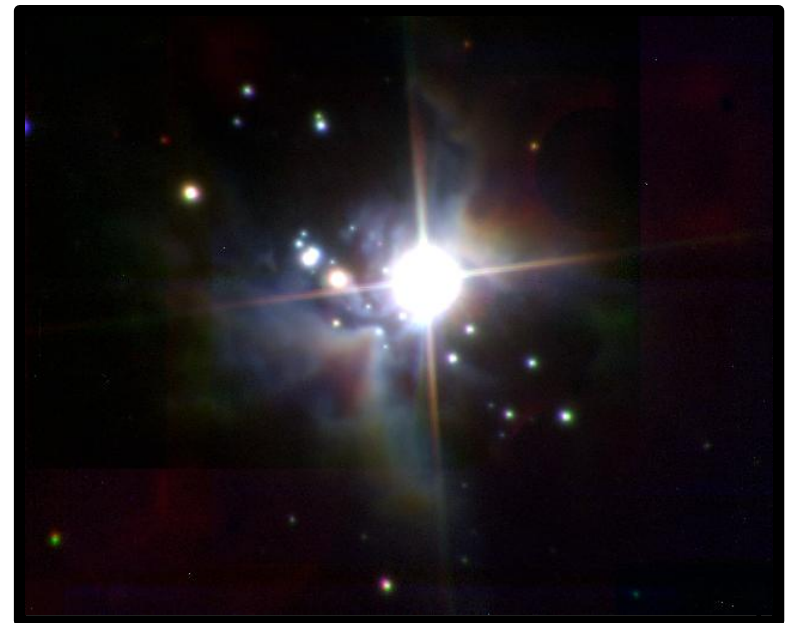# Spectro-astrometry of Herbig Ae/Be binary systems

Hugh Wheelwright & René Oudmaijer

The School of Physics and Astronomy,
The University of Leeds,
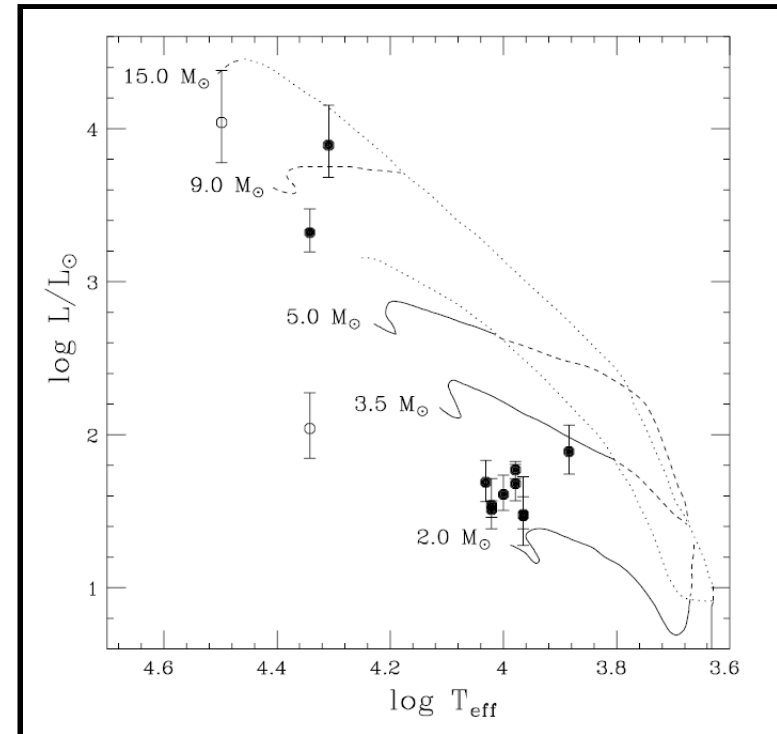**Leeds,**
West Yorkshire,
UK,
LS2 9JT.

JENAM 2009

(Brandner et al. 2000)

Young stars of intermediate mass (M_*~2-10 $M_\odot$) - still contracting to the ZAMS *(Herbig, 1960)*.

Most massive objects that experience an optically visible PMS evolutionary phase.

