

What will Eta Car look like in 2000 years?

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Enormous Outbursts: 1837,1892

100 M_{SUN} star with
 $\sim 5 M_{\text{SUN}}$ companion

Two lobes expanding at
650 km/s

Slower 'waist'

Diffuse gas expanding
at > 1000 km/s

Nitrogen-Rich

UNIQUE



M31 Supernova Remnant Catalogs

Optical:

Blair et al. 1982

Walterbos and Braun 1992, Braun & Walterbos 1993

Lee & Lee 2014

Radio:

Dickel & D'Odorico 1984

Galvin & Filipovic 2014

X-Ray:

Stiele et al. 2011

Sasaki 2018

UV:

Leahy 2023

Odd Object in Caldwell et al. PNe Survey

Hectospec low resolution multifiber instrument on the MMT.

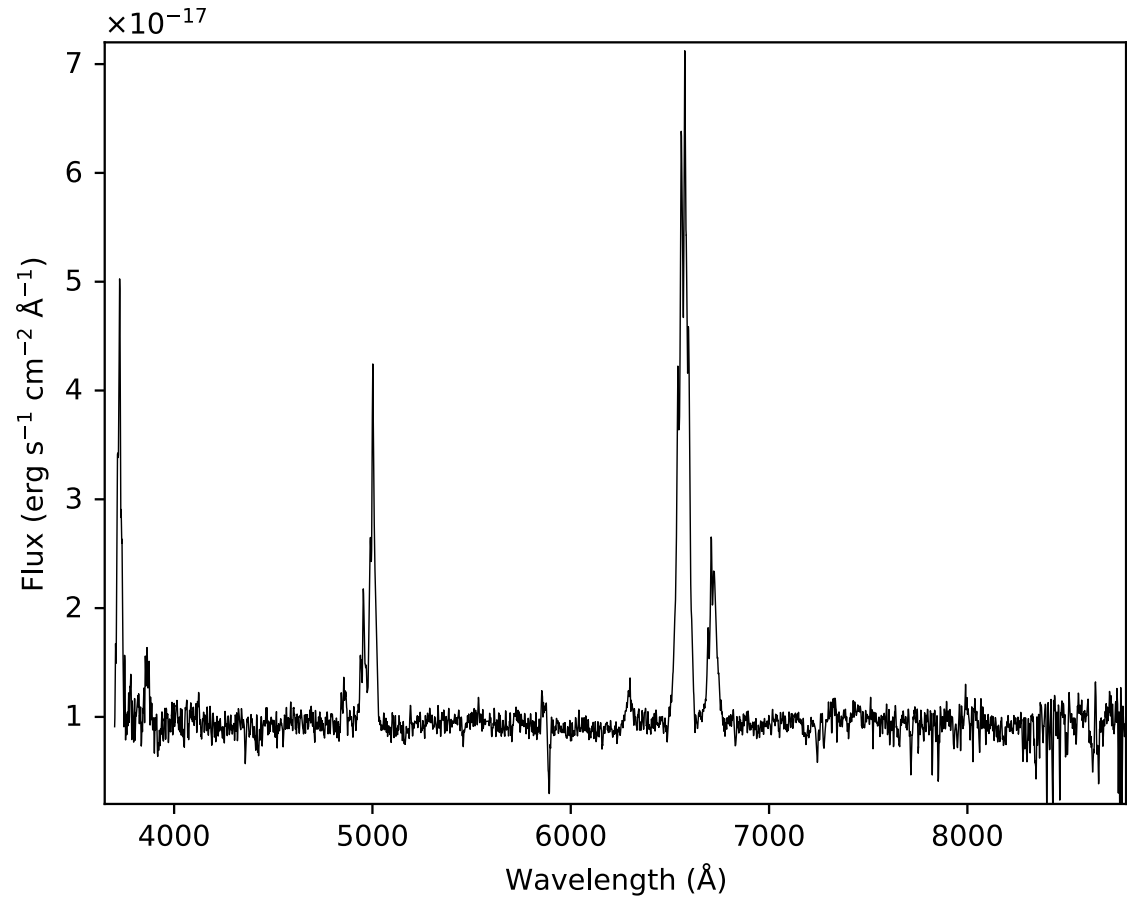
NOT in SNR Catalogs:

Apparent [S II]/H α is too small

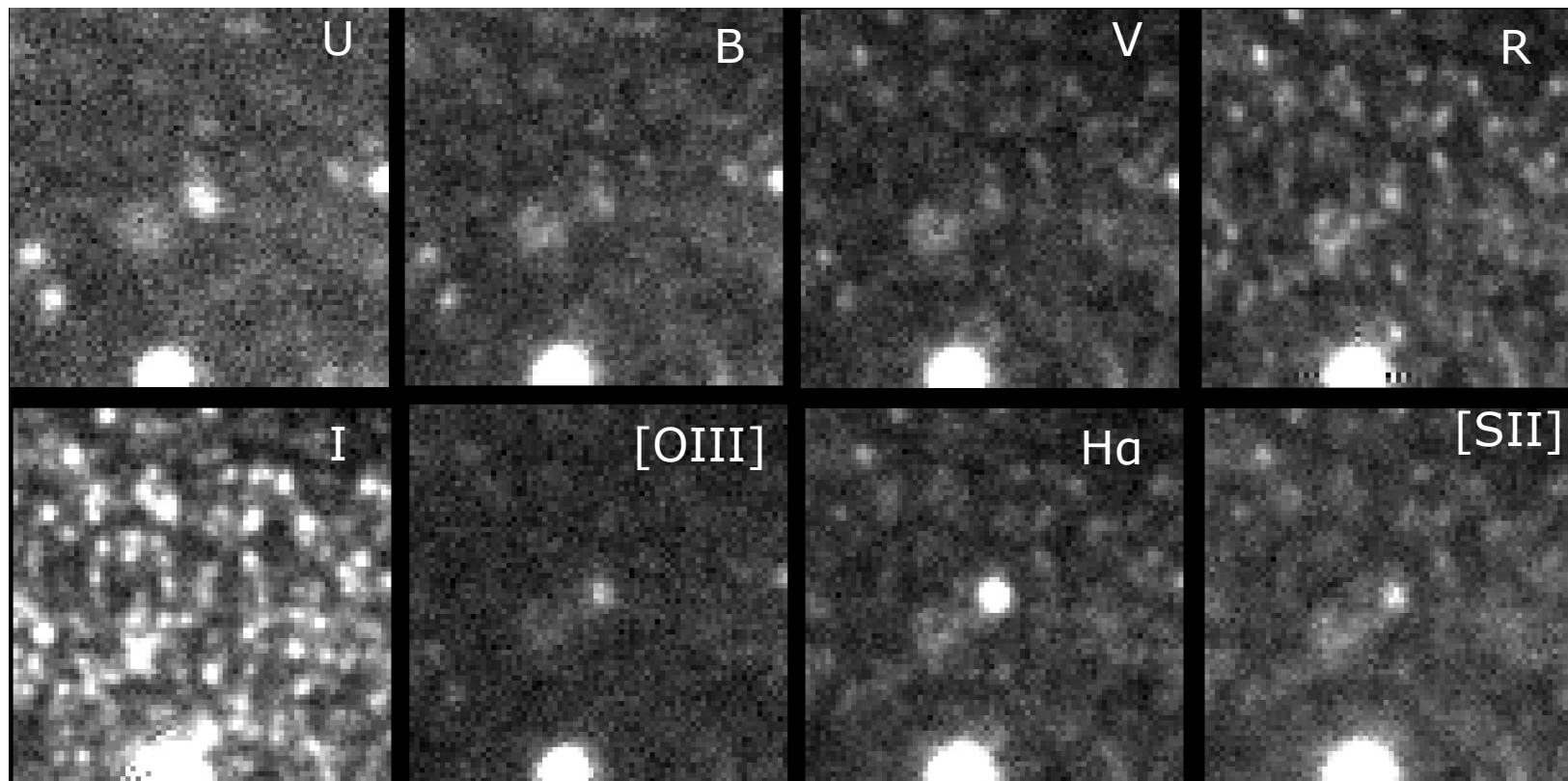
[N II] \gg H α

Line widths \sim 3000 km/s

