary mirror (*UIST* and *UFTI* are mounted at folded cassegrain focii). Consequently, the half-wave retarder is the first optical element in the telescope beam after the primary and secondary mirror, thus minimising instrumental polarization. For linear polarimetry the wave plate is usually stepped between four angles, 0°, 45°, 22.5° and 67.5°. Positional accuracy is achieved by way of toothed gears, a tensioned belt and opto-switches mounted in the wave plate holder. Movements between angles are rapid - taking only a few seconds - so polarimetric observing is very efficient.

Three half-wave retarders are available for linear polarimetry in the JHKLM bands. A quarter-wave plate and rotating mount is also available for circular polarimetry (although this mode is only available in collaboration with the Univ. of Hertfordshire). The most-used wave plate is a quartz and magnesium fluoride achromat that covers the J, H and K bands. Magnesium Fluoride compound zero-order plates are used in the L and M bands (optimised for use at 3.5 $\mu\text{m}$  and 4.75 $\mu\text{m}$  respectively). The three half-wave plates have an unobscured aperture of 95 mm, which is well-suited to the 1.5' and 2' fields of view of *UFTI* and *UIST*.

In both *UIST* and *UFTI* the polarizing analyser is a Wollaston prism. The dual-beam capability provided by each prism has the advantage that both beams are measured simultaneously (so changes in seeing and atmospheric transmission

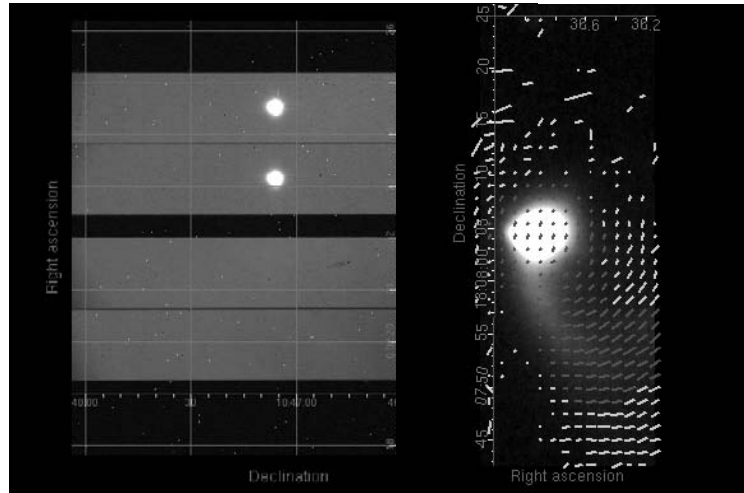


Figure 1. Left - a raw *UIST+IRPOL* image of a point source showing the e- and o-beams projected onto the array. Right - data fully reduced with the *ORAC-DR* pipeline software (which uses the *Starlink Polpack* package).

do not affect polarization measurements). The *UIST* prism is made from Magnesium Fluoride, the *UFTI* prism from Beta Barium Borate (both are uncoated). Each prism yields an e-beam/o-beam divergence of  $\sim 20''$ .

## 2. Imaging and Spectro-polarimetry

For imaging polarimetry with both *UIST* and *UFTI*, focal-plane masks are used to isolate two adjacent regions, roughly  $20'' \times 100''$  in size, on the sky. The two regions are separated by  $\sim 30''$  so that, after passage through the prism, the e- and o-beam images fit onto the array with essentially no overlap (see e.g. Figure 1). Normally, images are obtained at the four nominal wave plate angles (noted earlier) and at dithered positions on the sky. Typically 12 frames (4 WP angles  $\times$  3 dither positions) would constitute a polarimetry observation.

The Wollaston prism in *UIST* is located inside the cryostat in one of the two grism wheels, so spectro-polarimetry is only available with half of the installed grisms. Much like imaging polarimetry, a slit mask is used to block part of the focal plane. Images through two  $20''$ -long slit sections are transmitted to the prism and then the spectroscopy grism. Sources can thus be observed at each wave plate angle, with the target offset by a few arcseconds up and down one of the two slit masks or (if more extended) nodded between the upper and lower slit mask for sky subtraction.

**Note to prospective *UKIRT/IRPOL* users:** *UKIRT* is available to all researchers, regardless of nationality. For further details specific to *IRPOL*, please see the *UKIRT* Instrumentation pages<sup>1</sup>.

<sup>1</sup><http://www.jach.hawaii.edu/UKIRT/instruments/>