Hunting for Progenitors in Ancient Remnants

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with:

Brian Schmidt
Mike Bessell
David Yong

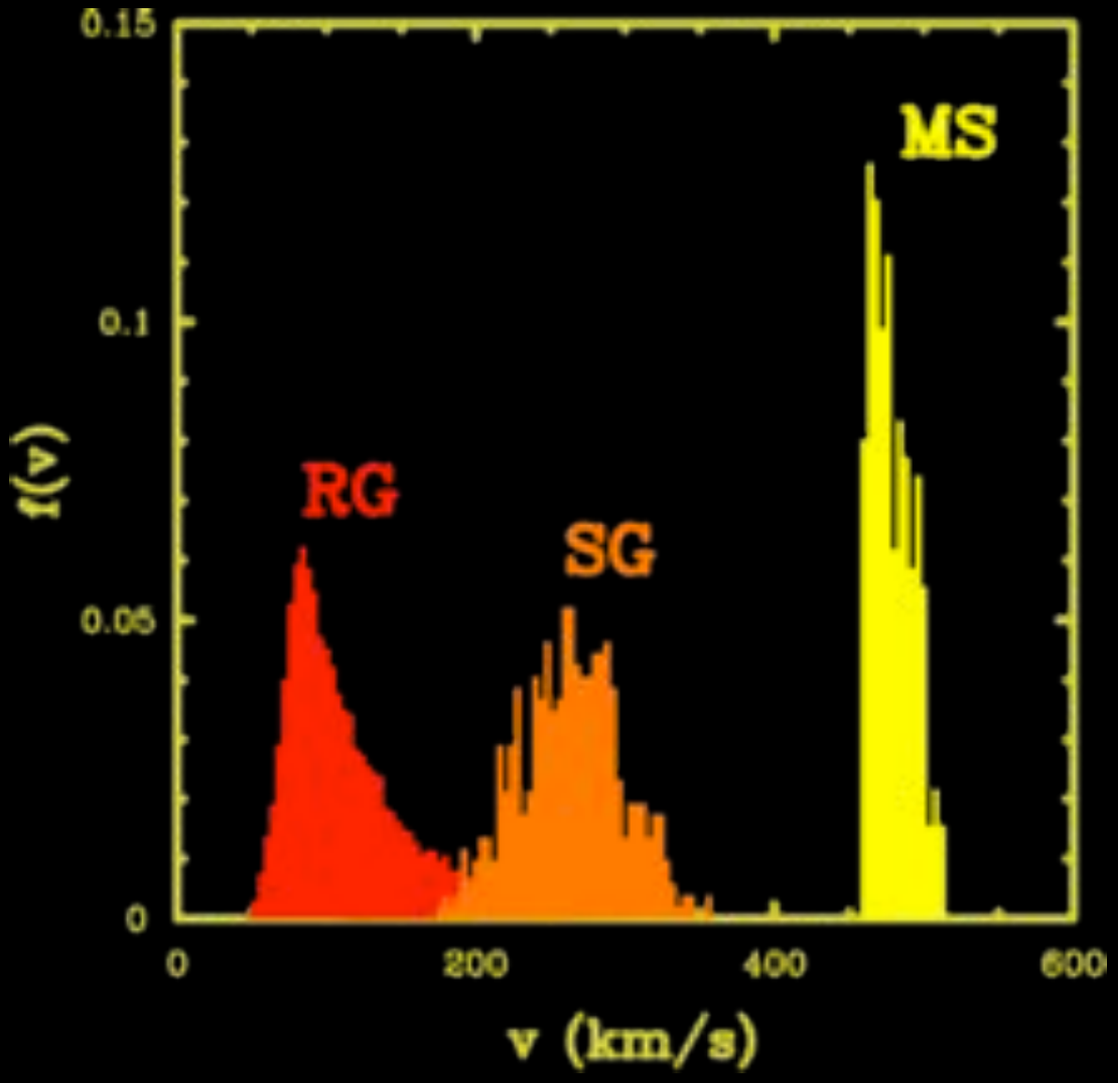
Ken'ichi Nomoto
Philipp Podsiadlowski
Simon Jeffery
Avishay Gal-Yam

and several others

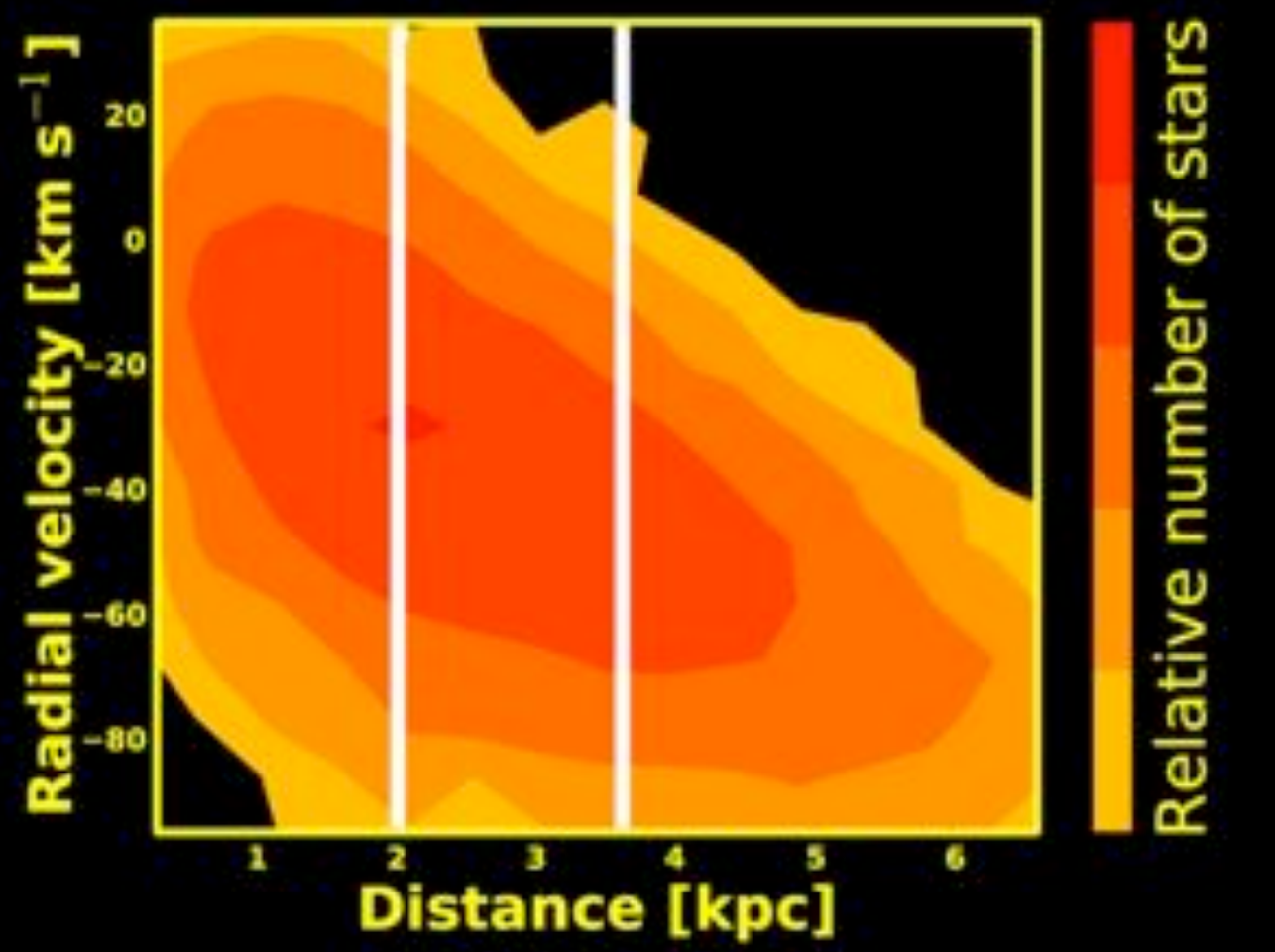
This star

- will be located in remnant centre
- should have an unusual velocity
- should have a fast rotation
- may have an unusual state

