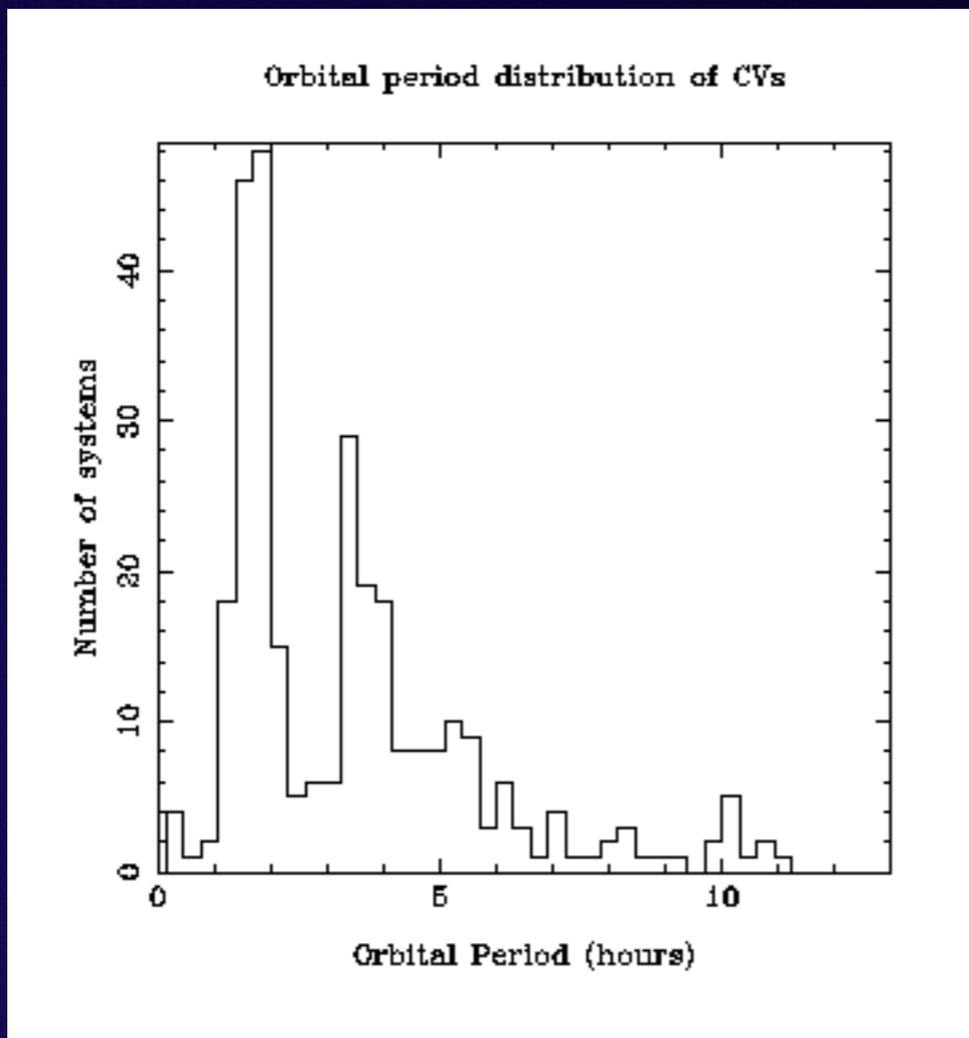




Roche tomography of the donor stars in CVs



Motivation - Understanding binary evolution

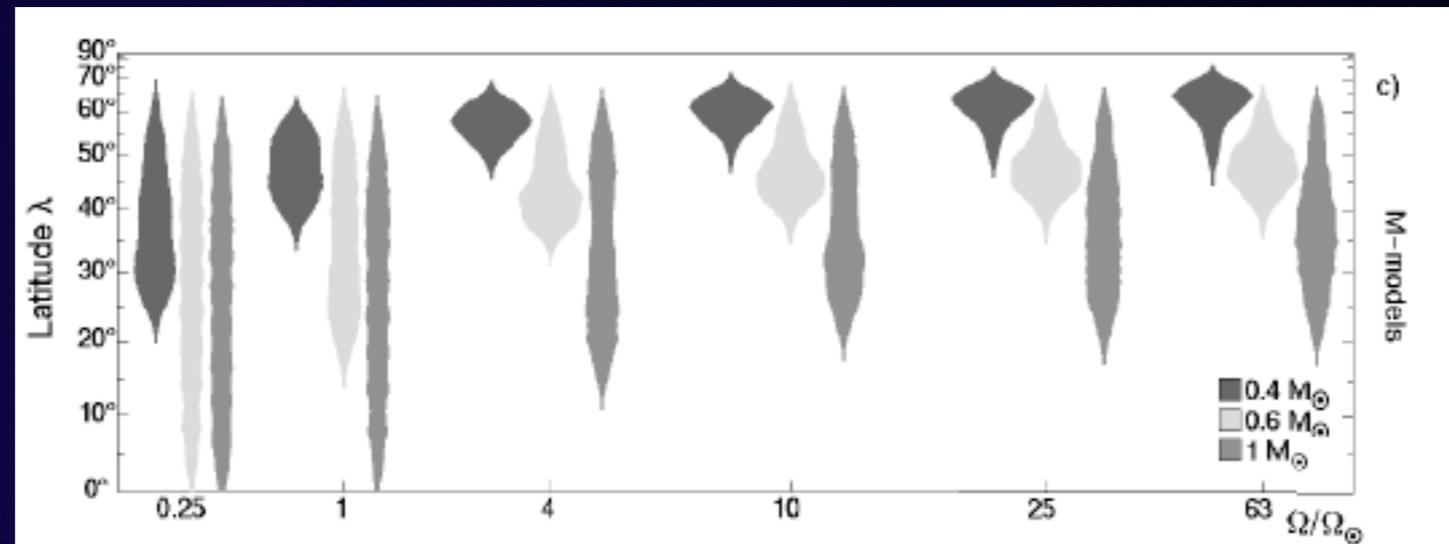


Understand magnetic activity in binaries

- understand CV evolution
- understand their behaviour?



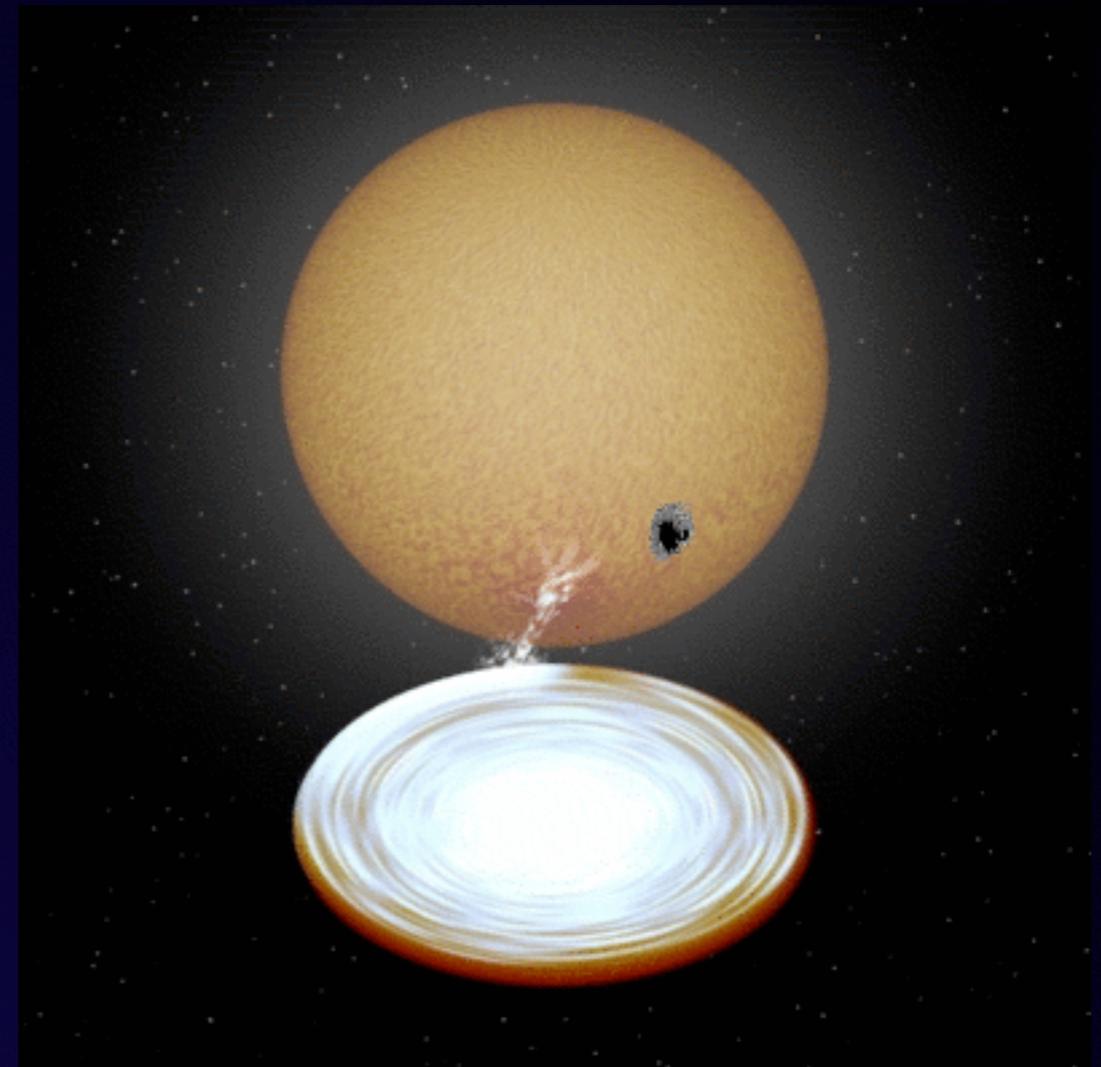
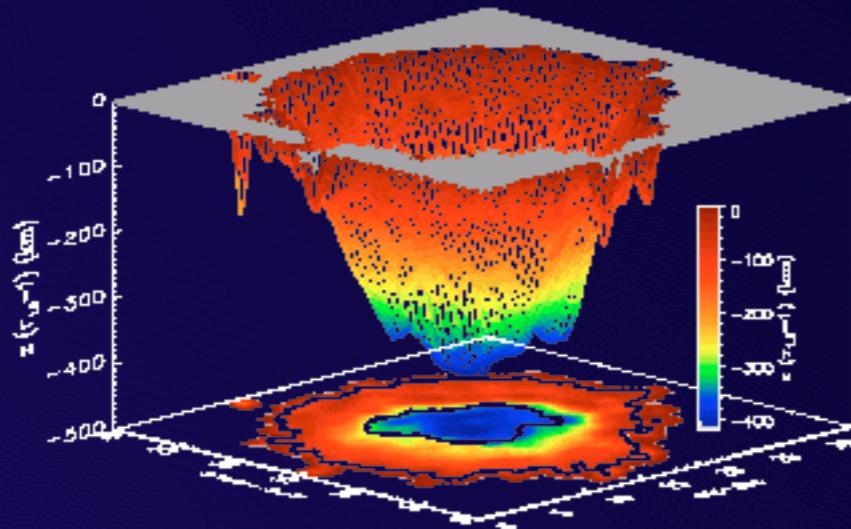
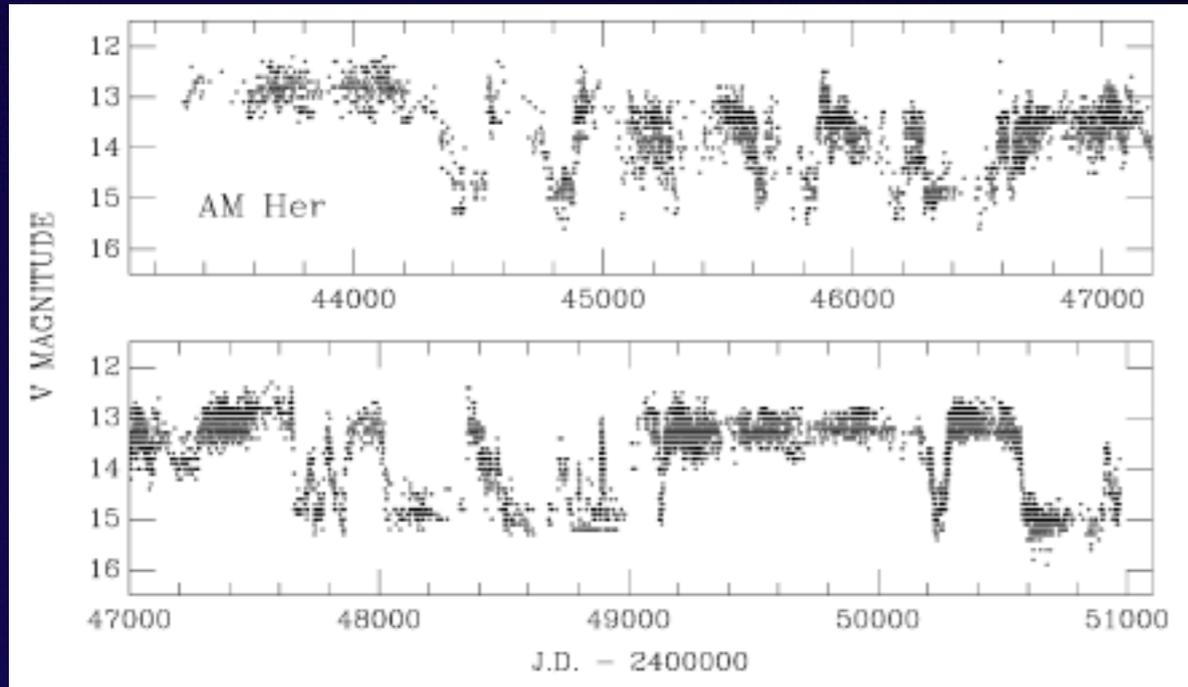
Motivation - Stellar dynamo theory



