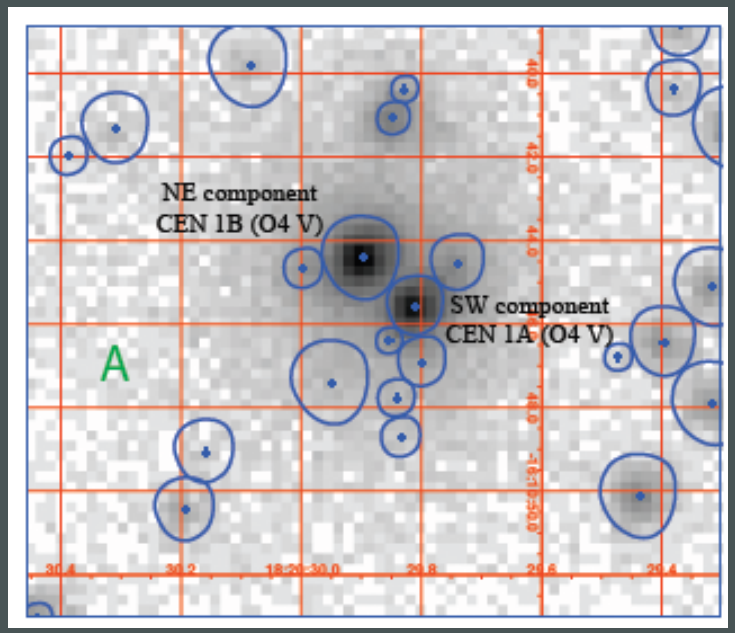
A pair of O stars with hard X-rays in M17

