Structure of accretion flow of IX Velorum

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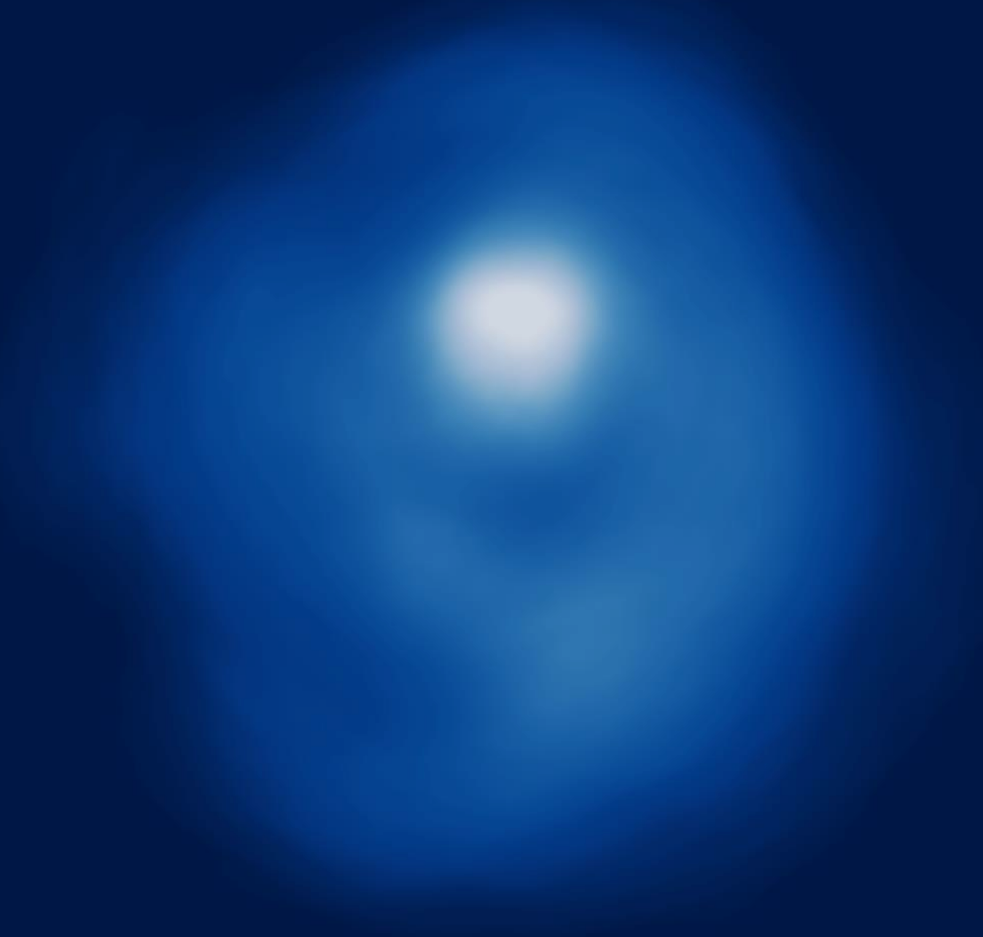
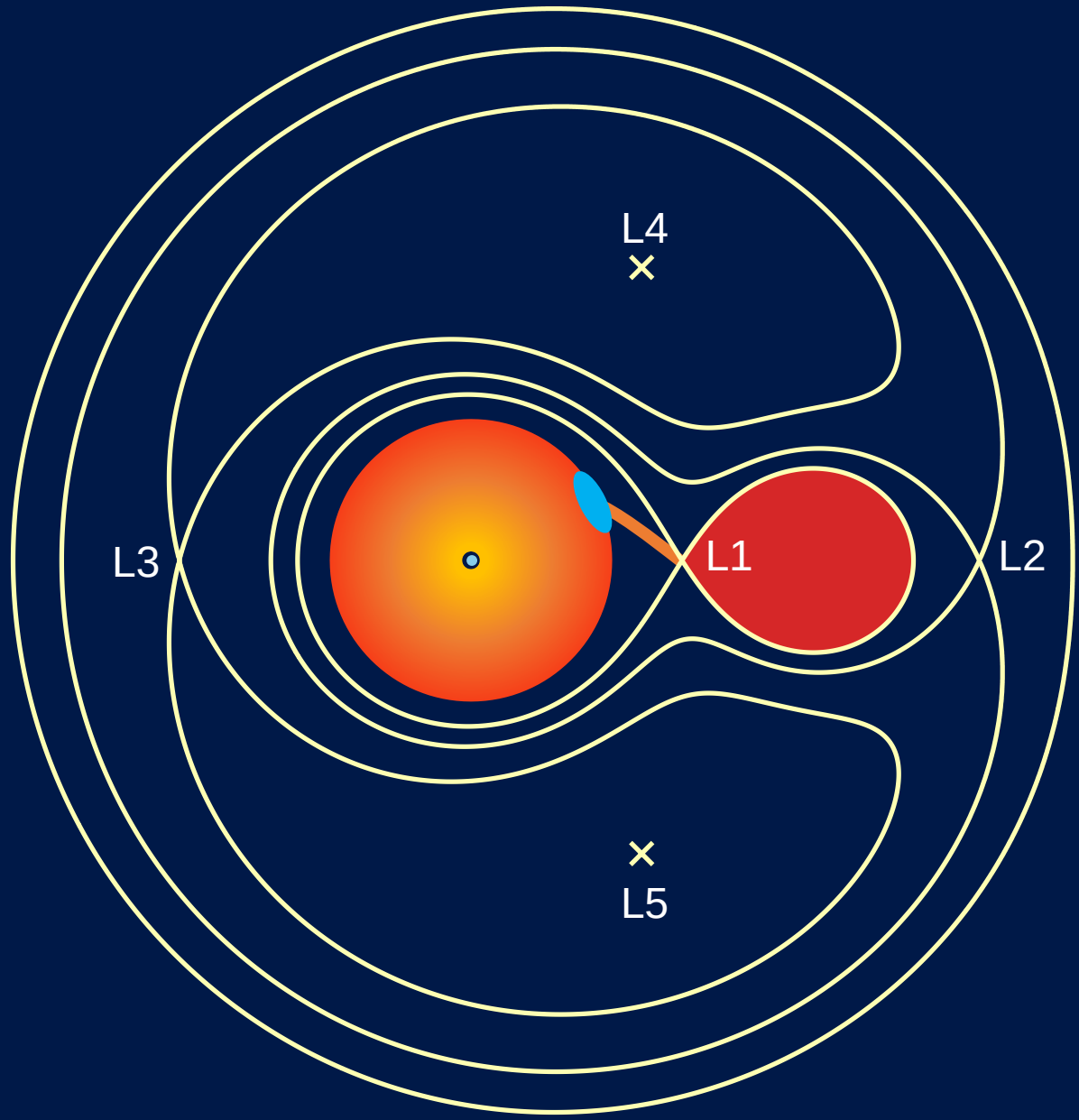


Symbiotic stars, weird novae, and related embarrassing binaries, June 3 – 7, 2024, Prague

Cataclysmic variables (CVs)