CVs and interacting binaries in general provide excellent labs for the study of;

- rapid rotation on magnetic activity
- tidal effects on stellar dynamos
- the effects of activity on accretion dynamics

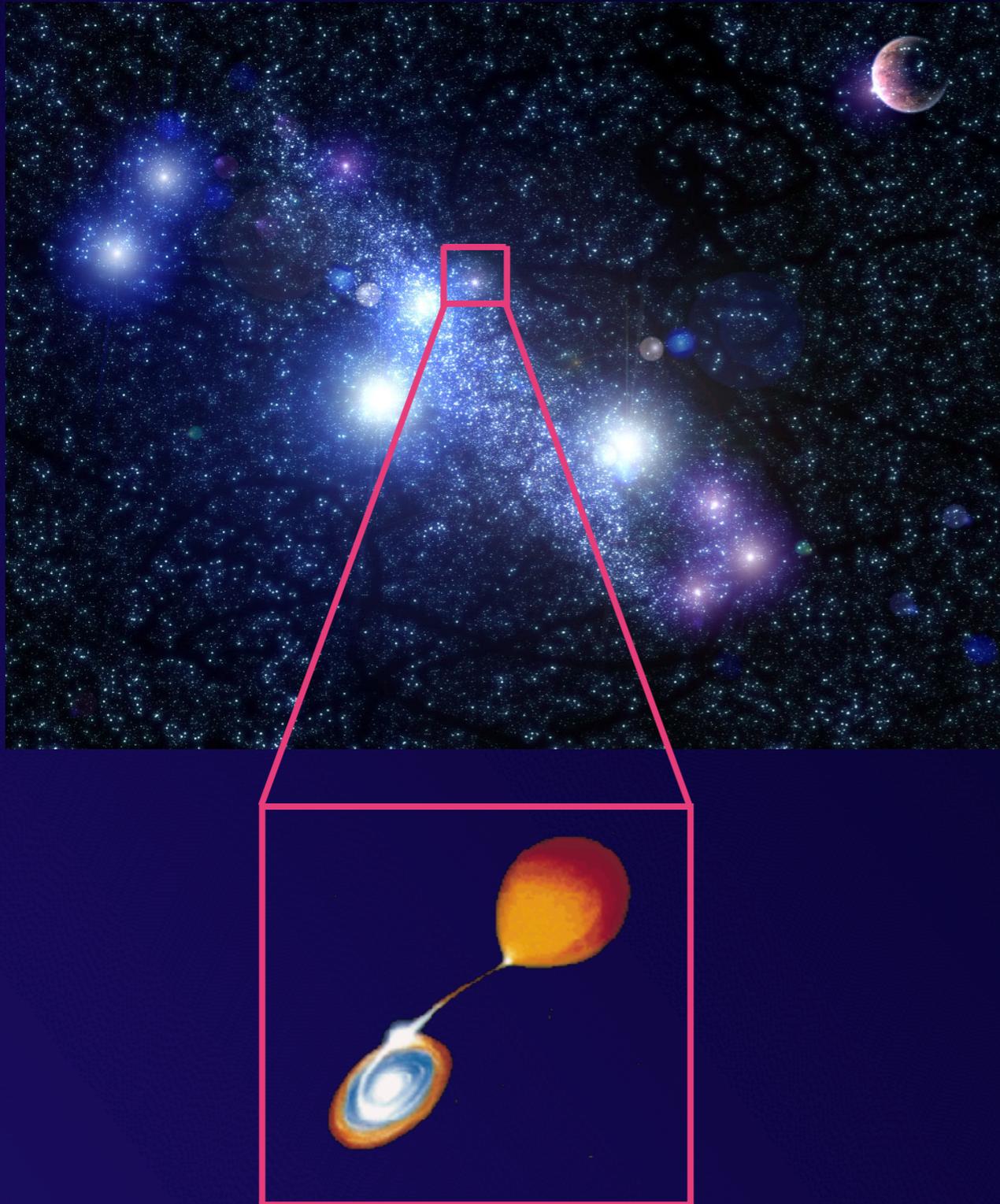
Motivation - Starspots & accretion dynamics



Hessman, Gänsicke & Mattei (2000)



Roche tomography - Technique



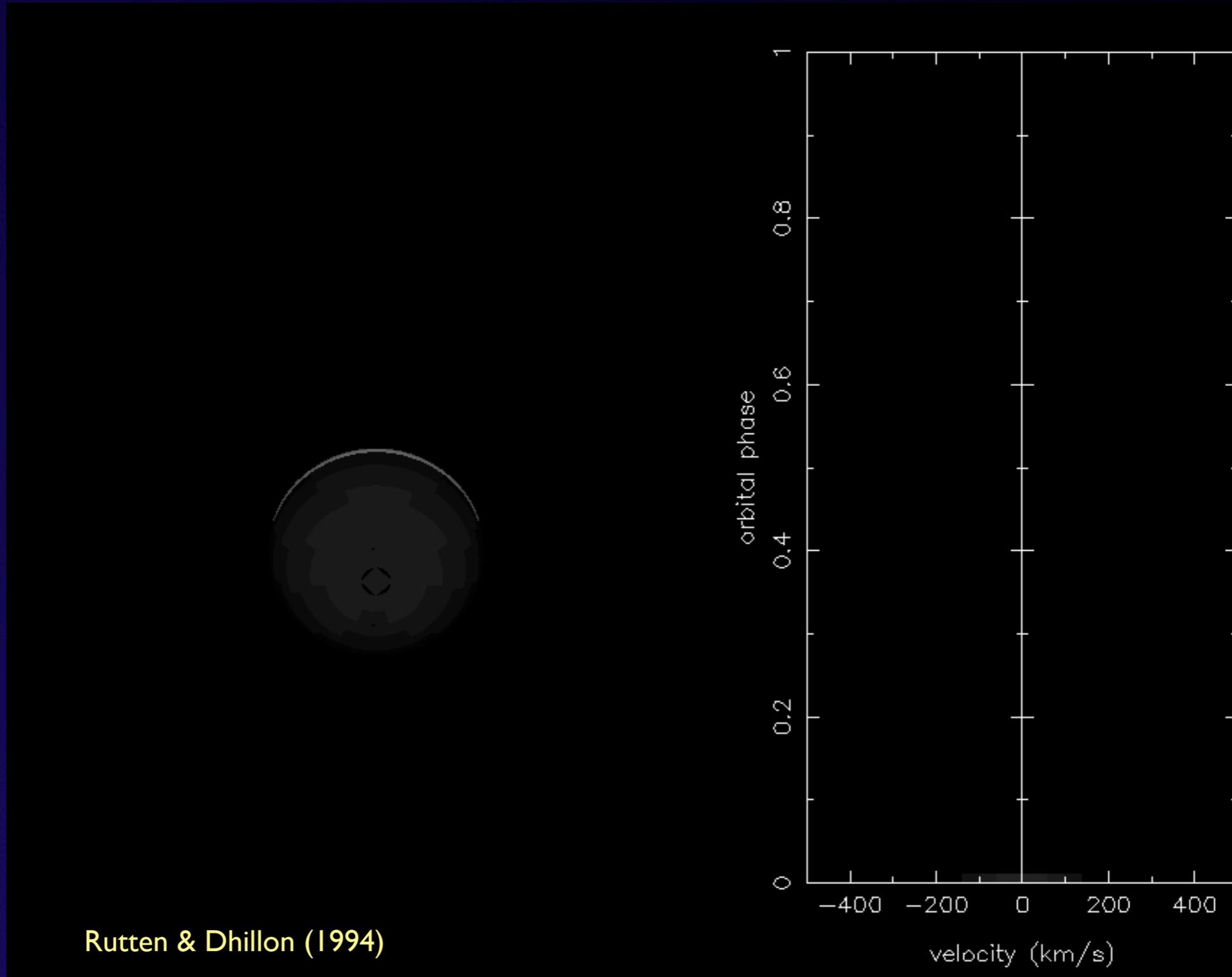
Direct images of the donor stars are impossible as they are