Marc Gagné & David Cohen

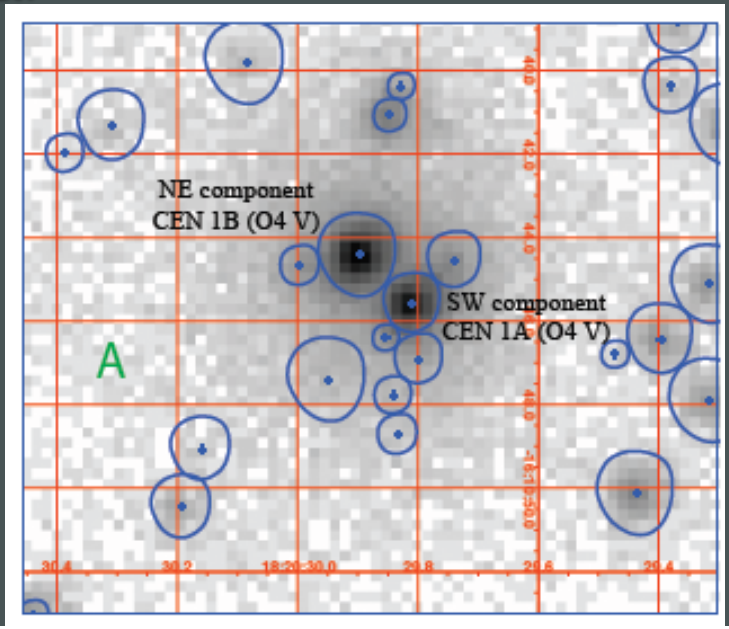
optical



Chandra

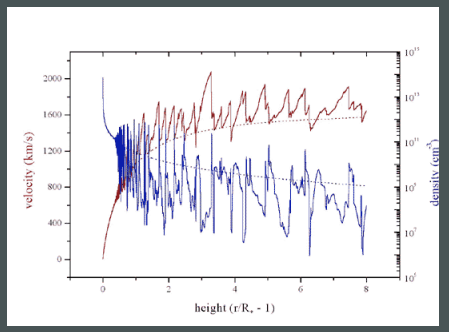
optical

2MASS

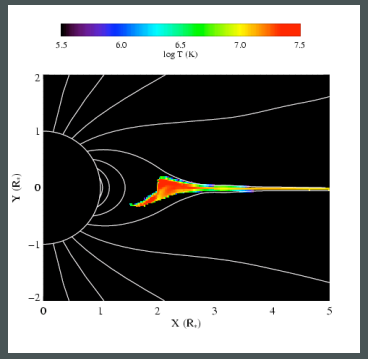


Three models for massive star x-ray emission

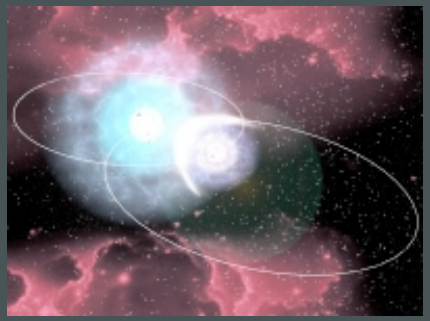
1. Instability driven shocks

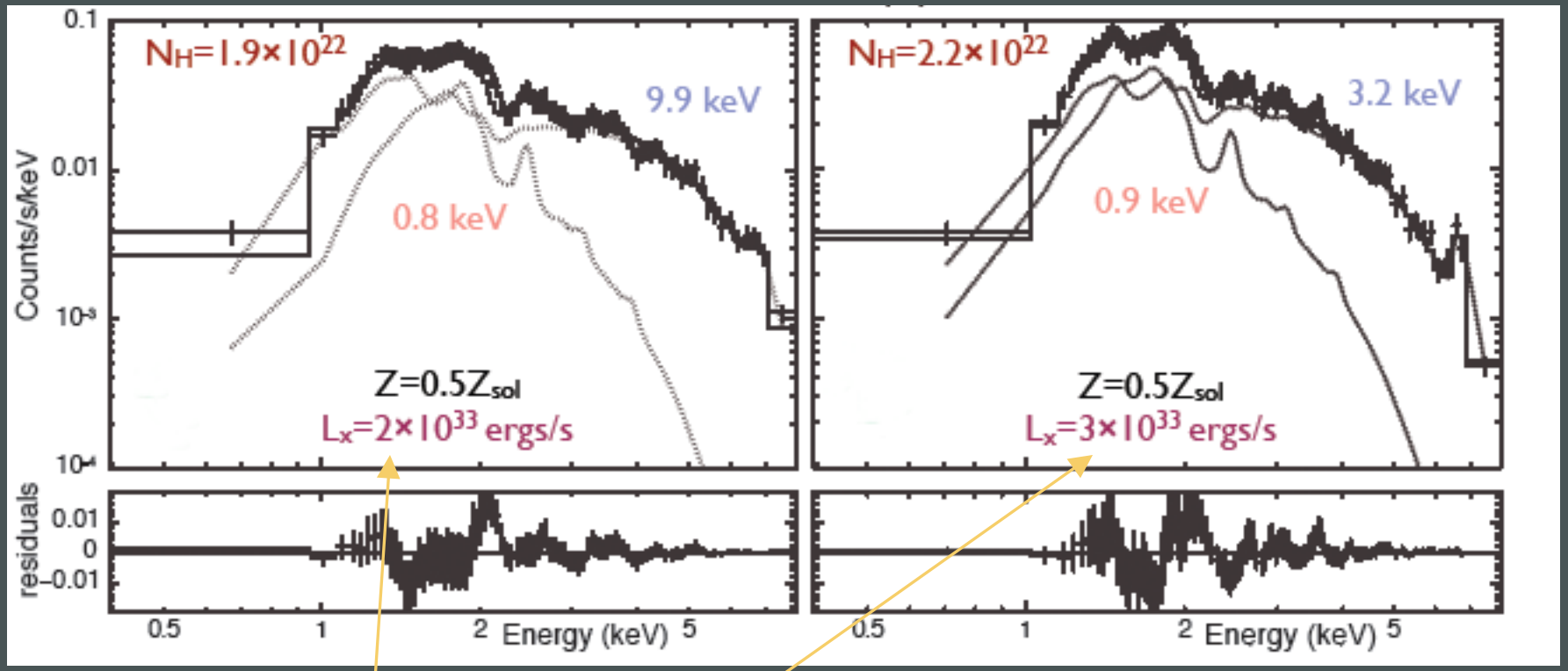


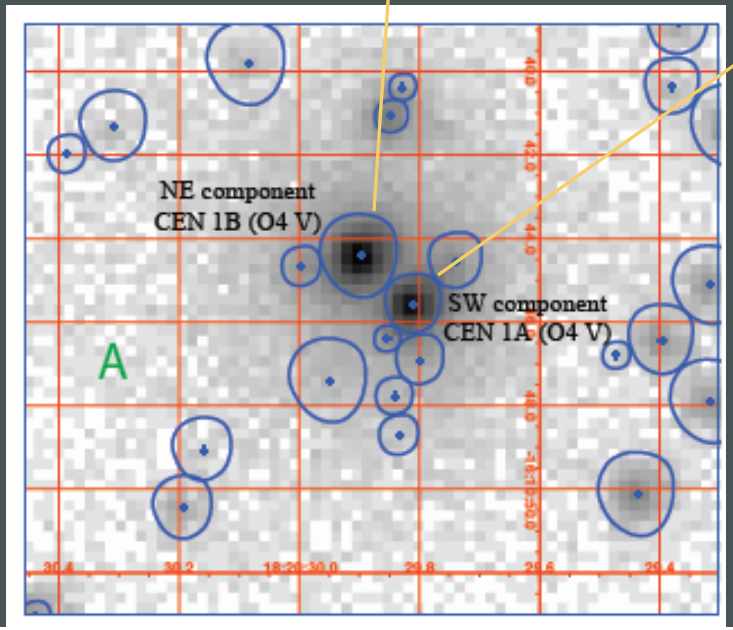
2. Magnetically channeled wind shocks



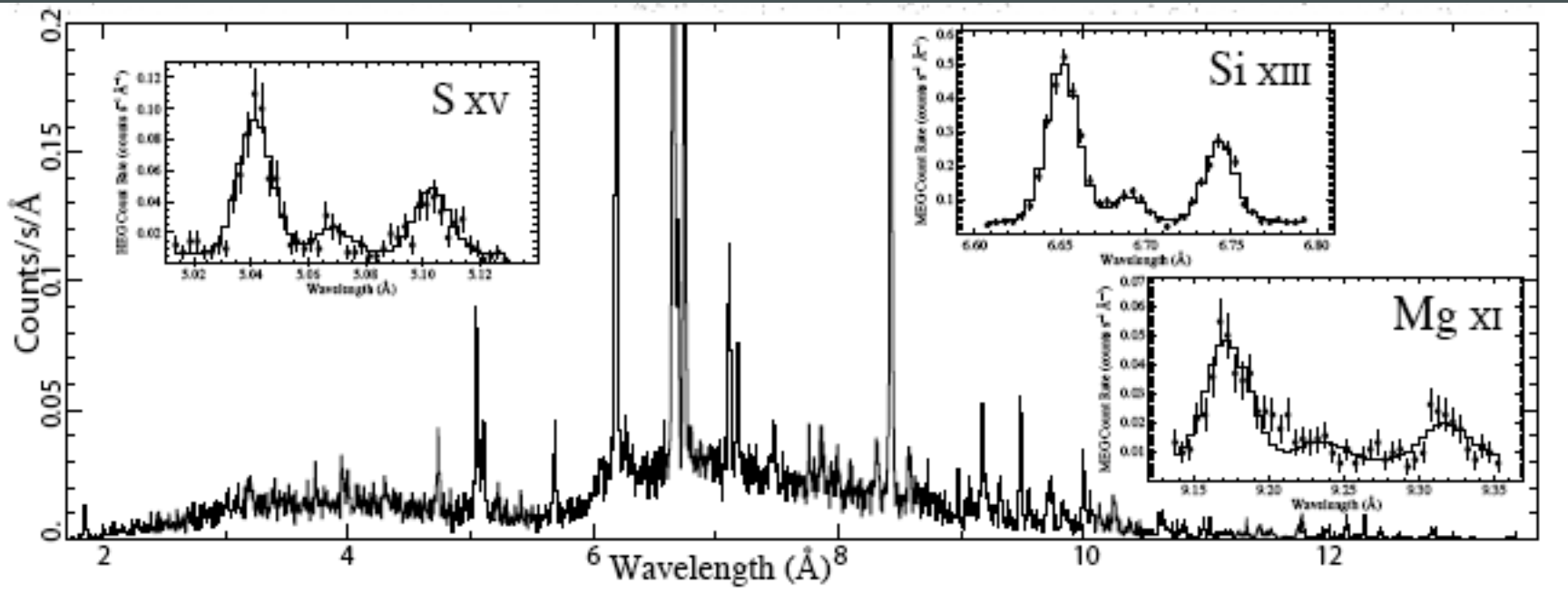
3. Wind-wind interaction in close binaries







CEN1AB - *Kleinmann's Anonymous Star* – is an O4 +O4 binary system – with 1.8" separation (2000 AU) – but indications that each component might be binary

