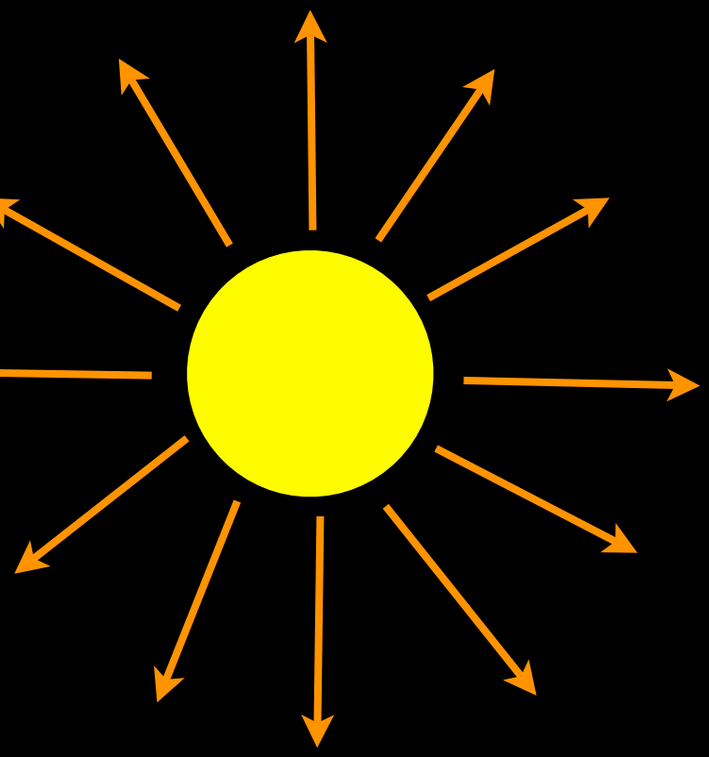
Probing the wind-field interaction with MiMeS and Chandra

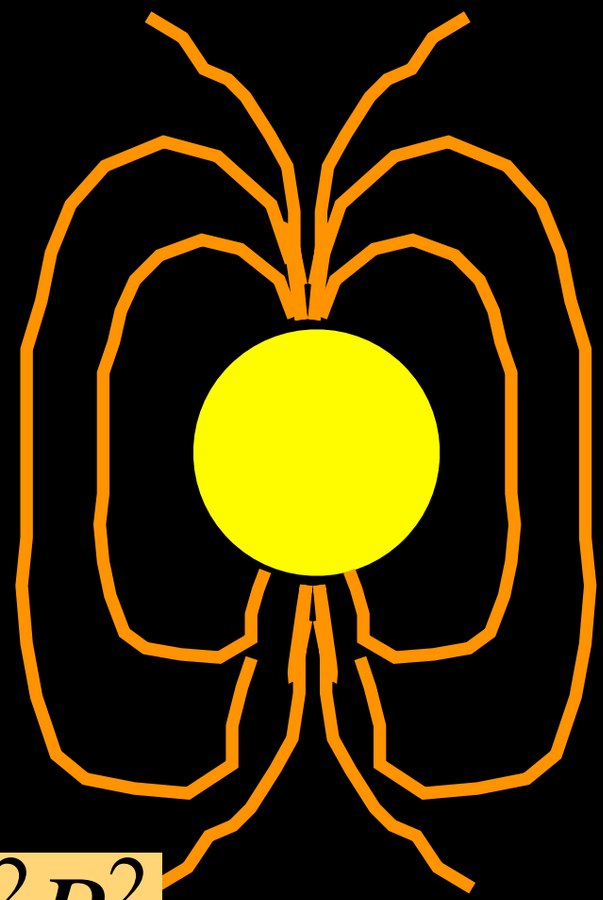
"Magnetic fields are to astrophysics as sex is to psychology"

-H. C. van de Hulst

V. Petit
L. Drissen
G. Wade
T. Montmerle
E. Alecian

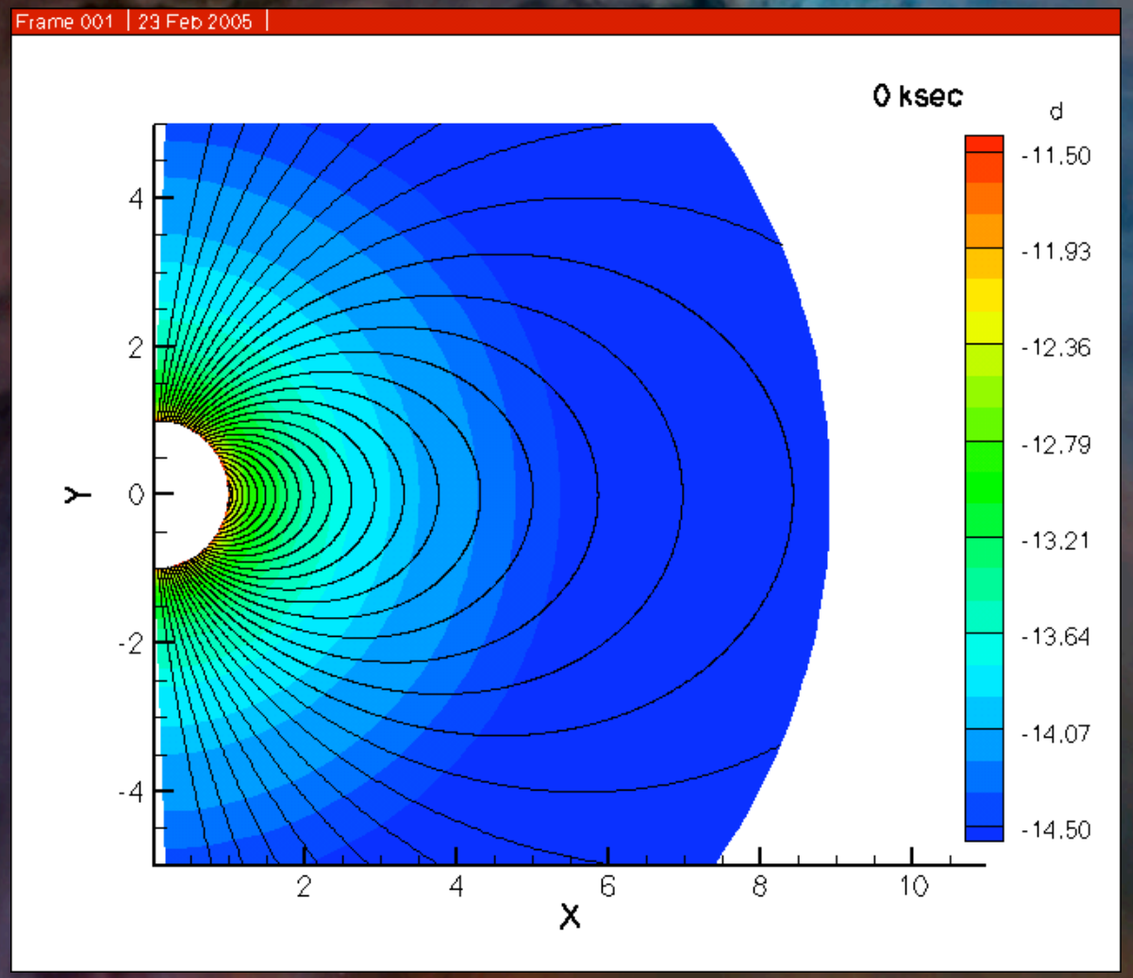
Wind-field interaction





$$\eta_\star = \frac{\text{field}}{\text{wind}} \propto \frac{B^2 R^2}{\dot{M} v_\infty}$$

MHD simulations



Strong shocks

Dynamical events

Localized

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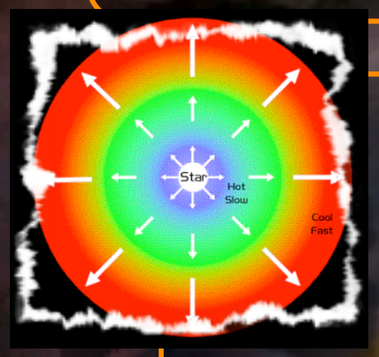
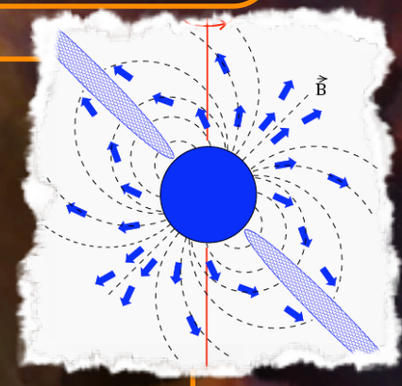
X-ray emission