Known to have a relatively high binary fraction, e.g. *(Pirzkal et al. 1997).*

From *van den Ancker et al. (1997).*

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High binary fraction: 68 +/- 11%
(Baines et al. 2006).
Binary properties can constrain binary
formation mechanisms: e.g.

- distribution of mass ratio
  (Woitas et al. 2001)
- orientation of circumstellar disks and
  binary orbit *(Wolf et al. 2001)*.

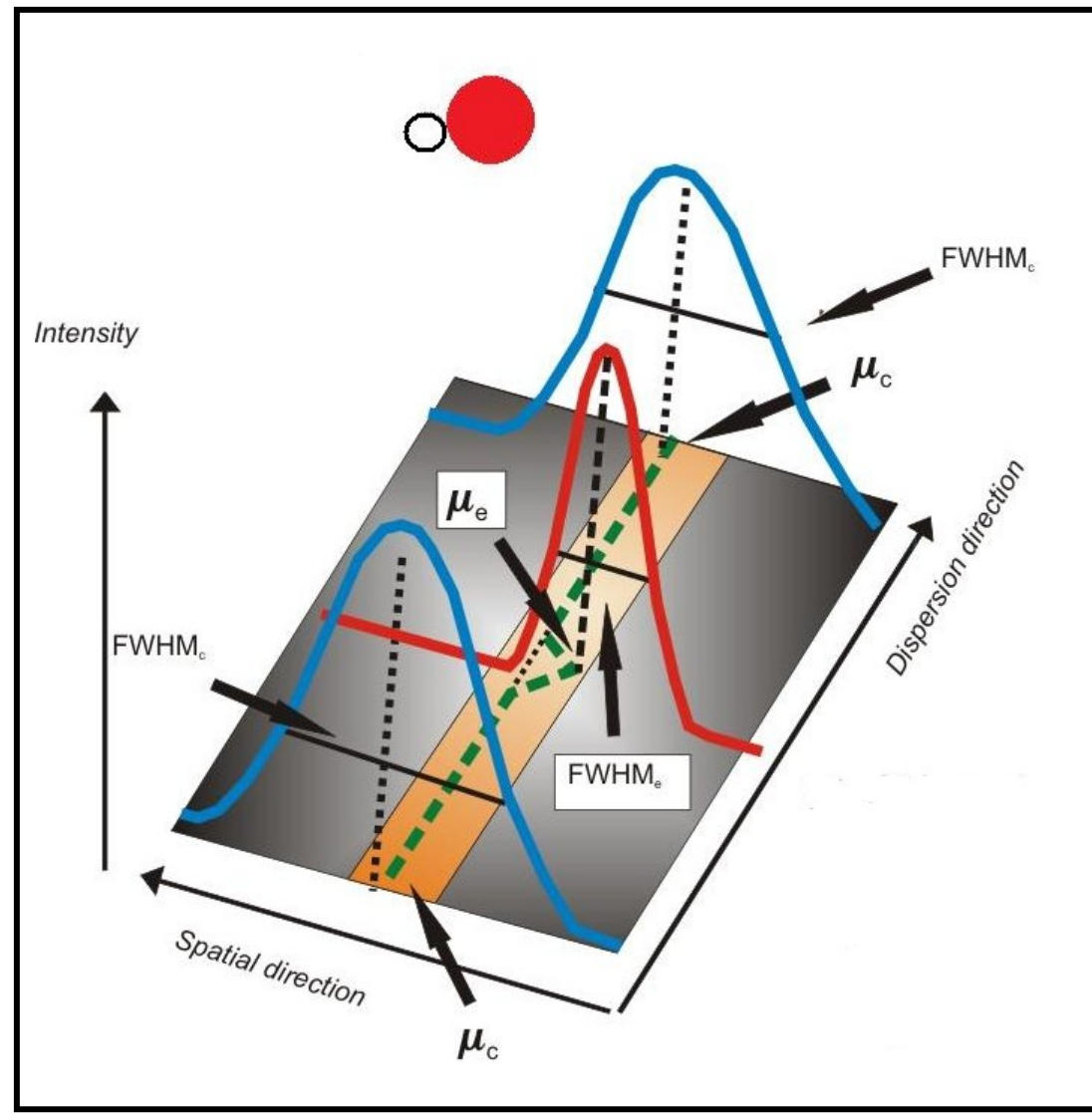**Aims:** Obtain mass ratio of Herbig
Ae/Be binary systems.
Method: Use spectro-astrometry to split
unresolved spectrum into
constituent spectra.