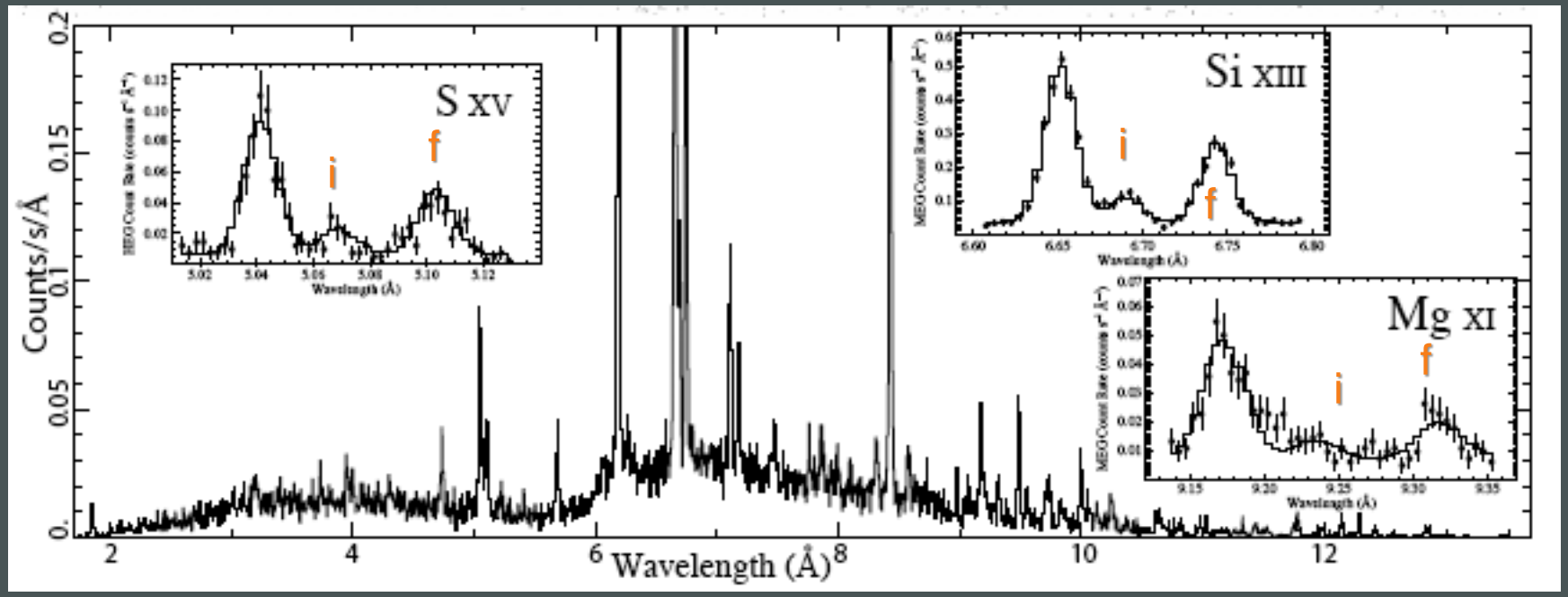


simulated *Chandra grating* spectrum

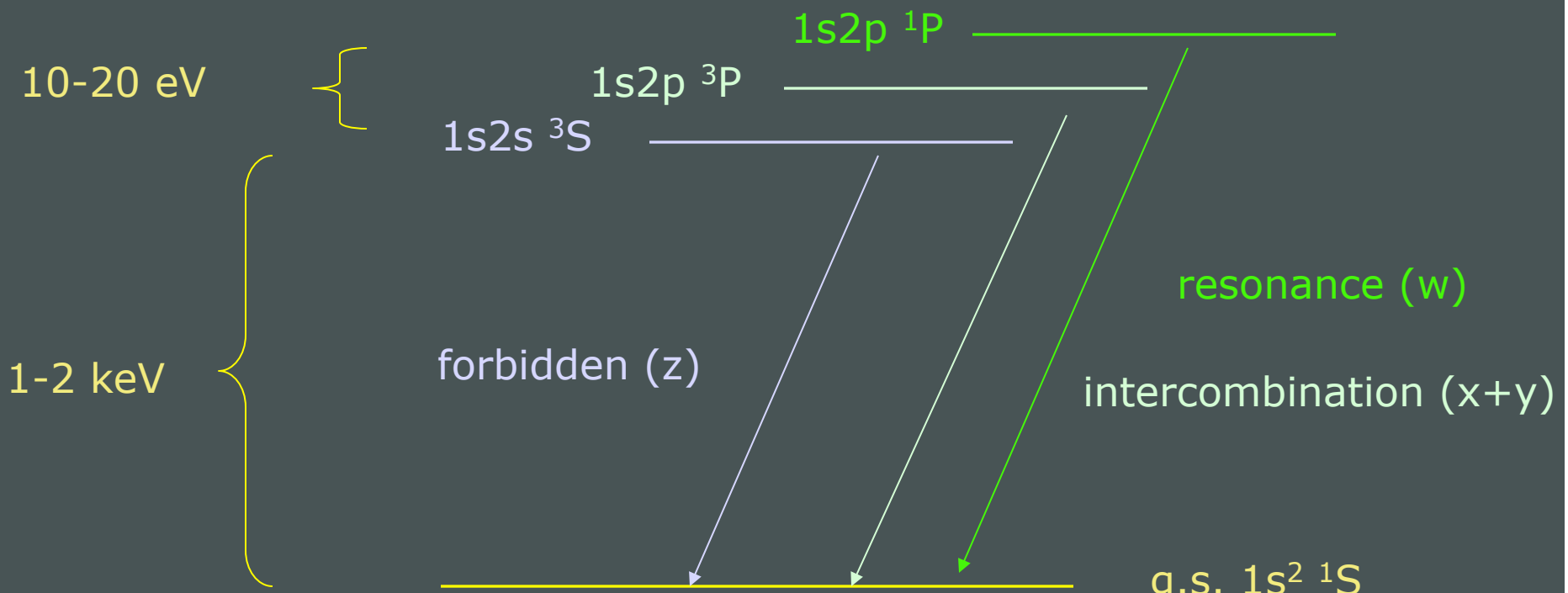
1. Line *ratios* for location of the X-ray emitting plasma
2. Line *widths* for the plasma kinematics

The *Chandra* X-ray Observatory started taking the data yesterday

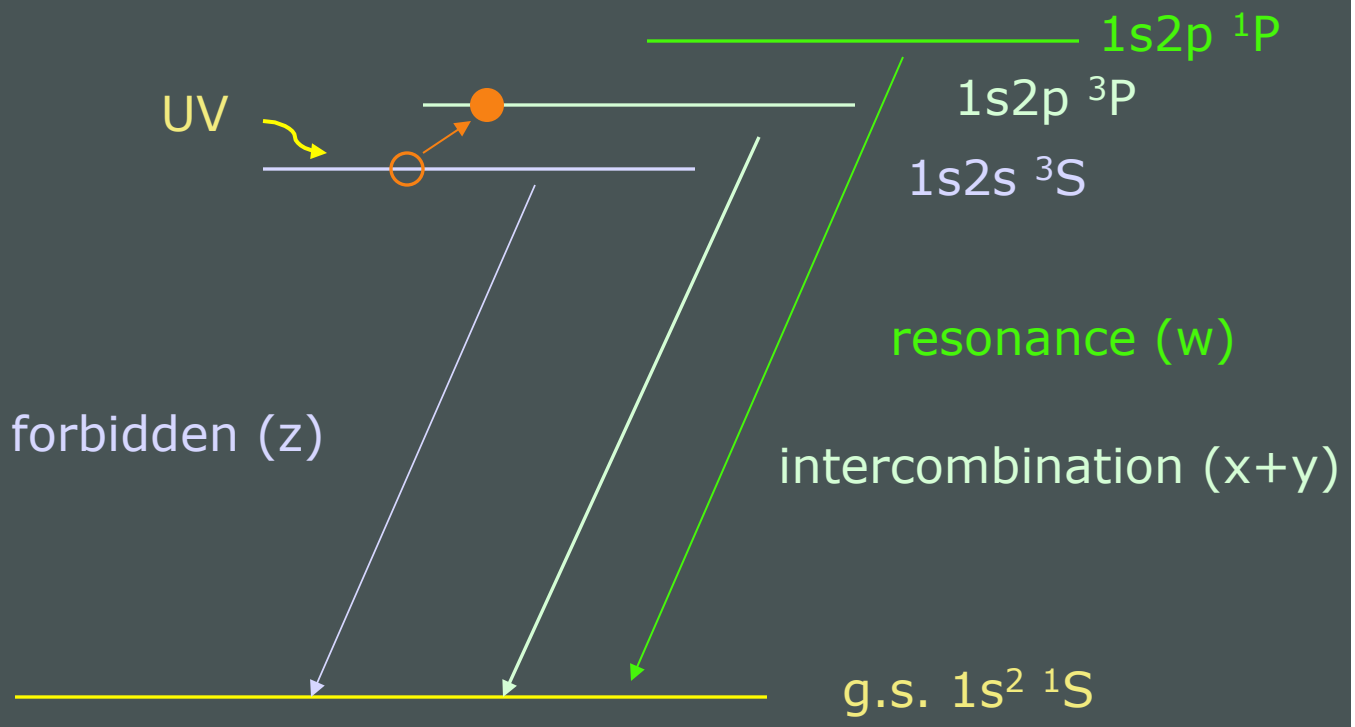
Helium-like species' forbidden-to-intercombination line ratios – *f/i* or *z/(x+y)* – provide information about the *location* of the hot plasma



