UKIRT: A British Success Story

RevIew

Q

at UKIRT

V

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Centre for Astrophysics Research
University of Hertfordshire

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Mua a me *mana'olana 'ole hope*

Bailey, Hough & Axon
IR photometry and polarimetry of 2A0311-227

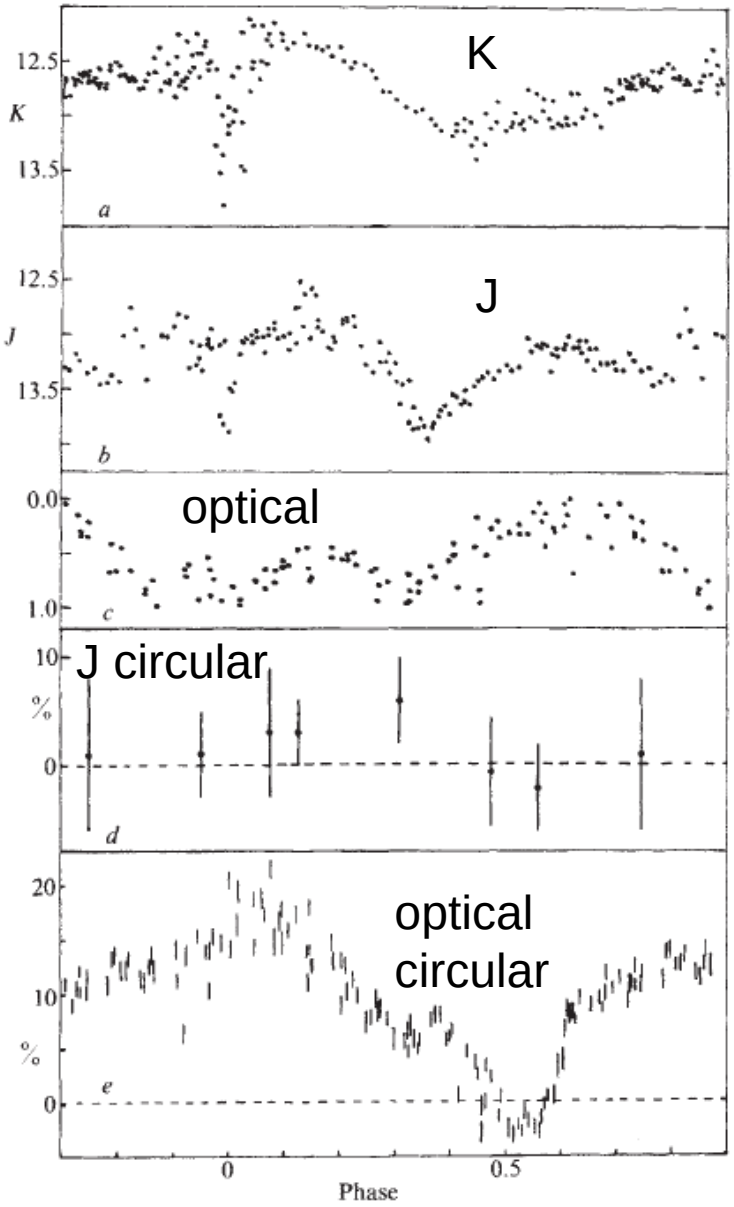
1980 Nature, 2985, 306
HATPOL observations
Nov 1979

93 polarimetry papers
(all instruments)

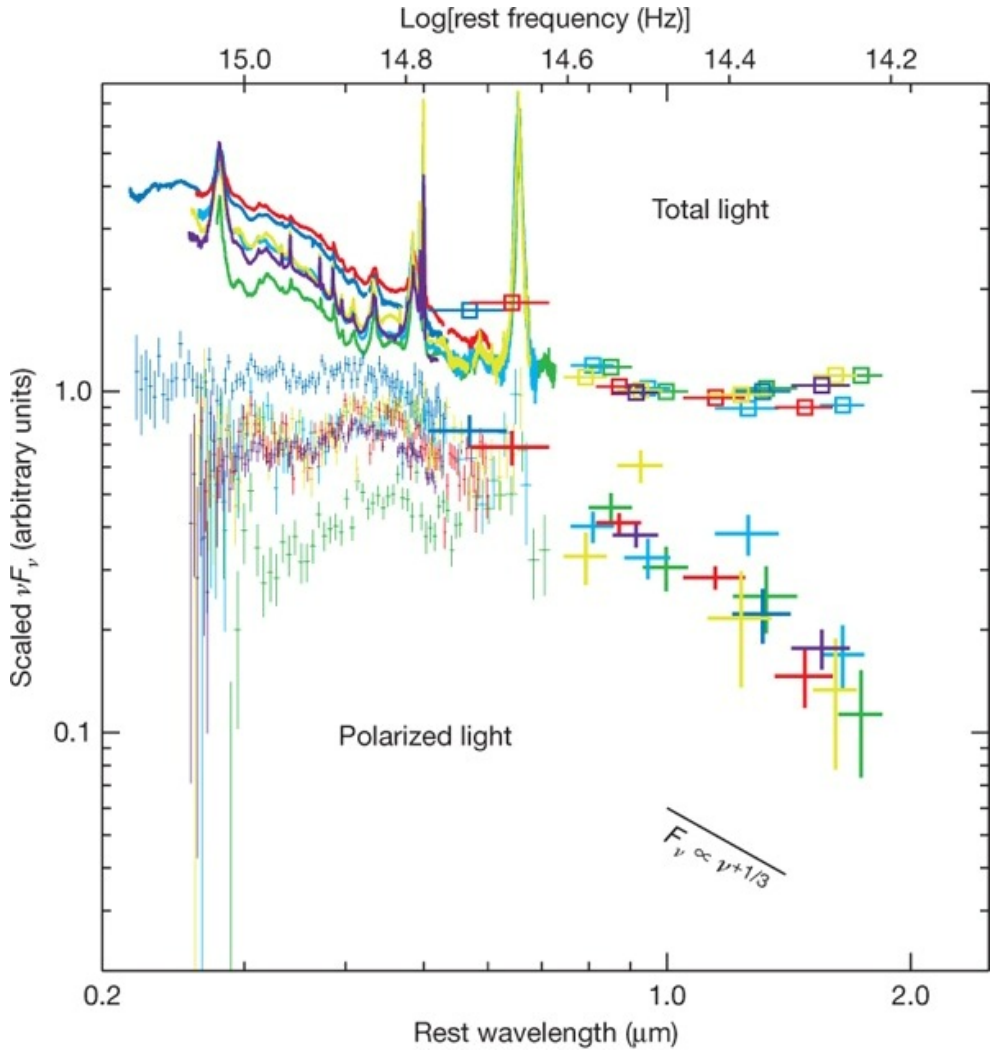
Kishimoto et al.
The characteristic blue spectra of accretion disks in quasars as uncovered in the infrared

2008 Nature, 454, 492
UIST/IRPOL

University of Hertfordshire UH



2A0311-227 (Polar)