- typically several hundred parsecs distant
- have radii of $\sim 400,000$ km

This means that to resolve the star, we would require a ~ 100 km class telescope!



Roche tomography - Technique



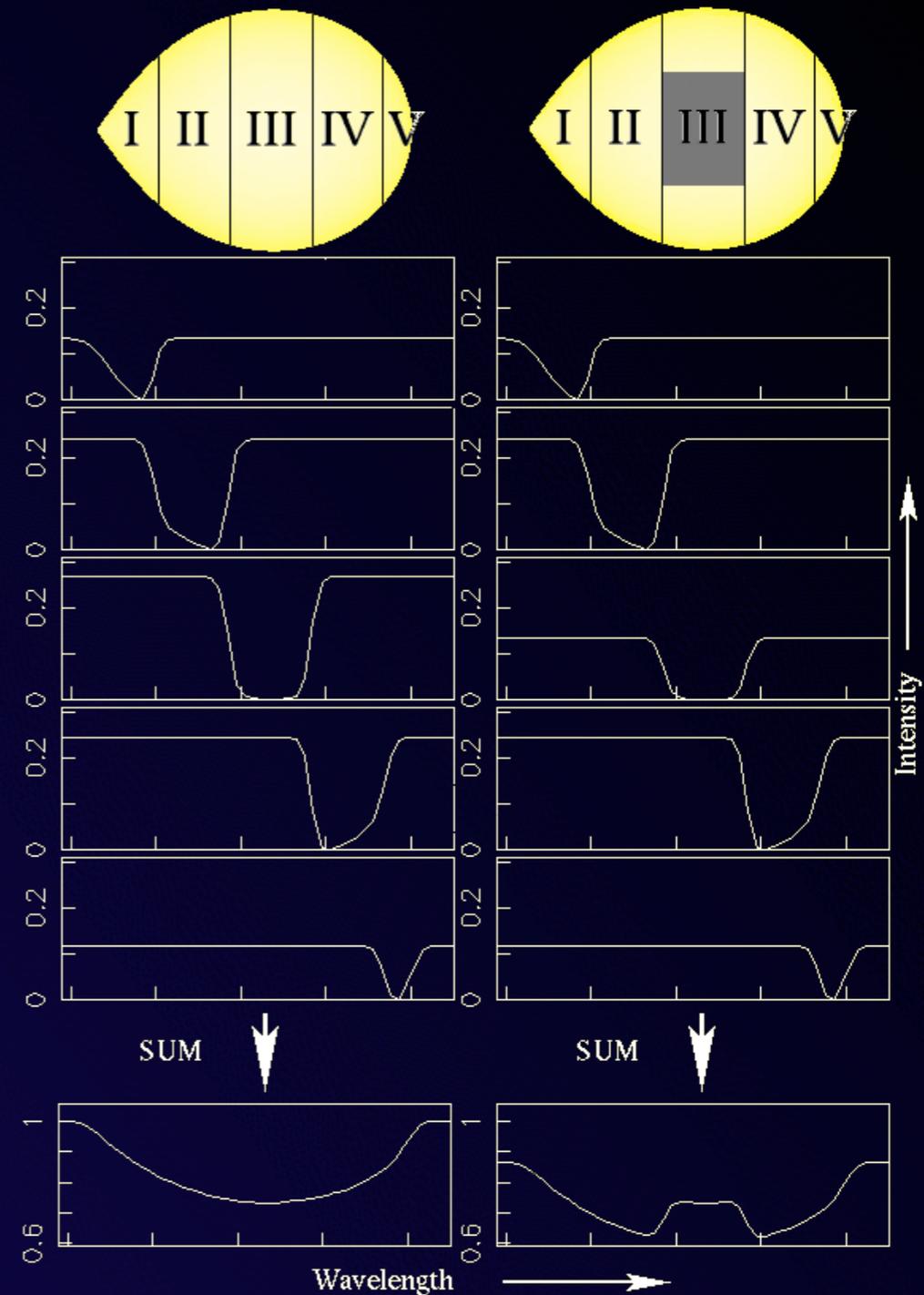
Rutten & Dhillon (1994)