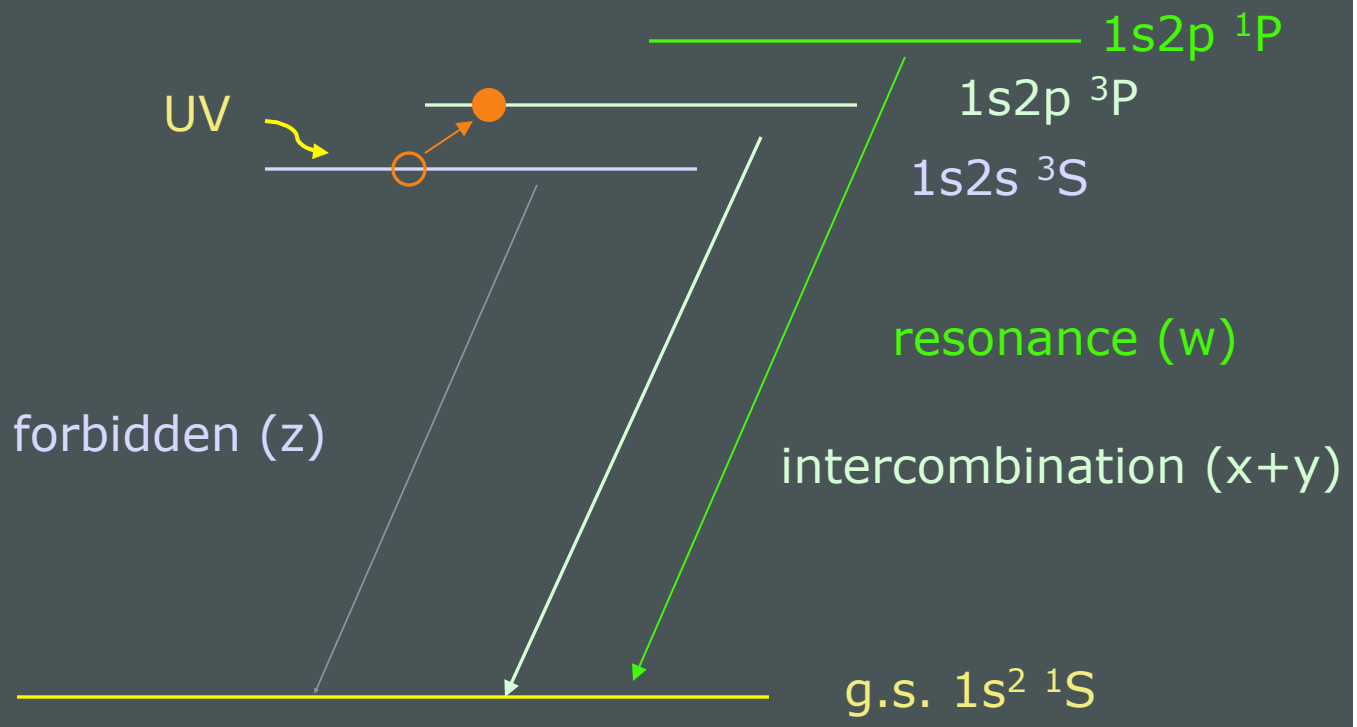
Helium-like ions (e.g. O^{+6}, Ne^{+8}, Mg^{+10}, Si^{+12}, S^{+14}) – schematic energy level diagram



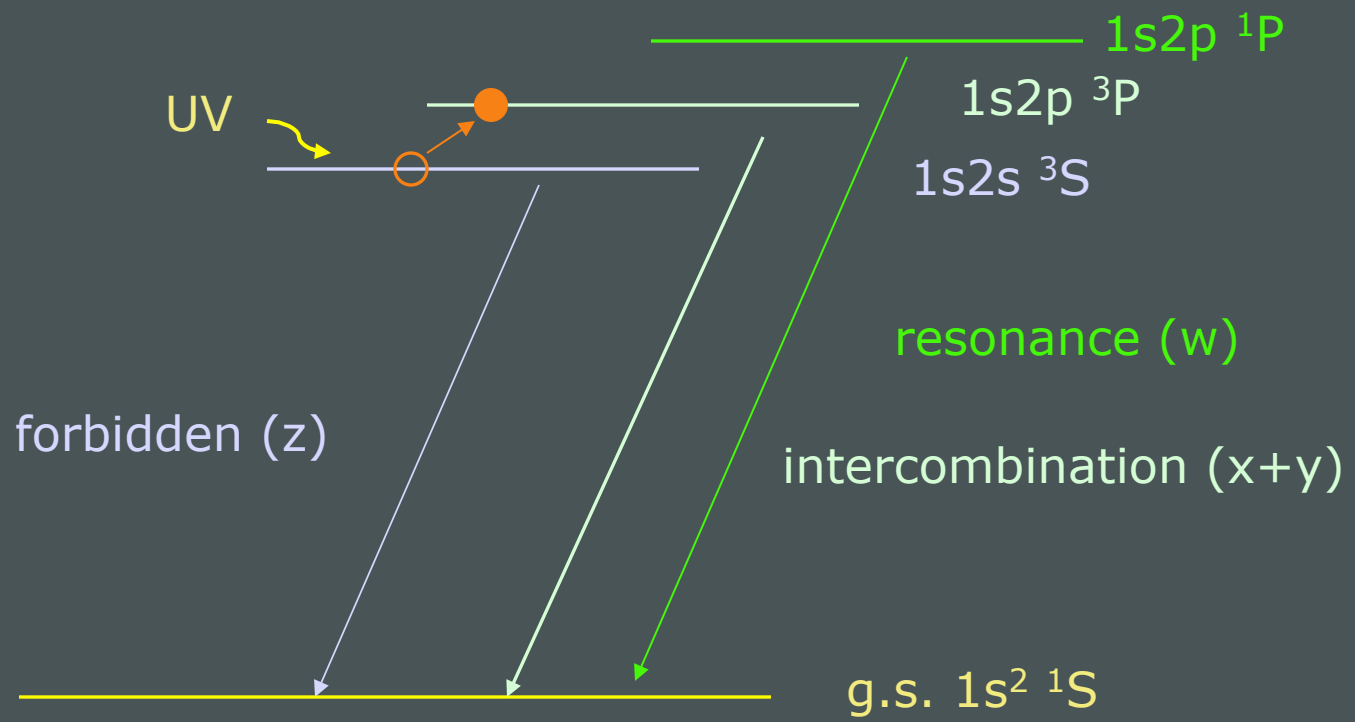
Ultraviolet light from the star's photosphere drives photoexcitation out of the ^3S level