Nearly unresolved



Emission line Object

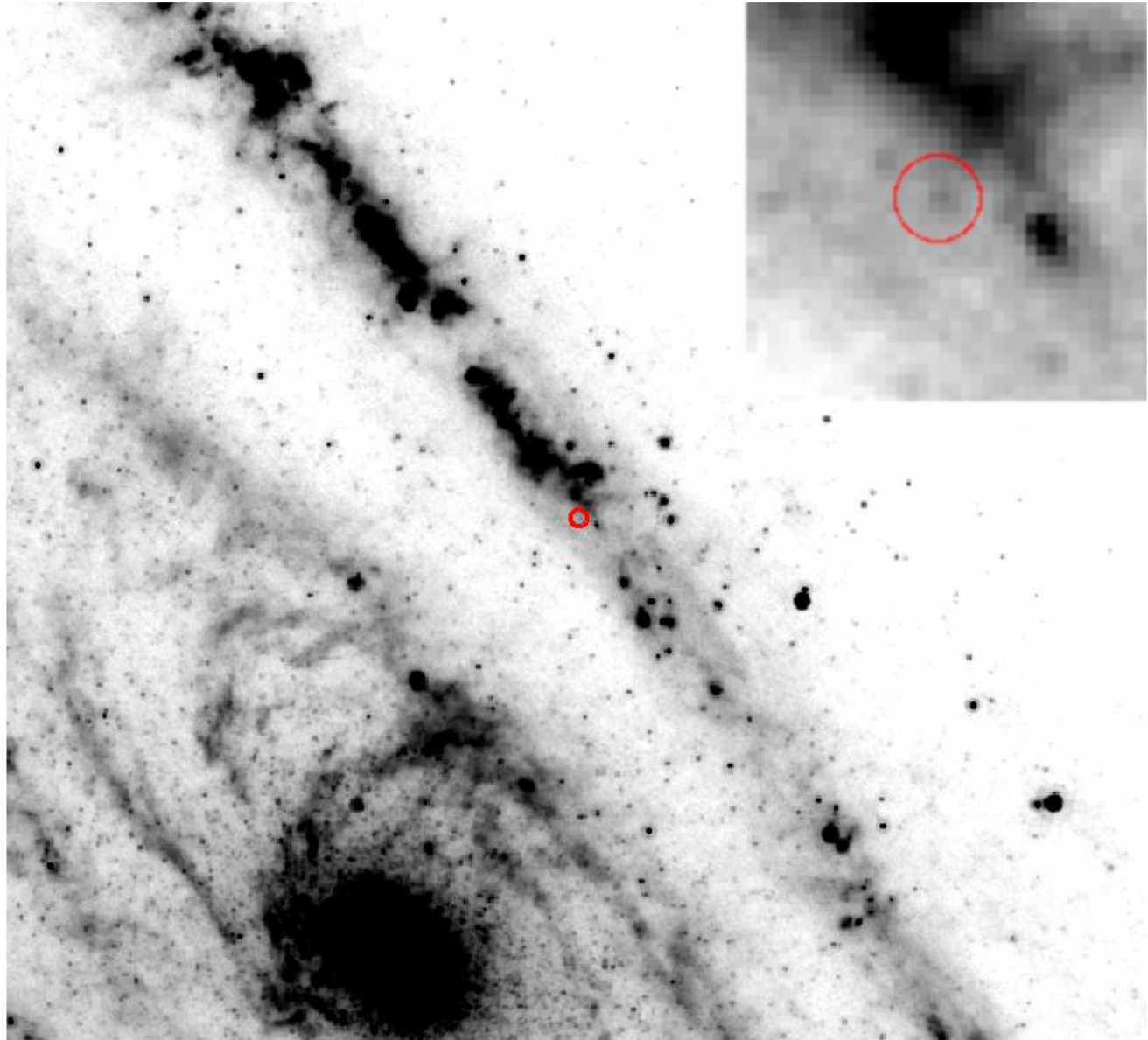


Barely resolved

Location:

Arm of M31 with lots of
Star formation

$$V_{\text{LSR}} = -300 \text{ km/s}$$



[O II] Line Profile

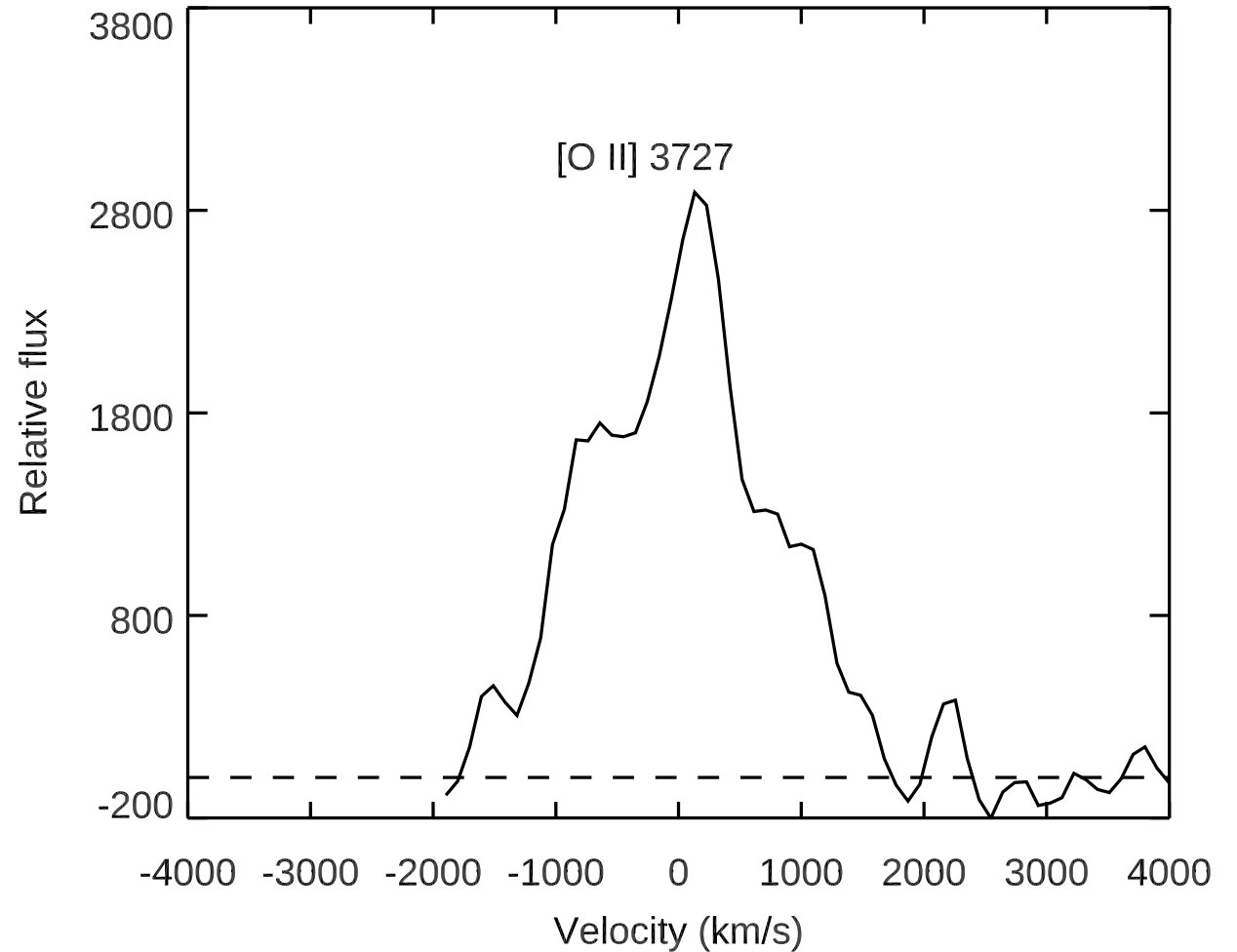
Velocity width ~ 3000 km/s

Very lumpy profile

Peak at 0 and near ± 800 km/s

(3727 at edge of detector)