Roche Tomography - Detecting star spots

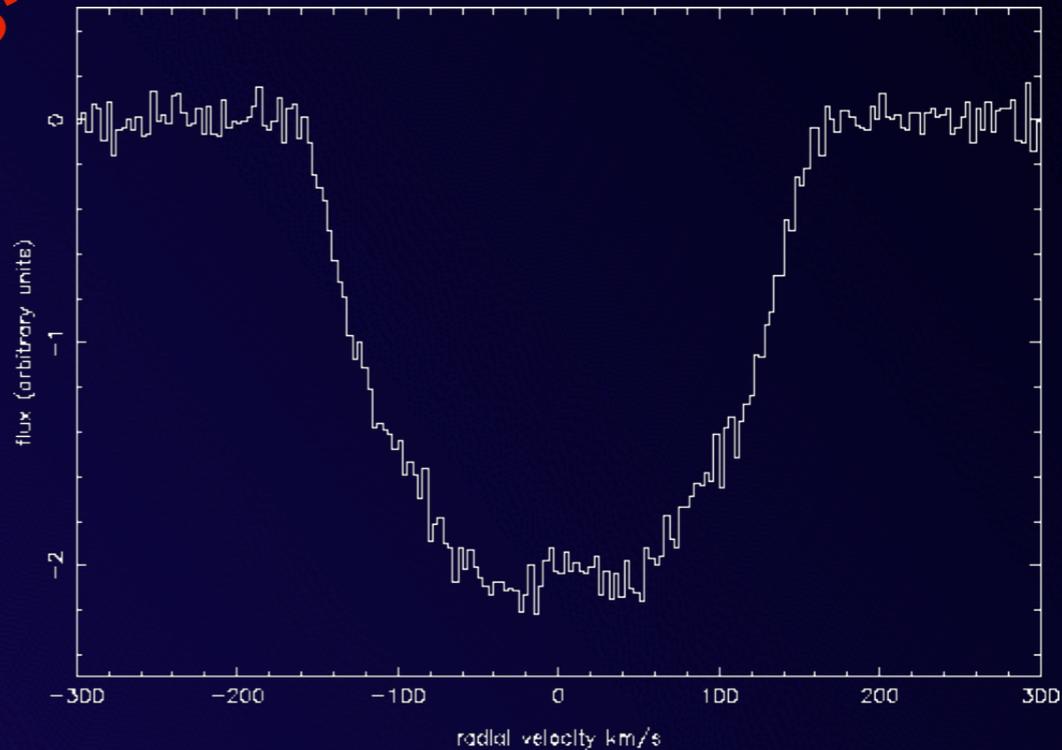
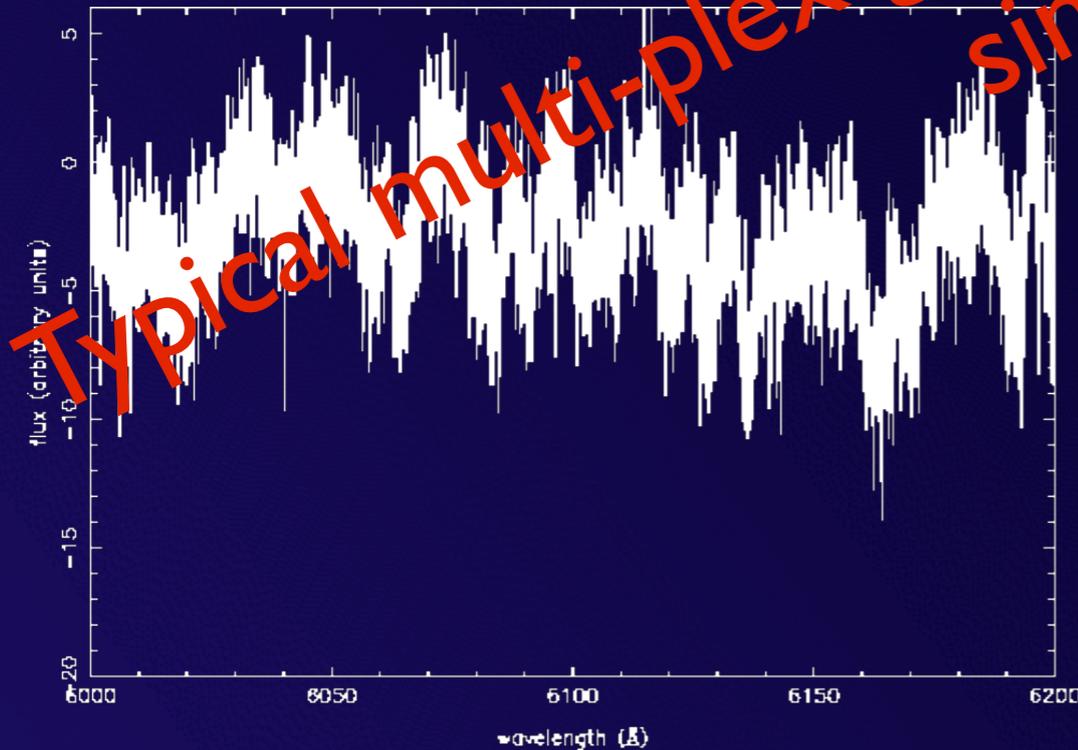
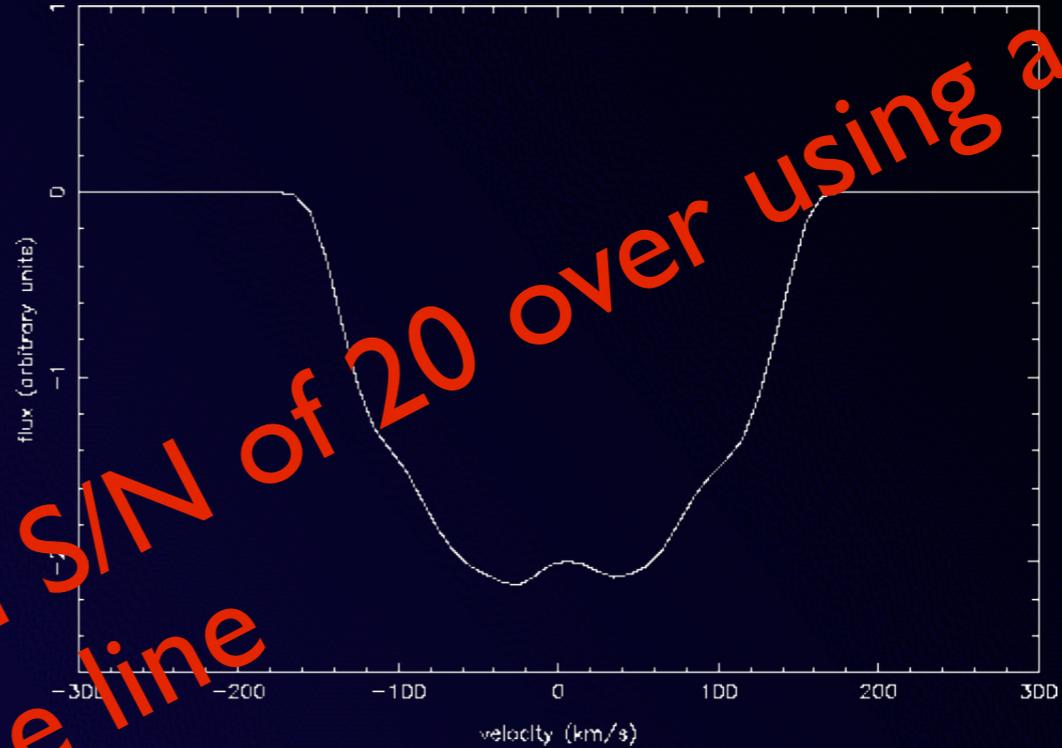
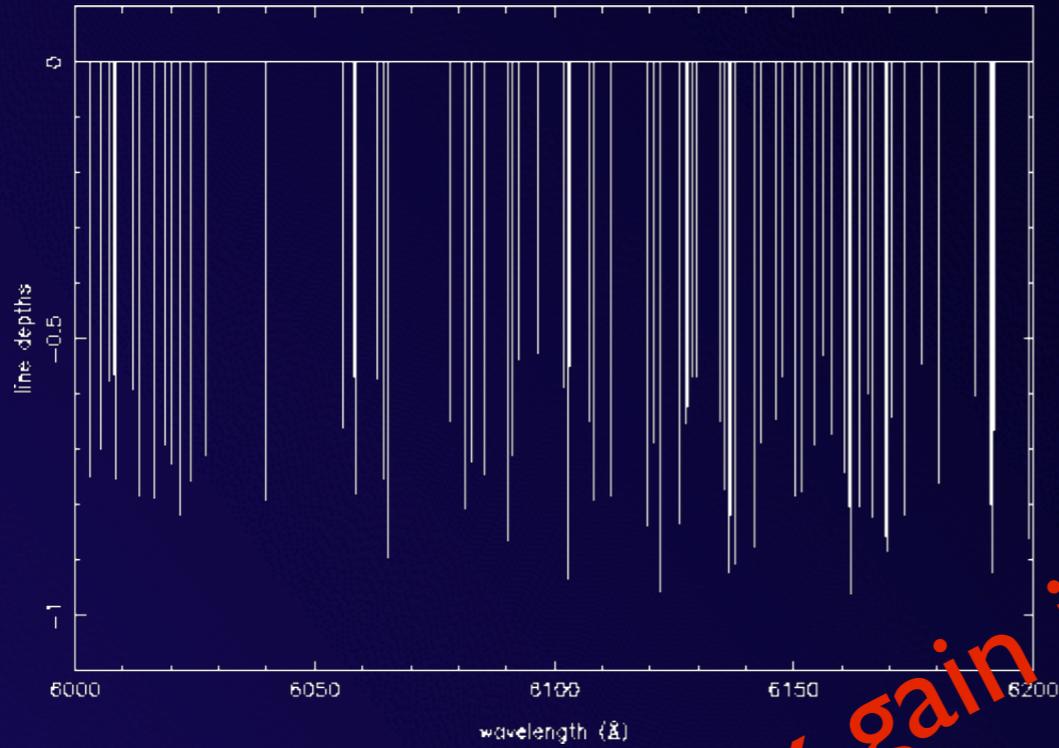
Star spots produce emission bumps in donor star line profiles.

Typically, the largest star spot distortions are $\sim 10\%$ of the profile depth.





Roche tomography - LSD



Typical multi-plex gain in S/N of 20 over using a single line



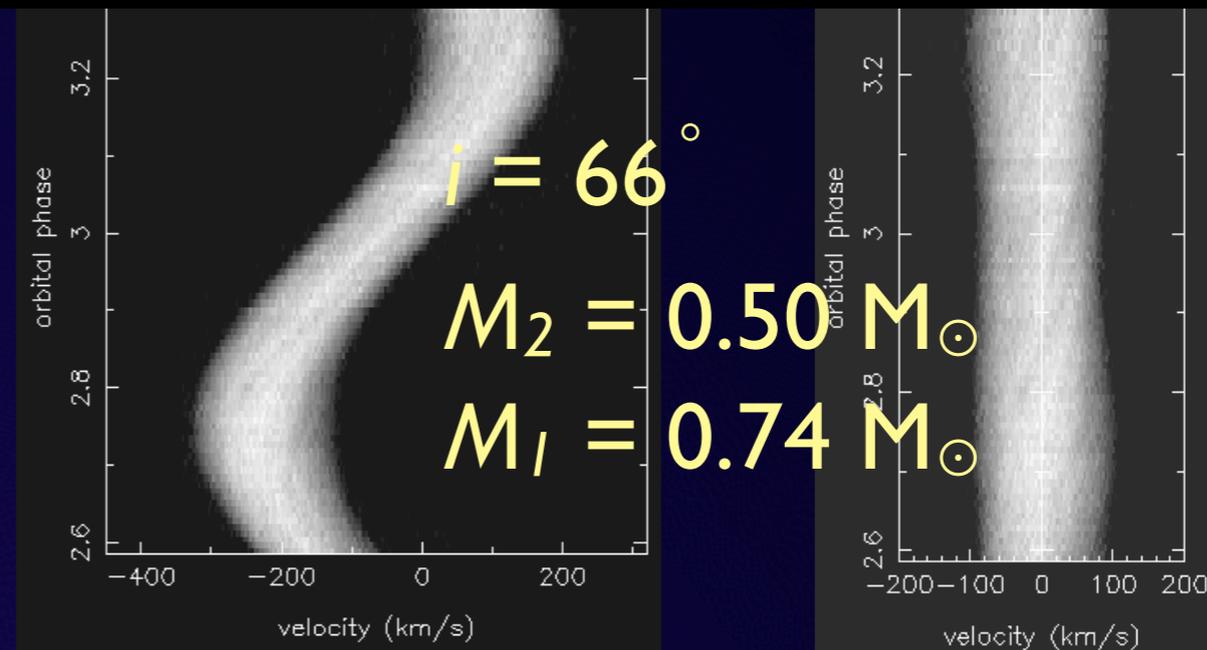
Roche tomography - AE Aqr (2001)

AE Aqr - 9.9hr period

Observations taken on 2 consecutive nights.