$\Delta\Theta$
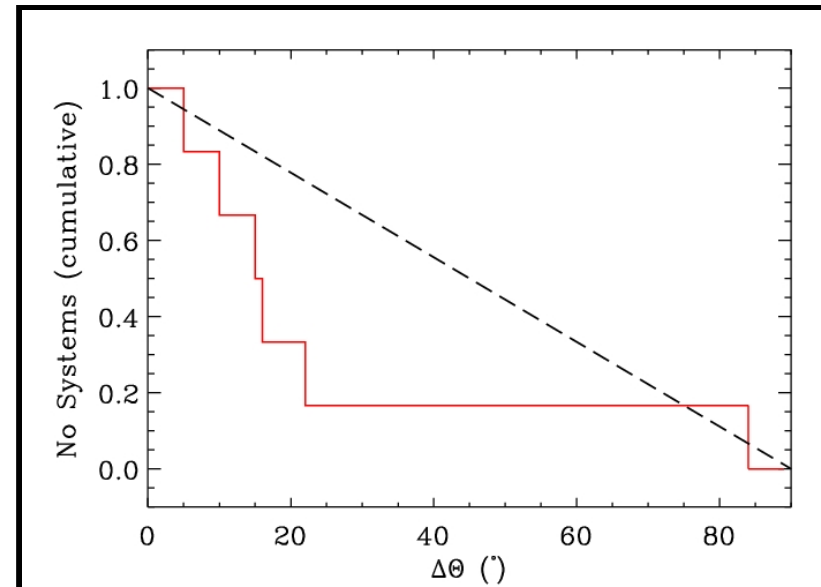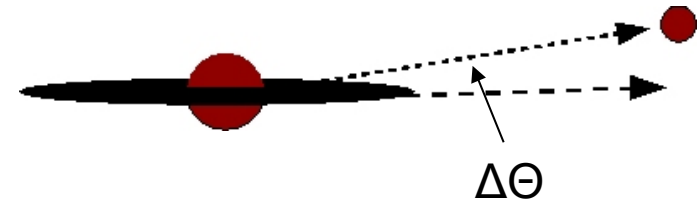
The difference between the circum-
primary disk and binary position angle,
from *Baines et al. (2006).*

Schematic representation of spectro-astrometry.

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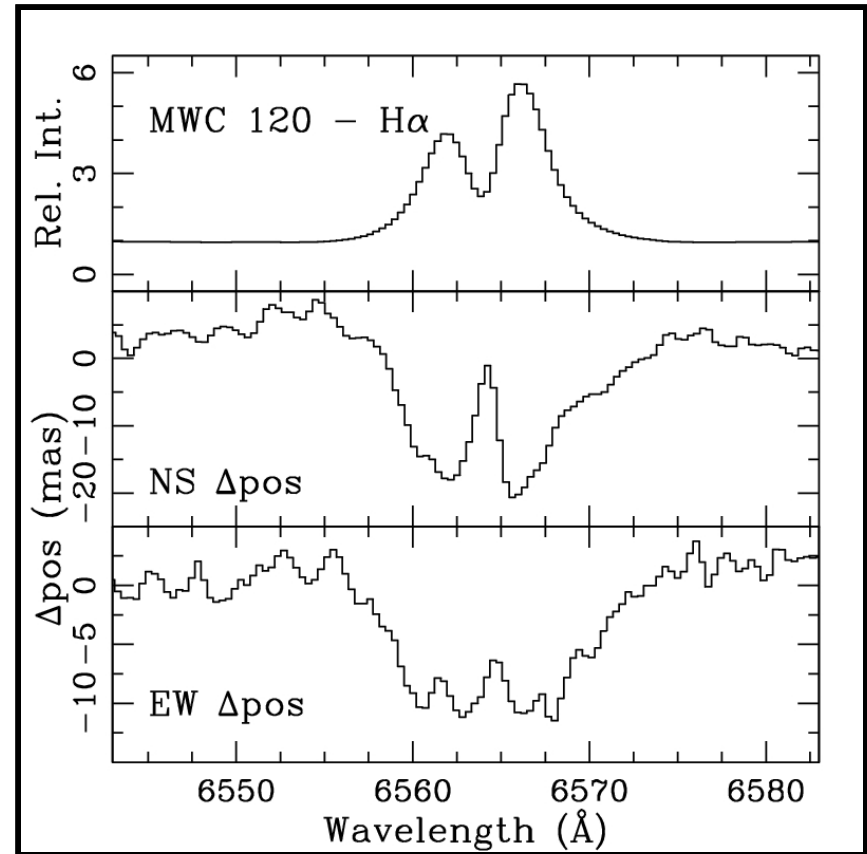
Sample: 47 Herbig Ae/Be stars.