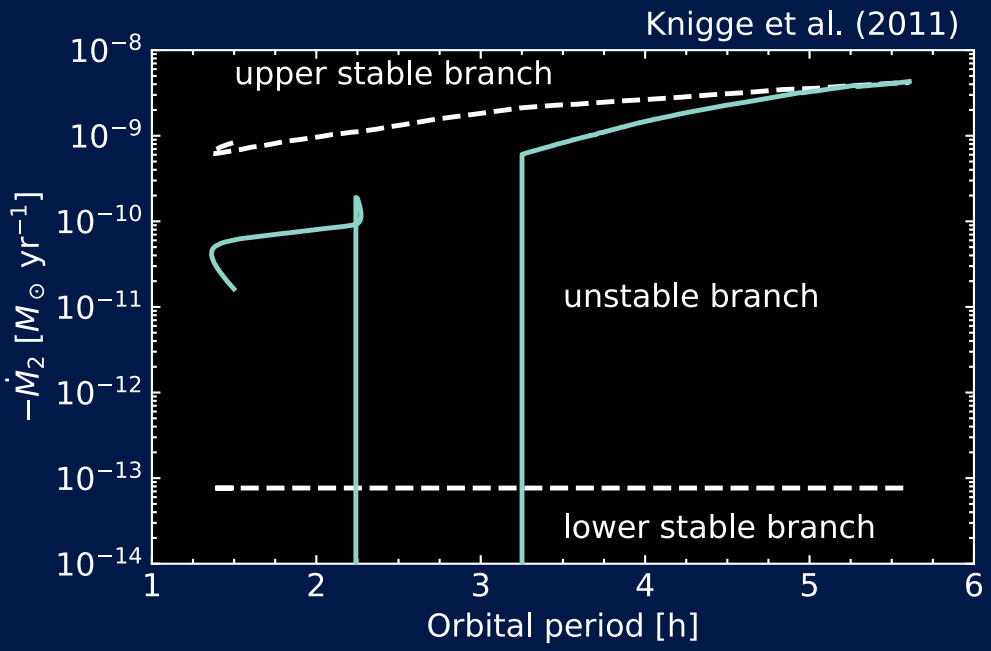
- Semidetached binaries
- White dwarf + red dwarf
  + accretion disc
- Orbital periods: 80 min – 10 h
  → separation: ~ 0.5 – 3 $R_\odot$

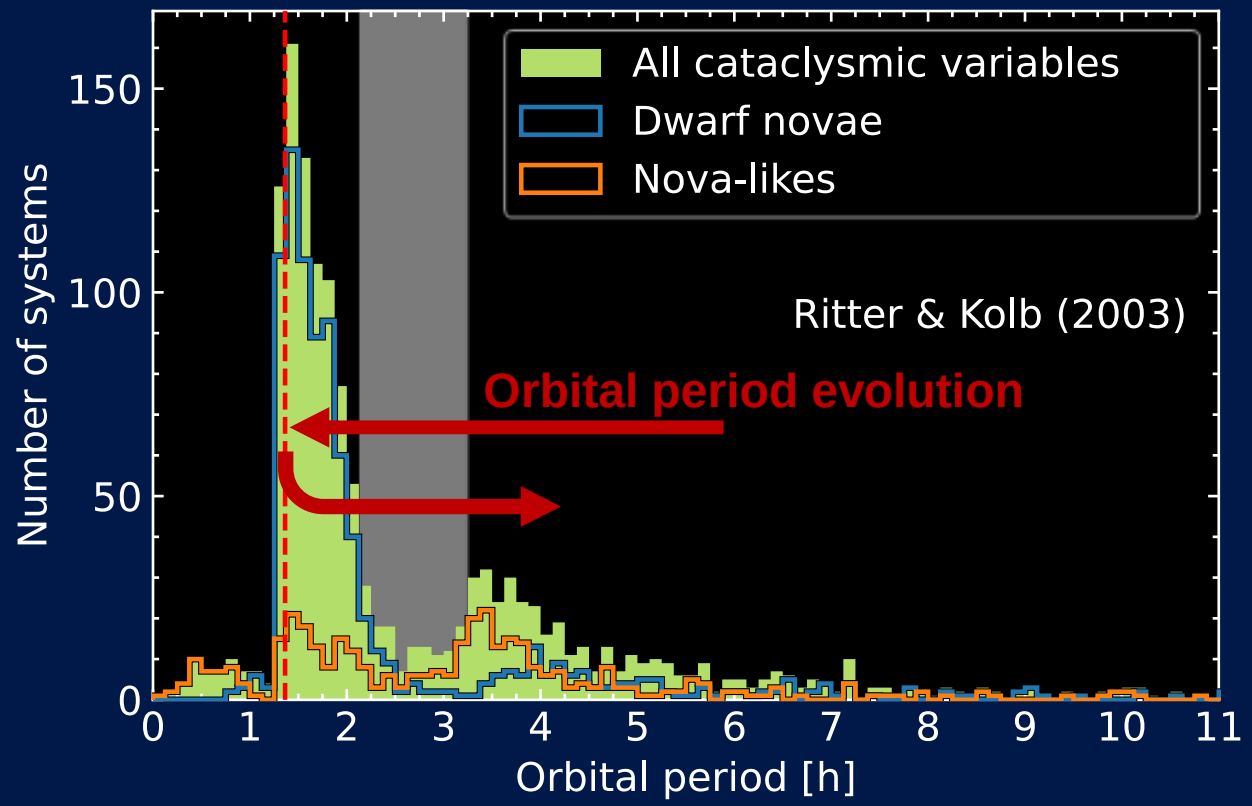


Evolution of cataclysmic variables

- CVs evolve towards:
  - Shorter orbital periods
  - Smaller separation
  - Smaller mass transfer rate

- Angular momentum loss
  - P > 3 h: magnetic breaking
  - P < 2 h: gravitational radiation

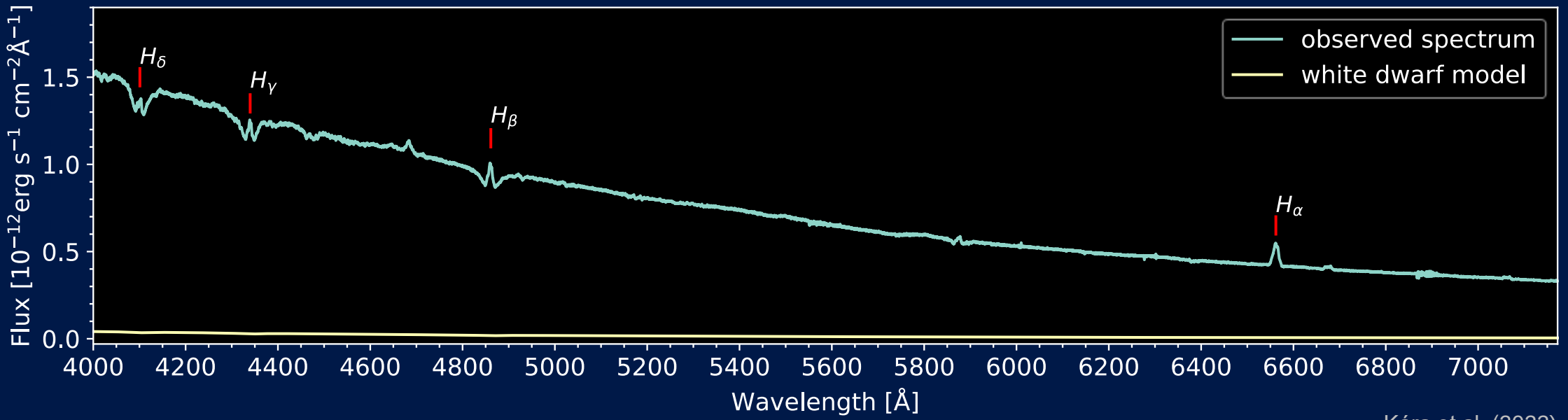




⇒ Additional angular momentum loss is needed

IX Vel

- Nova-like CV — Garrison et al. (1982, 1984)
- Orbital period : 4.5 h
- M_{WD} = 0.80 $M_\odot$, M_2 = 0.52 $M_\odot$, $\dot{M} = 5 \cdot 10^{-9}$ $M_\odot$ yr^{-1} — Linnell et al. (2007)