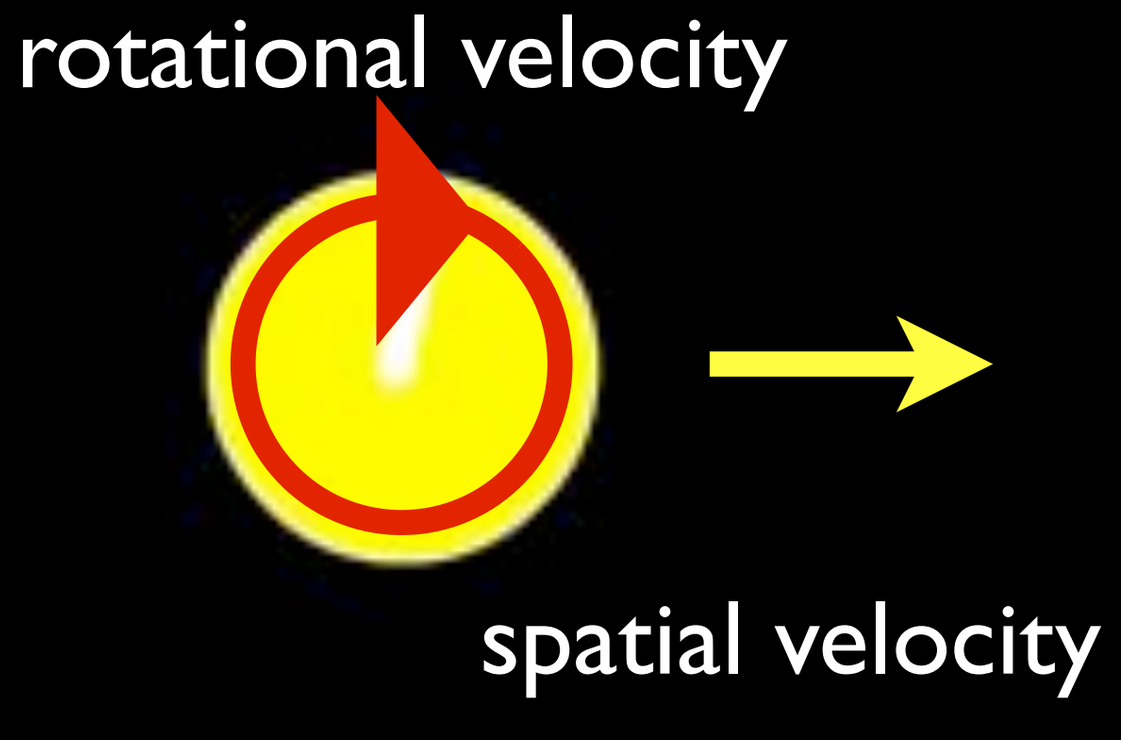
Unusual Velocity



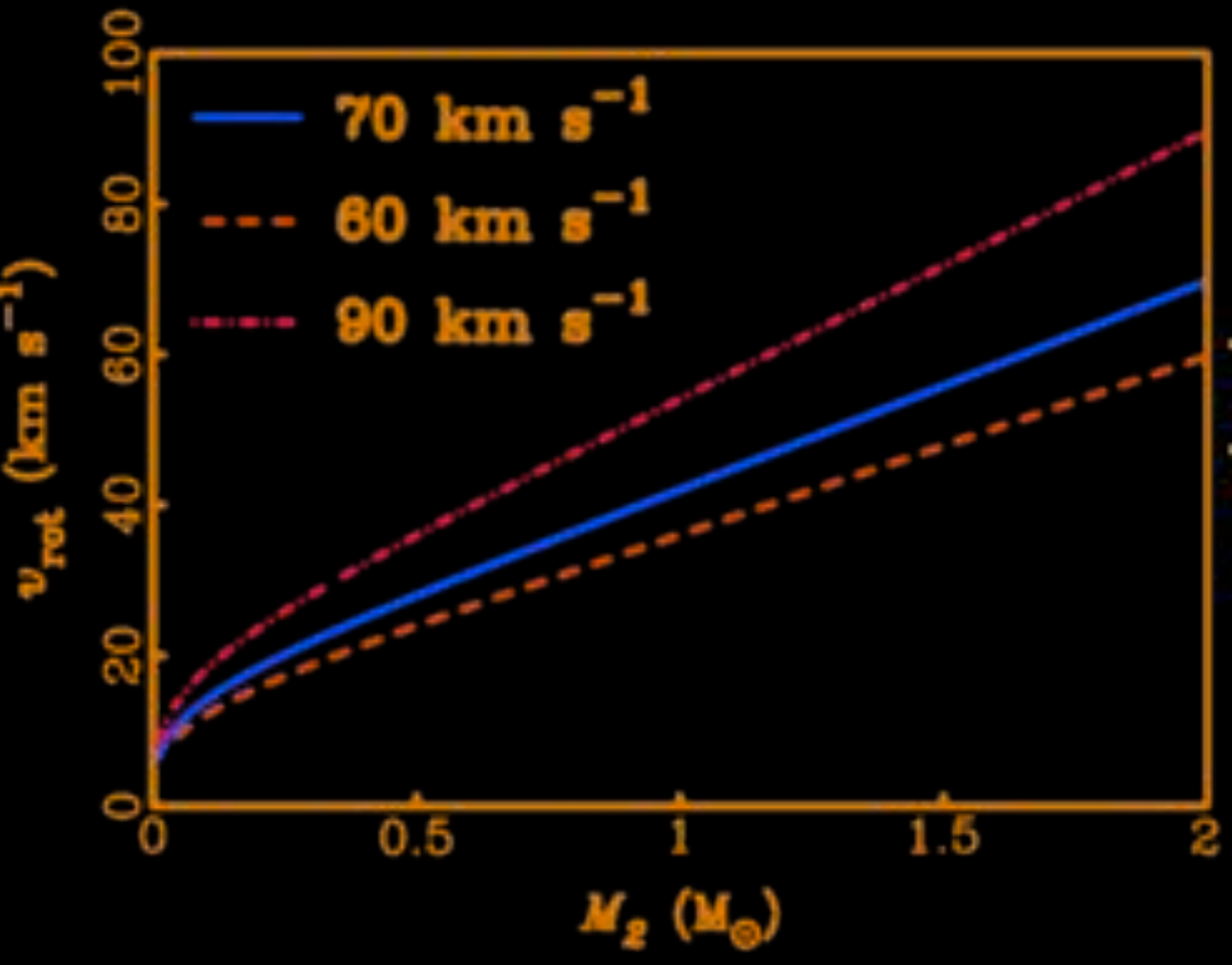
Canal et al. 2004



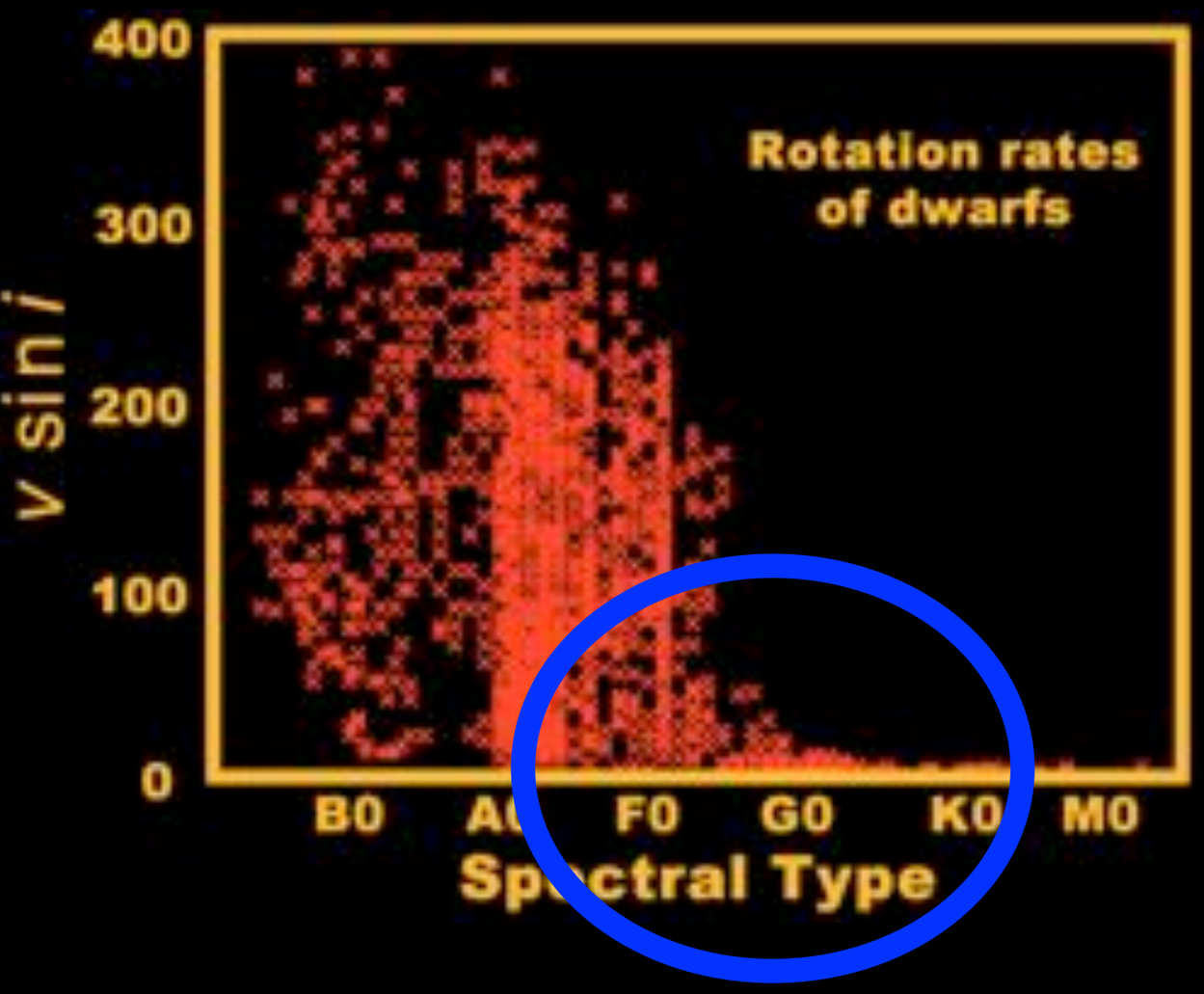
Besancon Model


rotational velocity
spatial velocity

Rotation



Kerzendorf et al. 2009



D. Gray - Analysis of Stellar Photospheres

Results of Simulations

Marietta et al. 2000, Pakmor et al. 2009

Main Sequence and Subgiant

- lose up to ~10% of envelope
- remain largely unchanged

Giants

- lose 96-98 % of envelope
- possibly exposed Helium core

In all cases

- It is difficult to accrete SN ejecta onto donor
- All objects remain and should have $L > L_{\odot}$