WHT+UES

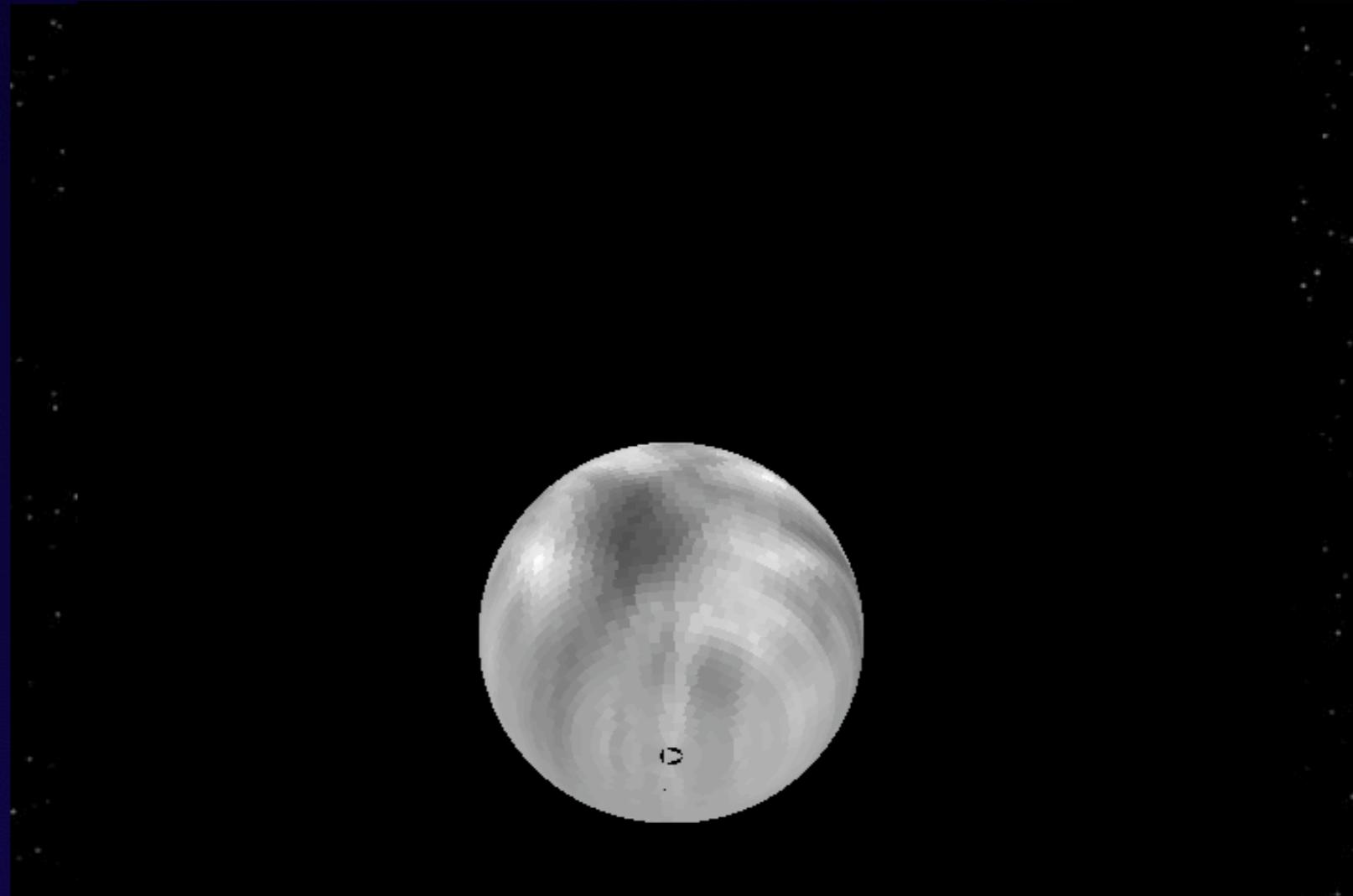
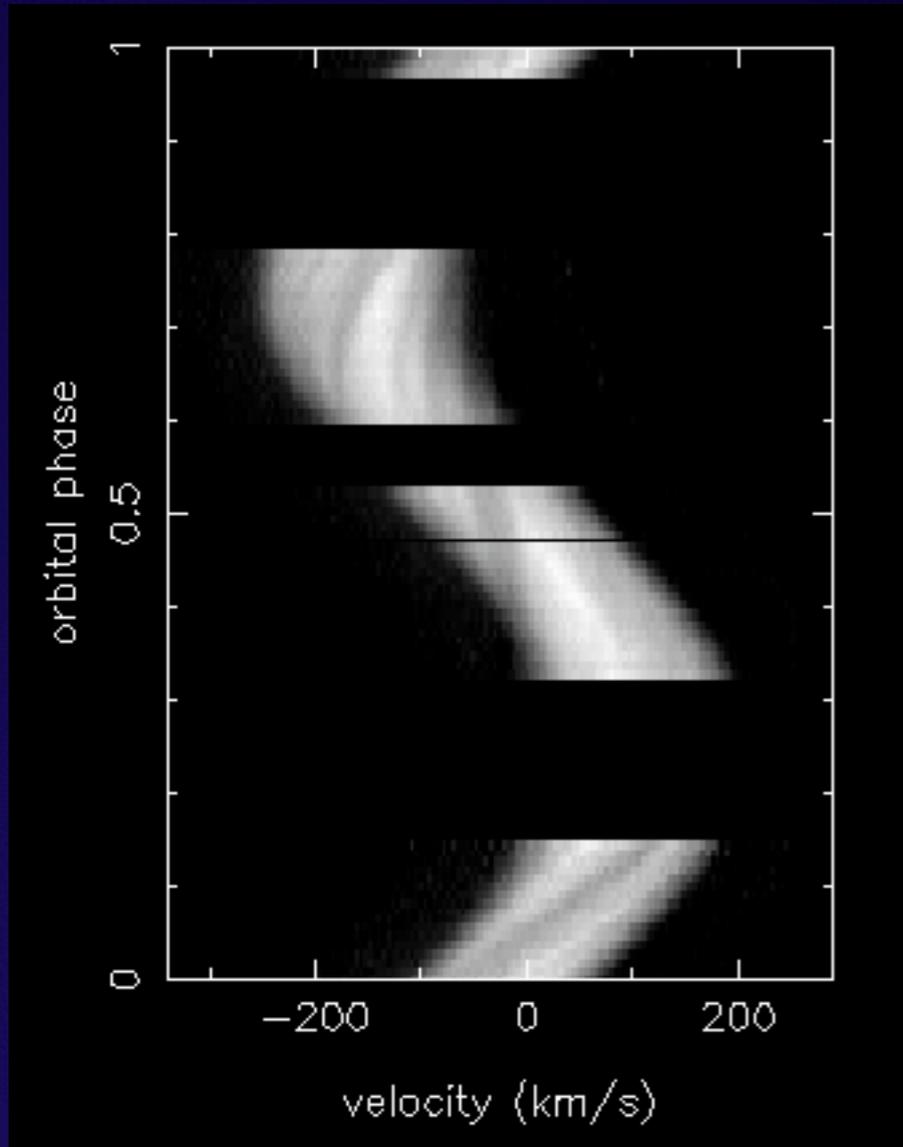
Simultaneous JKT Photometry



Watson et al. (2006)