Detect all but 1 known close binaries.

12 new close binary detections.

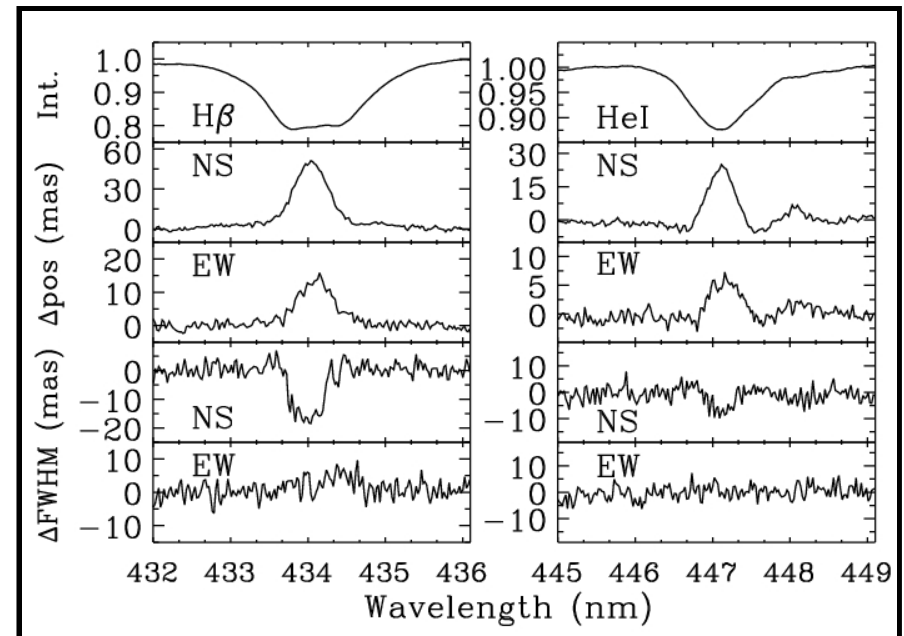High binary fraction, 0.68.

Spectro-astrometric example: MWC 120.

Splitting binary spectra

Use the spectro-astrometric signatures over photospheric lines to separate binary spectra.

Two methods, see: *Bailey (1998a), Porter et al. (2004)*.