"All that heat must cool down"



X-rays:
soft (~0.5 keV)
stable

$L_x \sim 10^{-7} L_{bol}$



X-rays:
variable
efficient
energetic

UV:
periodic variation

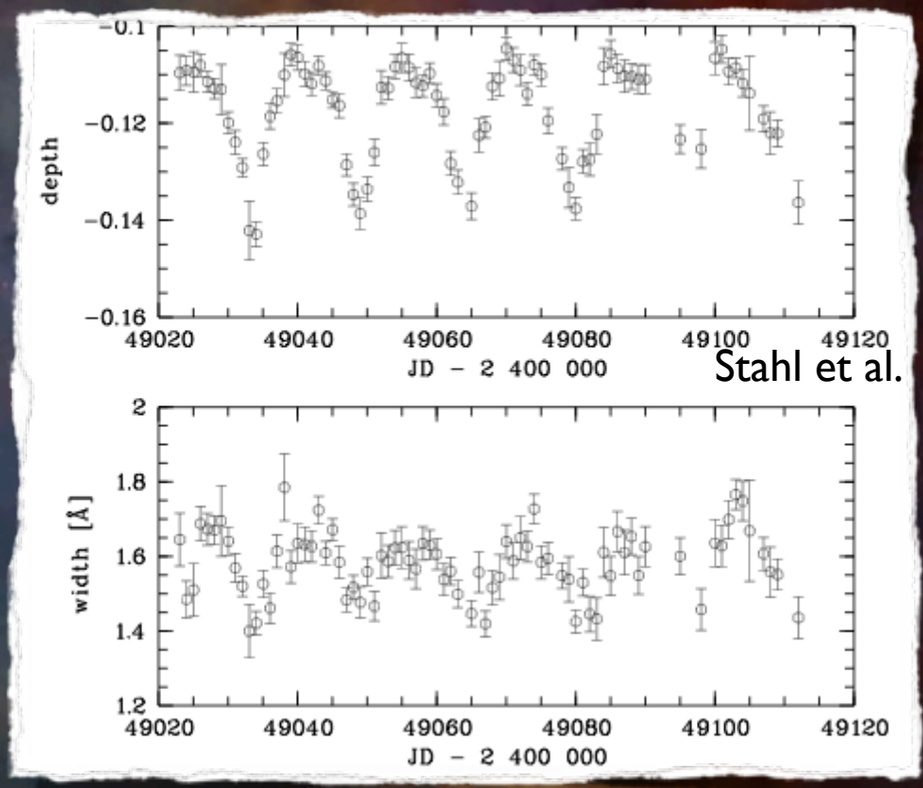
Visible:
emission
disk

Archetype: Theta 1 Orí C

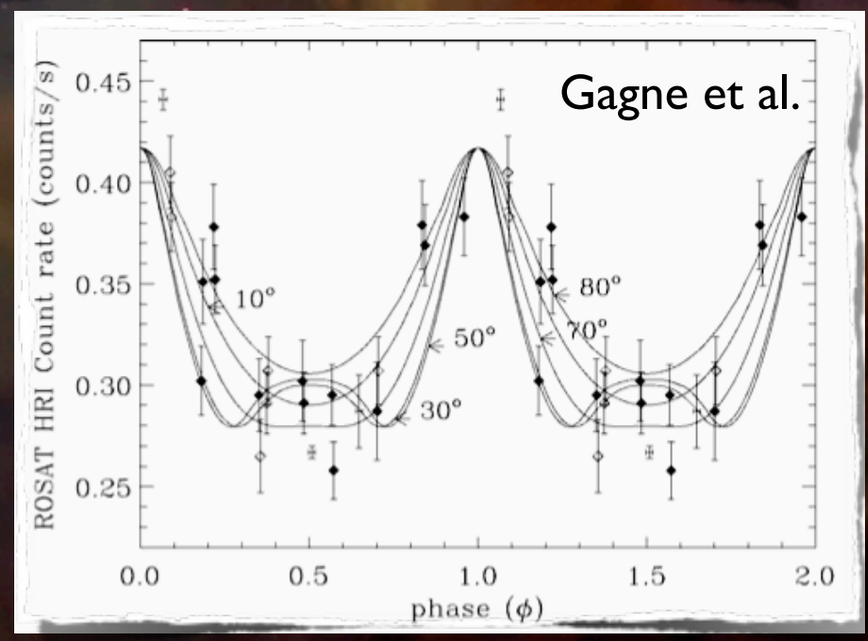
O7 V
B-field: 1 kGauss

Unusual X-rays
Periodic modulation
Emission from the magnetosphere

All fit !
... almost....

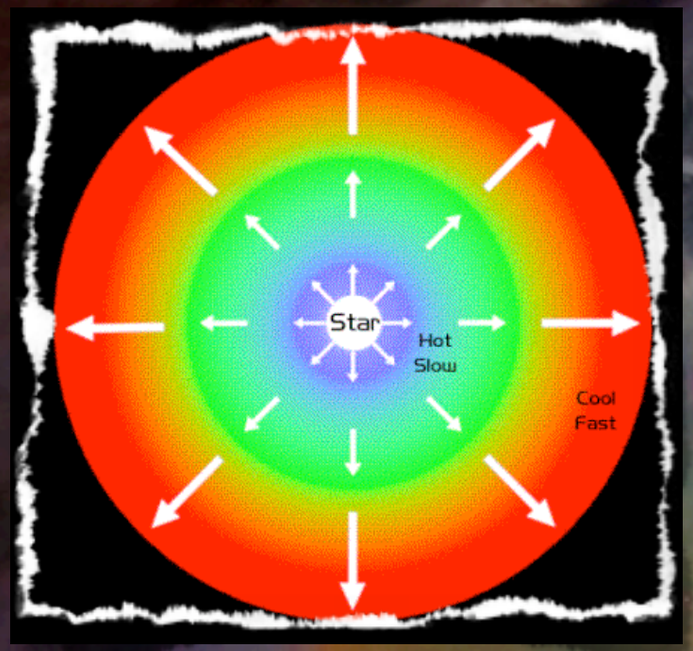


Stahl et al.



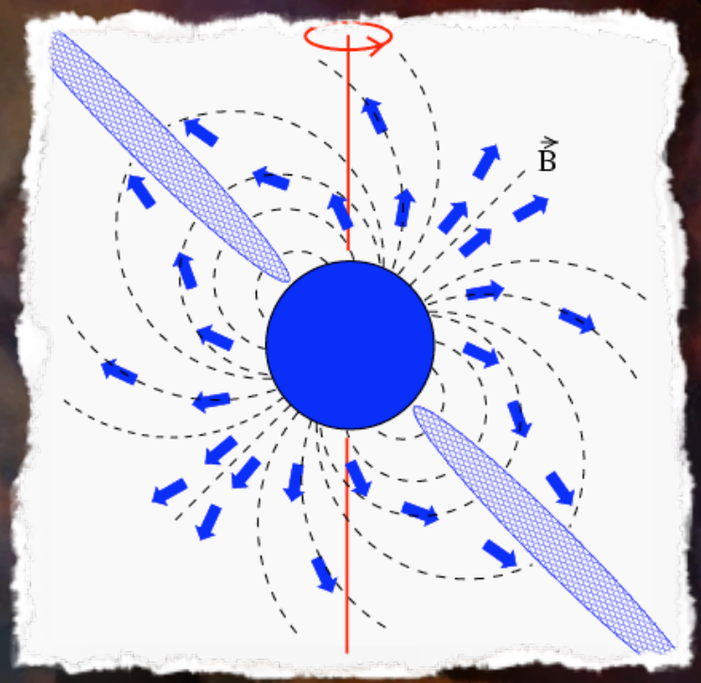
Gagne et al.

X-rays of massive stars



Non magnetic winds
vs
Magnetic winds

Only Theta 1 Ori C ?
Detection ?
Characterization ?