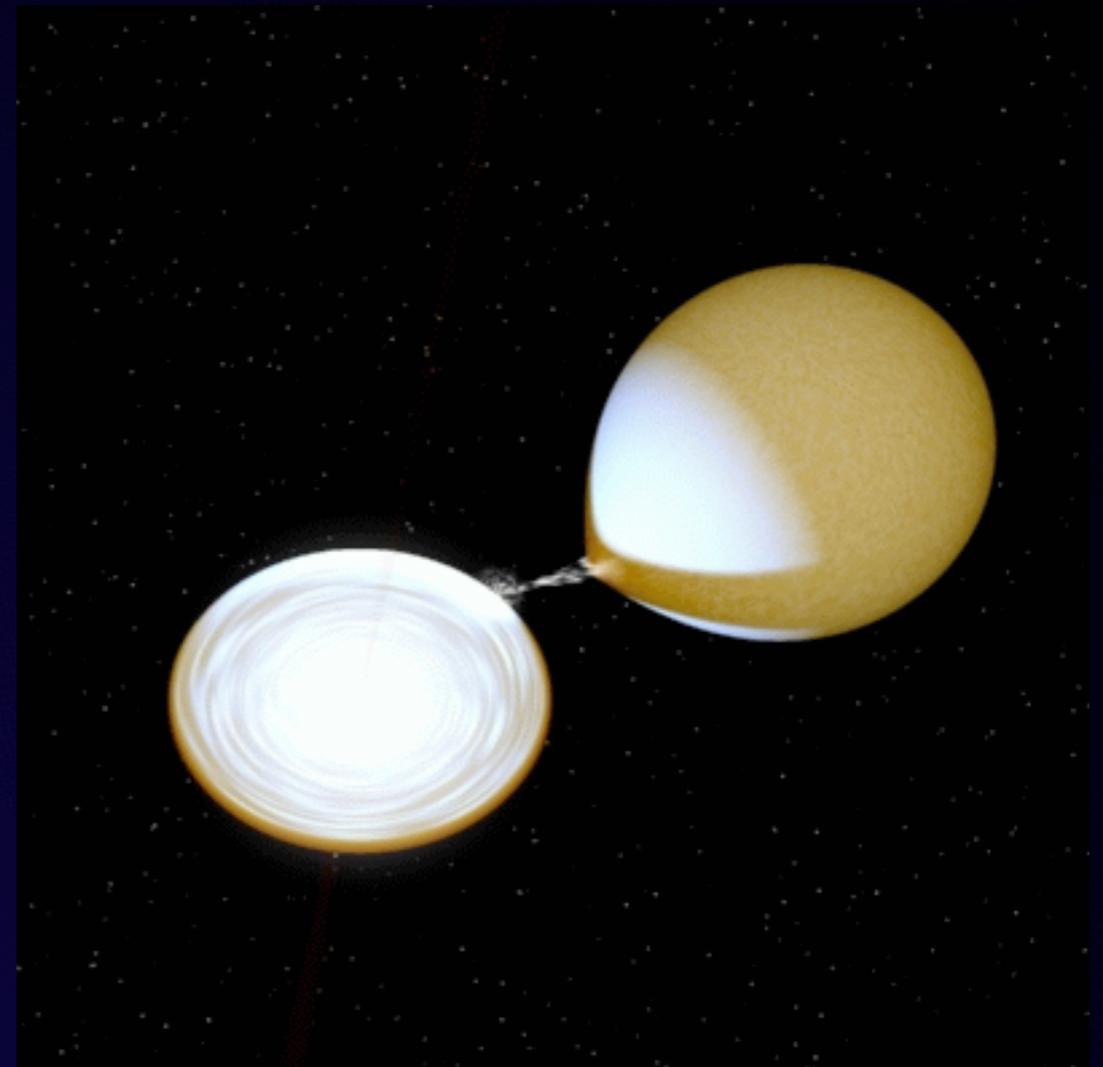
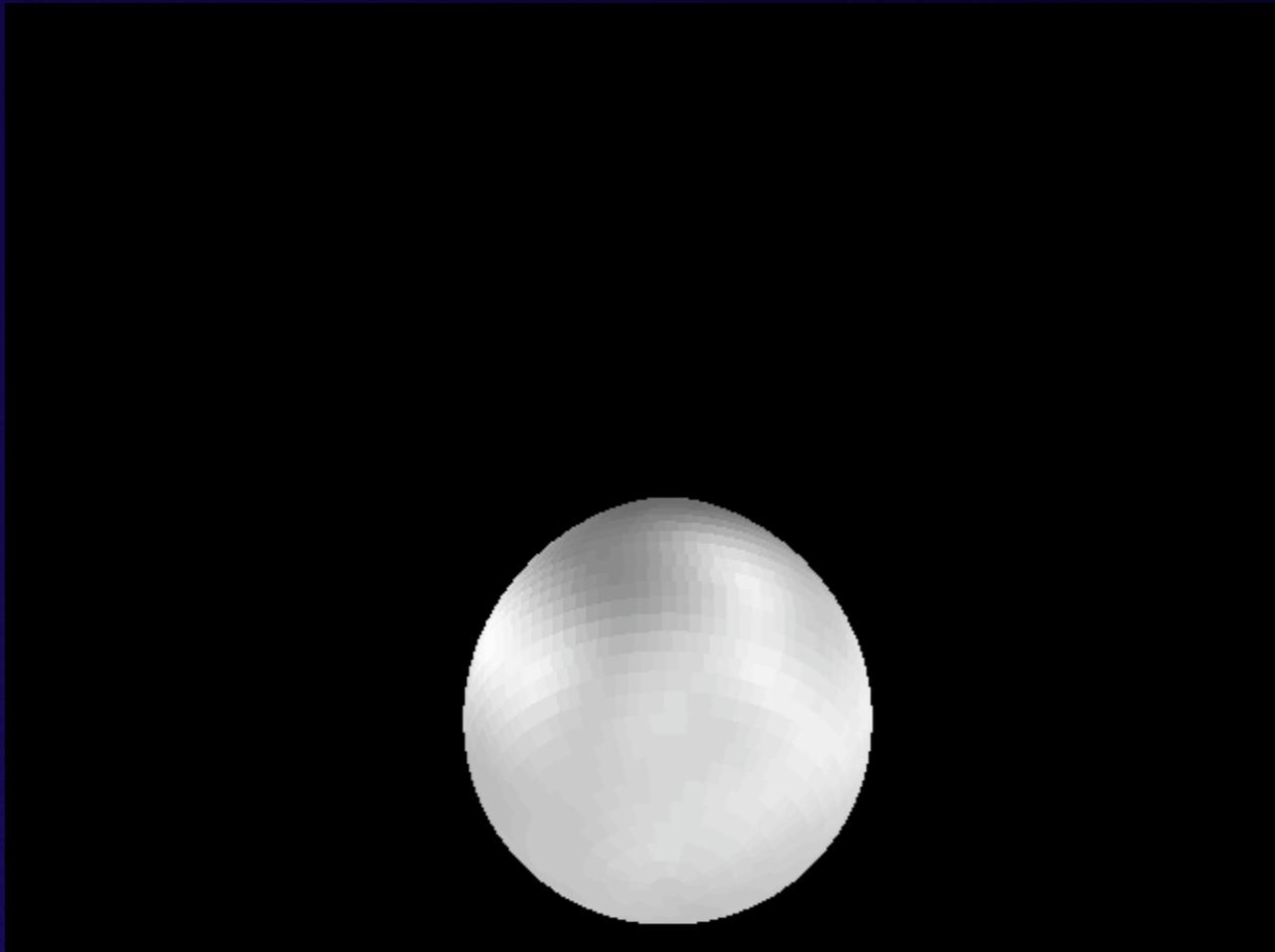
Roche tomography - BV Cen



Magellan + MIKE echelle spectroscopy
Simultaneous Photometry (I-m Henrietta Swope)



Roche tomography - RU Peg



RU Peg (novalike) observed with WHT+ISIS in high state
(See poster by Robert Smith, Alex Dunford & myself)

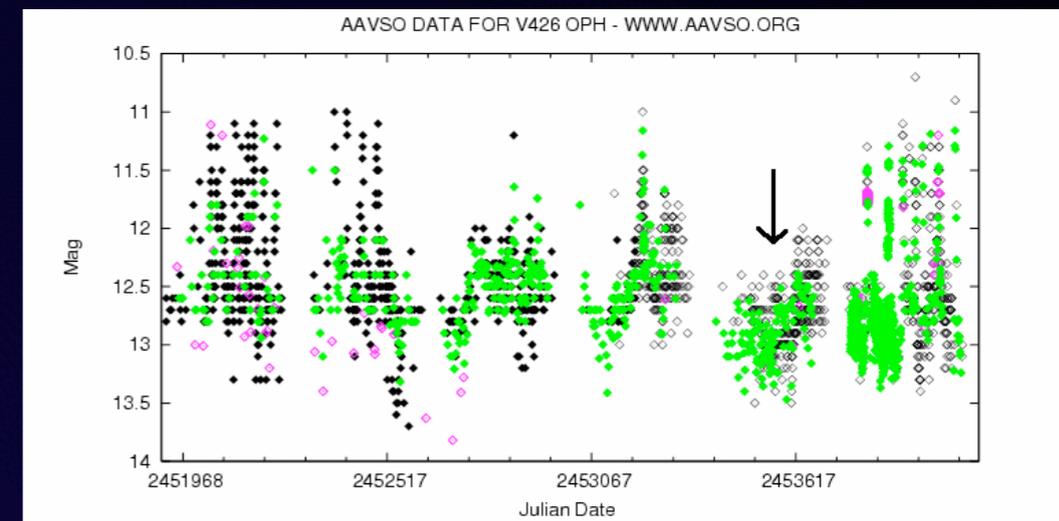


Roche tomography - V426 Oph



Orbital Period = 6.8 hours

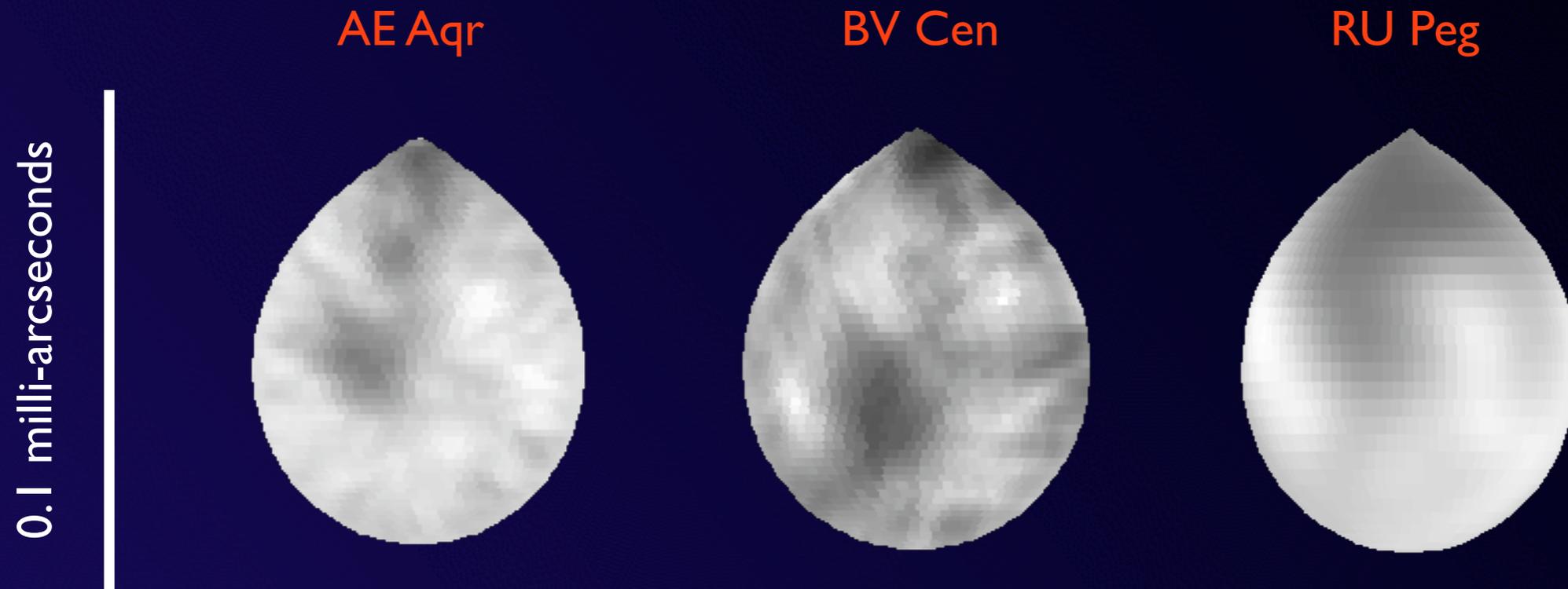
No pronounced polar spot.
Caught in a year long <low> state.



Magellan + MIKE echelle spectroscopy
Simultaneous Photometry (I-m Henrietta Swope)



Roche tomography - Spot distributions

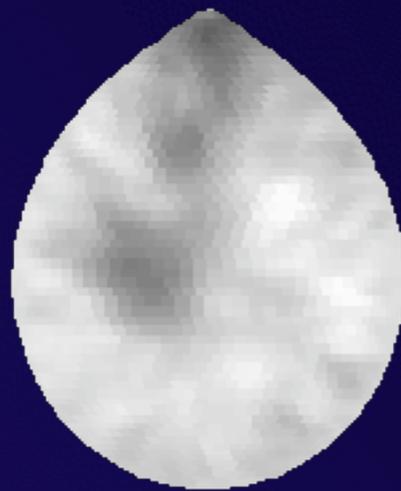


Seeing the impact of Coriolis + Tidal forces?