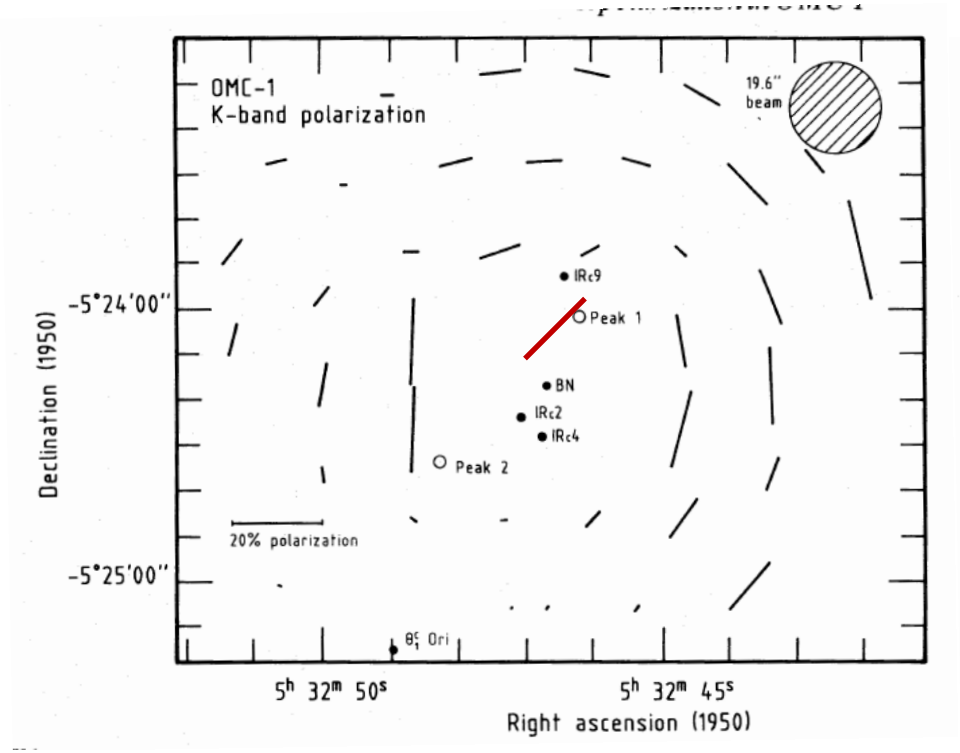


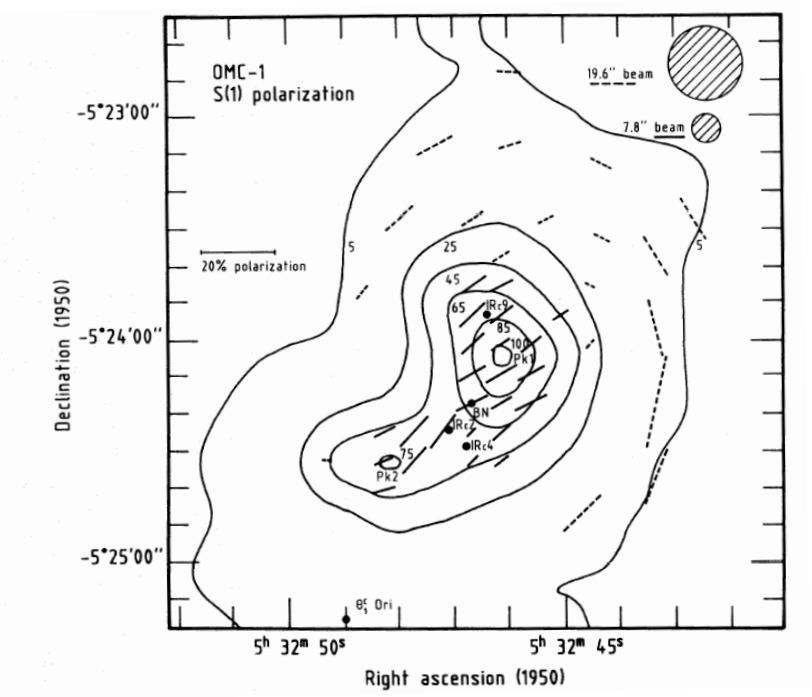
Polarized and total light spectrum for six different quasars

Polarimeters - private

- Some of the earliest successes at UKIRT did come from private instruments (in some cases, e.g. HATPOL, with eyepieces, and through earthquakes!)
- HATPOL: initially provided near-IR polarimetry and then near-IR plus simultaneously U, B, V, R, I
  - used between 1979 and ~1990 with UKT6/9 single element InSb detectors
- KYOTO-POL: near-IR
  - used between ~1984 and ~1989 with UKT6/9
  - polarimetry with Japanese astronomers (Sato, Morimoto, Kaifu, Hasegawa, Tamura et al.) largely laid the foundations for the JCMT/Nobeyama collaborations, and the MoU for UK-Japanese Co-operation in Ground-Based Astronomy, which in turn led to FMOS
- UCL array spectrometer: first used as a polarimeter on UKIRT in ~1986

First Kyoto Polarimeter observations at UKIRT – using bucket mode





K-band and S(1) line polarization images of OMC-1
Red line indicates the polarization close to BN/IRc2 (from AAT)

Hough et al. 1986

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Signing of MoU for UK-Japanese Co-operation in Ground-Based Astronomy 1997