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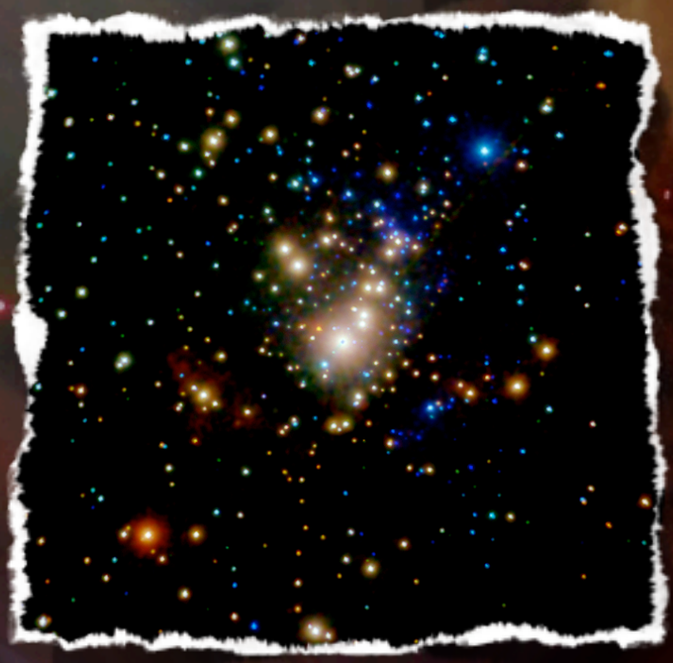
Magnetic survey of Orion

9 massive stars

ESPaDOnS @ CFHT
Circular polarisation
by Zeeman effect

Chandra Orion
Ultradeep Survey



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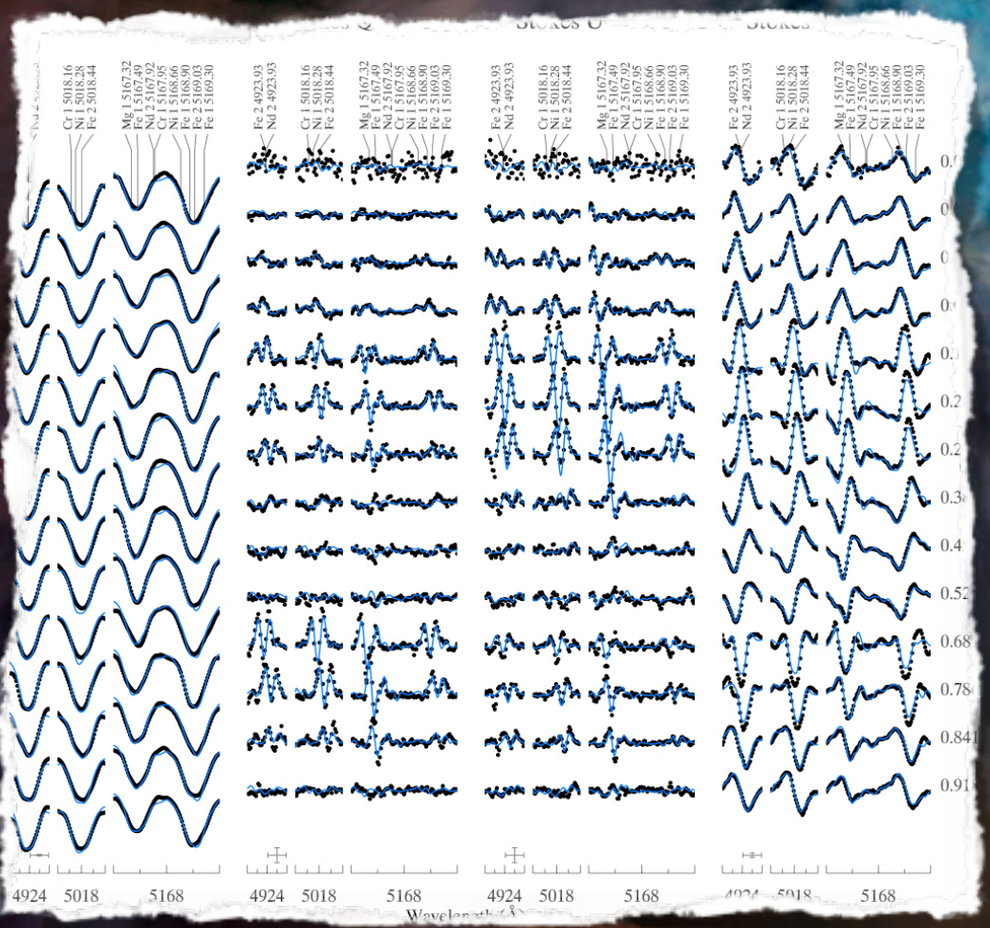
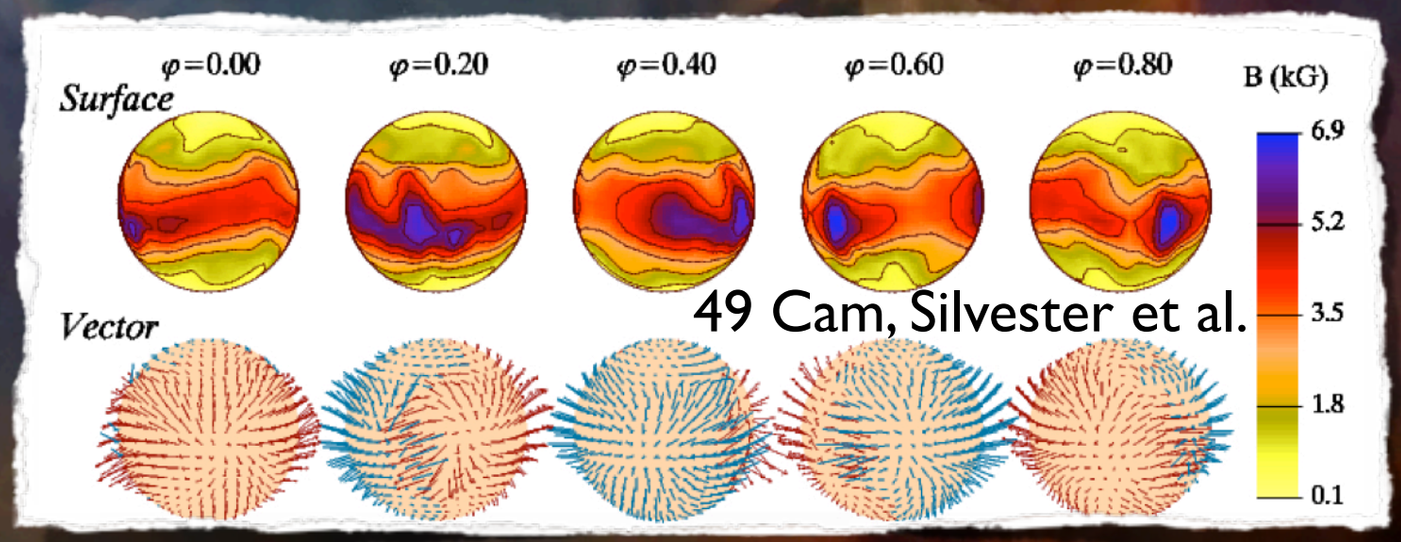
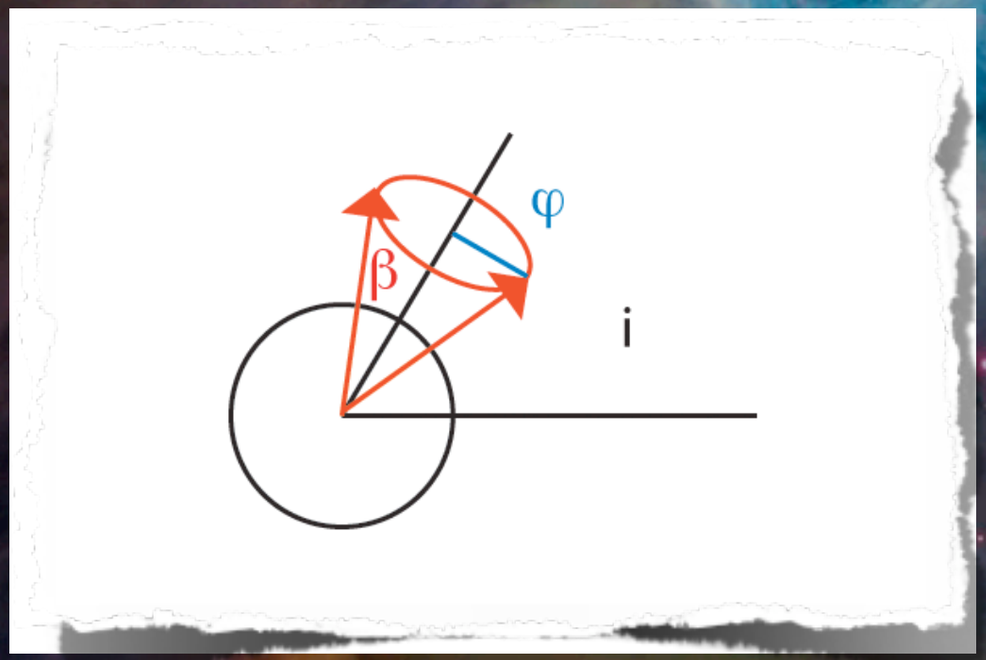
Surface field