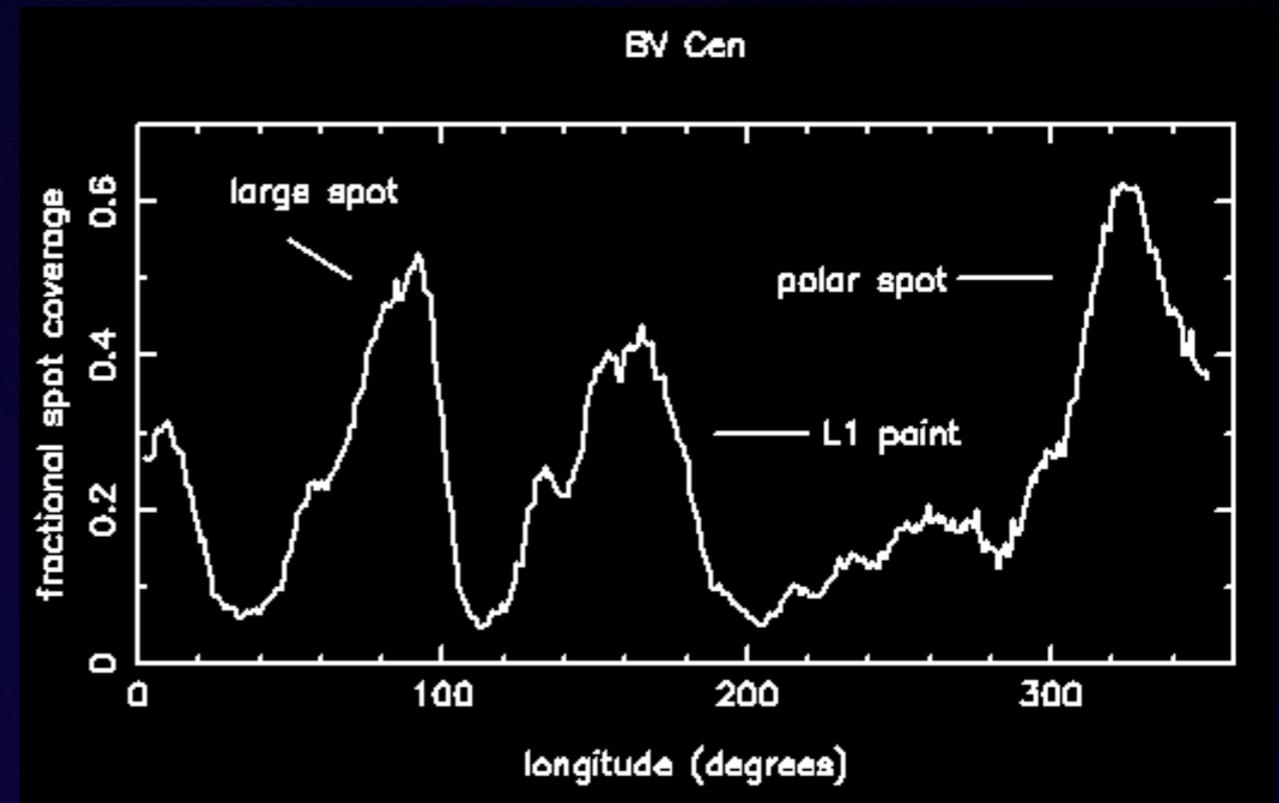
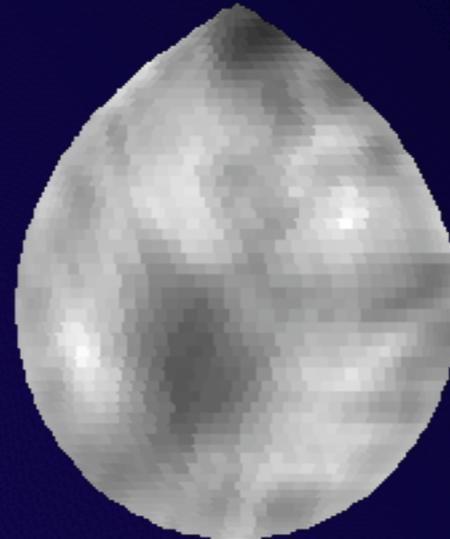


Roche tomography - Spot distributions

AE Aqr



BV Cen

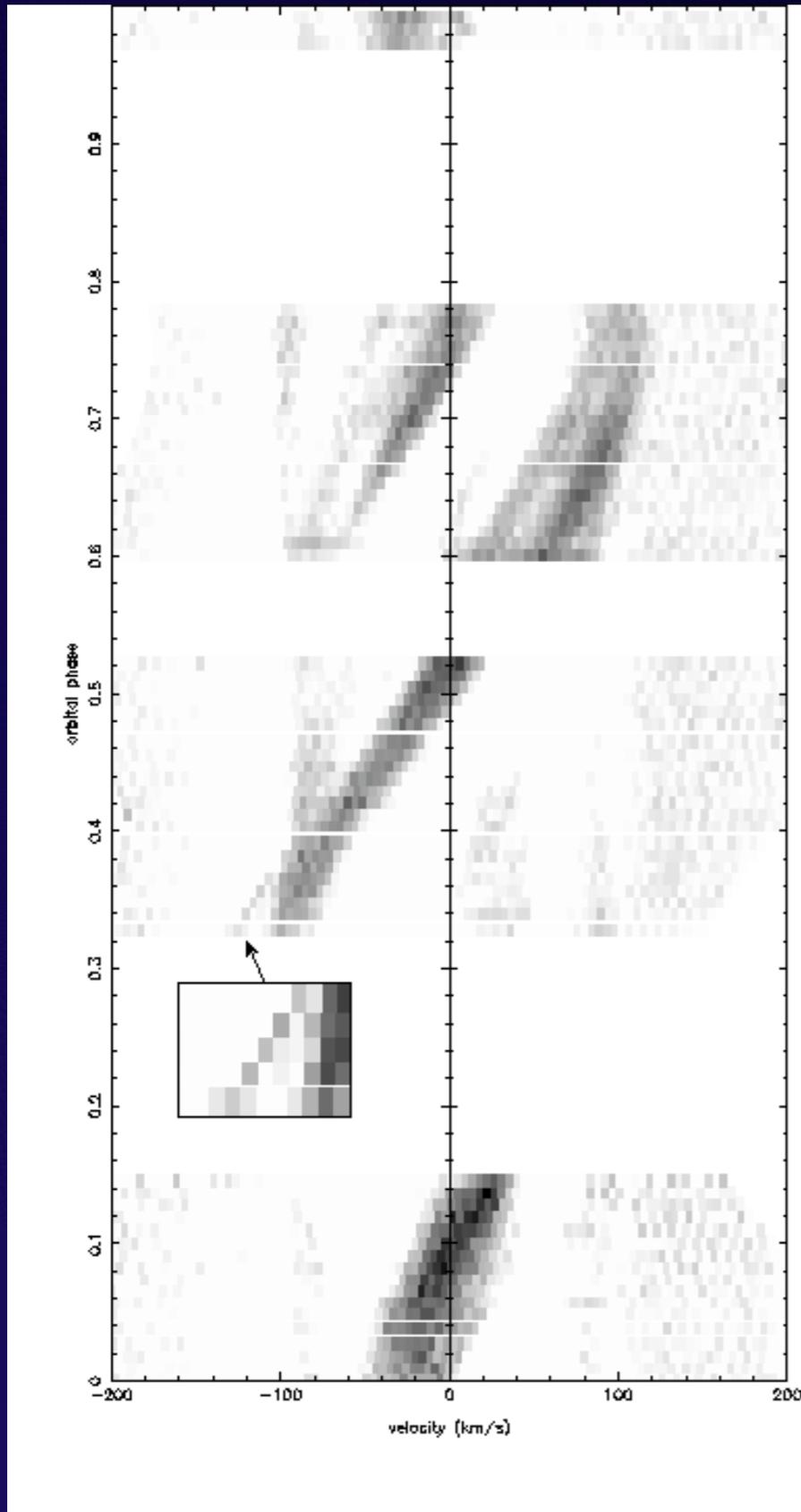


High spot coverages found around the mass transfer nozzle.

Close to predictions by modeling light curves.