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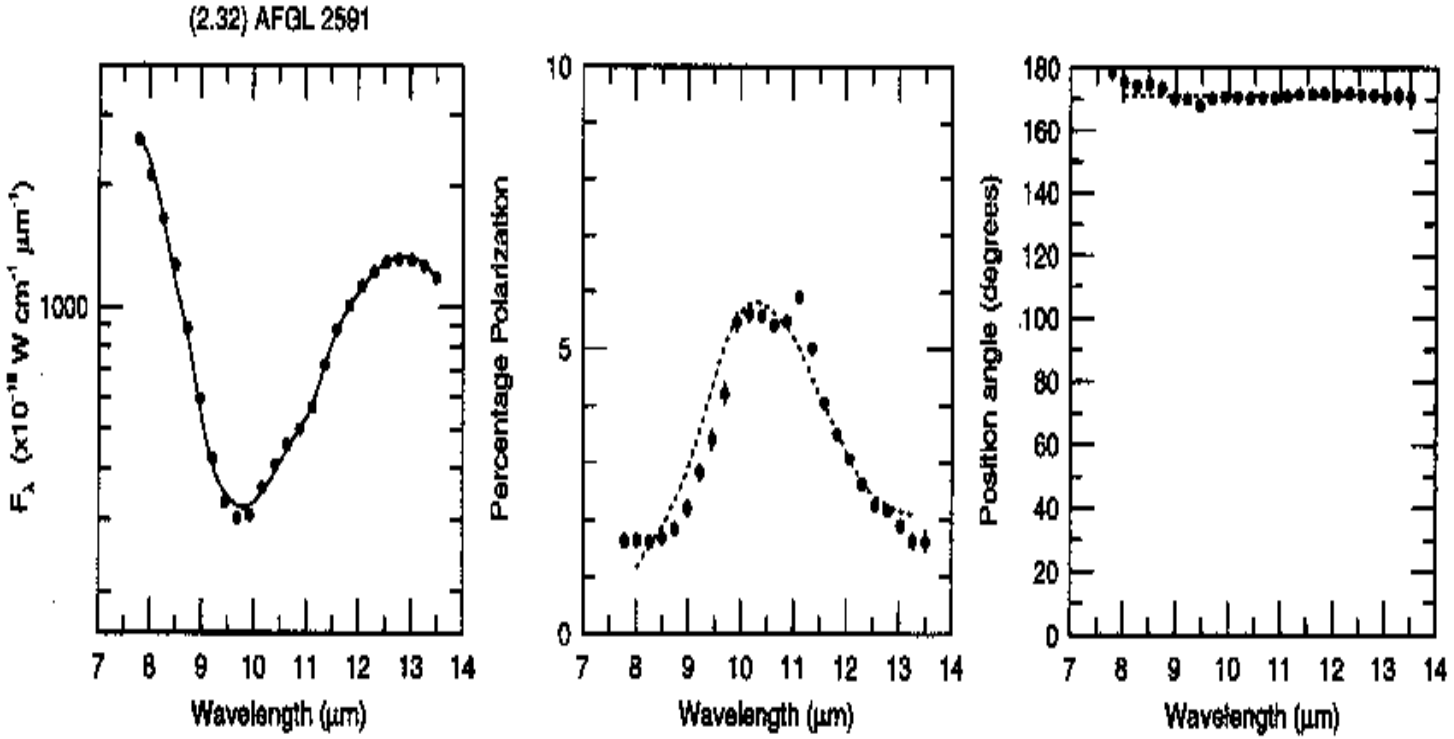
UCL spectropolarimeter



Spectropolarimetry along the line of sight to AFGL2591. Rare example of crystalline silicate in the 10μm spectrum

Aitken et al. 1988

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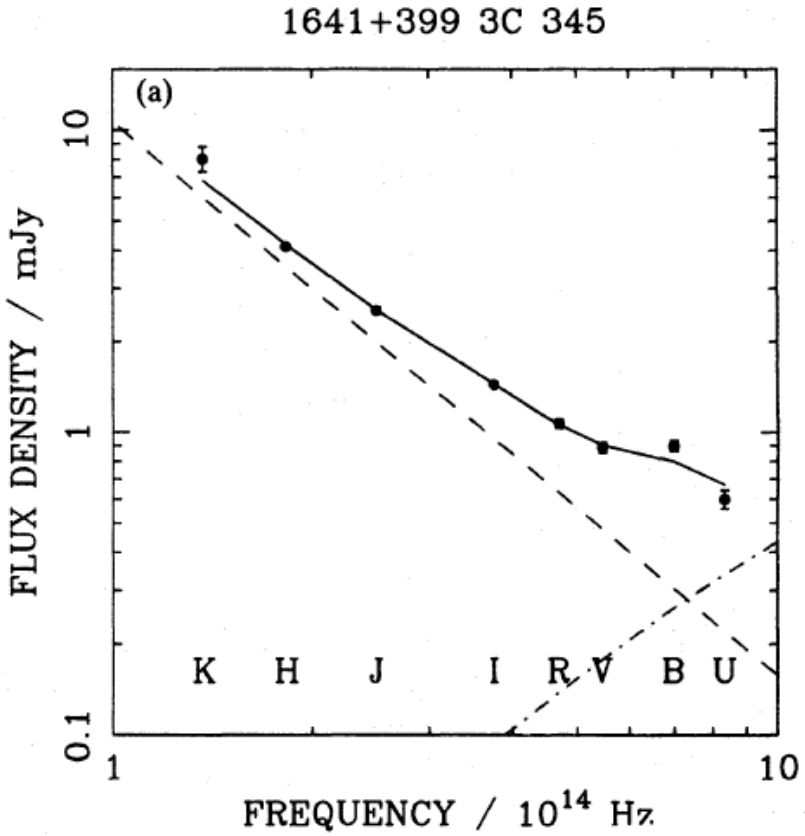
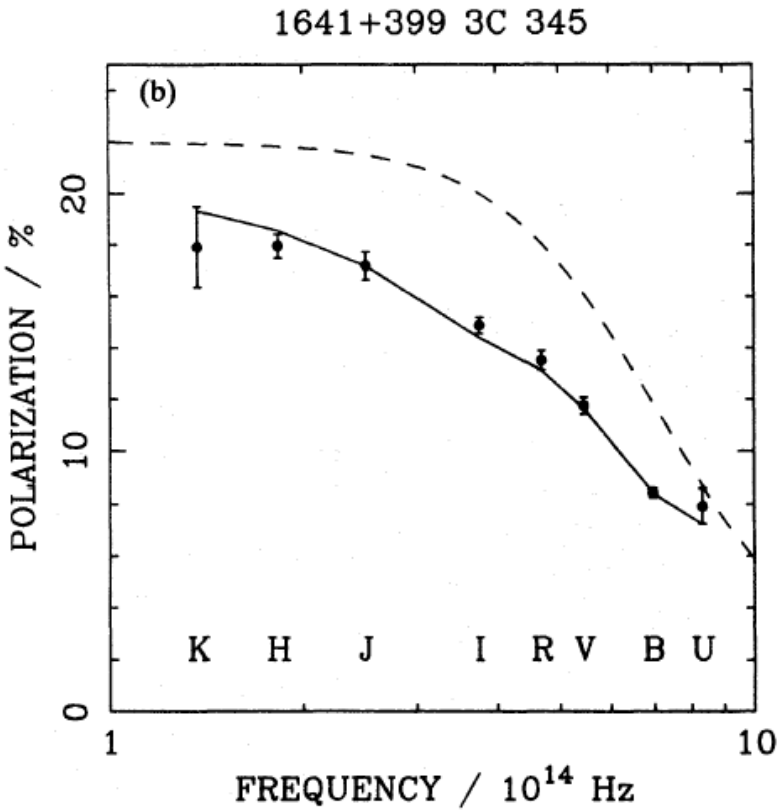
Polarimeters (facility)

- The introduction of CCDs and [2d] IR arrays largely made the single element polarimeters redundant
  - although the simultaneous optical-IR capability of HATPOLs gave significant advantages for point sources/variable objects
- UKIRT then moved to an era when most instruments had polarimetric capability, although these were sometimes added as an afterthought which compromised their effectiveness in some cases
  - IRPOL, mounted above the ISU dichroic, allowed a range of waveplates to be rotated (polarization modulator)
  - each instrument then included a polarization analyzer, preferably dual-beam so that the e- and o- beams could be recorded simultaneously (then requiring a focal plane mask for extended sources)