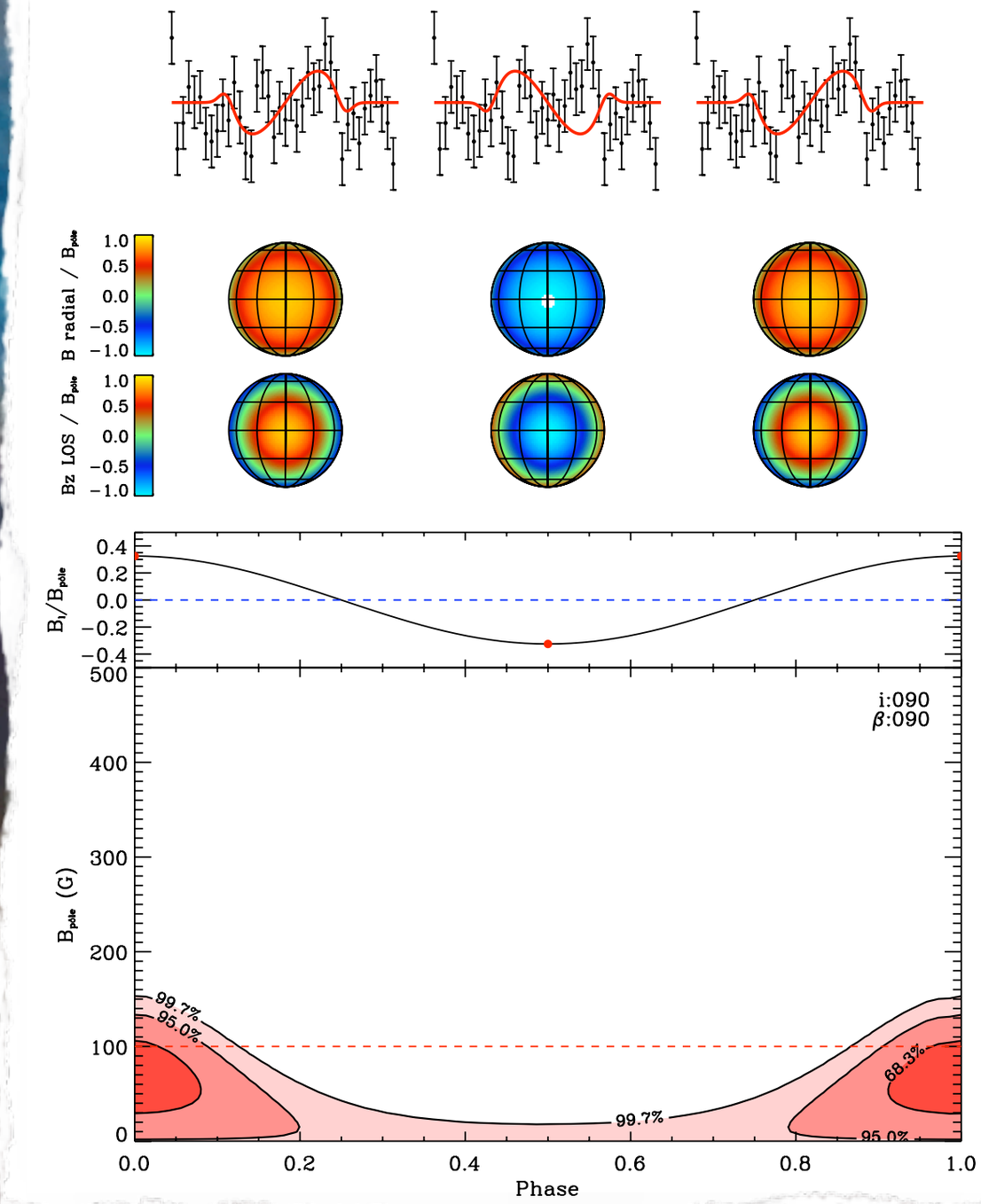




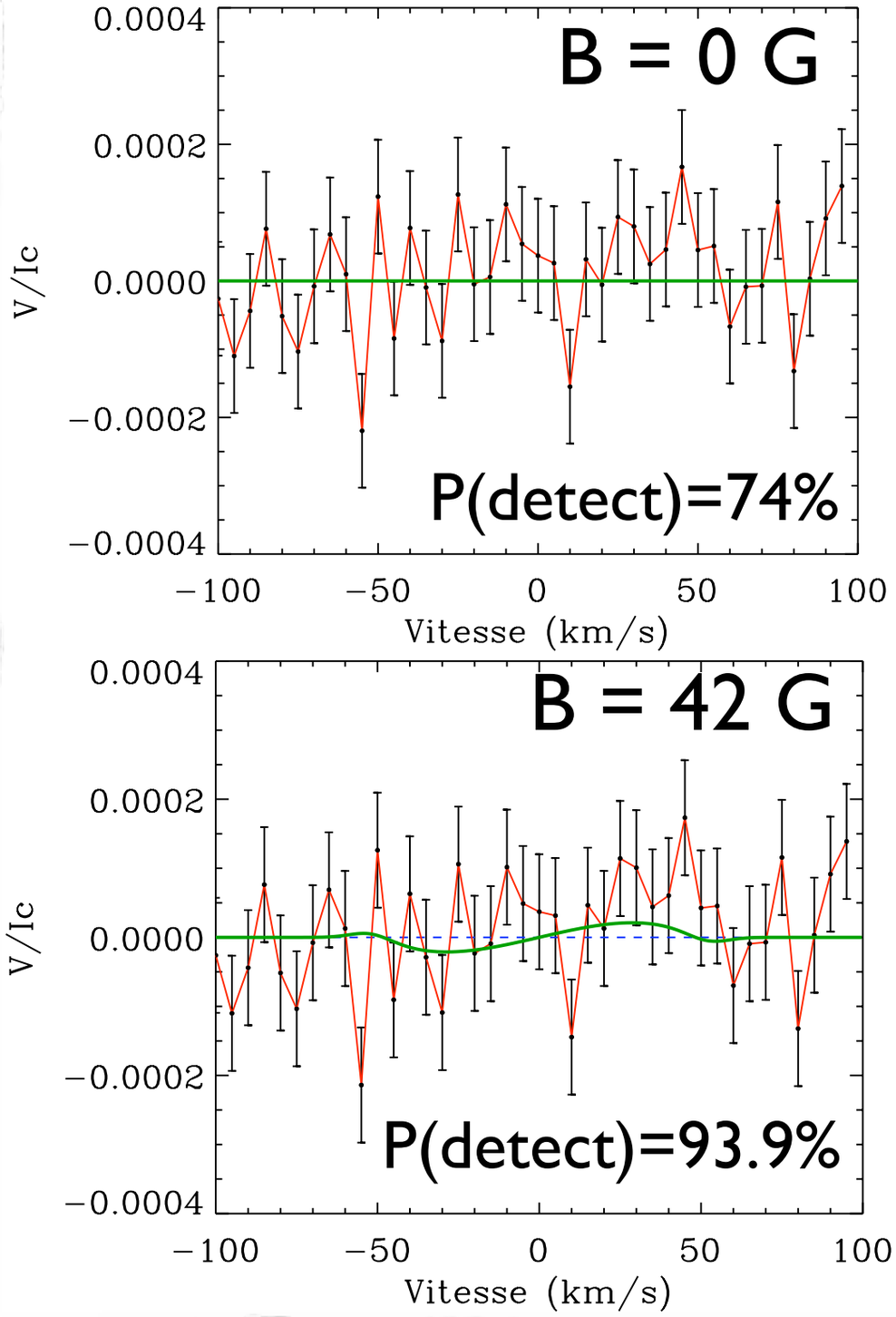
49 Cam, Silvester et al.