NASA

CRAB

3C58

CAS A

Tycho

Sun

G347.3

RCW86

G7.8

KEPLER

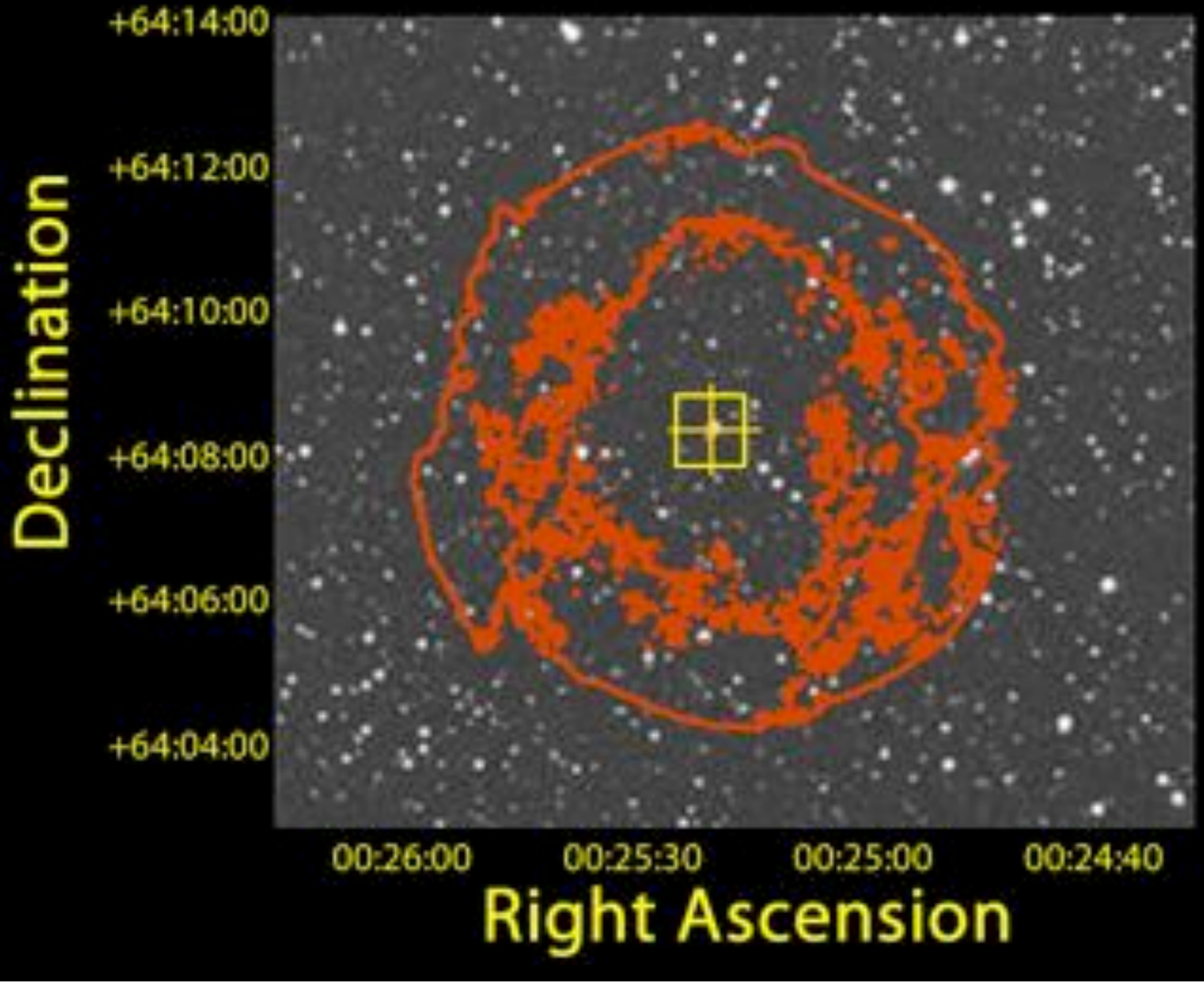
G11.2

Kepler

SN1006

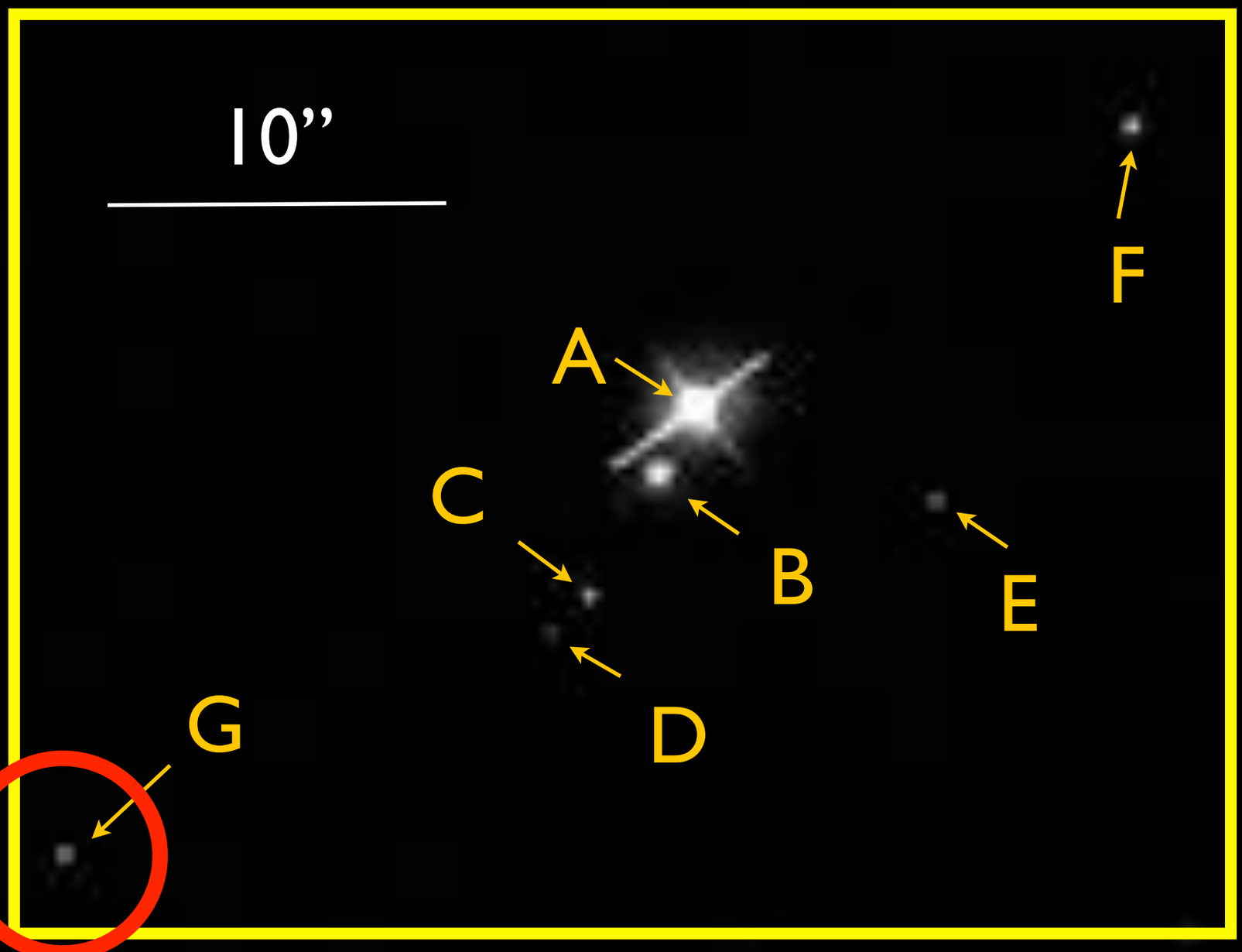
SN 1572 (Tycho)

add scale