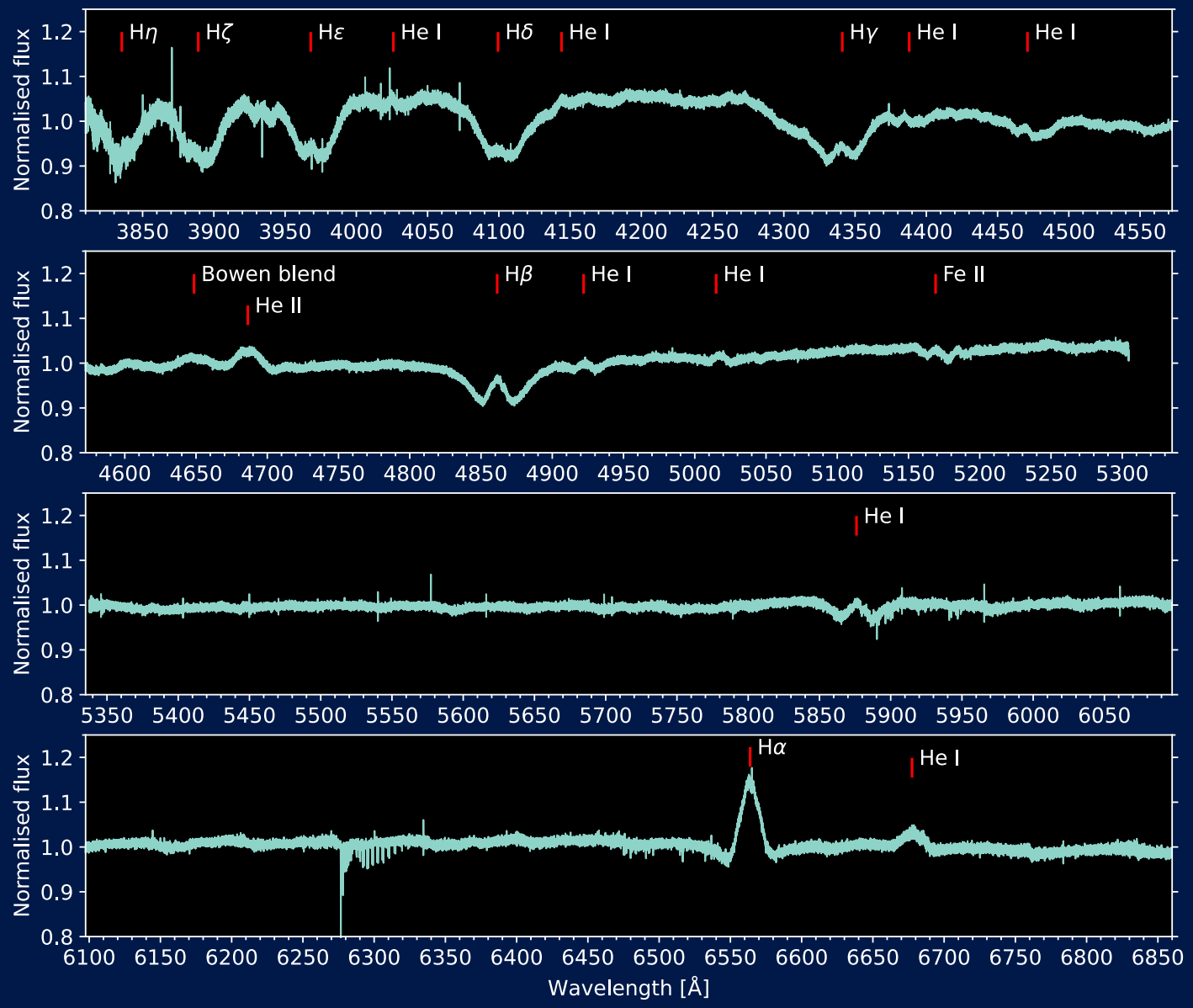


Kára et al. (2023)

IX Vel

Observations:

- 3.6m at La Silla + HARPS
- obtained in 2017 & 2019
- 159 spectra
- exposure 300 s
- R = 160 000