Surface field

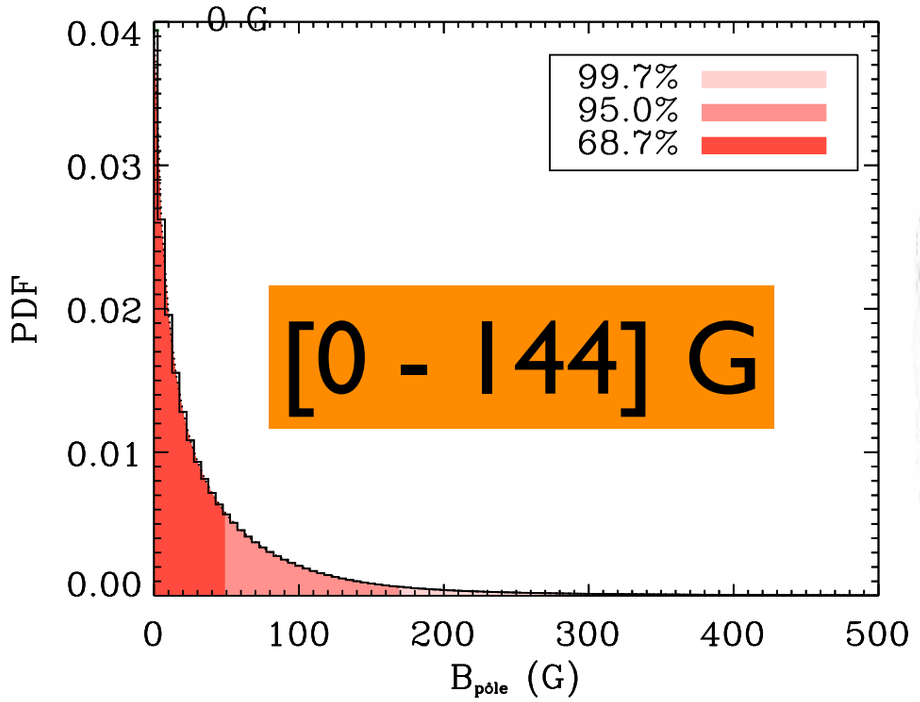




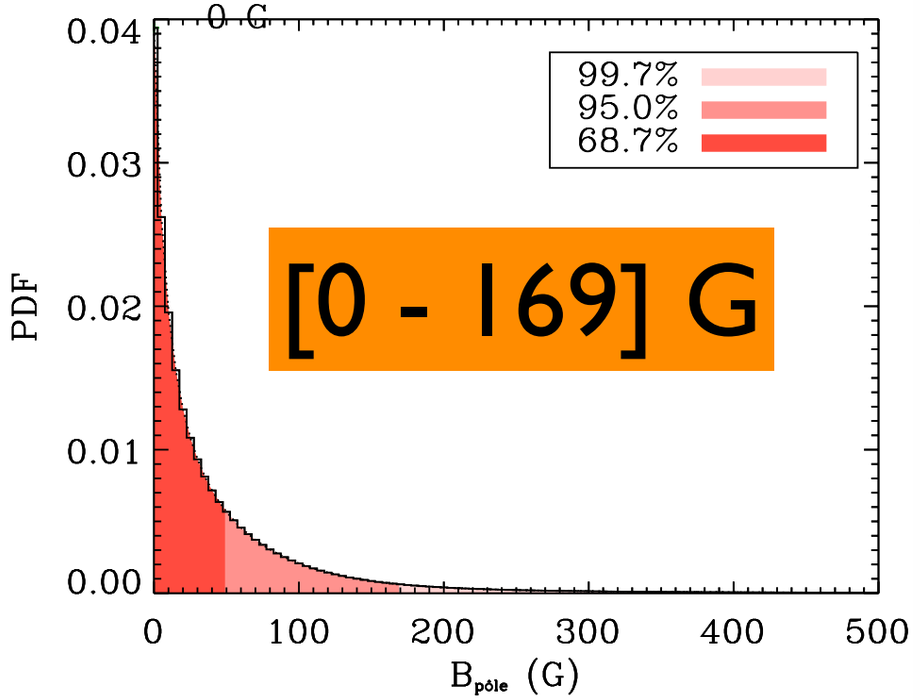
Mr. Bayes, the Trained Eyes!



