Collisions in massive binaries

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Colliding winds

- Massive stars eject dense stellar winds
    (v~1000s of km/s, mass-loss of $10^{-4 \text{ to } -8}$ M_{sol}/yr)
- In binaries, winds collide and some collisions emit X-rays
- Phase-locked variations expected:
    ➢ Because of changing orbital separation
    ➢ Because of changing absorption along the line-of-sight

Light curves of WR21, EPIC-pn in green MOS-1 in black, MOS-2 in red
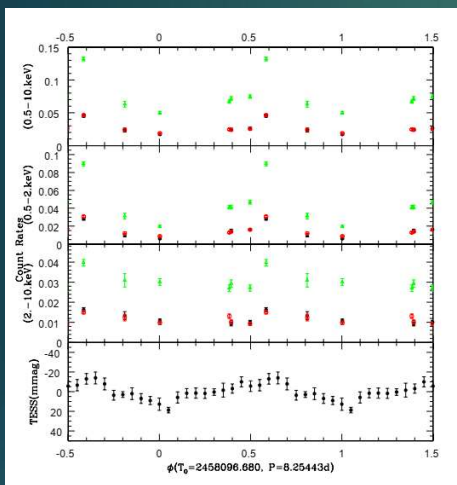

An experiment…

- V444 Cyg (WN5+O6, P=4.2d, i=78°) monitored in detail with XMM
    (Lomax et al. 2015, A&A, 573, A43)
- Two other systems with similar properties
        (circular orbit, short period):
    ➢ WR21 (WN5+O7, P=8.3d)
    ➢ WR31 (WN4+O8, P=4.8d)
→ Possibility to study colliding winds while changing as few parameters as possible

Notes:
- ephemeris checked with optical photometry & spectroscopy – only minimal changes requested
- Inclination derived from spectropolarimetry : ~50° for both cases

WR21

- 6 exposures: no variation within each pointing but between them, peak at φ~0.6 (NOT 0.5!)
- Spectral fitting : 3 temperatures
    ➢ Lowest one has a constant absorption but is slightly brighter when O-star in front
    ➢ Absorption larger when WR in front
- Modelling
    ➢ OK for soft band with large annuli closer to O-star and slightly offset + intrinsic wind emission
    ➢ Hard band not well fitted
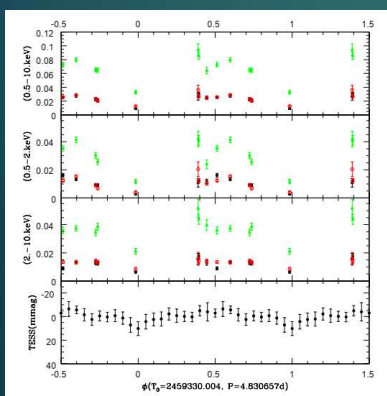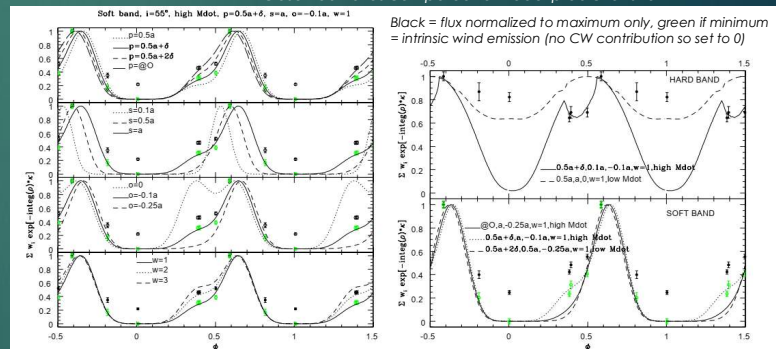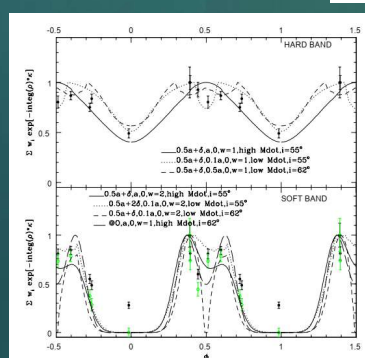   (variations either too large or too small)
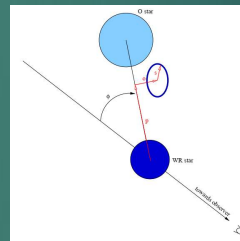
Sketch of the model

Simple modelling

- Emission annuli potentially offset from the line of centers
- Absorption of WR wind only

Observed fluxes compared to model predictions for WR21

Black = flux normalized to maximum only, green if minimum = intrinsic wind emission (no CW contribution so set to 0)

WR31

- 8 exposures
- Peaks before AND after φ = 0.5
- Larger absorption when WR in front
- Modelling: OK for hard band and soft band (eclipse, no offset + intrinsic wind emission needed)

Light curves of WR31 (EPIC-pn in green MOS-1 in black, MOS-2 in red)

Observed fluxes compared to model predictions for WR31

Reference : Nazé et al., in prep.
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