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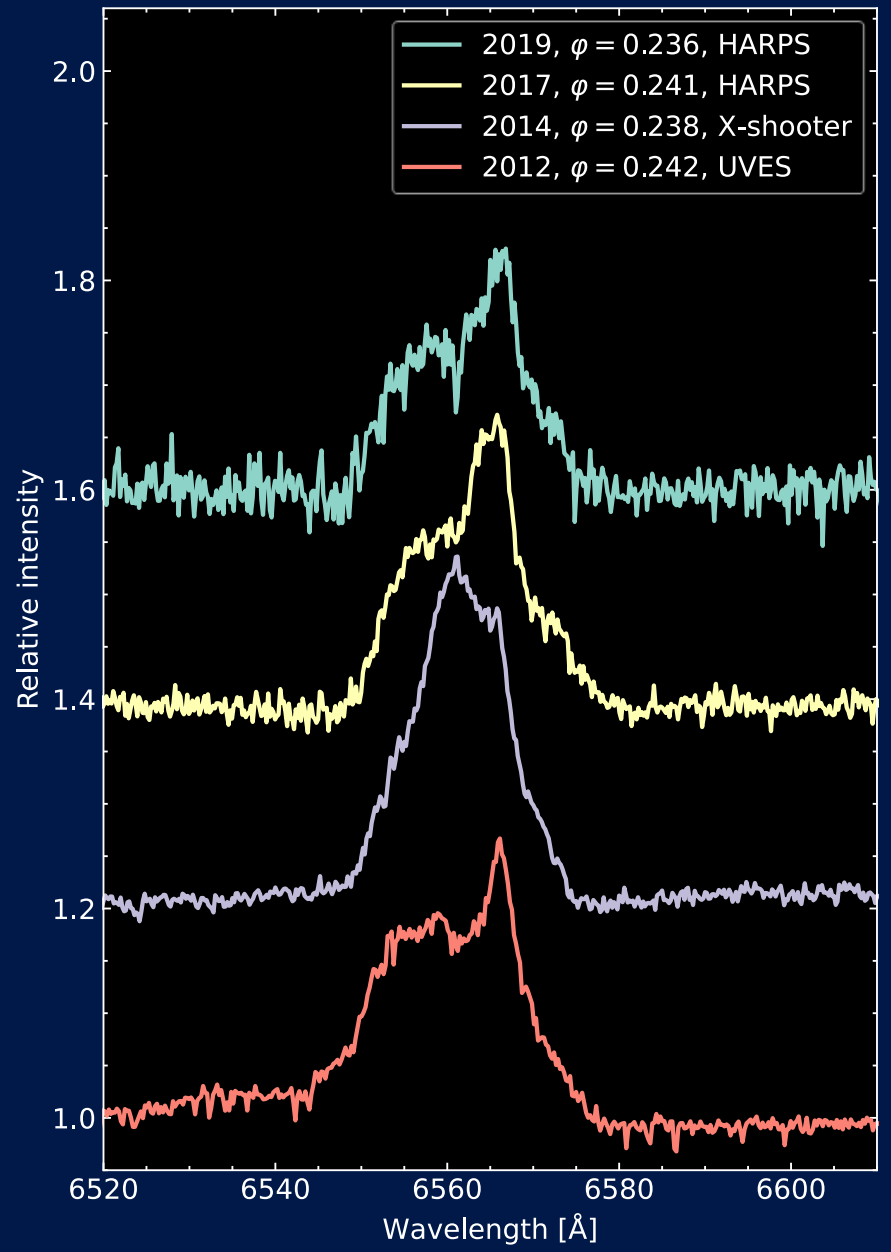
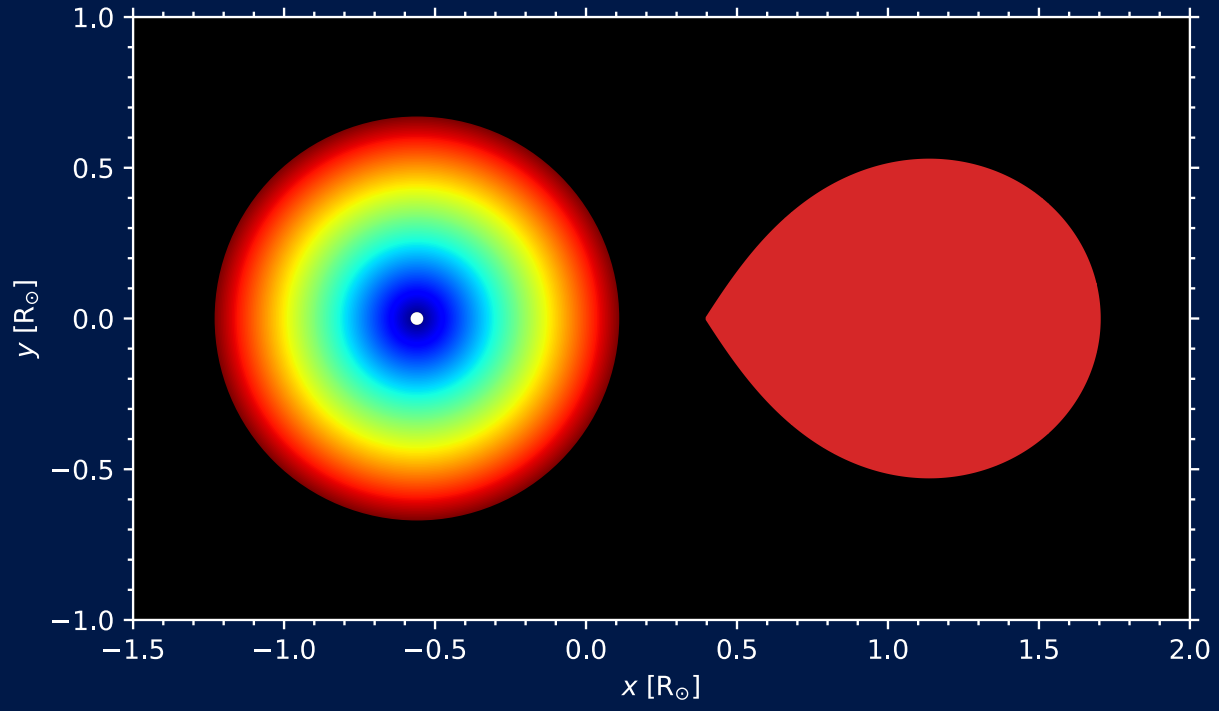
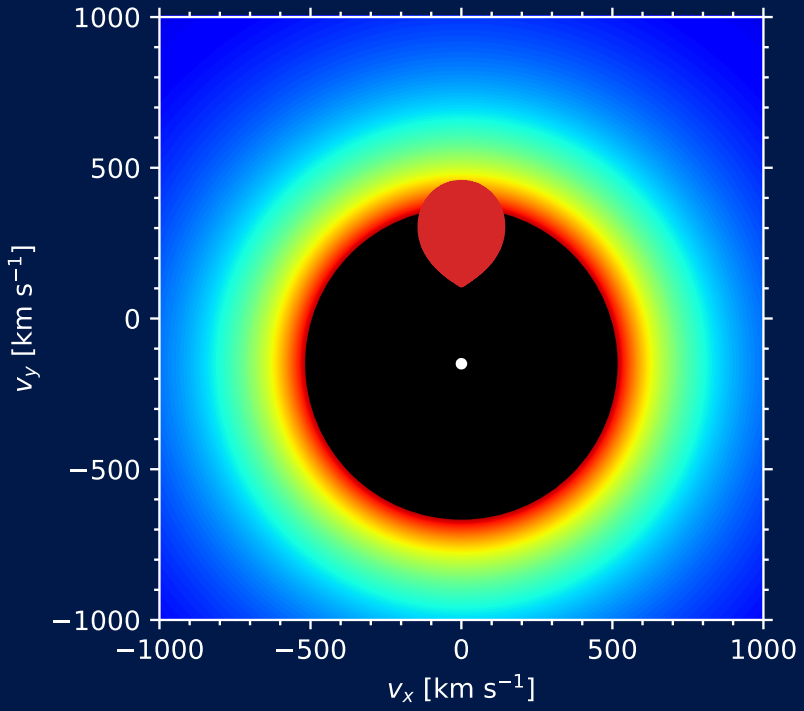