HATPOL: simultaneous U, B, V, R, I + one of J, H, K





Mead et al. MNRAS , 1988

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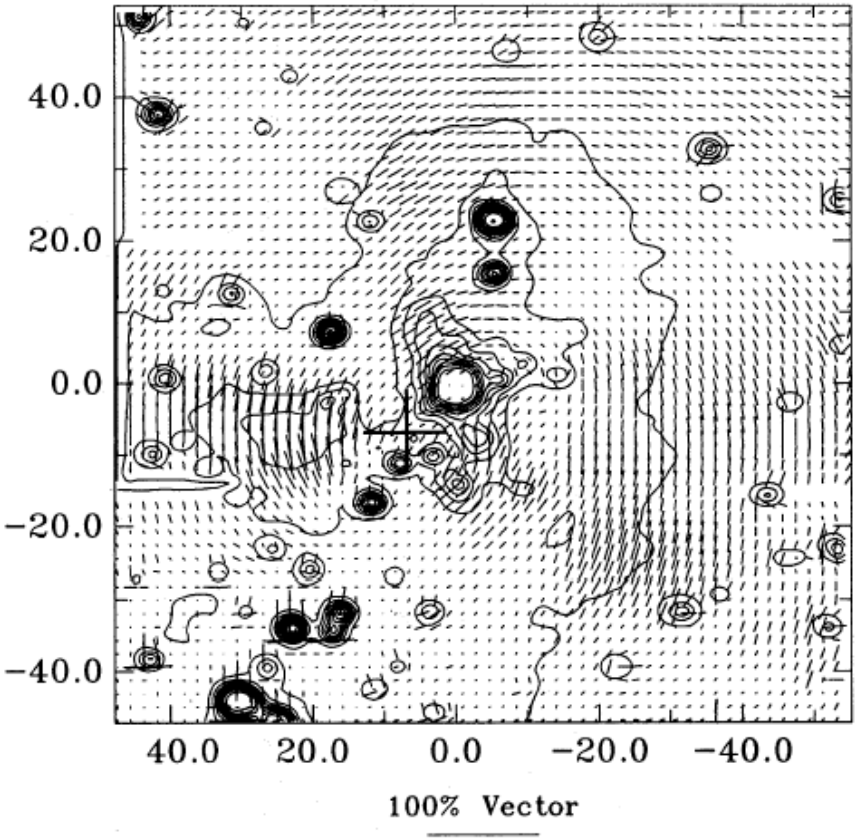
Polarimeters (facility)

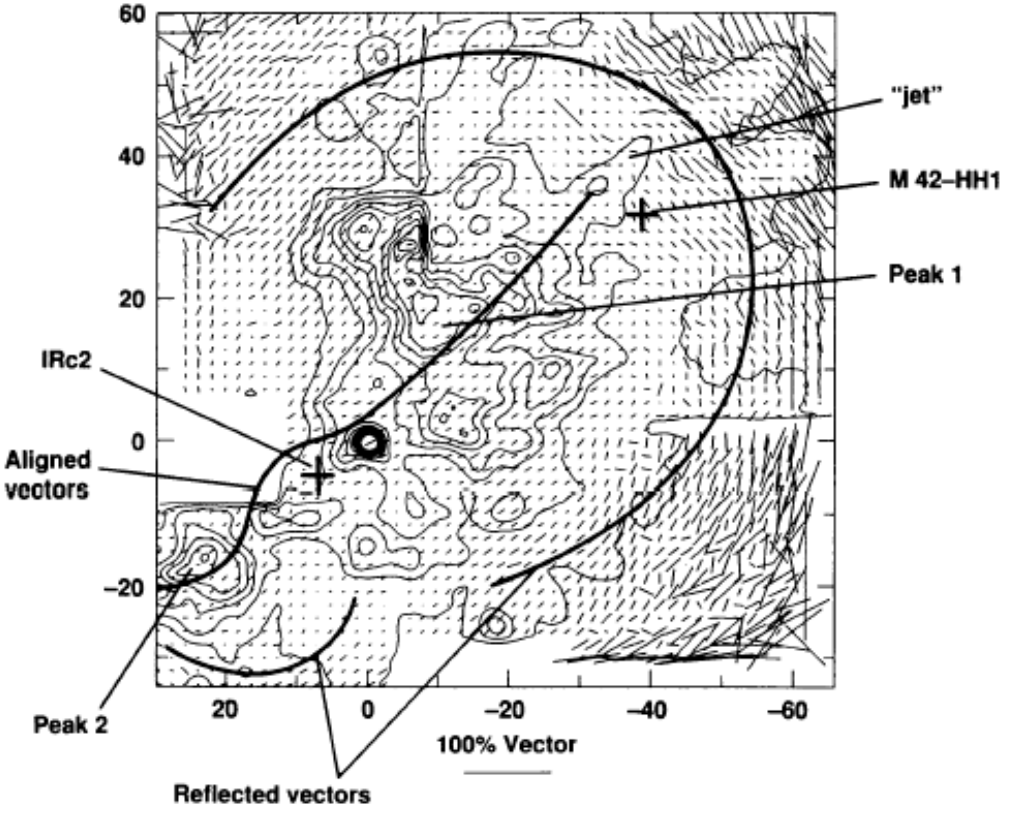
- The first instrument to include polarimetry was IRCAM
- This was followed by CGS4
  - this worked less well as the dual-beam analyzer had to be placed above the slit
- Then more recently
  - UFTI: 1-2.5µm imager
  - UIST: 1-5µm imager-spectrometer
- Finally circular polarimetry, in collaboration with UHerts, was introduced (a half-wave retarder is continuously rotated in front of a stepped quarter-wave retarder)

First IRCAM + IRPOL (OMC1)



K-band

Minchin et al. MNRAS, 1991



S(1)

Burton et al. 1991

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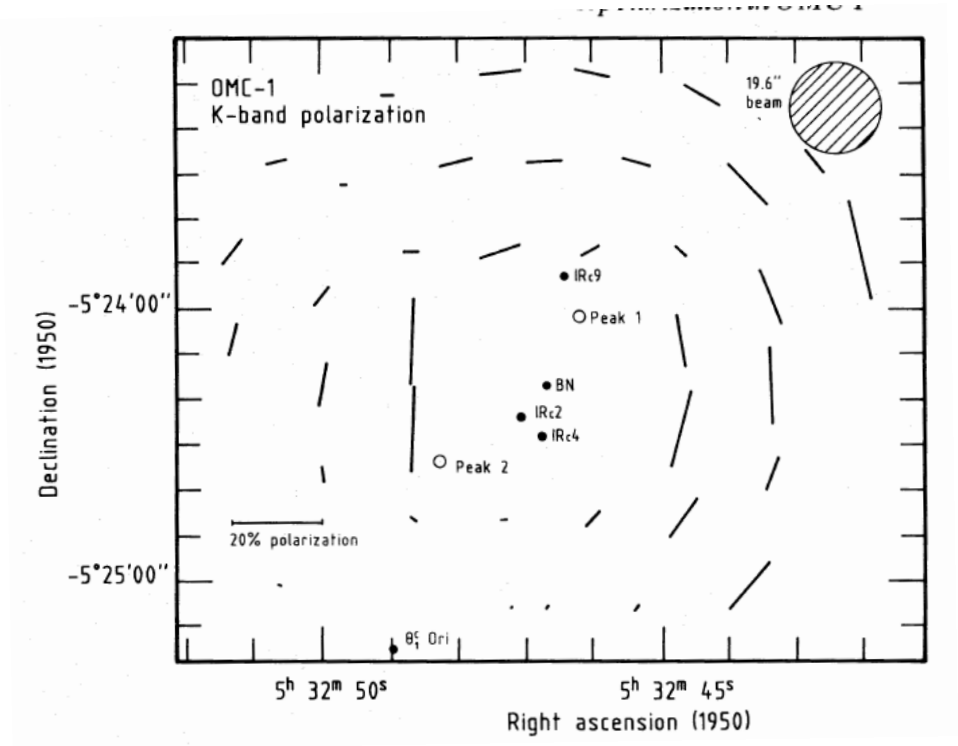