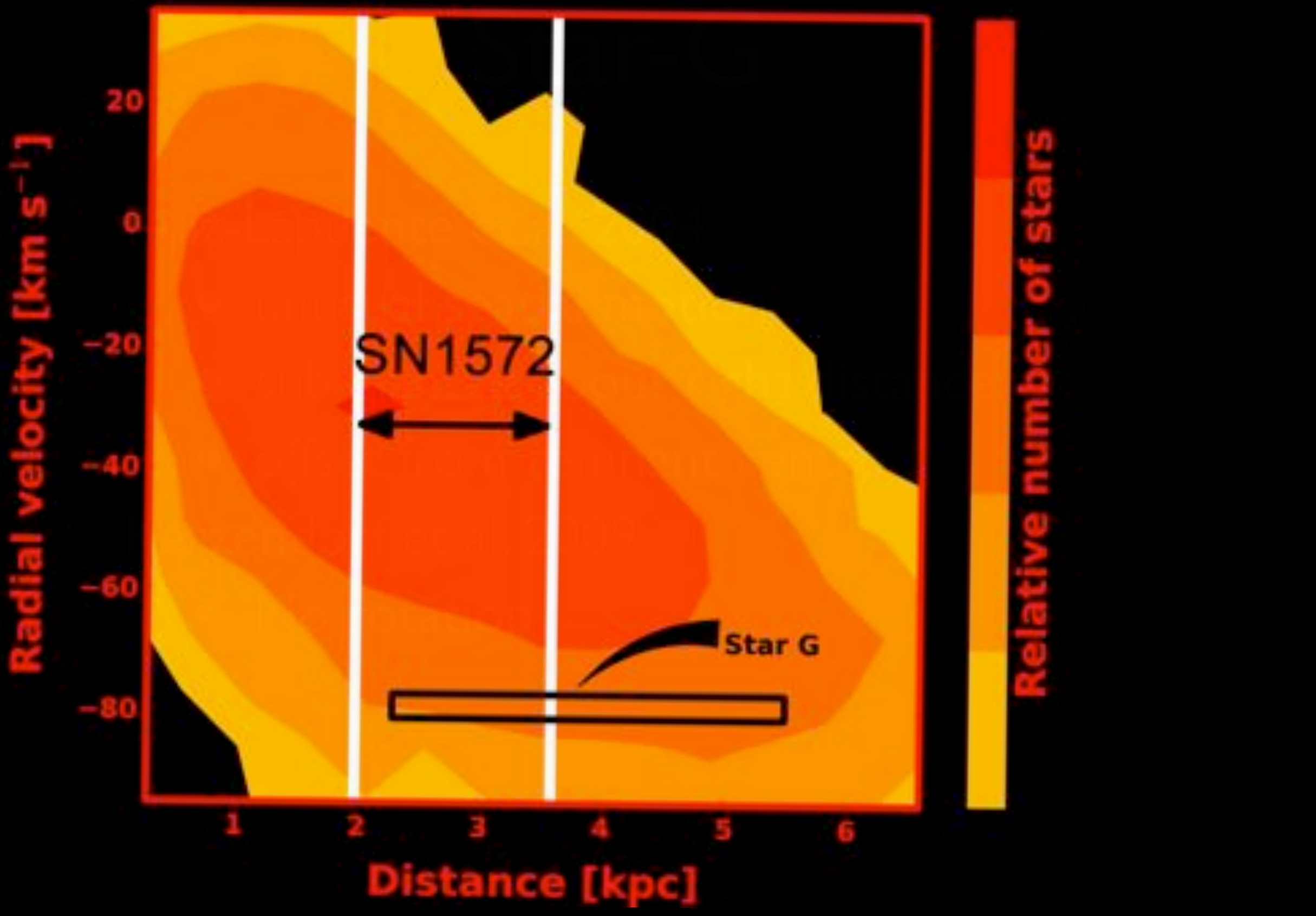


SN 1572 (Tycho)

add scale



Ruiz-Lapuente et al. 2004


Radial velocity [km s⁻¹]
20
0
−20
−40
−60
−80
SN1572
Star G
1
2
3
4
5
6
Distance [kpc]
Relative number of stars