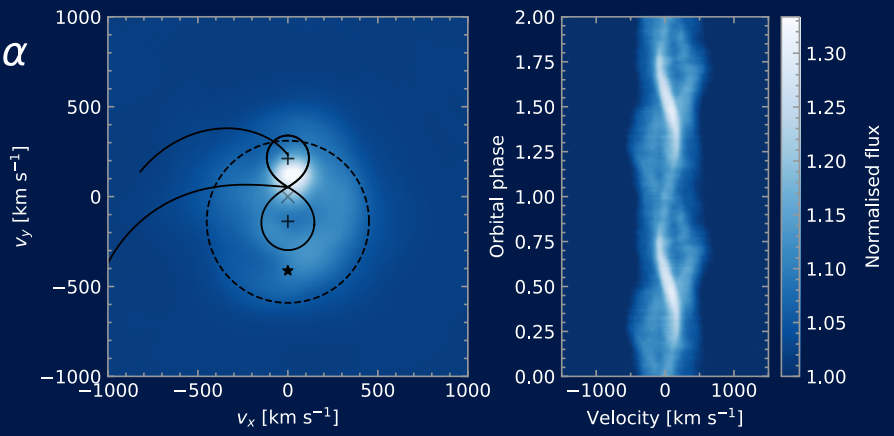
Doppler tomography



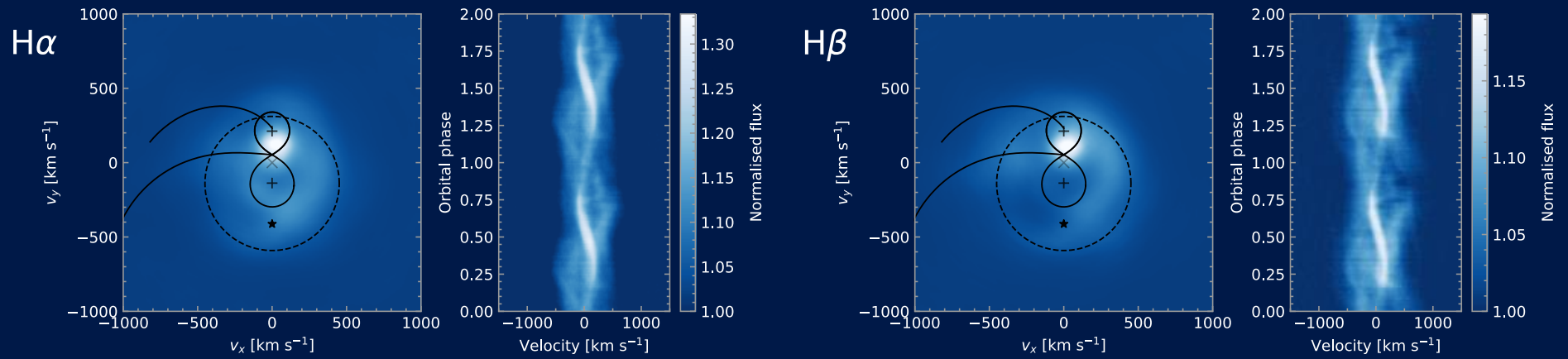


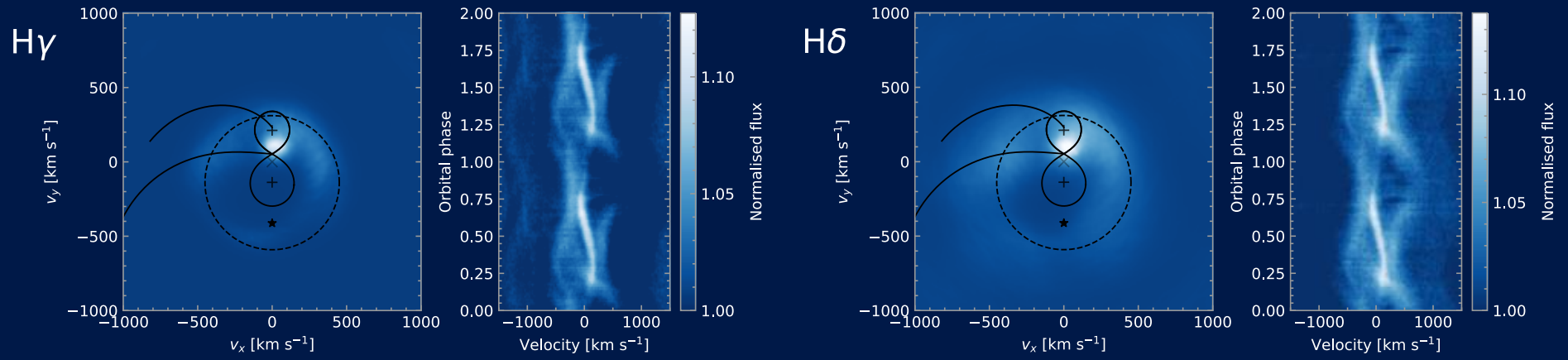
Doppler tomography

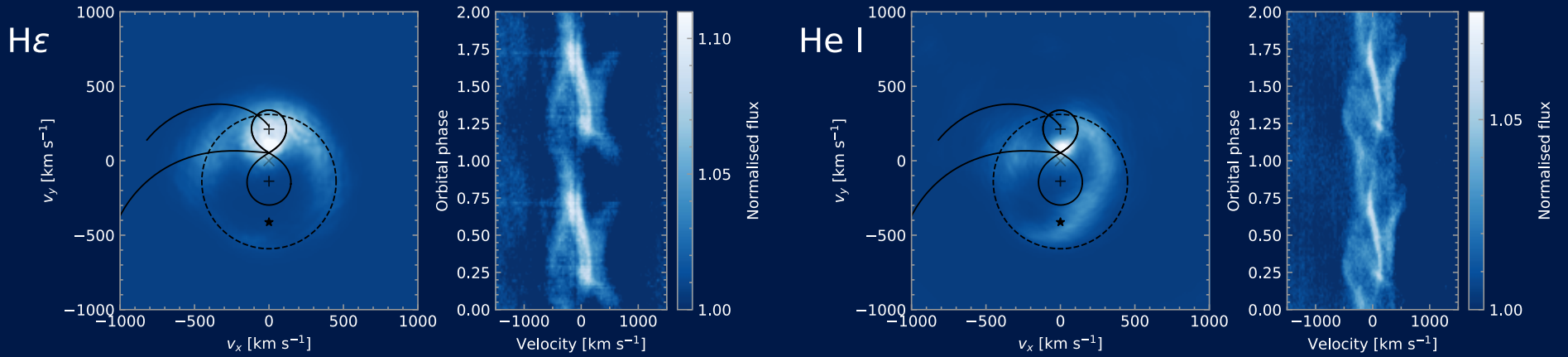
Hα



Doppler tomography