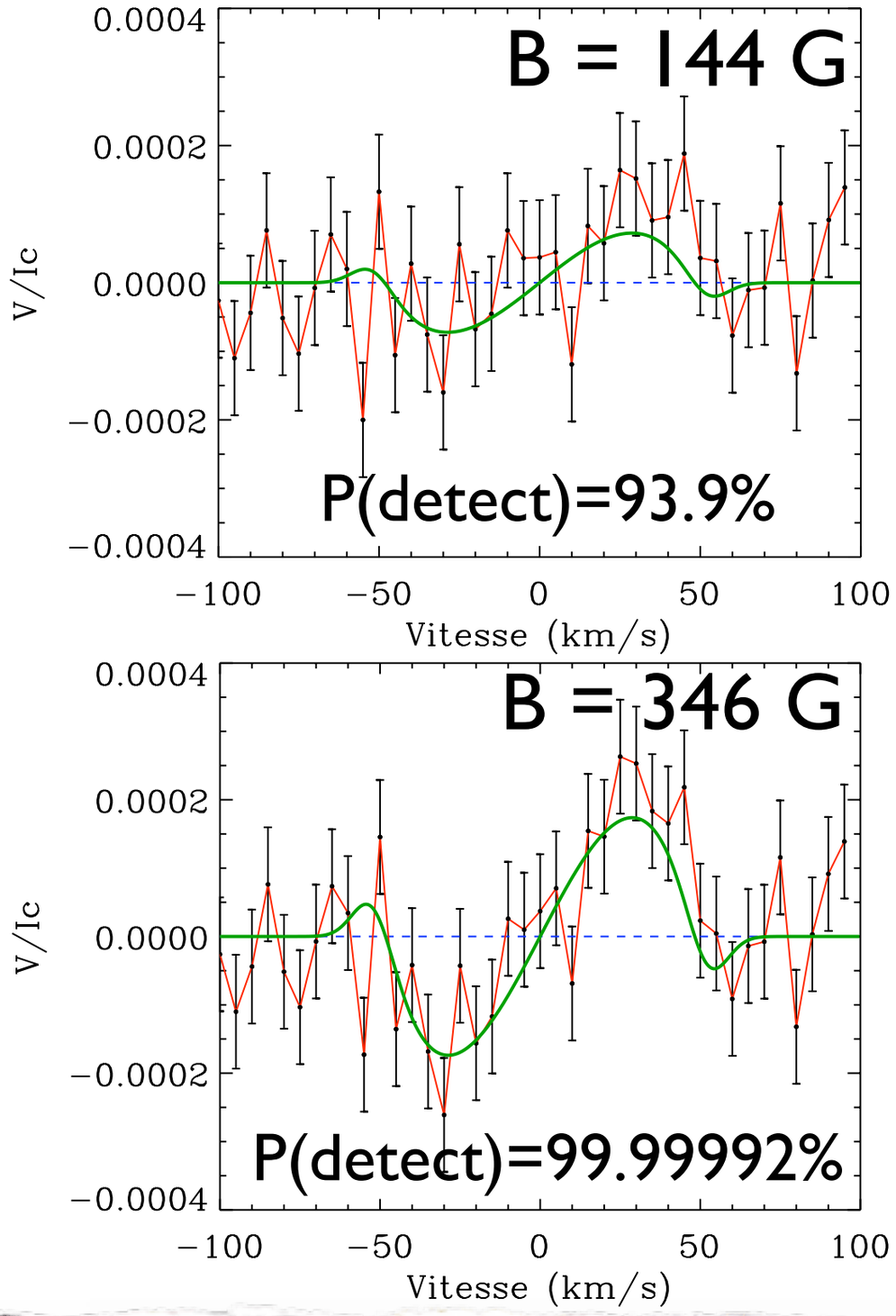
odds
2.05



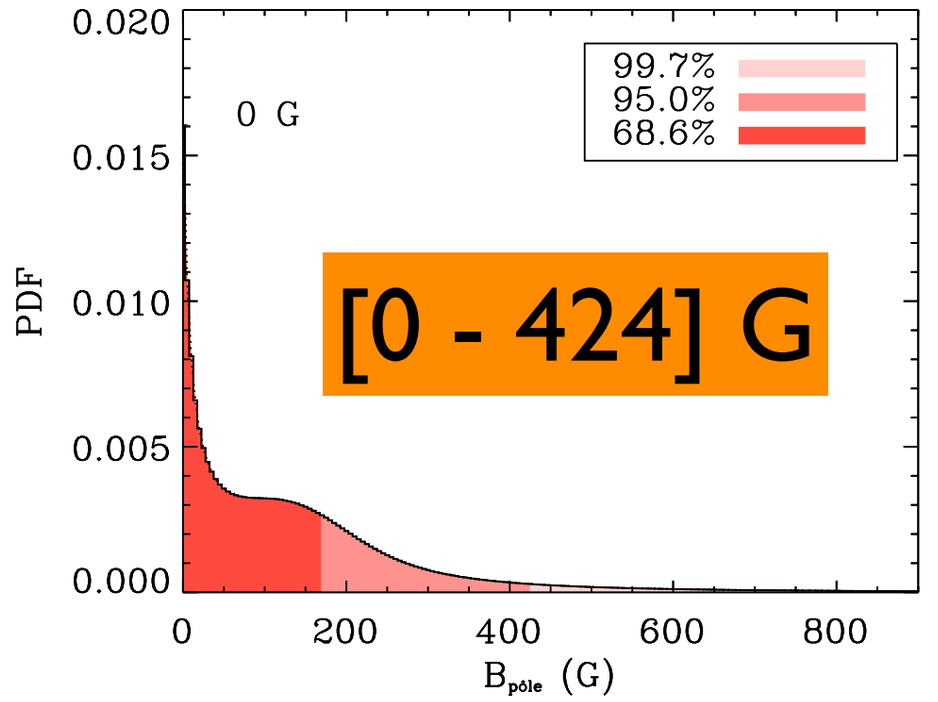
odds
1.87



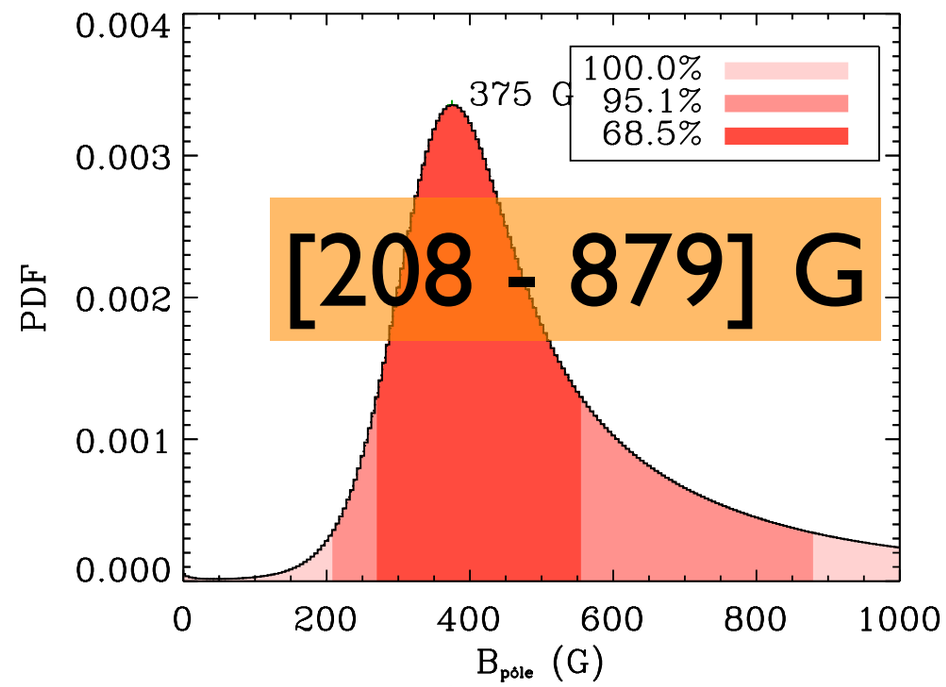
Mr. Bayes, the Trained Eyes!



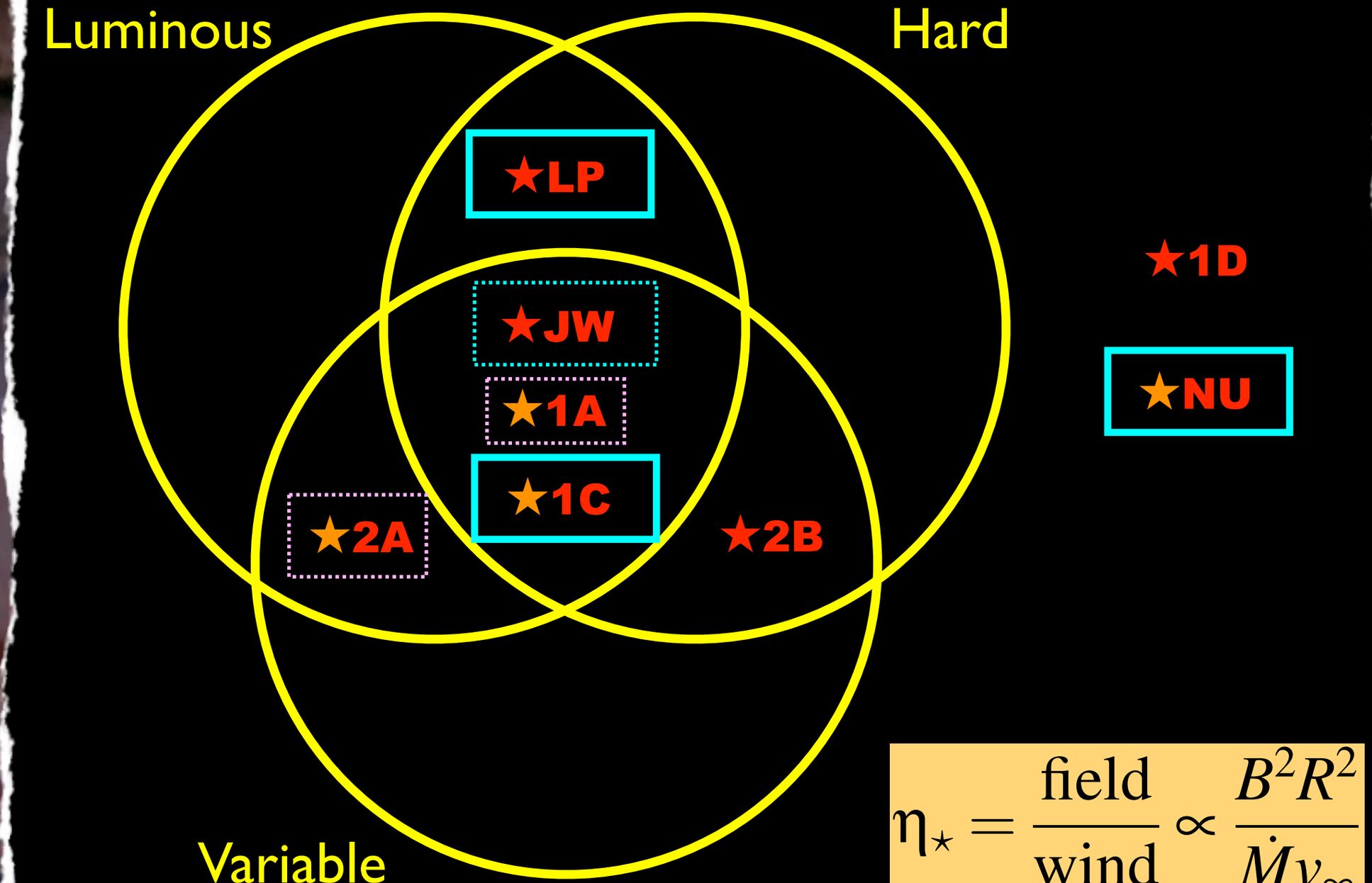
odds
0.38



odds
2×10^{-7}

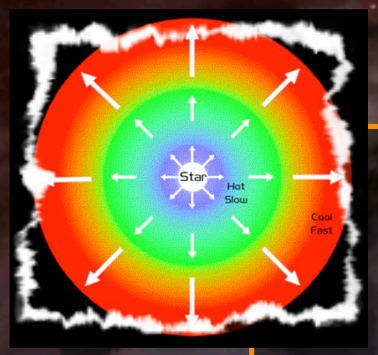


Results



$$\eta_\star = \frac{\text{field}}{\text{wind}} \propto \frac{B^2 R^2}{\dot{M} v_\infty}$$

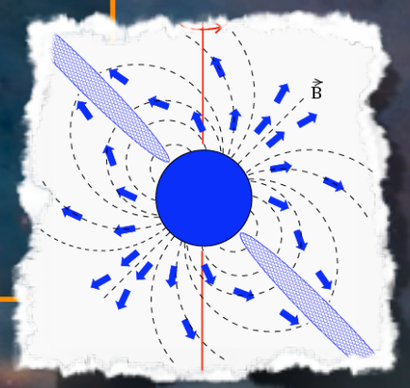
Conclusion 1



Only Theta 1 Ori C ?