Roche tomography - Slingshot prominences



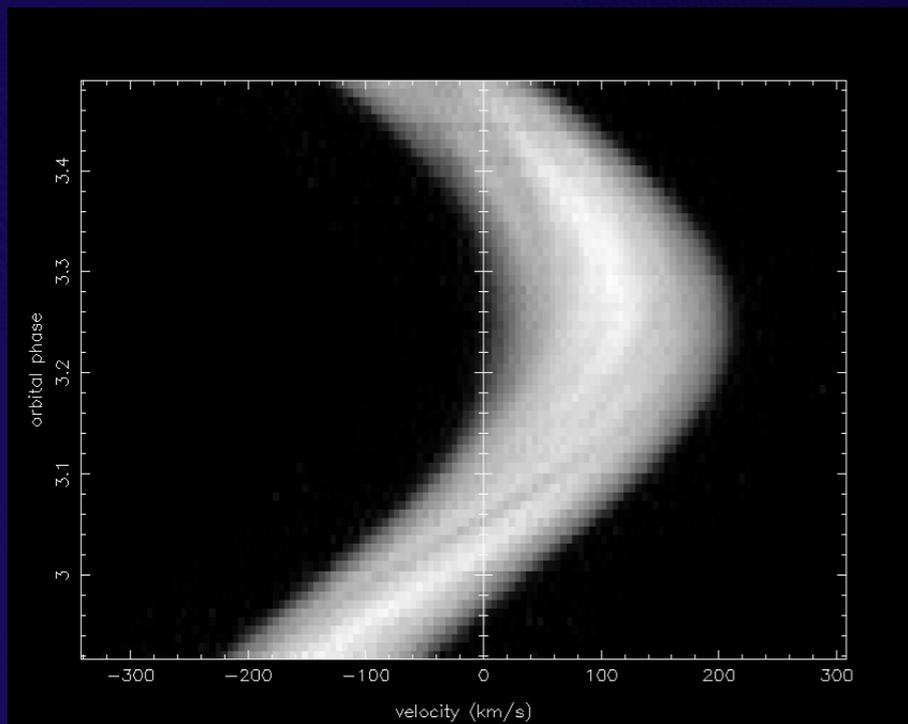
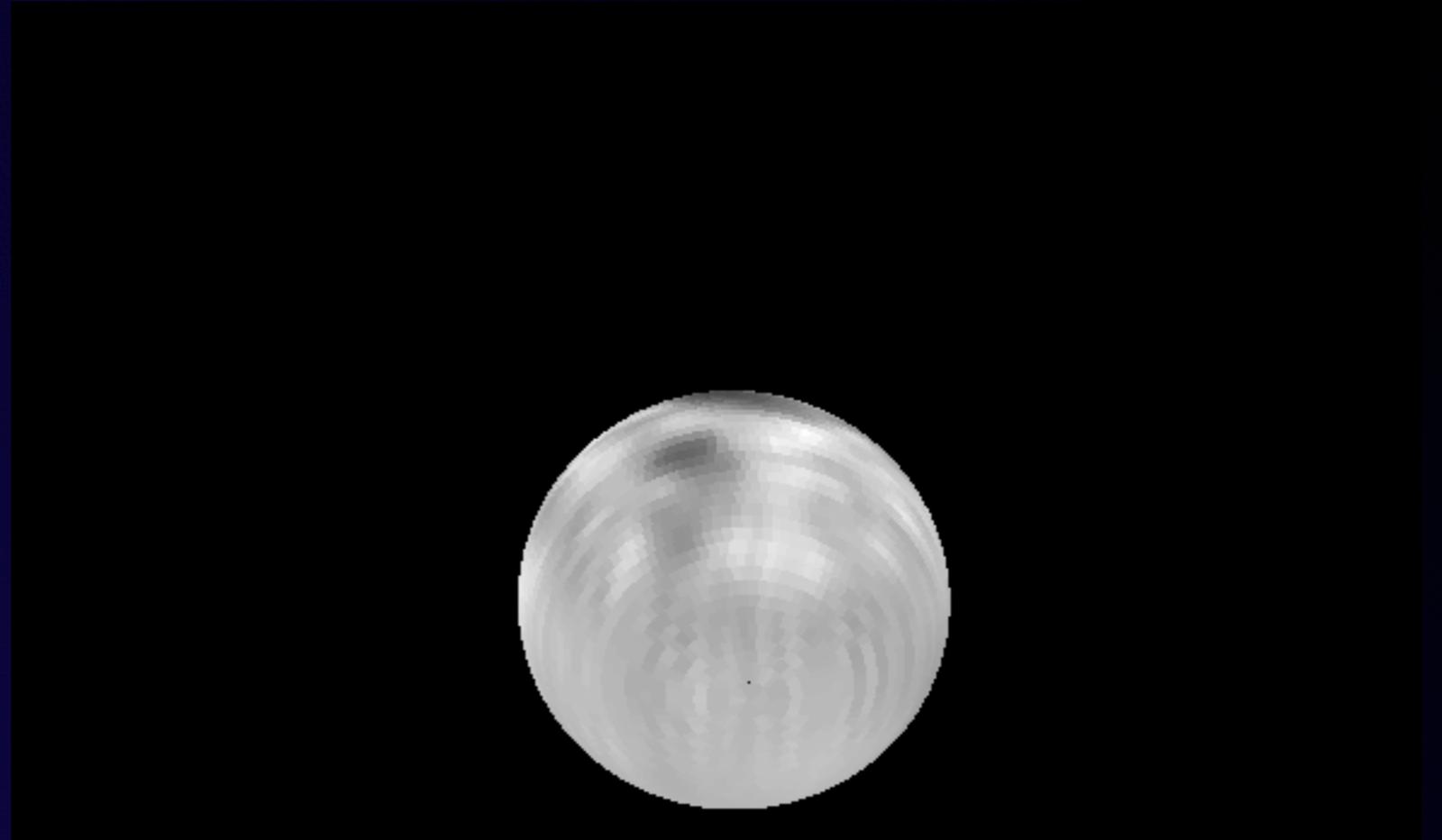
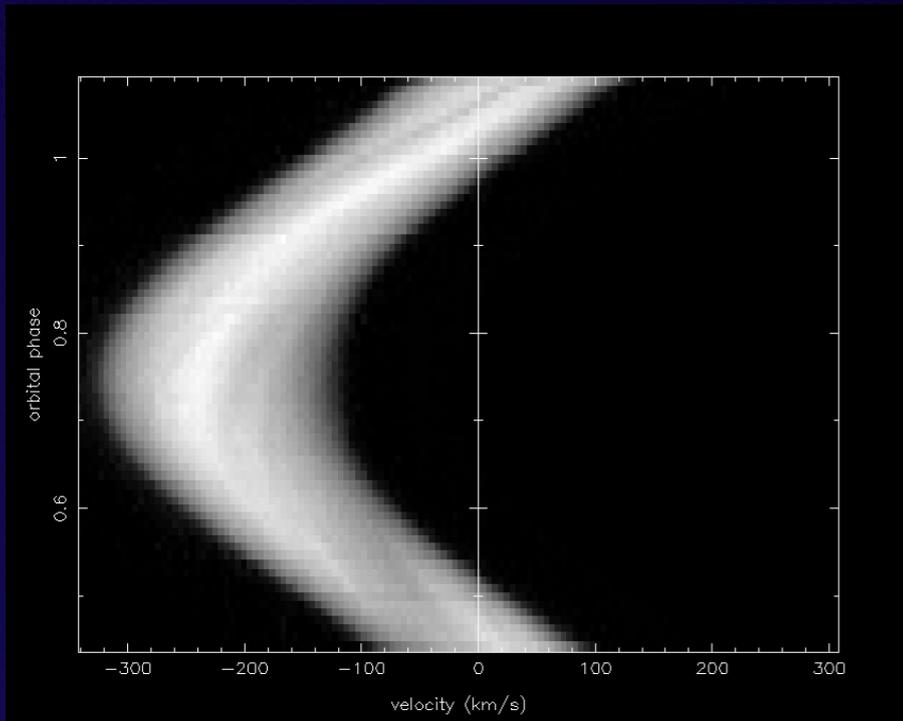
Emission feature observed outside stellar line profile.
Observed at phases $0.328 \rightarrow 0.366$
Also at phases $1.974 \rightarrow 2.038$

Centred on systemic velocity of BV Cen.

Illuminated by irradiation?



Roche tomography - AE Aqr (2004)



2001 parameters

$$i = 66^\circ$$

$$M_2 = 0.50 M_\odot$$

$$M_1 = 0.74 M_\odot$$

2004 parameters

$$i = 64^\circ$$

$$M_2 = 0.53 M_\odot$$

$$M_1 = 0.82 M_\odot$$



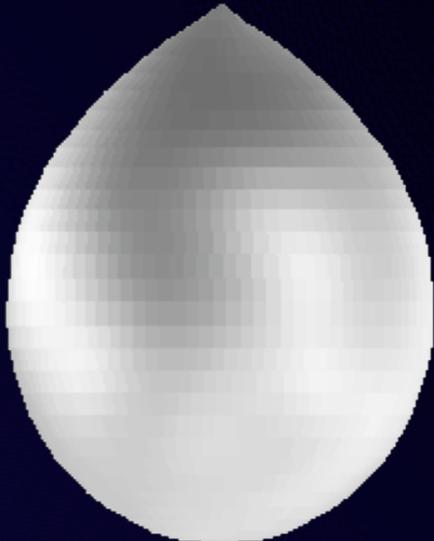
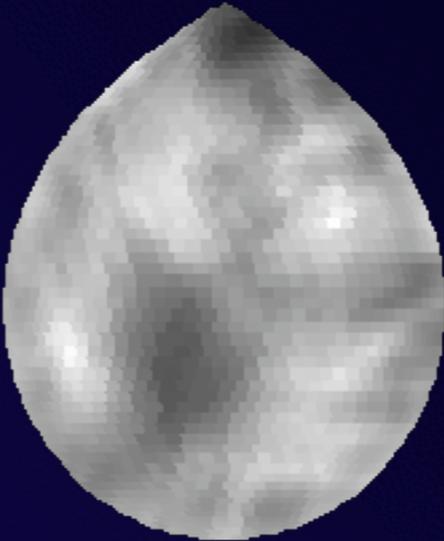
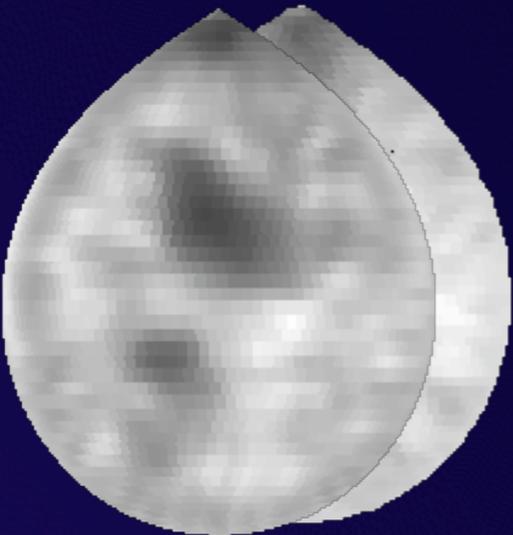
Roche tomography - Spot distributions

AE Aeq A (2001)

BV Cen

RU Peg

0.1 milli-arcseconds





Roche tomography - Conclusions(?)

CV donor stars show large spot coverages (e.g. AE Aqr ~20%; BV Cen ~25%)

High spot coverages near mass transfer nozzle:

- seeing influence of tidal forces on magnetic tube emergence?
- launching site of 'slingshot' prominences?
- blobby magnetized accretion stream/flickering?

All but V426 Oph show prominent high latitude spots

V426 Oph seen in low-state

- link between activity cycle and accretion rate?

Possible deflection of 'polar' spots?