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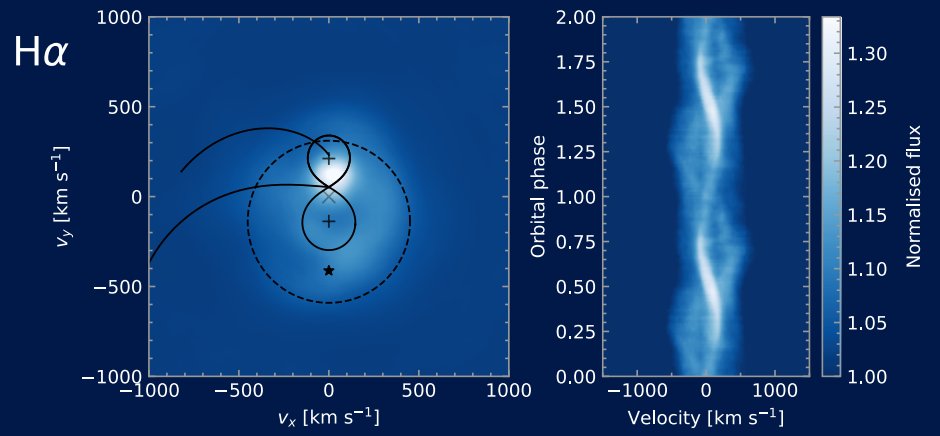
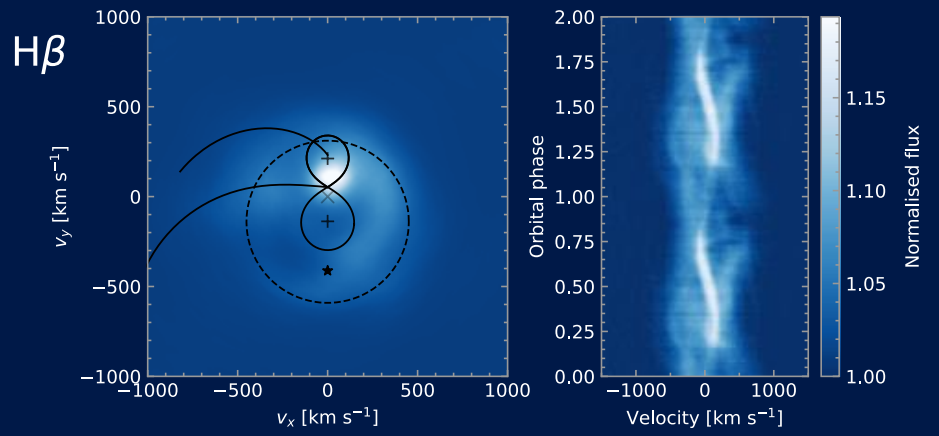
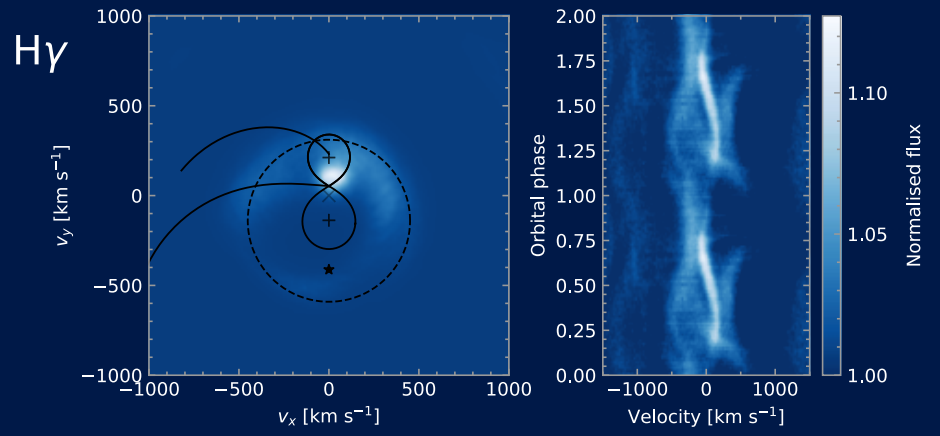
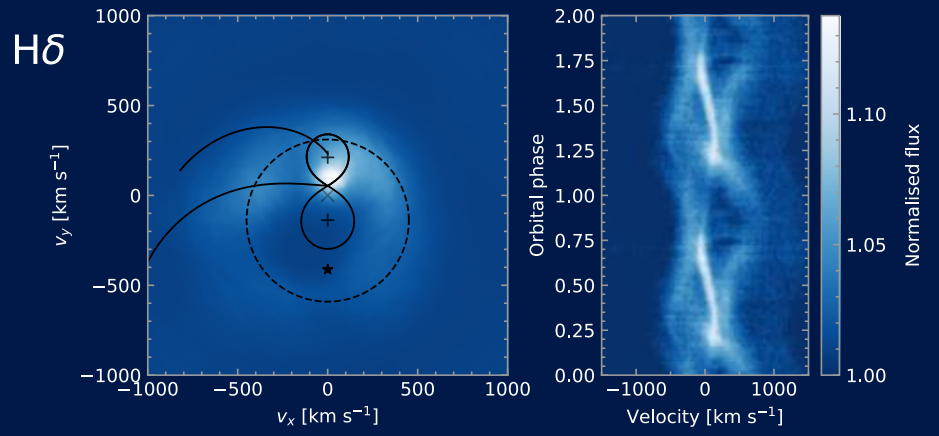
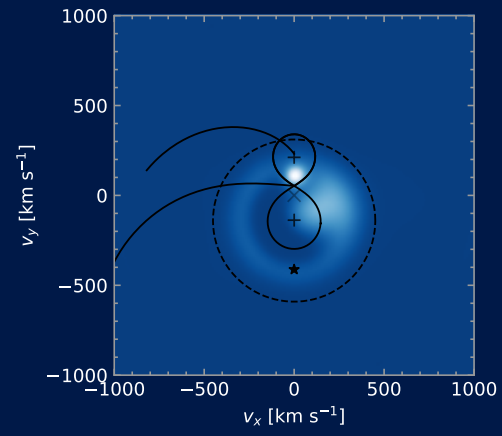
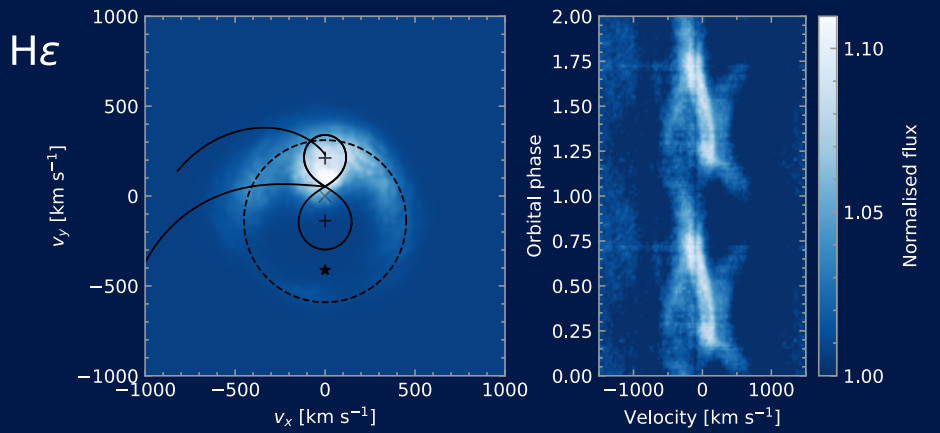