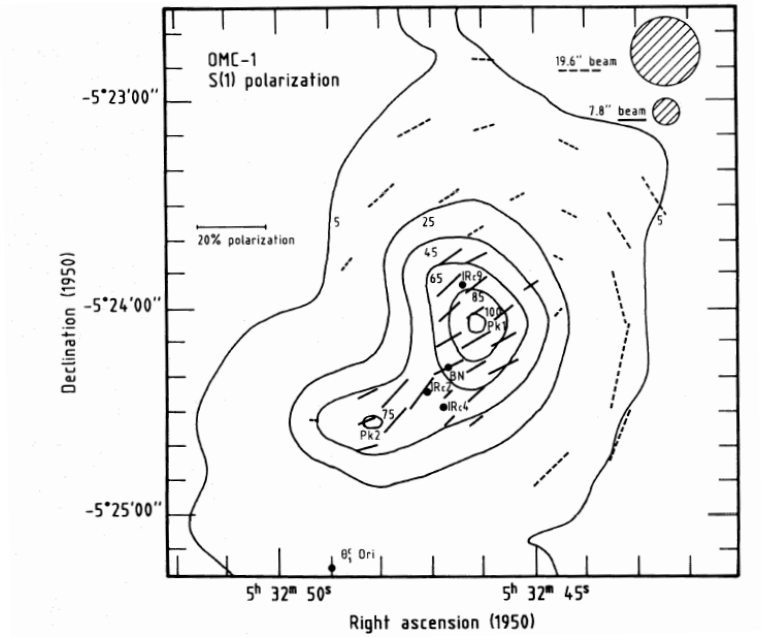

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Hough et al. 1986

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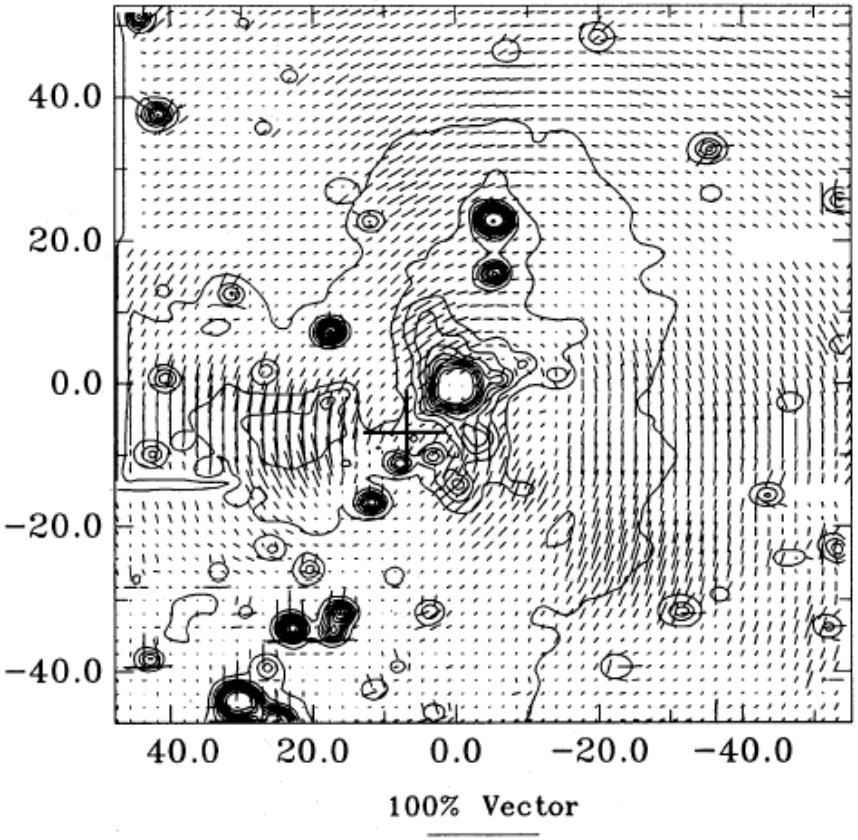

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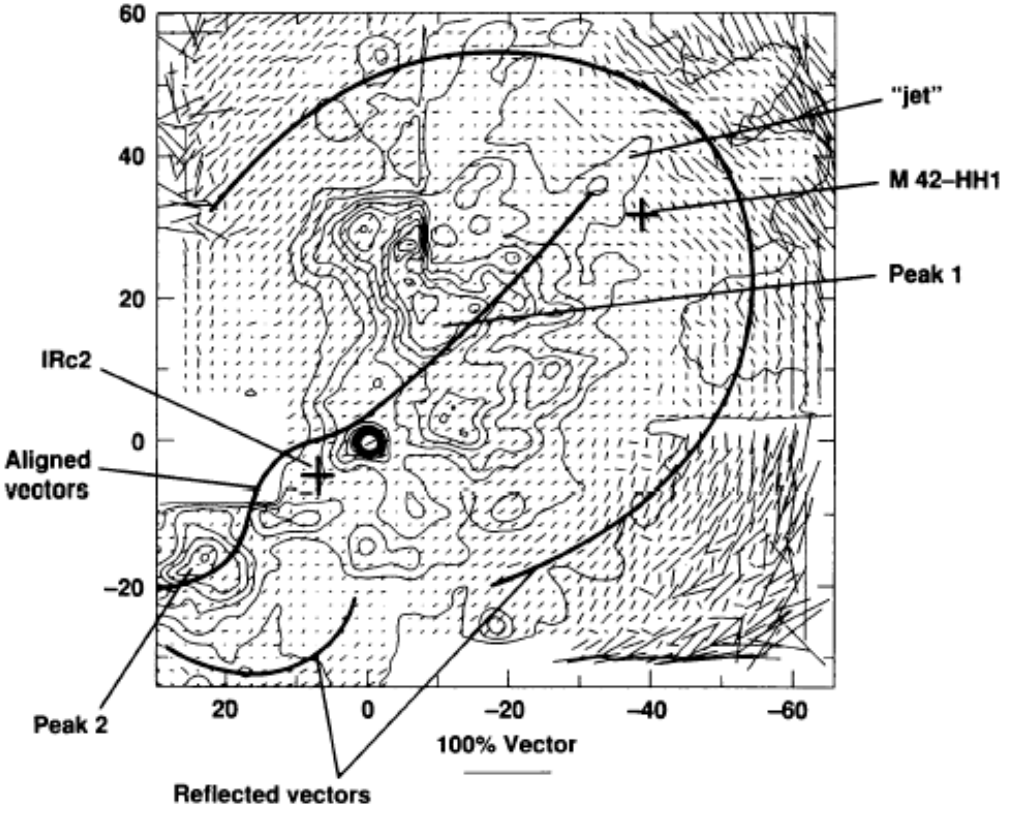