Use the separated constituent spectra to spectrally type binary components, and hence determine the mass ratio.
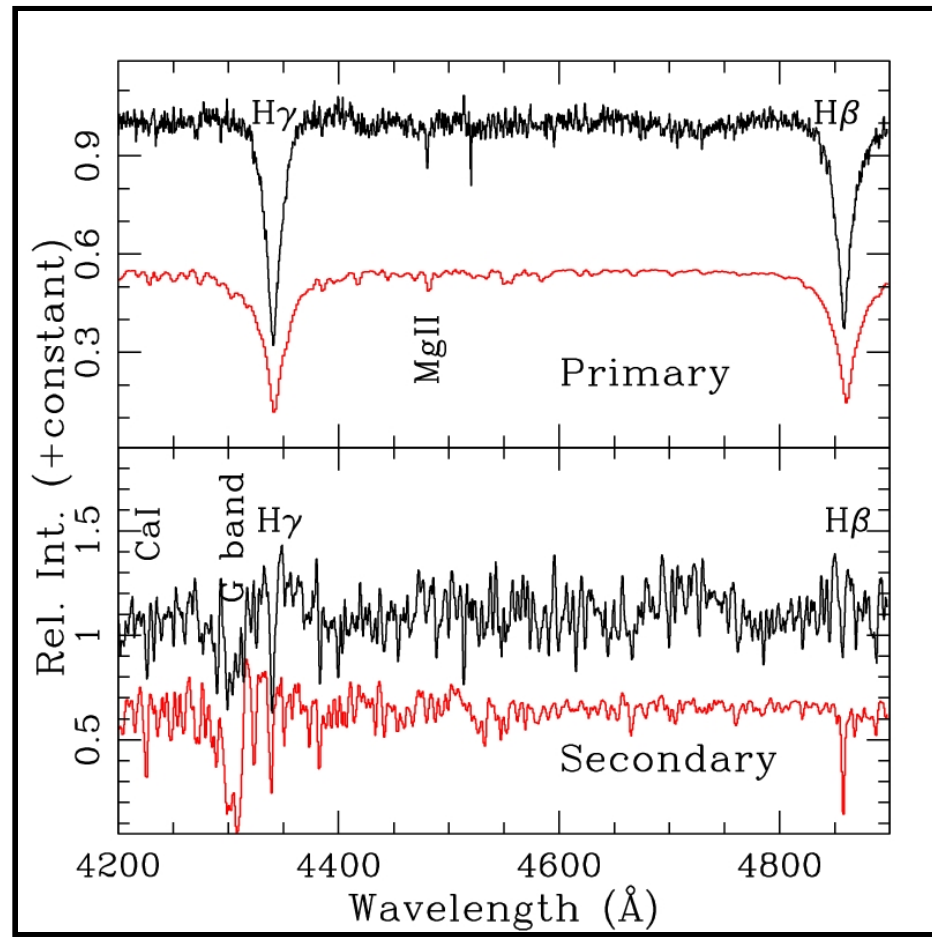

GU CMa: spectro-astrometric signatures over different lines.