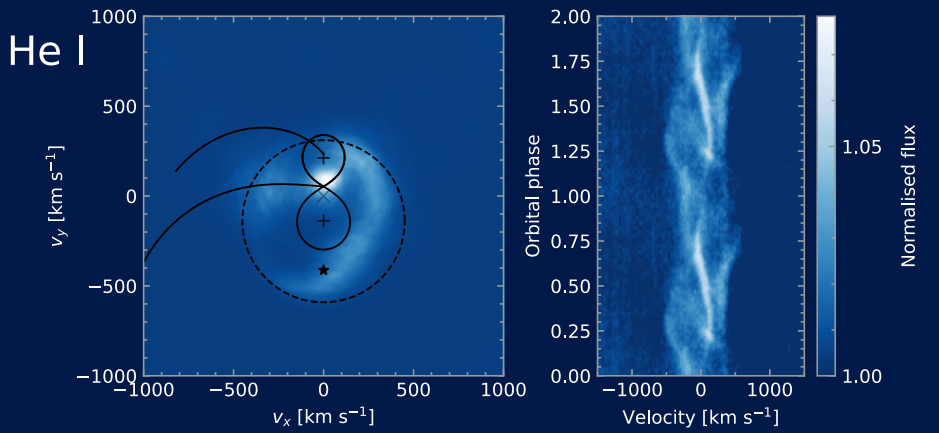








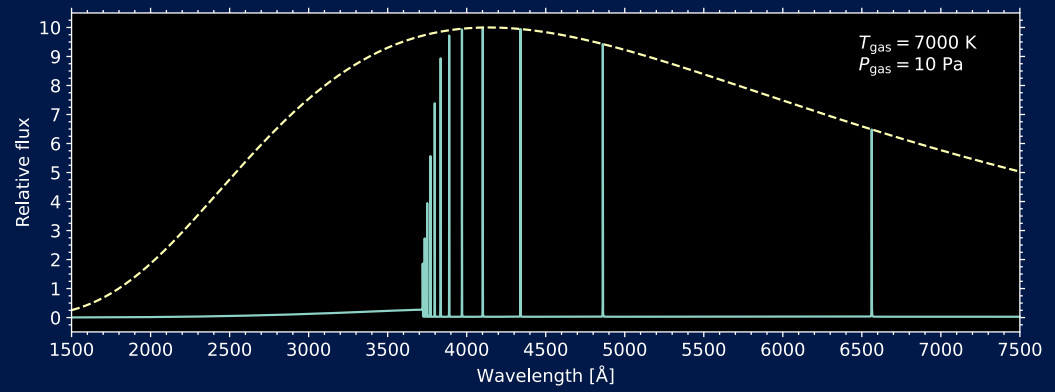


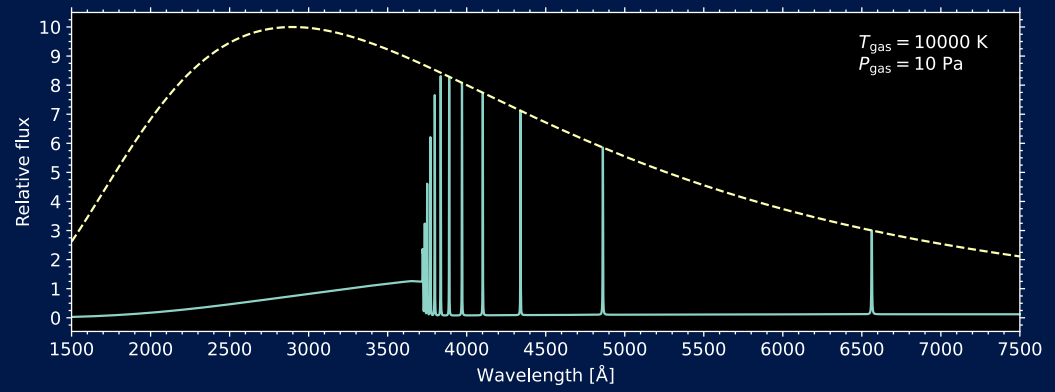


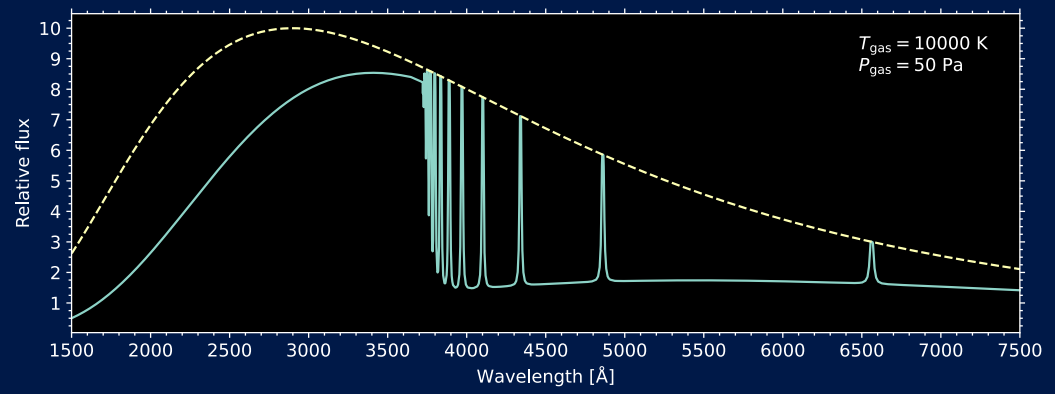
Map based on model presented by Kubiak et al. (1999)

Spectra of accretion discs

- Flux in Balmer lines follows the black-body radiation





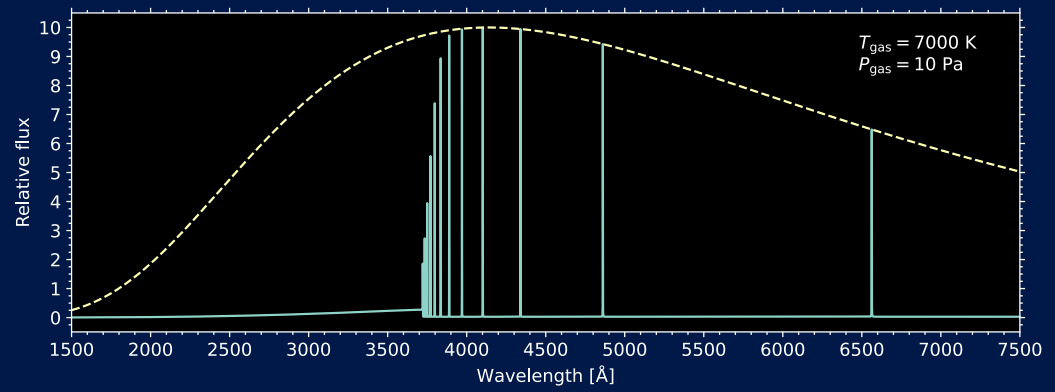


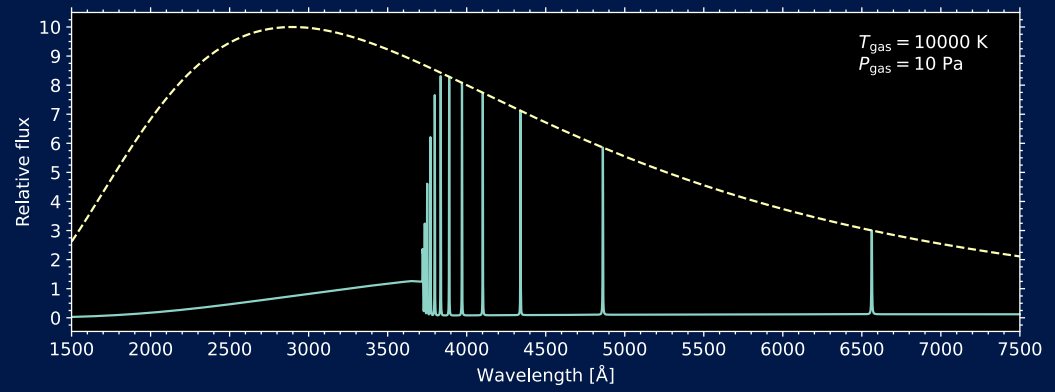
Spectra of accretion discs

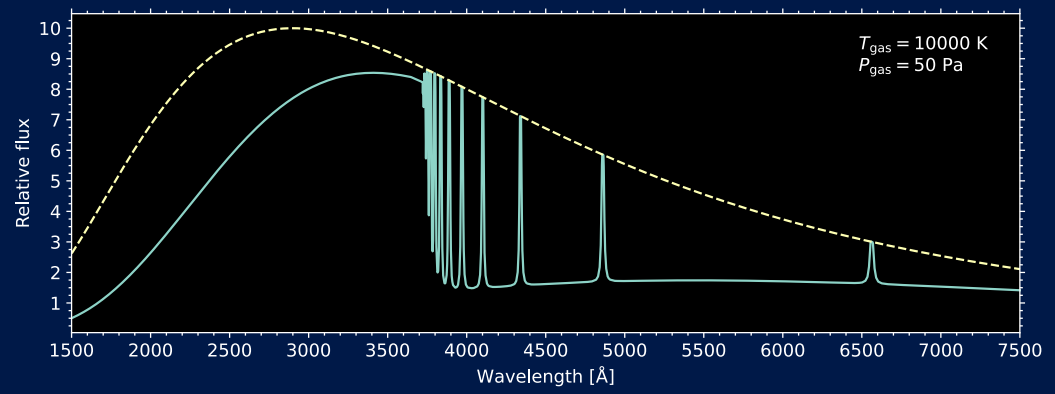
- Flux in Balmer lines follows the black-body radiation