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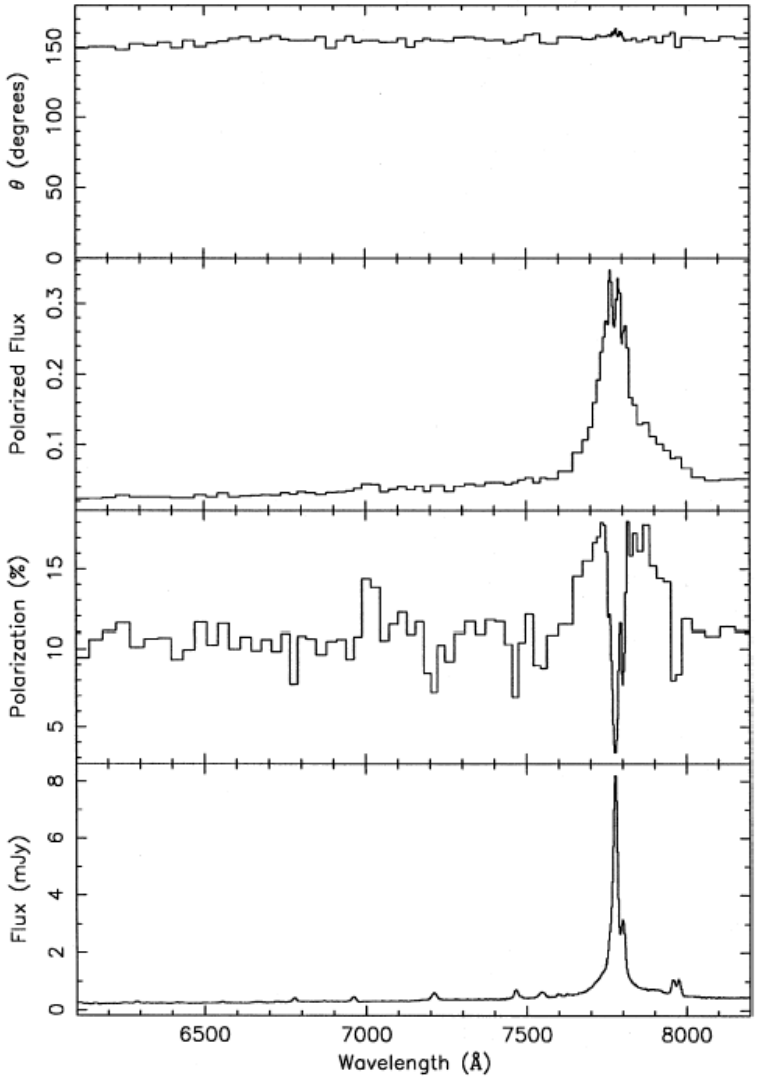
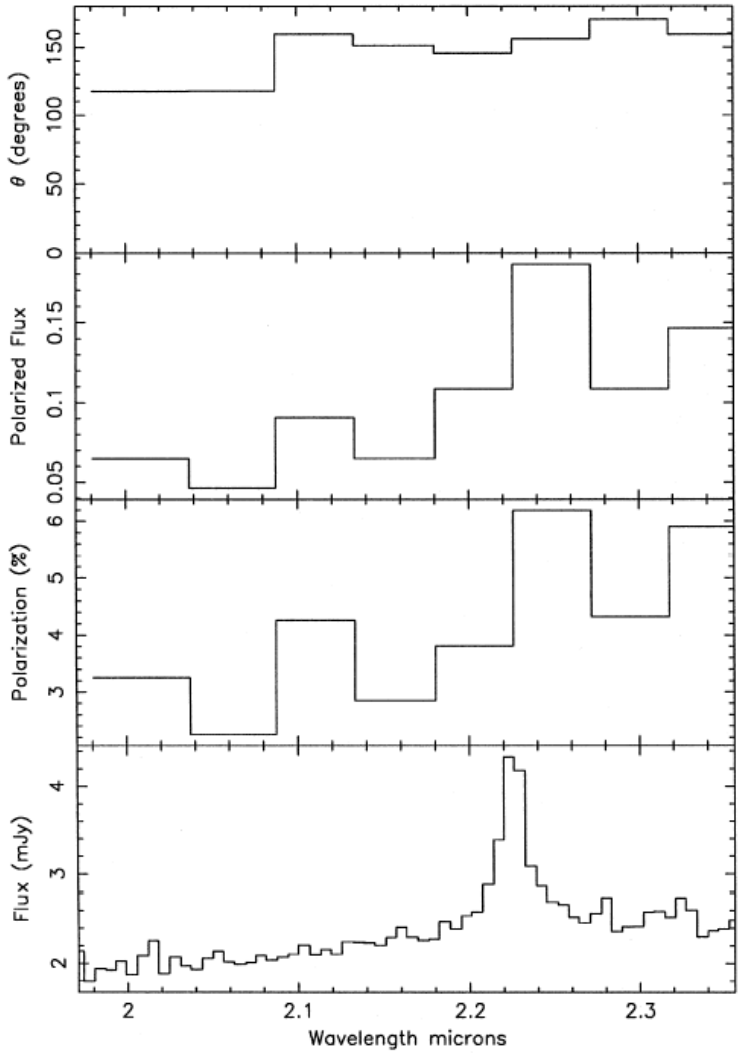
CGS4 + IRPOL, 3C234 (1992)





Young et al. 1998

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More science with facility polarimeters

- Polarimetry of post-AGB stars
  - imaging polarimetry can be used to investigate the structure and density of the dusty envelopes, giving details on the evolution of the mass-loss process
  - an important feature of imaging polarimetry is that it can separate polarized circumstellar material from the unpolarized psf : so-called differential imaging
- Infra-red jets in X-ray binaries
  - shallower than expected spectra could arise from the near-IR flux containing a synchrotron contribution from an optically thin jet
- Grain alignment
  - a common theme in polarimetry is the influence of aligned dust grains
  - how they align is a topic of continuing discussion