Star-G

Ruiz-Lapuente et al. 2004

- unusual spatial motion
- sub-giant at about right distance
- offset from remnant centre

Kerzendorf et al. 2009

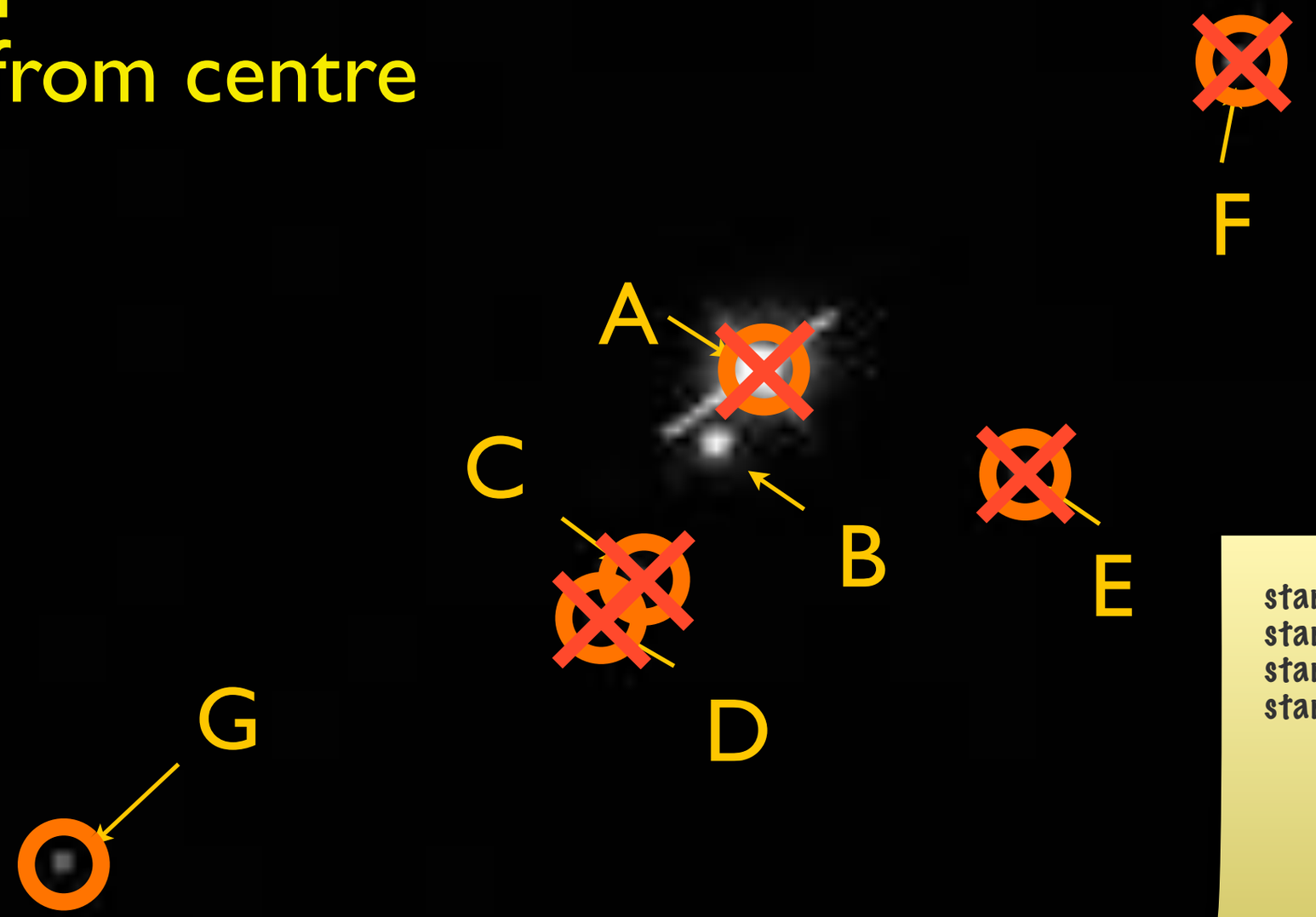
- No rotation

Gonzalez-Hernandez 2009

- Confirmed RP04 stellar parameters

Tycho's Six