- Ratios of Balmer line fluxes → temperature

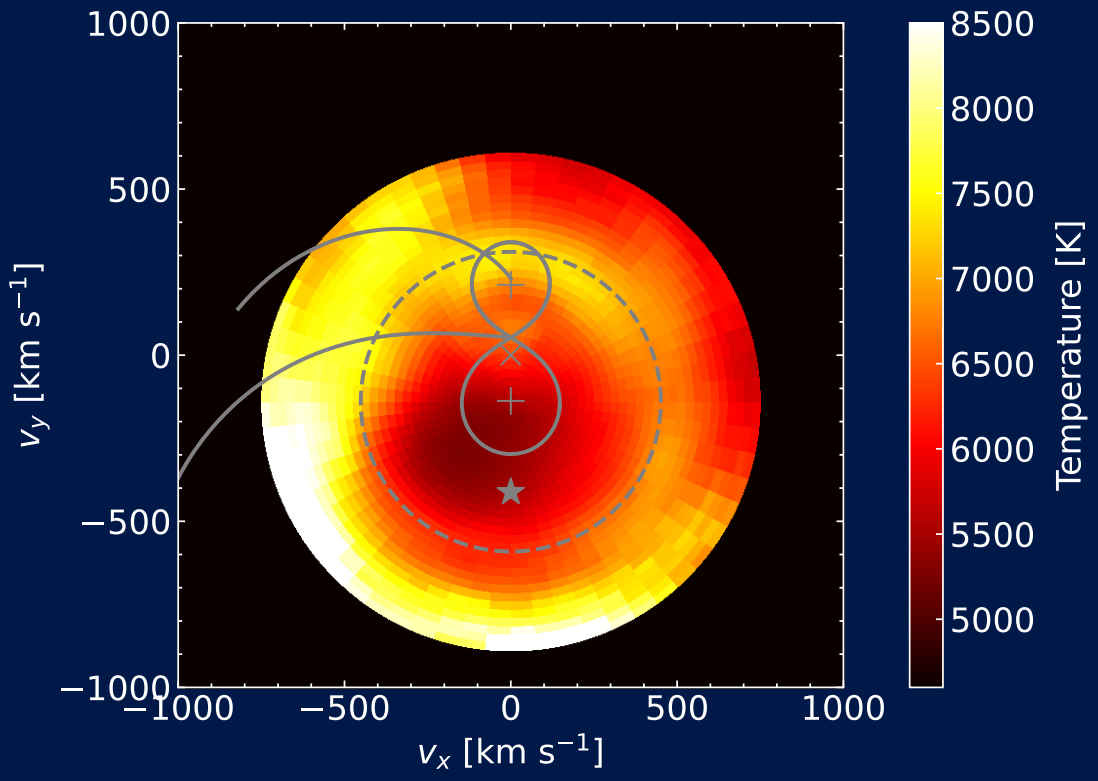
Rutkowski et al. (2016)

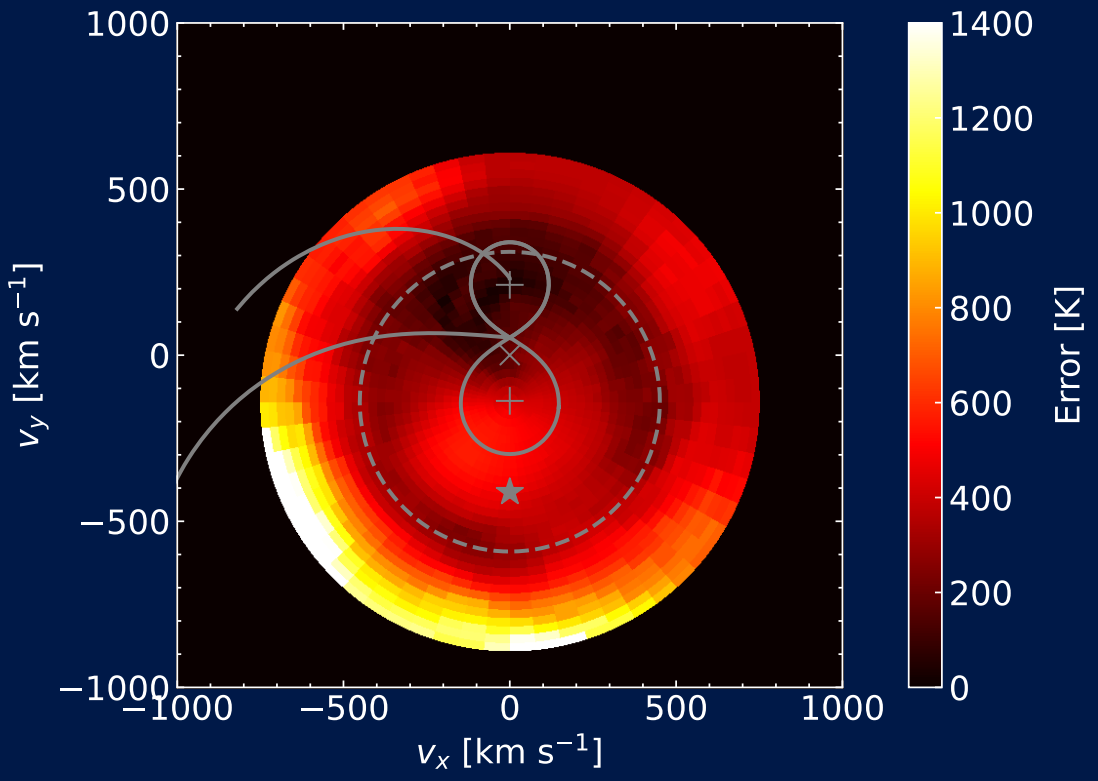






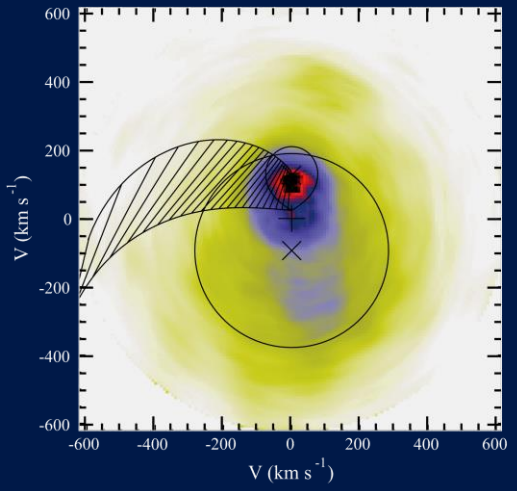
Temperature distribution map





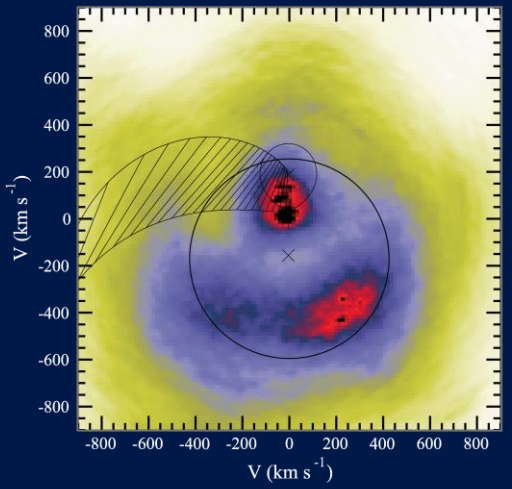
Outflows observed in other high mass-transfer nova-like CVs

RW Sex



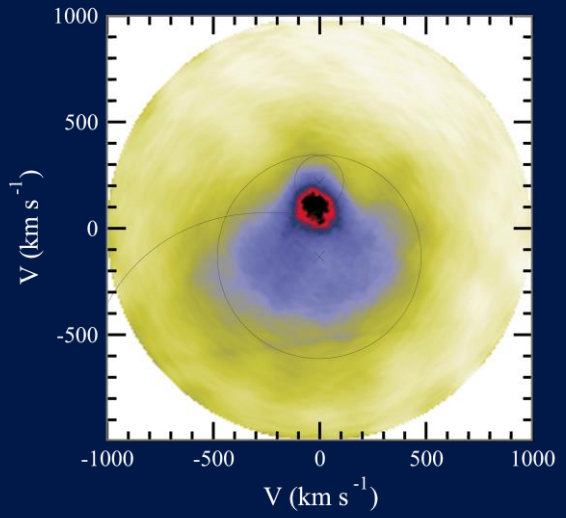
Hernandez et al. (2017)

1RXS J064434.5+334451



Hernandez et al. (2017)

RW Tri



Subebekova et al. (2020)

Summary

- We presented first study of IX Vel using Doppler tomography
- IX Vel shows emission originating outside of the disc in an outflow region.
- The presence of outflows classifies IX Vel as a member of RW Sex stars as defined by Hernandez et al. (2017).
- The structure of outflows can be probed using high-resolution time-resolved spectra.
- Presence of outflows in nova-like systems might play an important role in understanding their evolution.