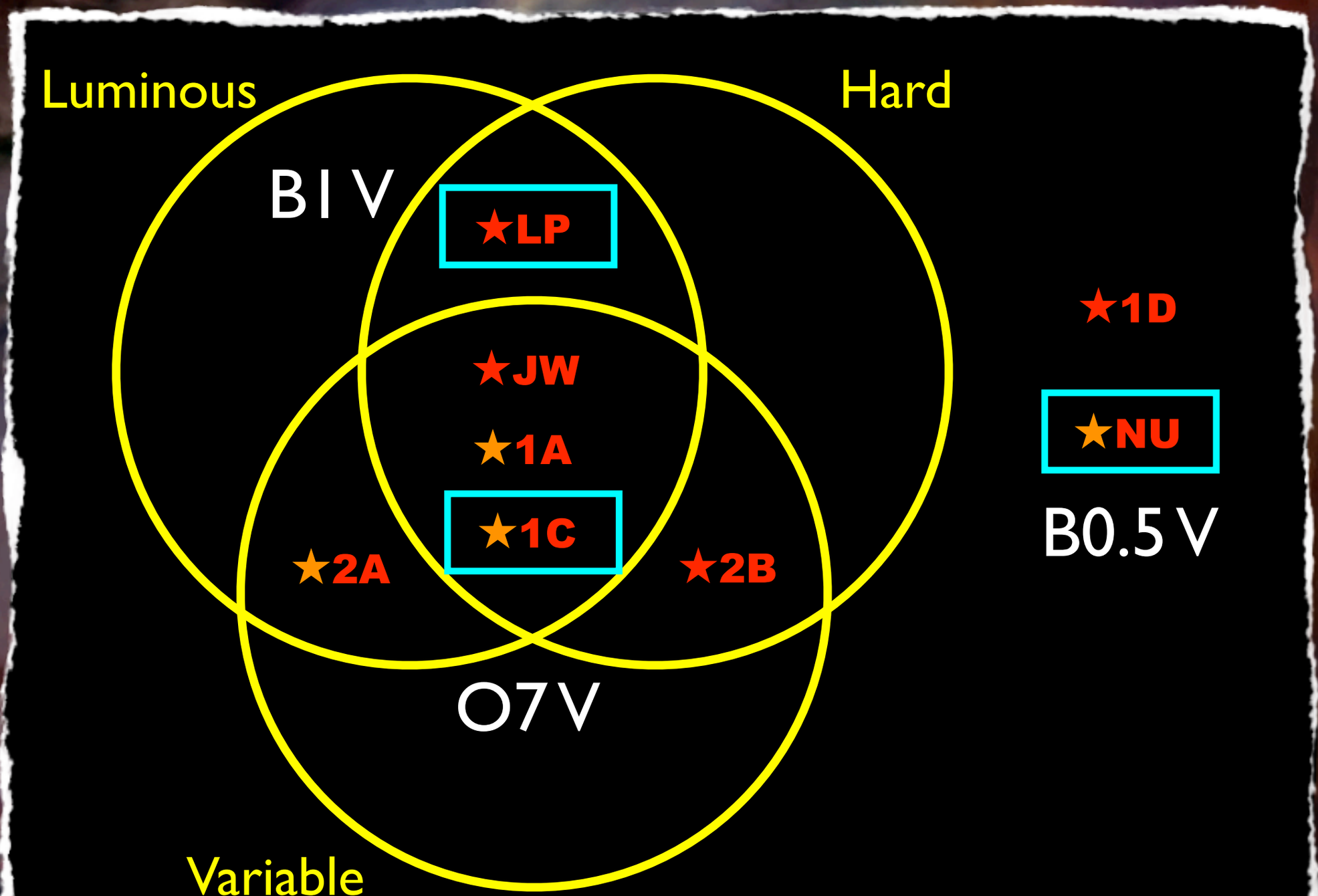
Detection ?

Characterization ?

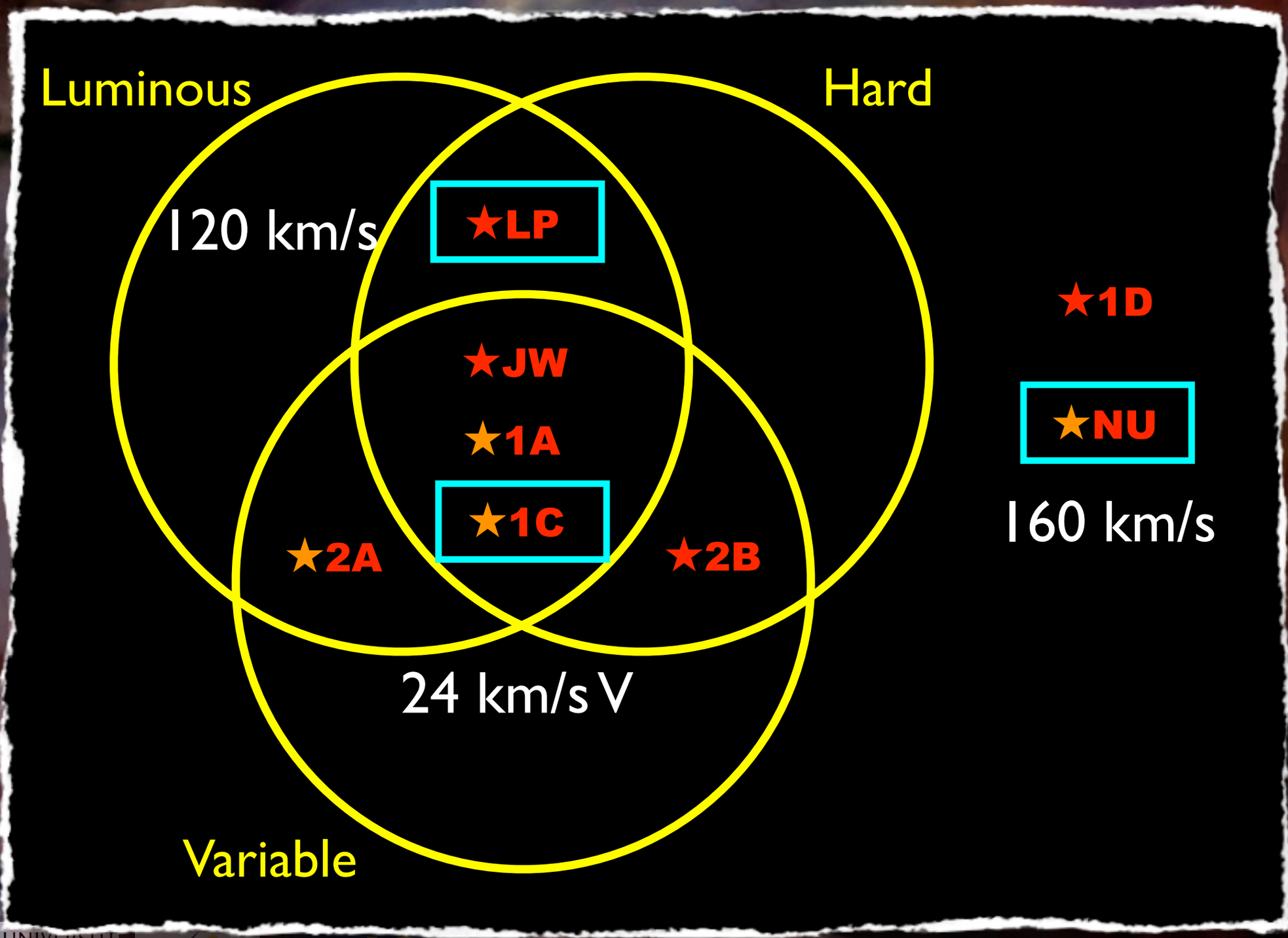


Variable, energetic and luminous X-rays are not systematically correlated with the presence of a large-scale magnetic field