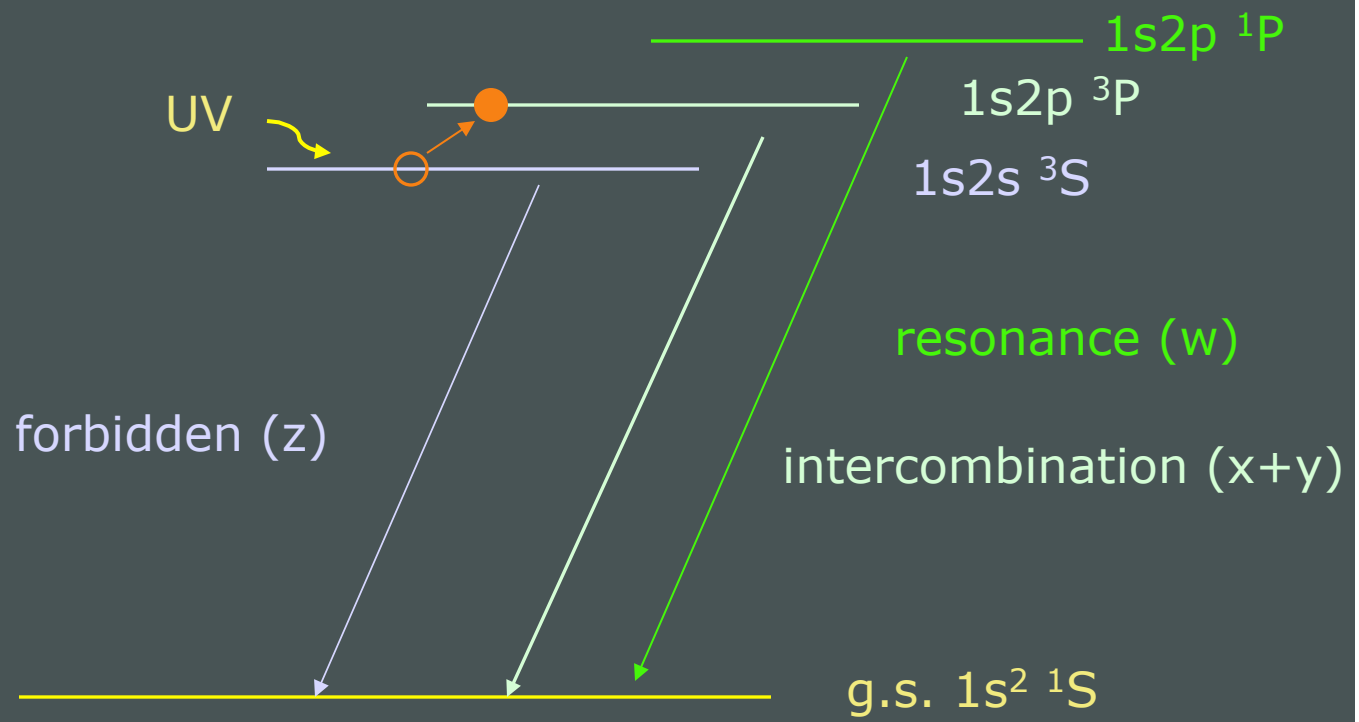
Weakening the forbidden line and strengthening the intercombination line



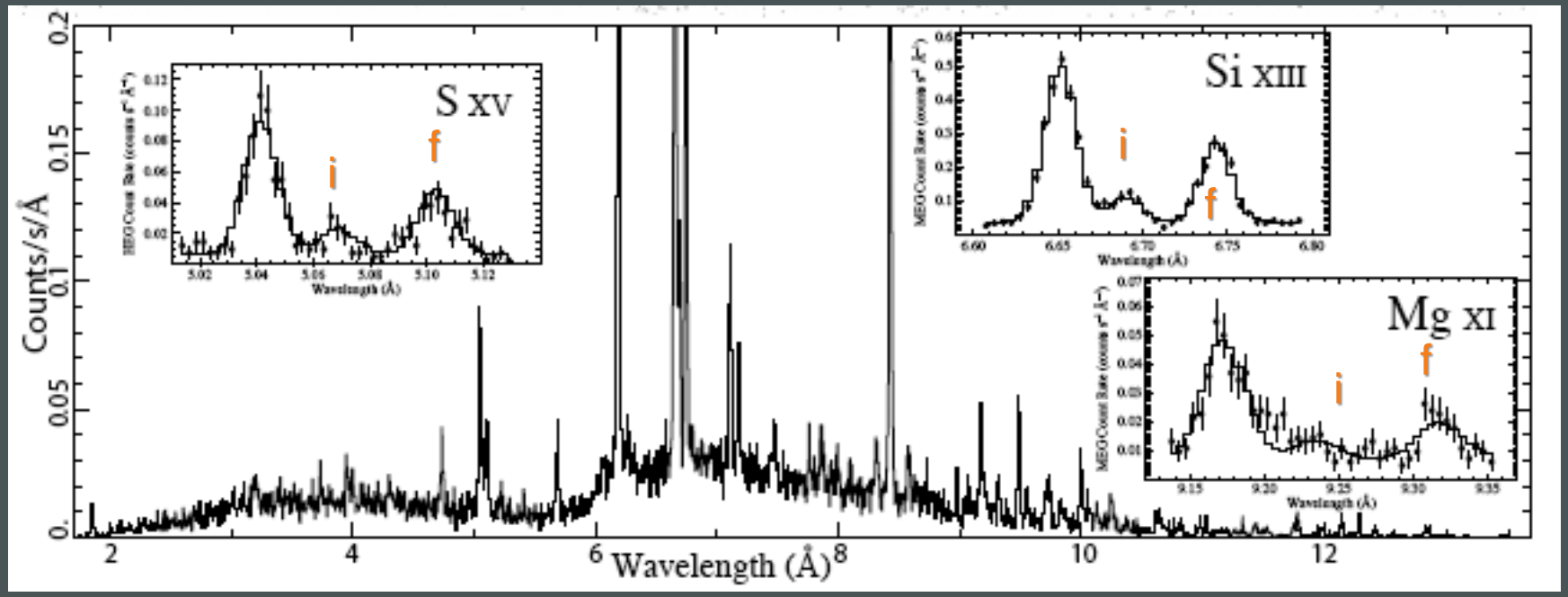
The f/i ratio is thus a diagnostic of the local UV mean intensity…