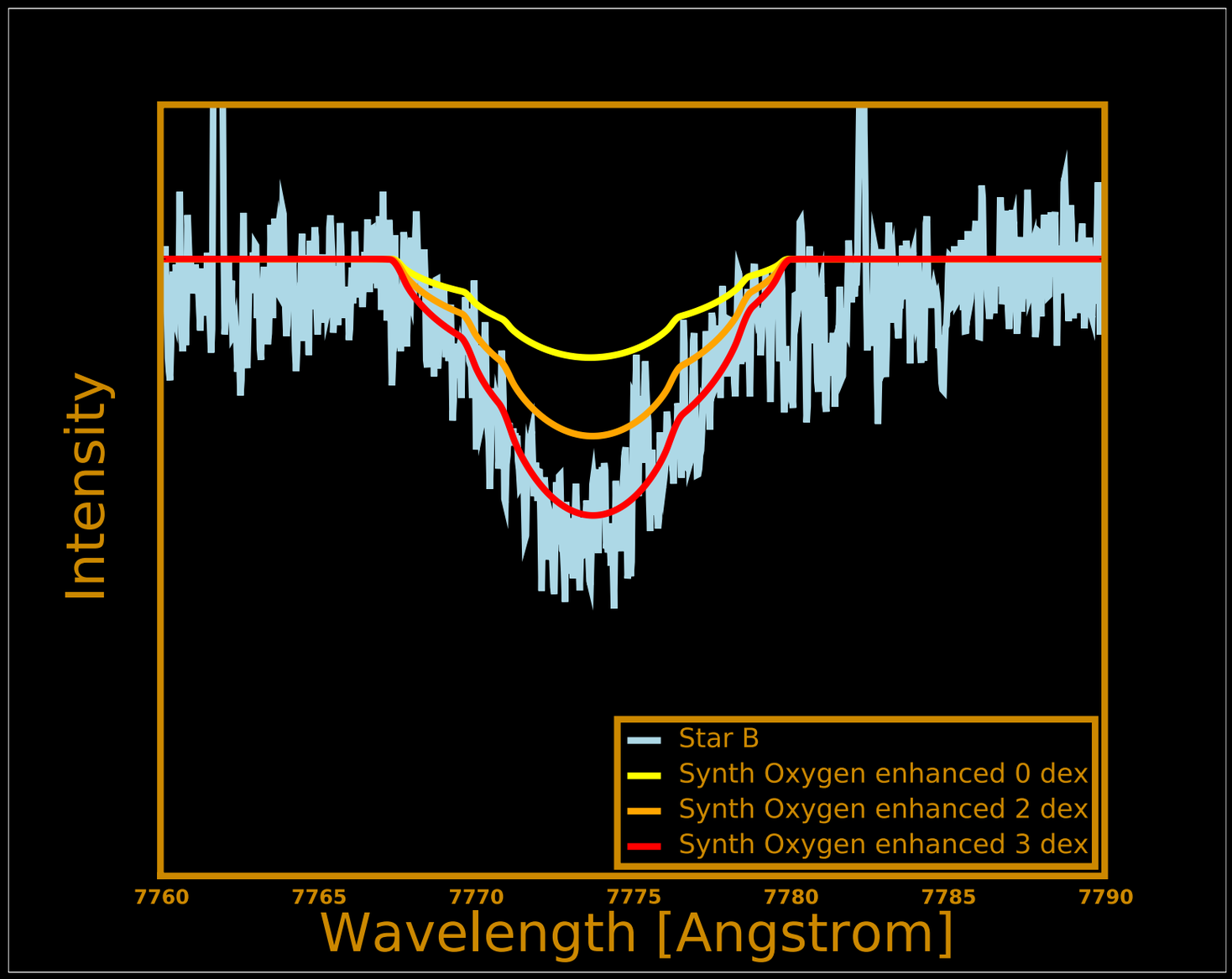
No proper motion
too far from centre



Ruiz-Lapuente et al. 2004

A NEW HOPE

- A-Star 10,000K
- [Fe/H]~-1
- v rot=170 km/s
- enhanced in C&O?



H-epsilon
Weak ca k line

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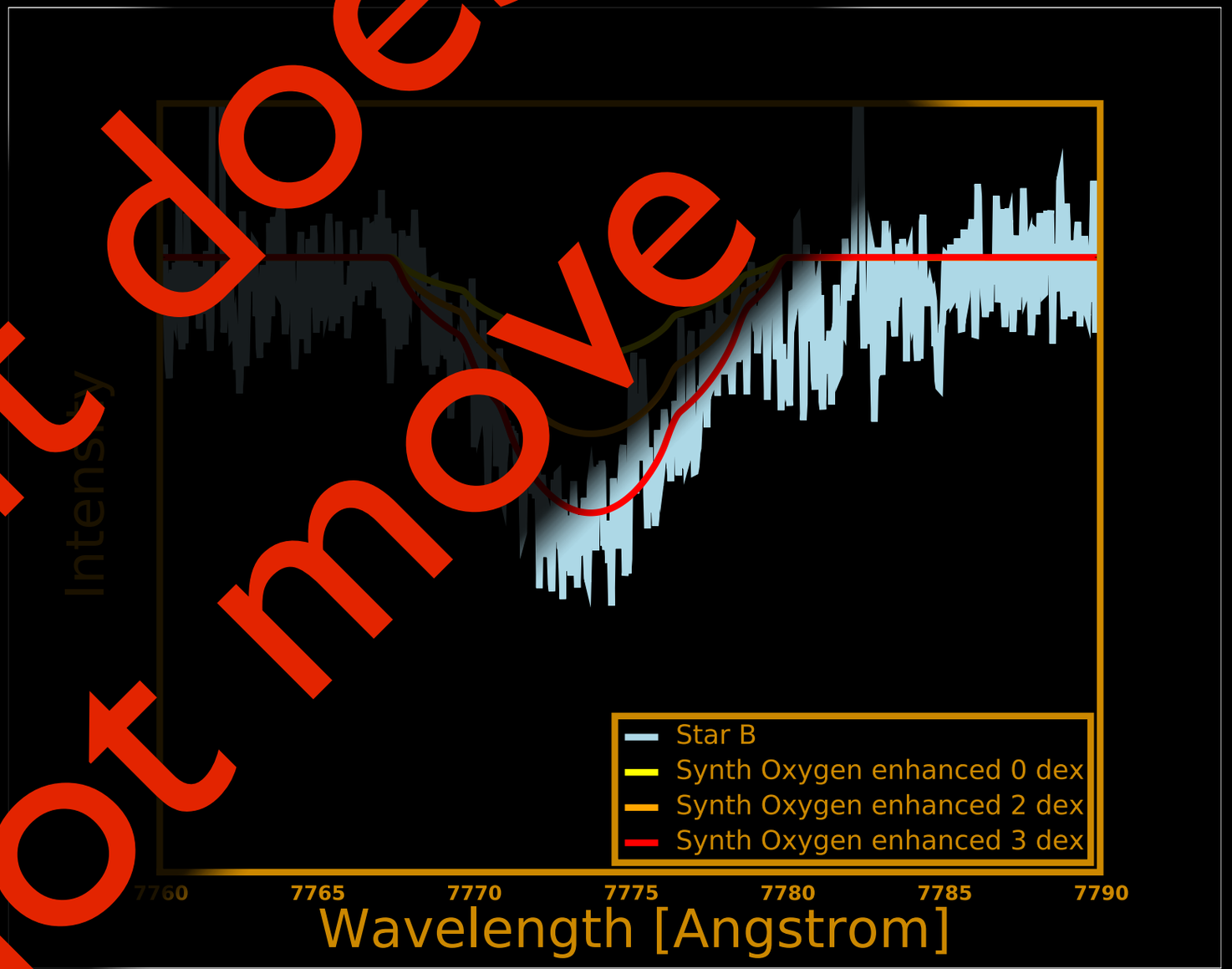


