Emission line spectropolarimetry and circumstellar structures

Jorick S. Vink
(Armagh Observatory)
Luminosity

HRD

O stars

Herbig AeBe

T Tauri

ZAMS

O B A F G K M
Outline

• Spectropolarimetry as a geometric Tool
• 2D Wind Flattening = Disk-like
• 3D Wind Clumping
• Kinematics: rotating accretion disks

• Massive Stars
• PMS stars
Polarisation across line?

1. No change
2. Dilution
3. LINE Polarisation
1 - No Polarisation
2 - Dilution
3 - Line Polarisation
Be star Zeta Tau - it works!

- [Graph showing H_alpha intensity, position angle, and velocity distribution.]

(Vink et al., 2009, A&A 505, 743)
Uppermost HRD
Line-driven winds

\[ g_{\text{rad}} = \frac{\kappa F}{c} = \frac{\kappa L}{4\pi R^2 c} \]
Progenitor for Collapsar model

- No hydrogen envelope: Wolf-Rayet
- Rapid Rotation
Population of rotating WR stars

Vink et al. (2011, A&AL 536,10)
LBV: AG CAR

Davies et al. (2005)
Line-Driven Instability

(OWOCKI)
Sub-surface convection!

Subphotospheric origin of clumping?

(Cantiello et al. 2009)
PMS data: Herbigs and T Tauris

Herbig Be

T Tauri
QU: Herbig Ae and T Tauri star

MWC 480

RY Tau
Models of COMPACT line emission

• 3D Monte Carlo
• Keplerian rotating disk
• Scattering only – no line transfer
• With & without a hole

(But see Milic & Faurobert (2014) for line transfer
see Kuhn et al. (2007) for optical pumping)
With/without a hole

T Tauri stars: Magnetospheric
Constraining the inner disk radius

(Vink et al. 2005a + 2005b)
Spectropolarimetric Monitoring
Summary

- Linpol can be used to identify rotating WR stars - and GRB progenitors at low Z
Summary

- Linpol can be used to identify rotating WR stars - and GRB progenitors at low Z
- Wind clumping starts IN photosphere! (sub-surface convection?)
Summary

- Linpol can be used to identify rotating WR stars - and GRB progenitors at low Z
- Wind clumping starts in the photosphere! (sub-surface convection?)
- Herbig Ae/Be have small-scale disks
Summary

- Linpol can be used to identify rotating WR stars - and GRB progenitors at low Z
- Wind clumping starts IN photosphere! (sub-surface convection?)
- Herbig Ae/Be have small-scale disks
- Transition between Herbig Bes and Aes
Summary

• Linpol can be used to identify rotating WR stars - and GRB progenitors at low Z
• Wind clumping starts IN photosphere! (sub-surface convection?)
• Herbig Ae/Be have small-scale disks
• Transition between Herbig Bes and Aes
• Inner disk radii consistent with magnetospheric accretion
Summary

• Linpol can be used to identify rotating WR stars - and GRB progenitors at low Z
• Wind clumping starts IN photosphere! (sub-surface convection?)
• Herbig Ae/Be have small-scale disks
• Transition between Herbig Bes and Aes
• Inner disk radii consistent with magnetospheric accretion
• QU specpol monitoring
Final message

- Lots of interesting stellar QU data
Final message

- Lots of interesting stellar QU data
- More expertise in polarizing mechanisms!