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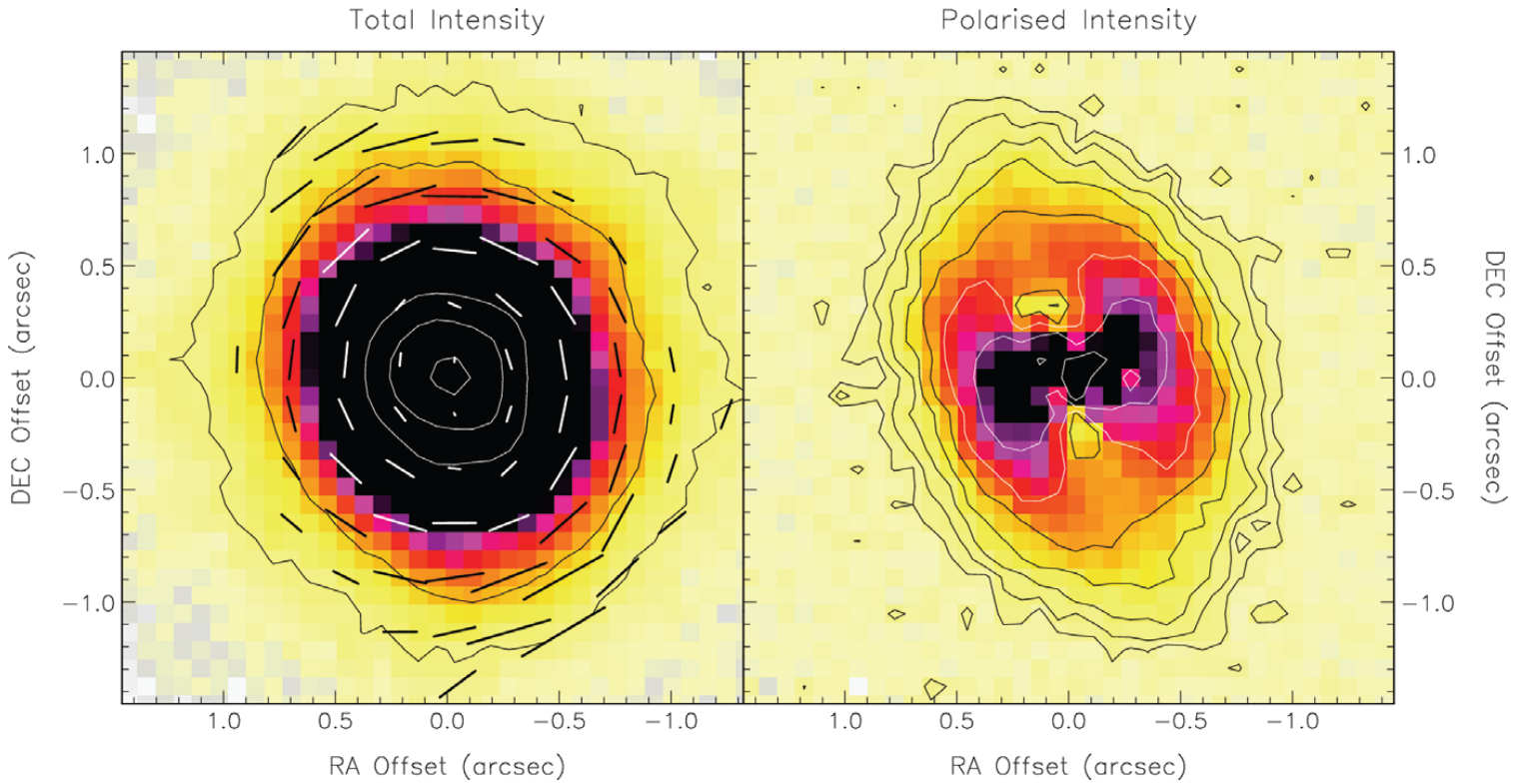
Post-AGB object IRAS 06530-0213



Total intensity (J-band)

Polarized intensity (J-band)

Gledhill et al.

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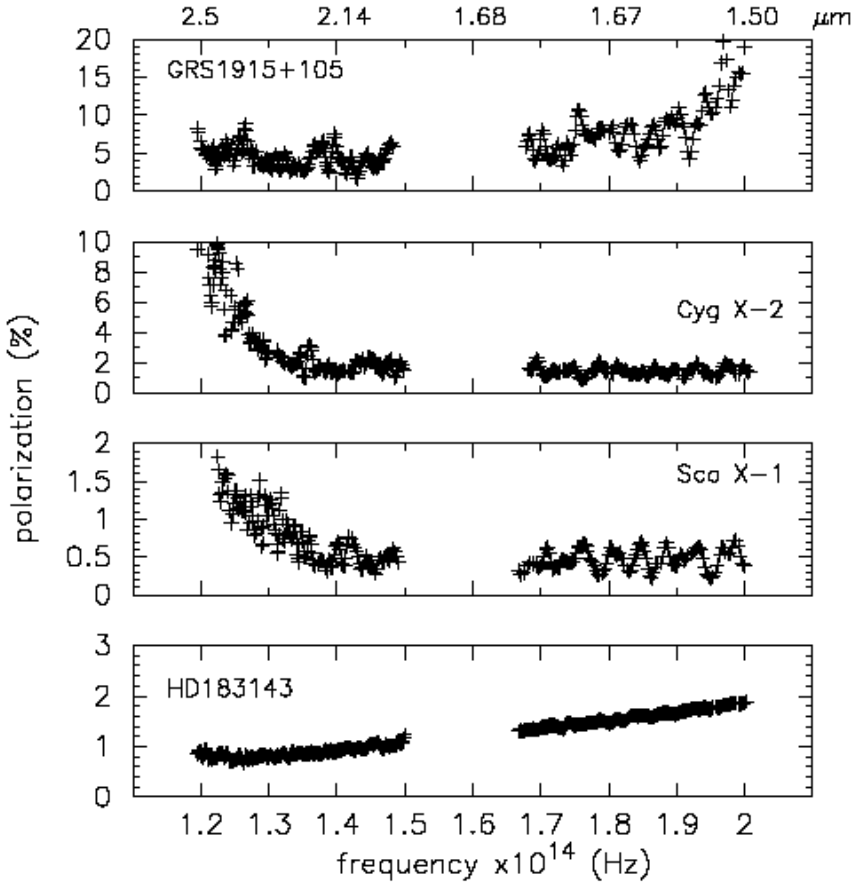
First polarimetric signatures of IR jets in X-ray binaries



Polarization spectrum of three X-ray binaries and a polarized standard star (Shahbaz et al. 2007)

Sco X-1 and Cyg X-2 show increasing polarization in the near-IR. For Sco X-1 the polarization PA is perpendicular to the PA of the radio jet, suggesting the magnetic field is aligned with the jet.

Polarization of GRS 1915+105 could be interstellar.