but it does not mo ve

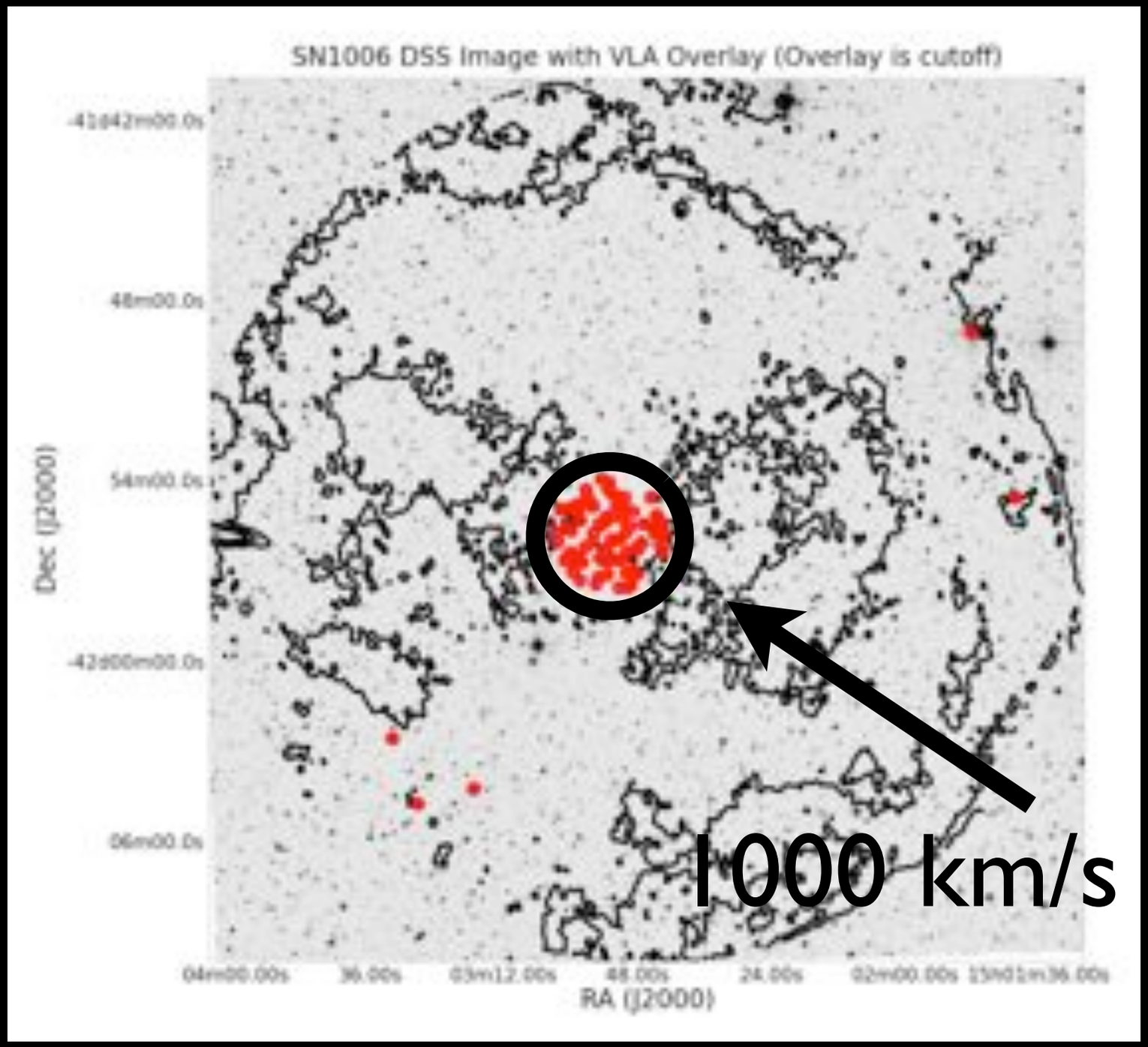
H-epsilon
Weak ca k line

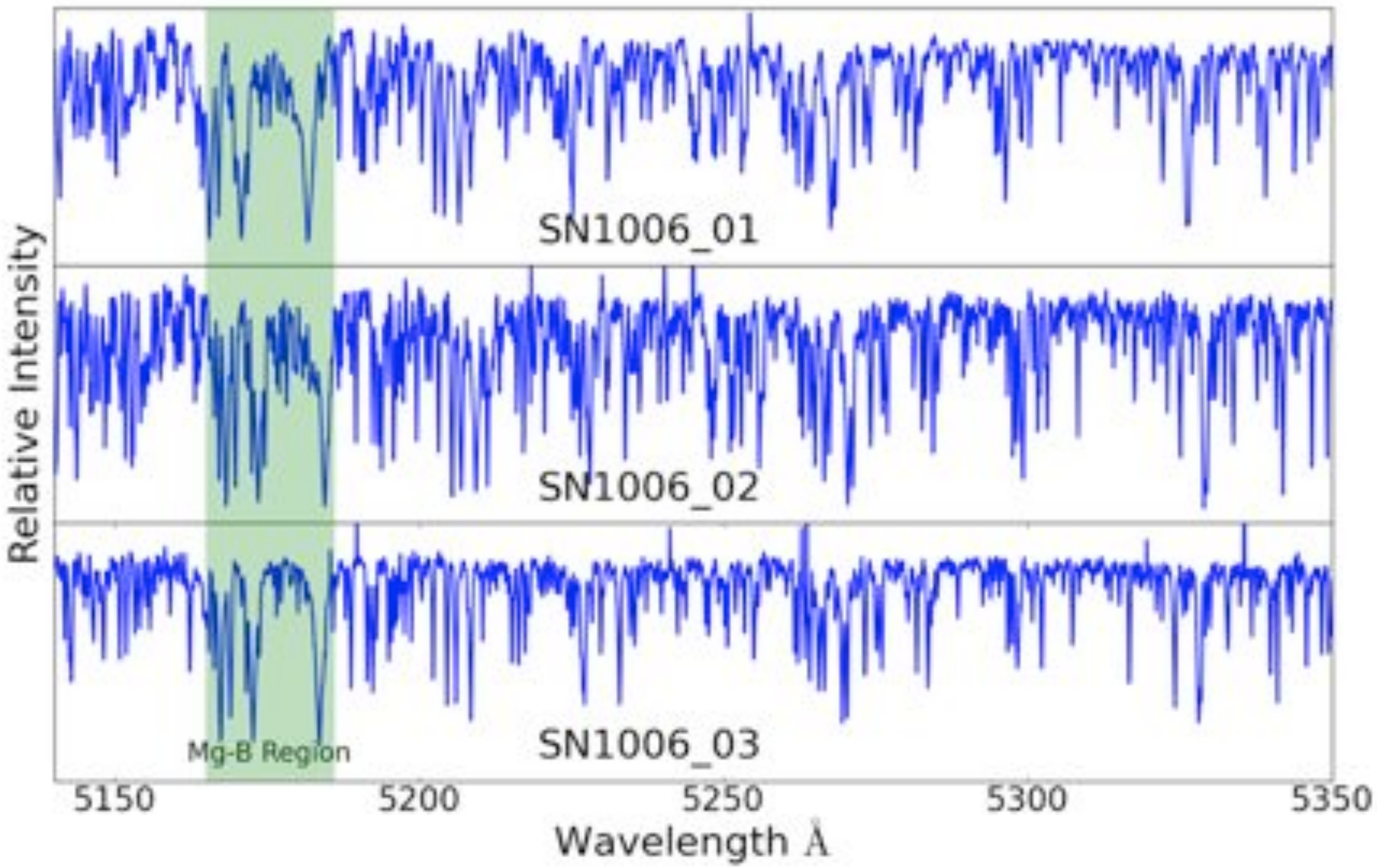
What about Tycho?

- Star G unlikely, but certainly not ruled out
- Star B interesting, but certainly not ruled in
- Look at other remnants and compare!