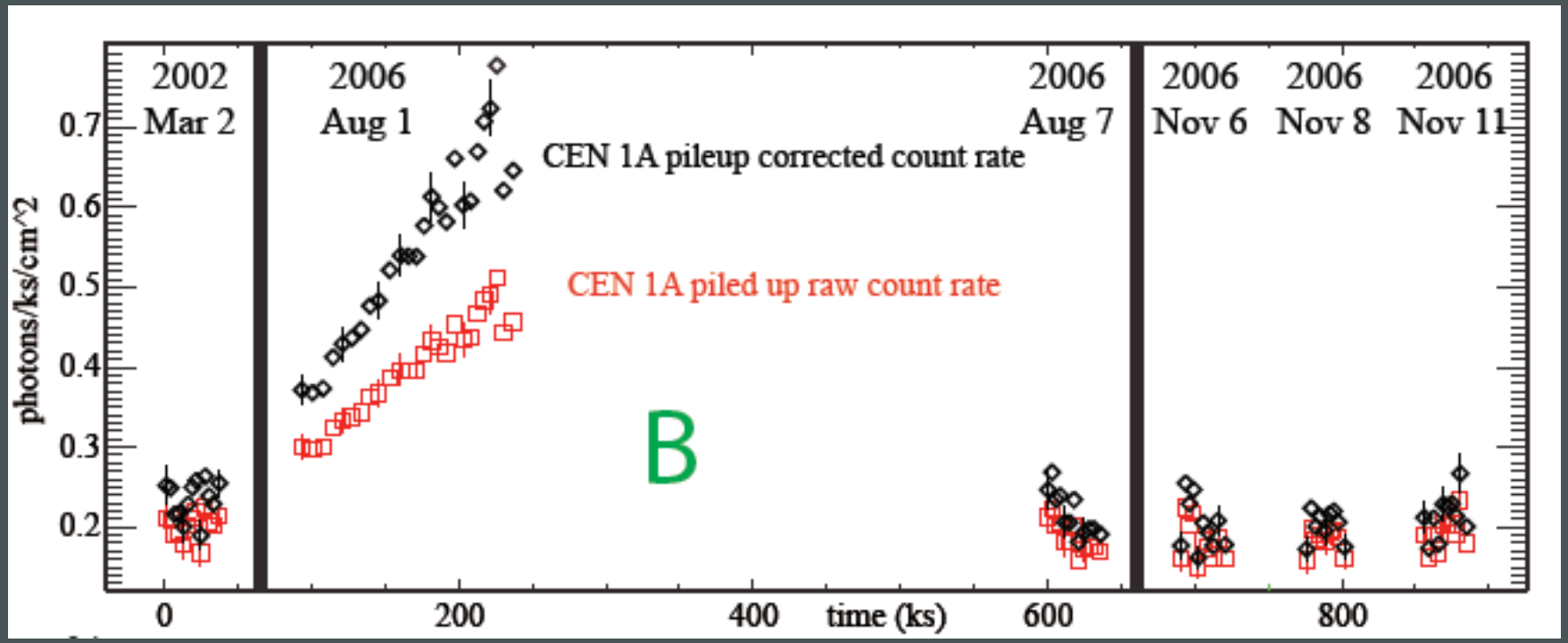
…and thus the distance of the x-ray emitting plasma from the photosphere



CWB not near periastron should have a high f/i ratio



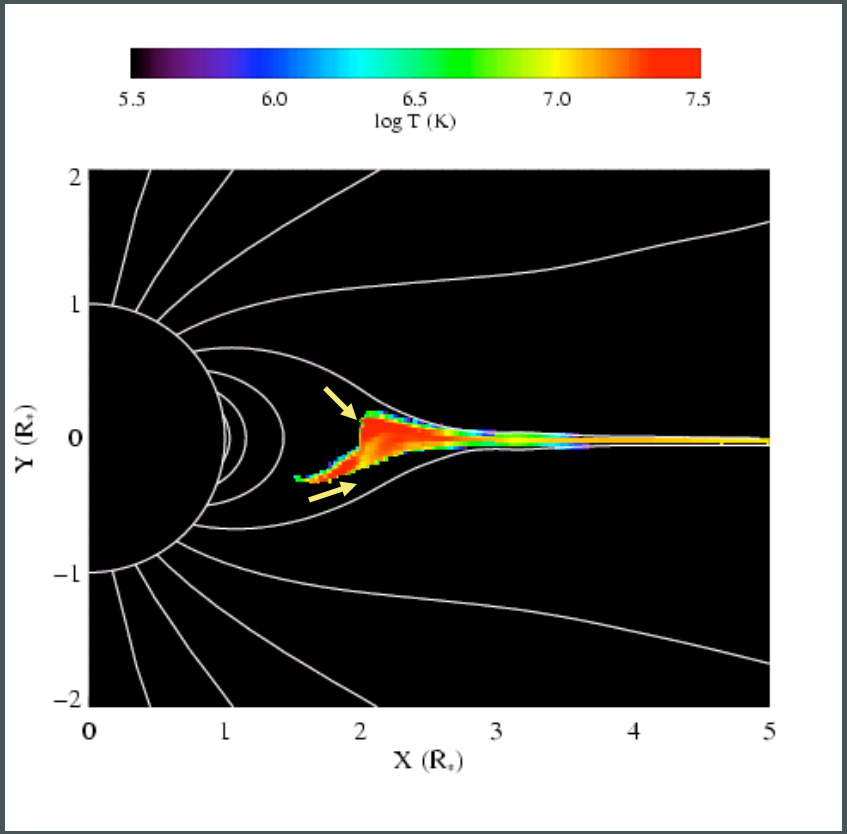
X-ray light curve of CEN 1A: increase over ~1d evidence for colliding wind binary?



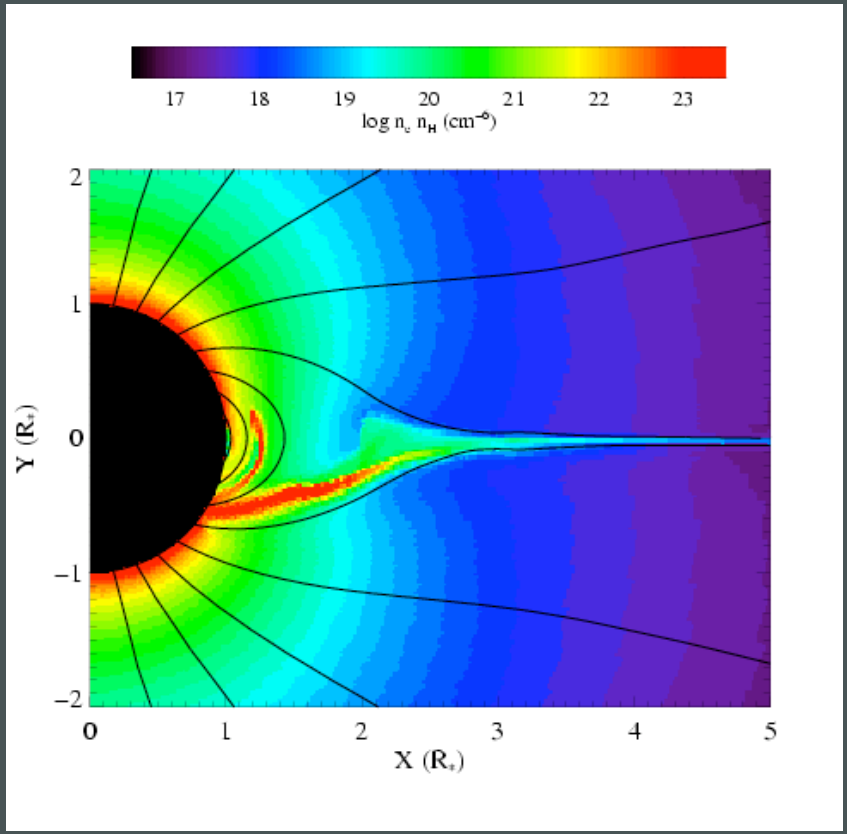
Another example of the f/i diagnostic: θ^1 Ori C