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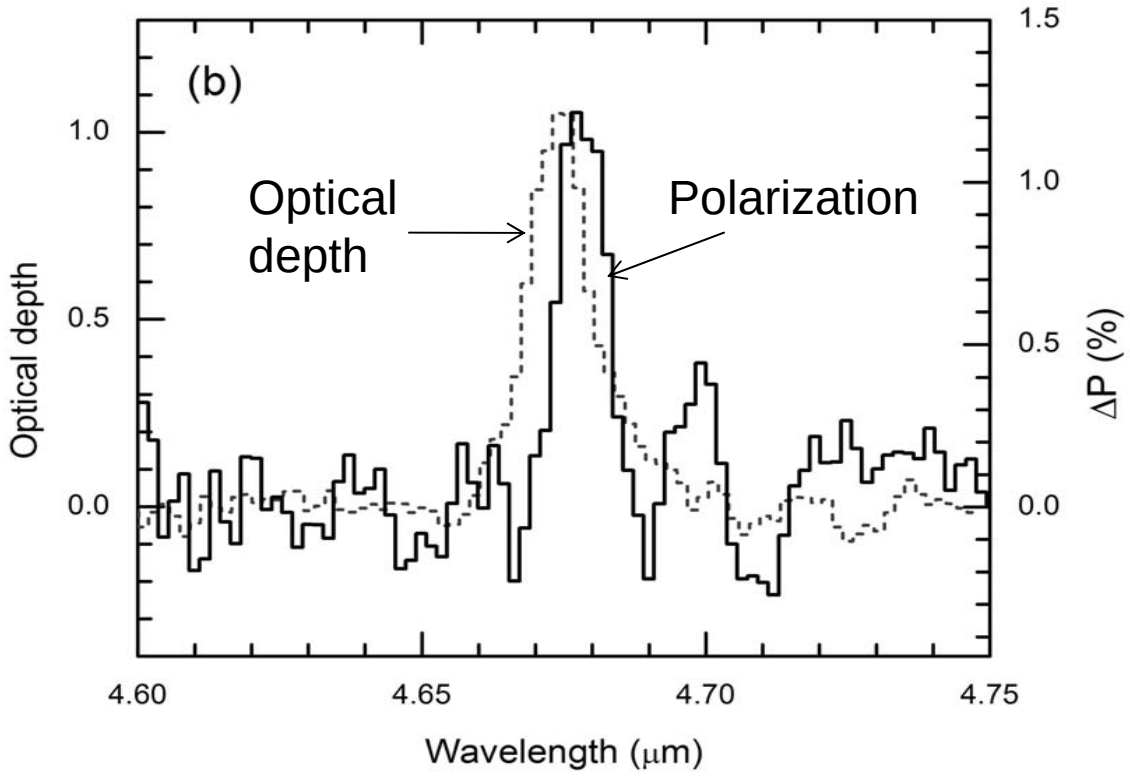

Linear polarimetry of solid CO along the line of sight to Elias 16 (TDC)

Hough et al. 2008

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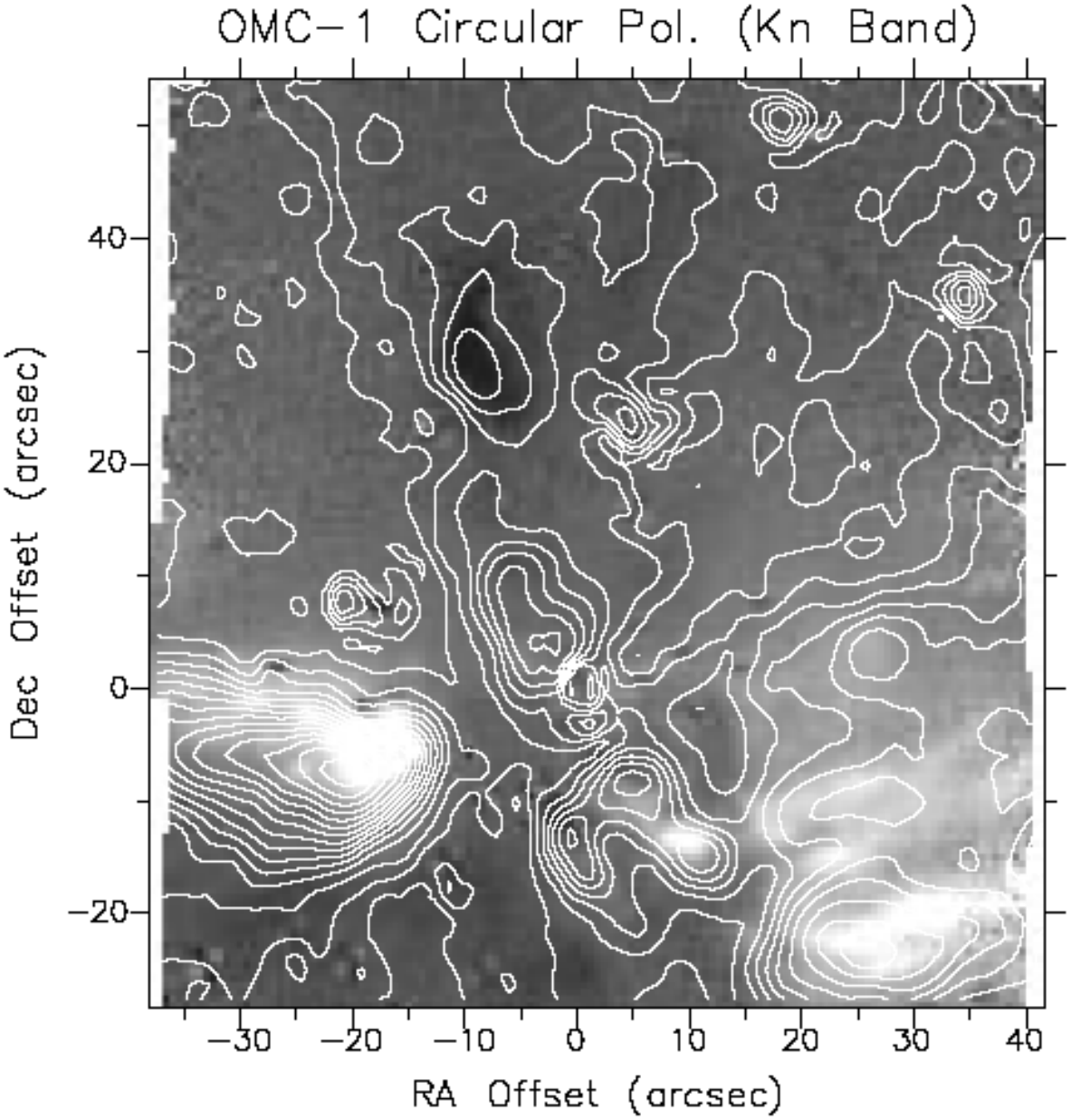

Degrees of circular polarization as high as ~15%. Black is negative and white is positive (overlaid on contours of linear pol^{n})

Zero coordinates correspond to the position of IRc2

Chrysostomou et al. 2000

The golden era for facility polarimeters

The period from ~ 1990 to ~2008 has been a golden age for UK polarimetry as most instruments at the AAT, WHT, UKIRT and JCMT had polarimetric capabilities

The situation is now far less favourable

- UKIRT is now dedicated to WFCAM
- AAT will no longer be available to the UK (but polarimetry has not been available for a few years)
- Optical and NIR now only available on the WHT

AND

Fewer telescopes accommodate private instruments

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