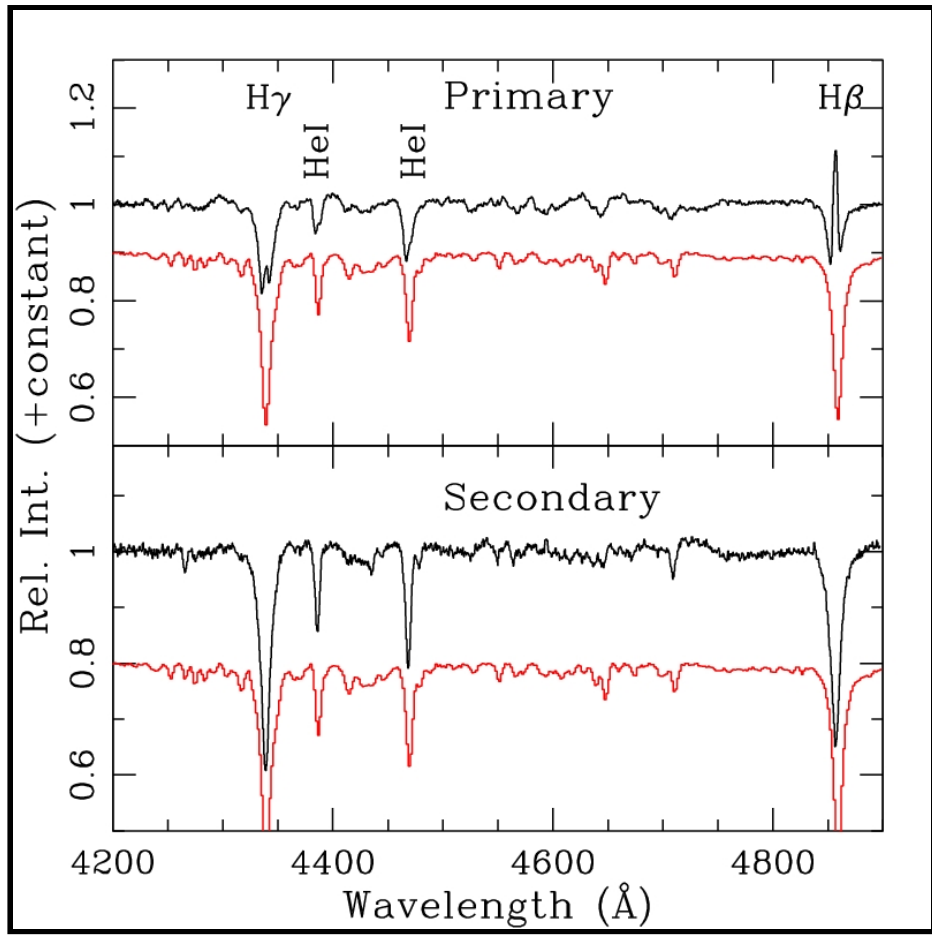UNIVERSITY OF LEEDS

HD 245906:

Separation ~ 0.1"

A2

G5

Separated spectra of the close HD 245906 binary system.

GU CMa:

Separation ~ 0.6"

B1

B2

Separated spectra of the close GU CMa binary system.

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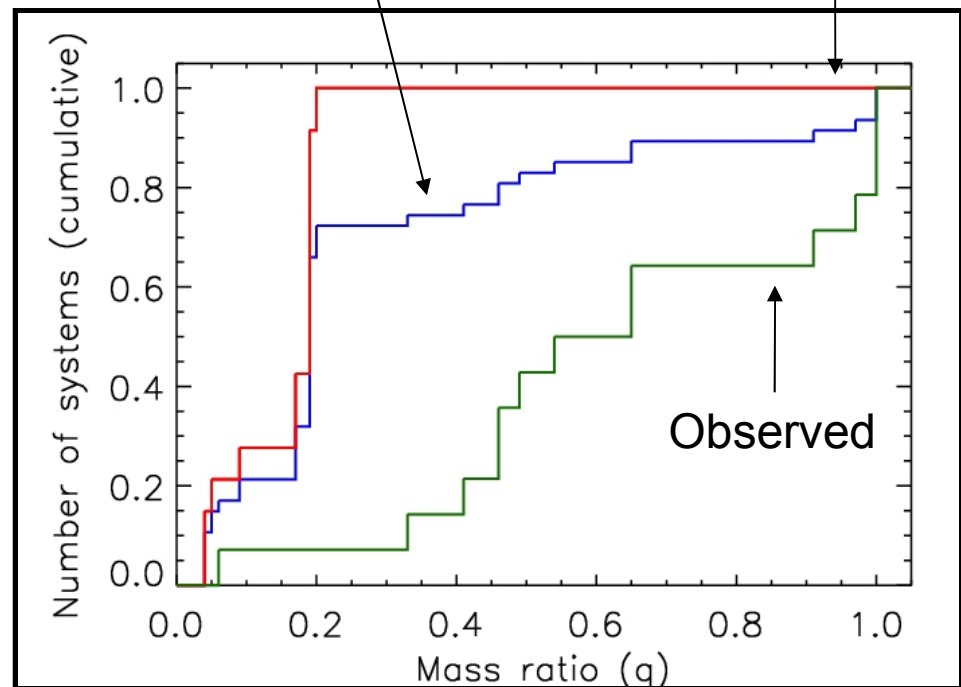Estimated mass ratio of 14 close binary systems.

Compare mass ratio distribution with random selection of secondary mass from IMF, from *Kroupa (2001)*.

Mass ratio distribution skewed towards equal mass systems.

This is not consistent with random pairing from the IMF.

Observed + undetectable systems

Predicted

Observed

Mass ratio distributions

Binary mass ratio inconsistent with random selection of secondary from IMF.

Either:

• Fragmentation process results in two components of comparable mass.

• Post-fragmentation processes alter system, e.g. hardening by dynamical decay of a tertiary system (*Goodwin et al. 2007), or* binary system interactions may destroy low mass ratio systems preferentially *(Hubber & Whitworth 2005).*

 Future work:

Put correlation between circum-primary disks and binary orbital plane on firmer statistical footing: on-going.

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