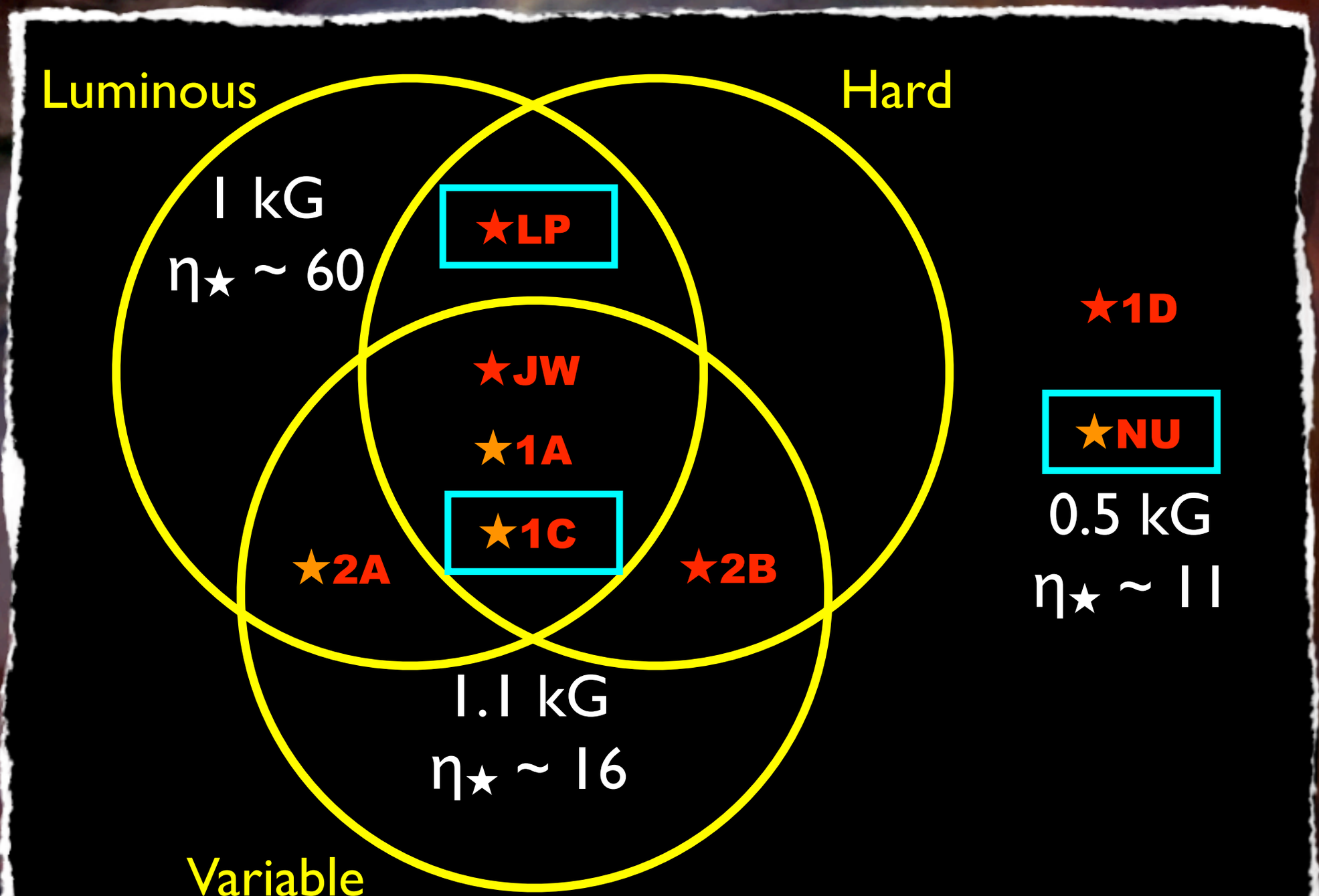
Results



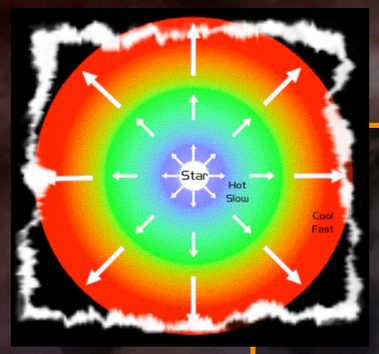
Results


Luminous
Hard
120 km/s
★LP
★JW
★1A
★1C
★2A
★2B
★1D
★NU
160 km/s
24 km/s V
Variable

Results


Luminous
Hard
1 kG
η⋆ ~ 60
★LP
★JW
★1A
★1C
★2A
★2B
★1D
★NU
0.5 kG
η⋆ ~ 11
1.1 kG
η⋆ ~ 16
Variable

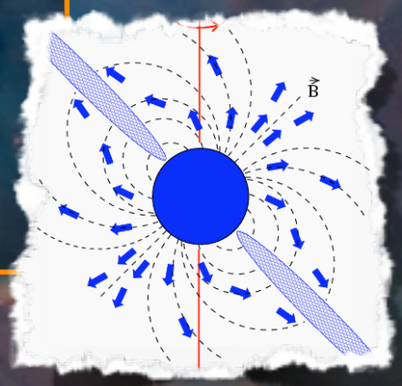
Conclusion 2



Only Theta 1 Ori C ?

Detection ?

Characterization ?

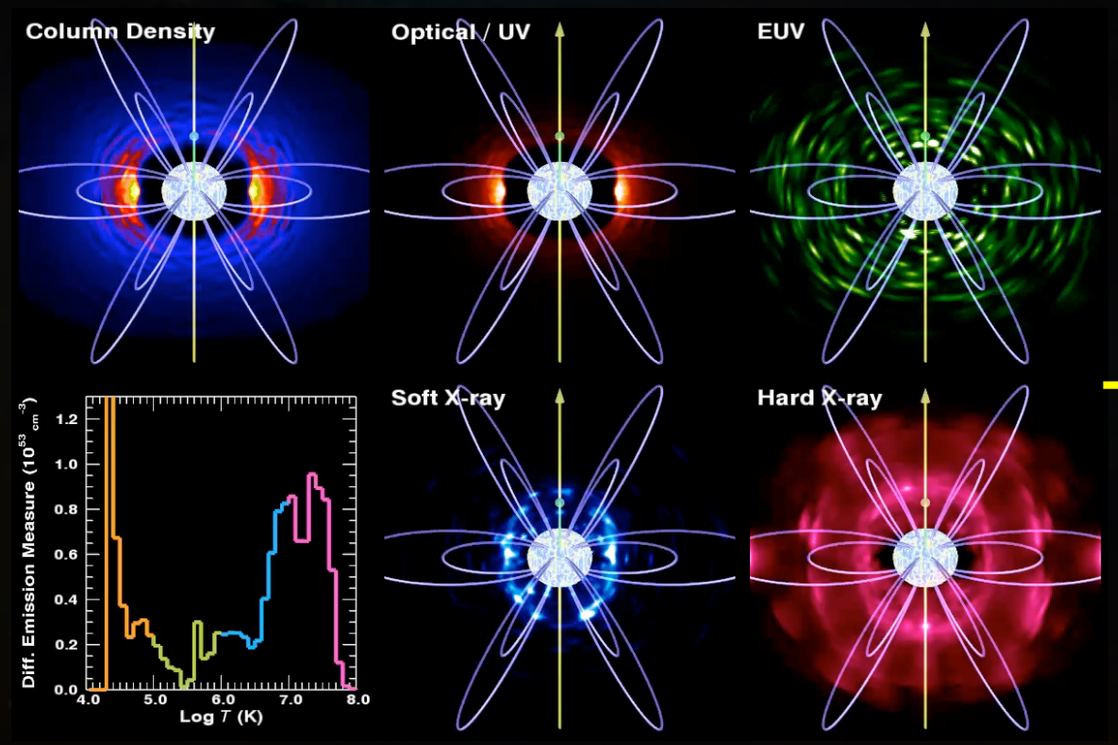


We need to understand under which condition magnetic stars produces X-rays, and which other observables will be modified

Conclusion 2

Fields (Mimes)

Winds (IUE)



Observable (Chandra)

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CHANDRA-MIMES: X-rays from massive stars

Chandra or XMM:

Theta 1 Ori C
HD 191612
HD 37017
Zeta Ori
Tau Sco
NU Ori
LP Ori
sigma Ori E
NGC2244 201
NGC661 601

Proposal:

ksi CMa
a Cen
V2052 Oph
V686 CrA
V1671 Cyg
31 Peg
V901 Ori
zeta Cas

---

16 Peg
HD 58260
HD 35502
CU Vir
IQ Aur