MHD simulation summary

temperature

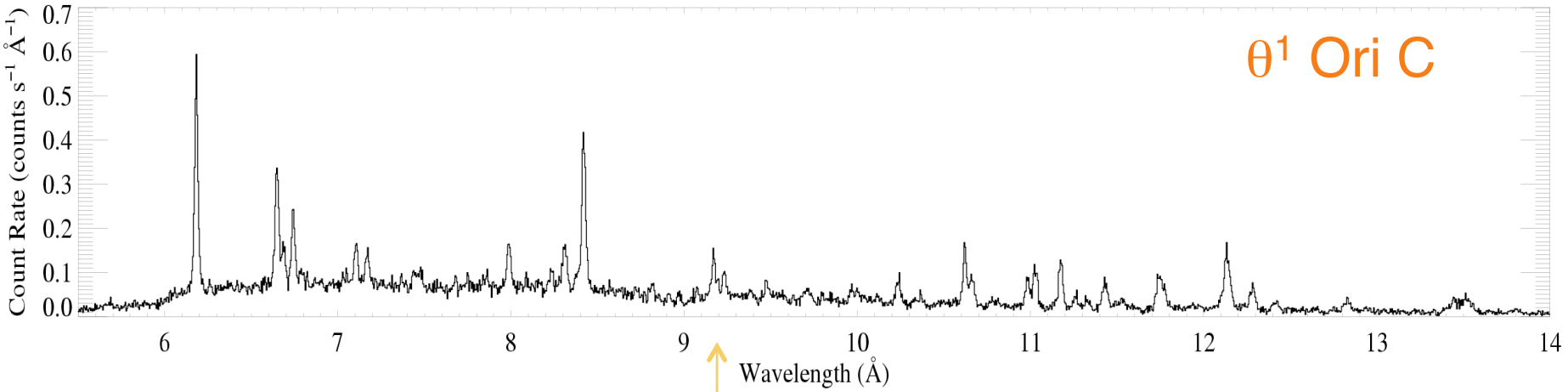


emission measure

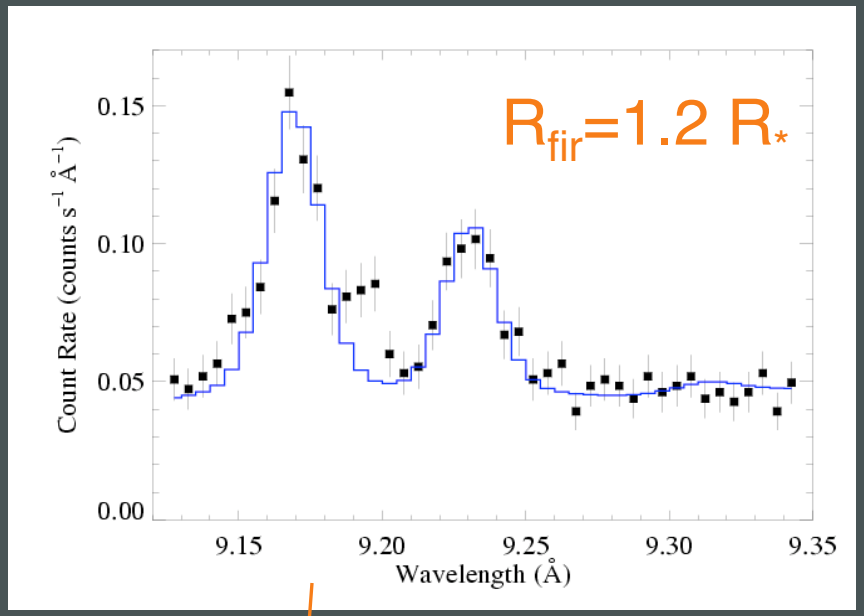


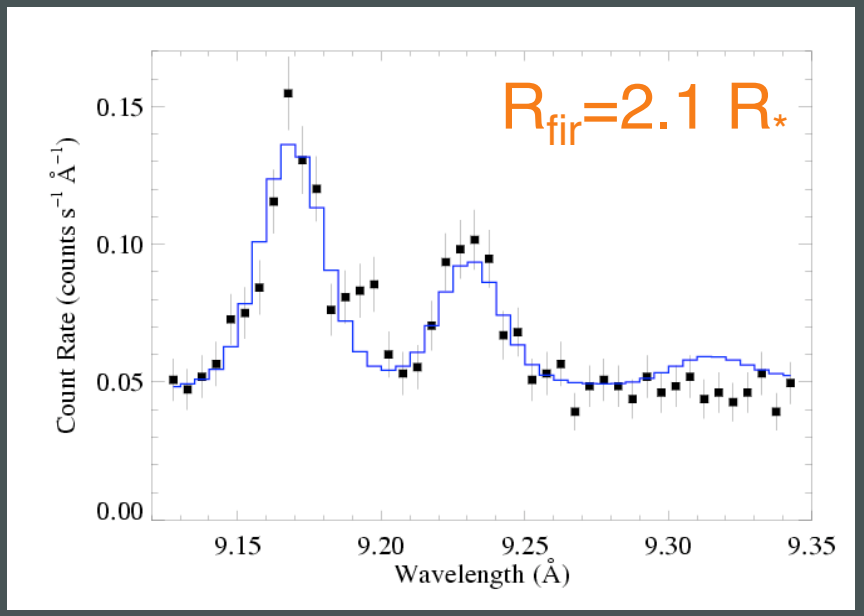
Gagné et al. (2005)

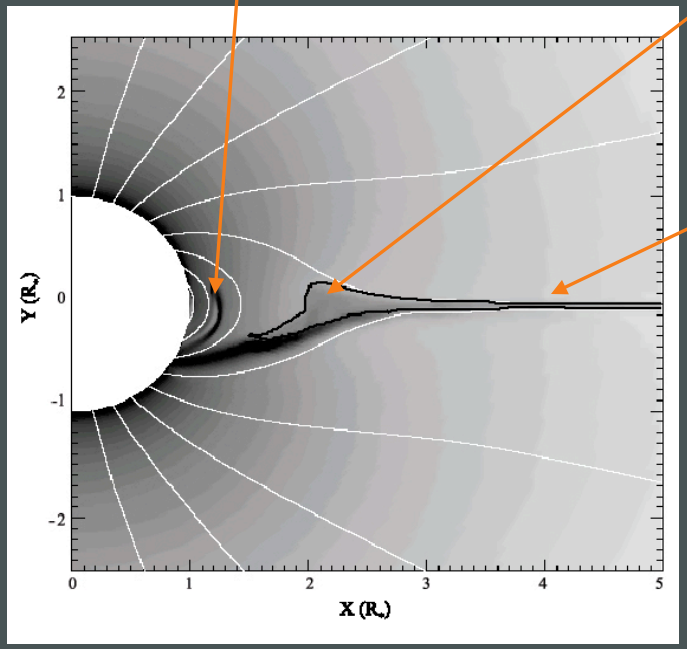
Channeled collision is close to head-on:
$\Delta v > 1000$ km s^{-1} : $T > 10^7$ K