SN1006

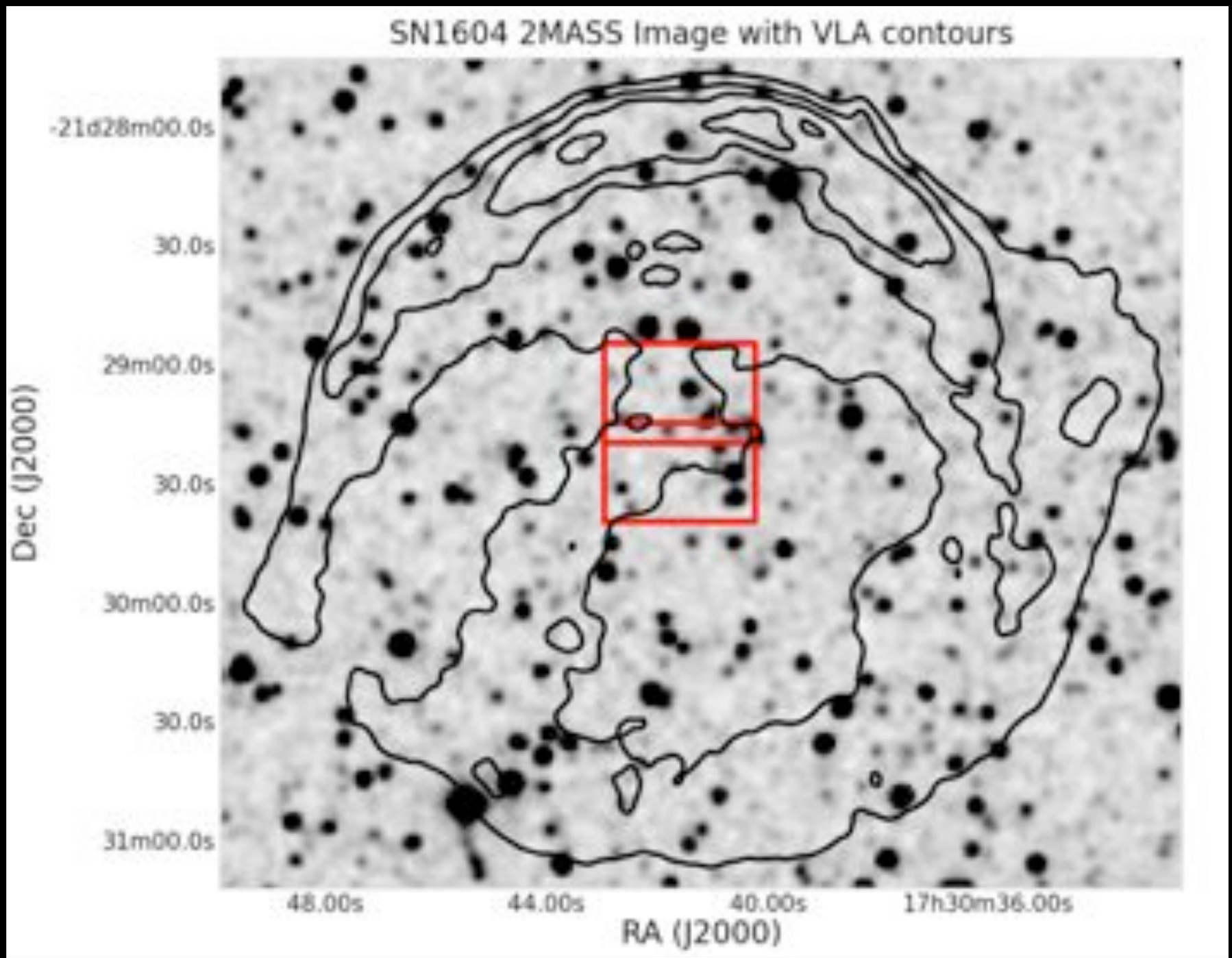
SN1006


SN1006 DSS Image with VLA Overlay (Overlay is cutoff)
-41d42m00.0s
48m00.0s
54m00.0s
-42d00m00.0s
06m00.0s
Dec (J2000)
04m00.00s
36.00s
03m12.00s
48.00s
24.00s
02m00.00s
15h01m36.00s
RA (J2000)
1000 km/s

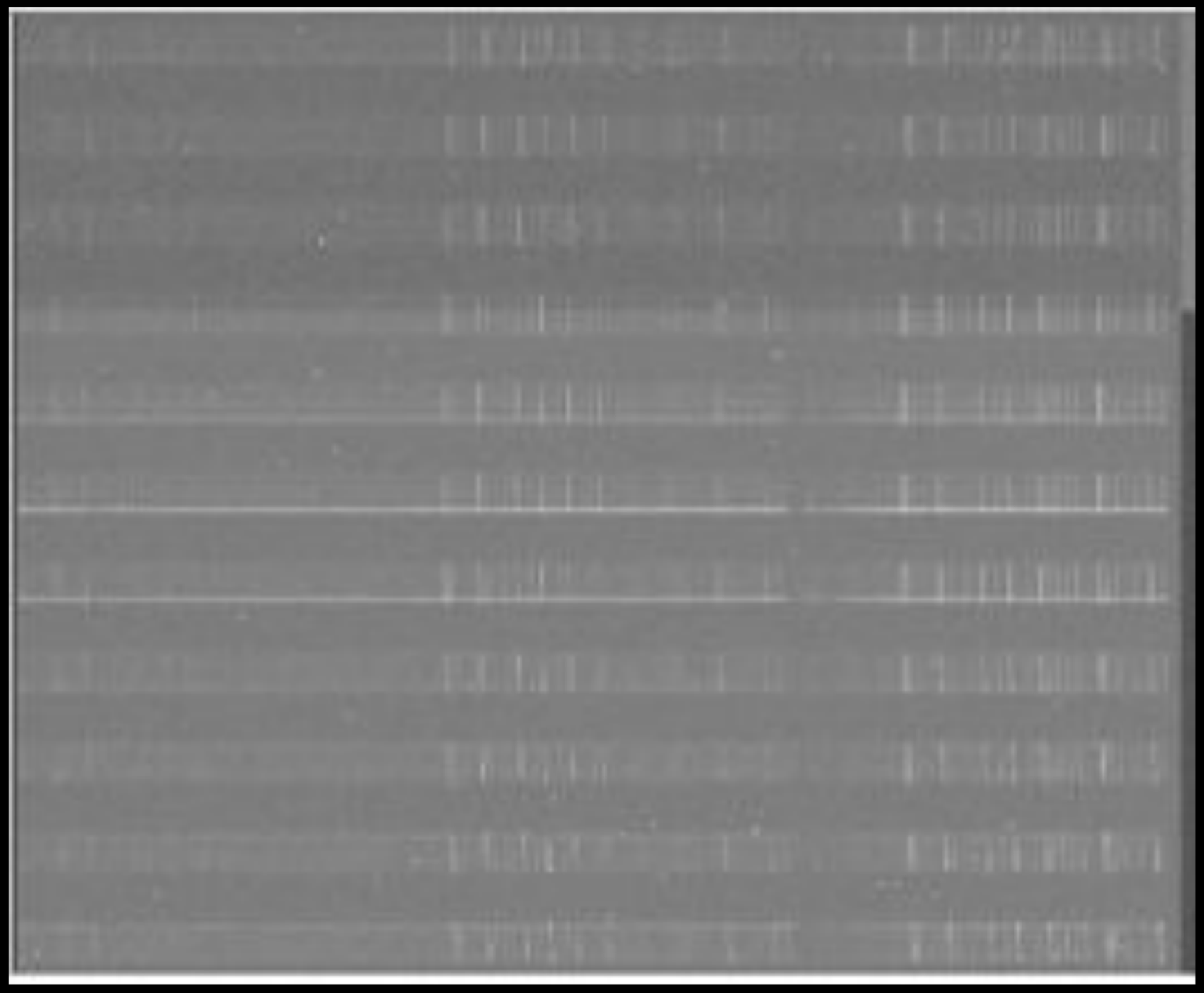

SN1006_01
SN1006_02
SN1006_03
Mg-B Region
Relative Intensity
5150
5200
5250
5300
5350
Wavelength Å

Kepler (SN1604)

Kepler (SN1604)



Hot off the CCDs



What now...

- Not every special star is “special”!
- On that note: Can Star B work?
- See what we get with the other remnants

Fin

Name	Temperature	log g	[Fe/H]	Rotation	Distance
Star A	4975 K	2.9	-0.08	< 6 km/s	0.7 kpc
Star B	10,000 K	3.7	~ -1	~ 170 km/s	5.3 kpc
Star C	4950 K	2.9	+0.09	<6 km/s	10.0 kpc
Star D	N/A	N/A	N/A	N/A	N/A
Star E	5825 K	3.4	-0.09	< 6 km/s	11.5 kpc
Star F	N/A	N/A	N/A	N/A	N/A
Star G	6025	4	-0.08	< 6 km/s	3.7 kpc

Besancon Model

- 1 sq degree area
- 21000 stars
- 0-7 kpc
- $-100<v_{rad}<40$