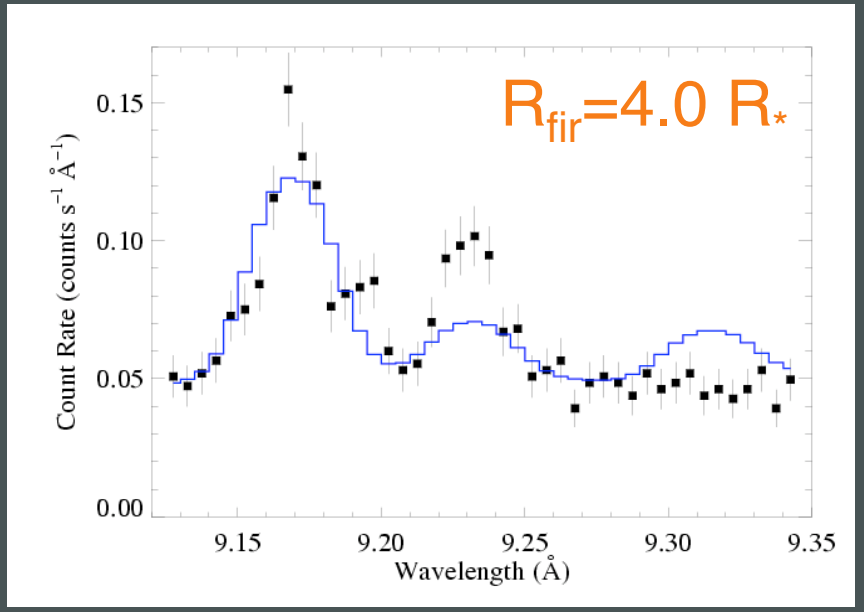

θ¹ Ori C
Count Rate (counts s⁻¹ Å⁻¹)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
6
7
8
9
10
11
12
13
14
Wavelength (Å)

Mg XI

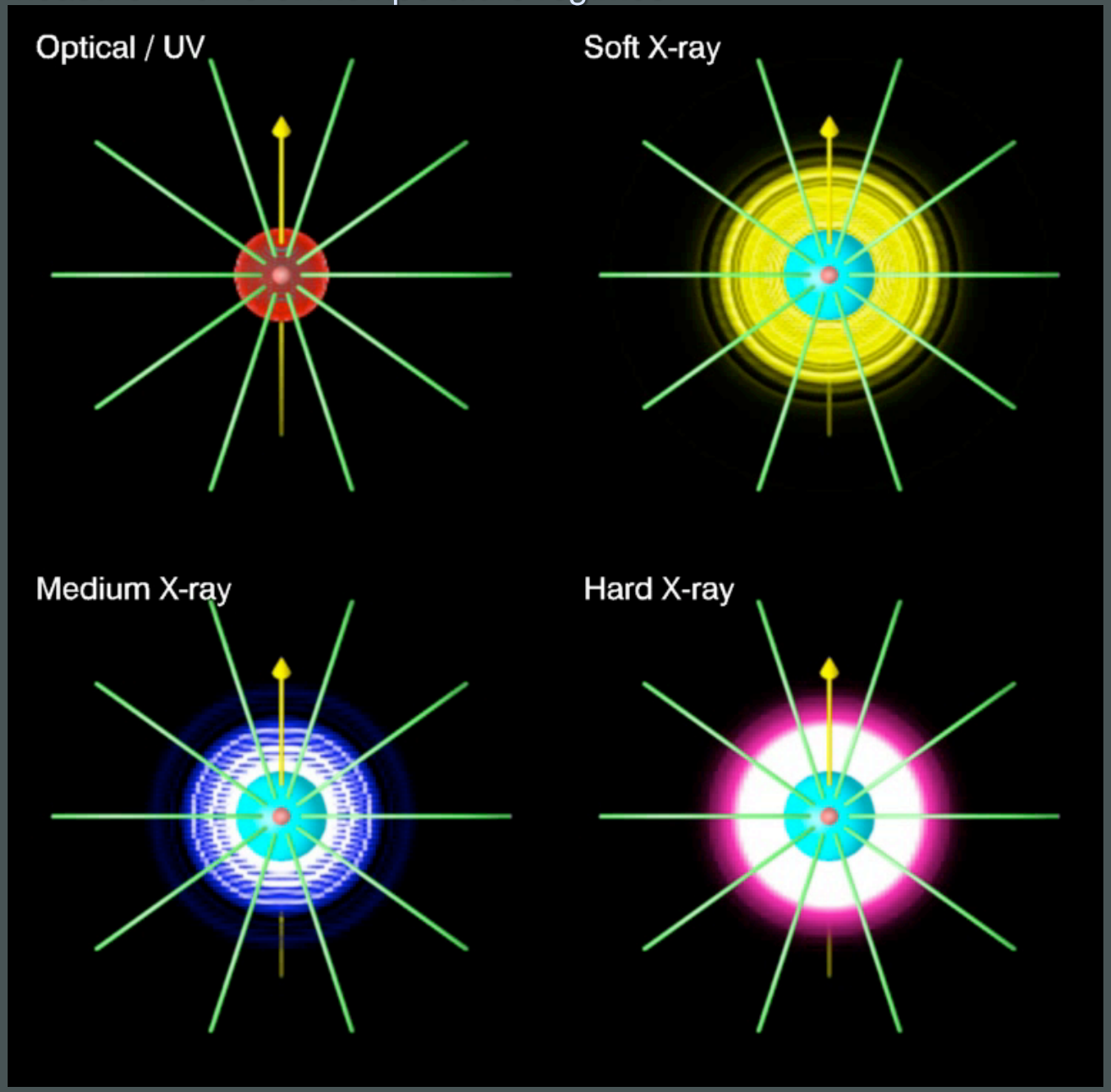

R_{fir}=1.2 R_*
Count Rate (counts s^{-1} Å^{-1})
0.15
0.10
0.05
0.00
9.15
9.20
9.25
9.30
9.35
Wavelength (Å)


R_{fir}=2.1 R_*
Count Rate (counts s^{-1} Å^{-1})
0.15
0.10
0.05
0.00
9.15
9.20
9.25
9.30
9.35
Wavelength (Å)


Y (R_*)
X (R_*)
2
1
0
-1
-2
0
1
2
3
4
5


R_{fir}=4.0 R_*
Count Rate (counts s^{-1} Å^{-1})
0.15
0.10
0.05
0.00
9.15
9.20
9.25
9.30
9.35
Wavelength (Å)

Dynamical models (ud-Doula; Townsend): color scale shows emission measure in different temperature regimes



astro.swarthmore.edu/~cohen/presentations/MiMeS2/zeus-movie.avi