V in frame of M31



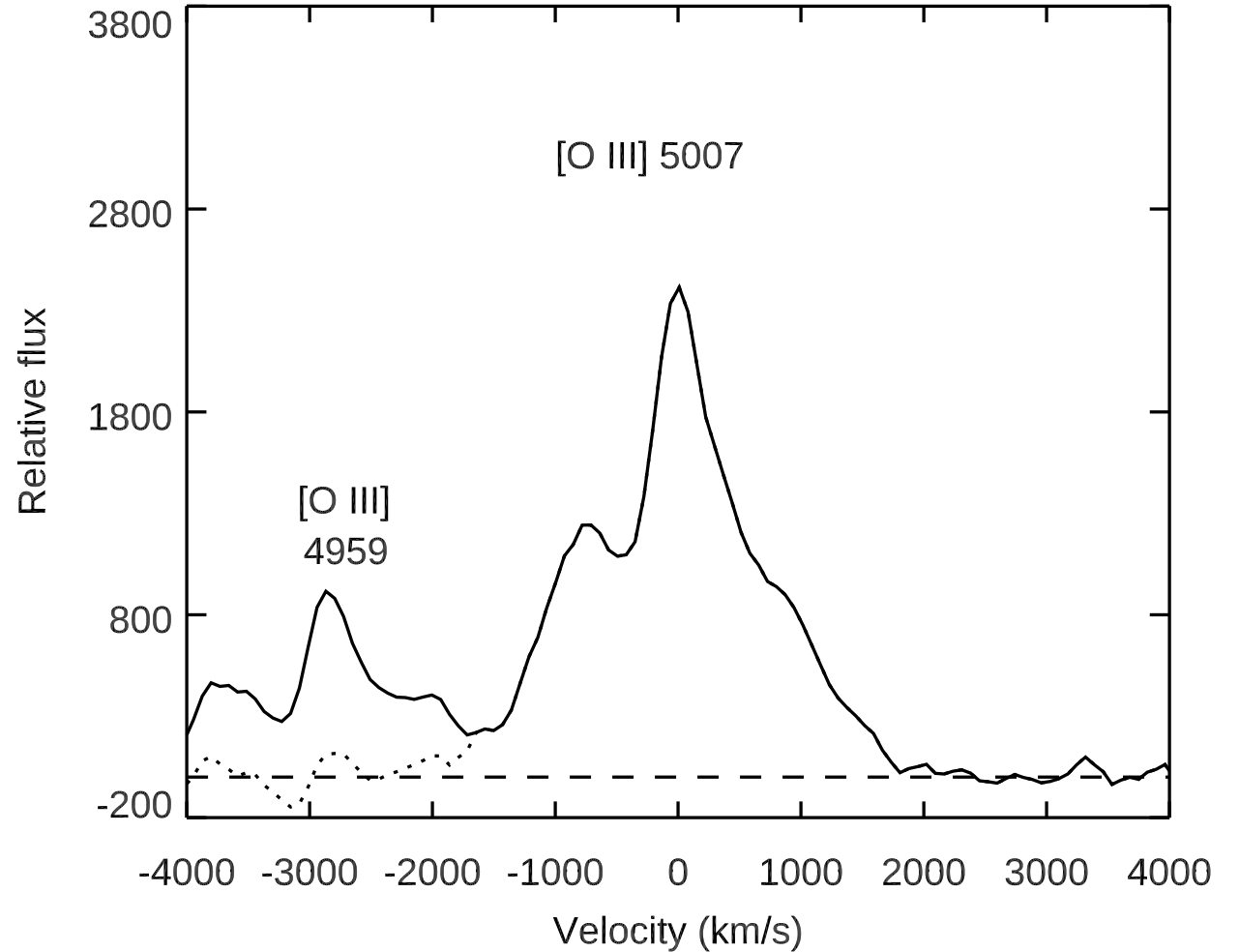
[O III] Line Profile

Peak near zero velocity with smaller
Peak at -800 and shoulder at
+750 km/s

Unfold the blend: $5007/4959 = 3$

Start from + velocity edge and
subtract 1/3 of the counts from the
bin 2880 km/s to the blue

Dotted line shows blue wing of 5007



[S II] Line Profile

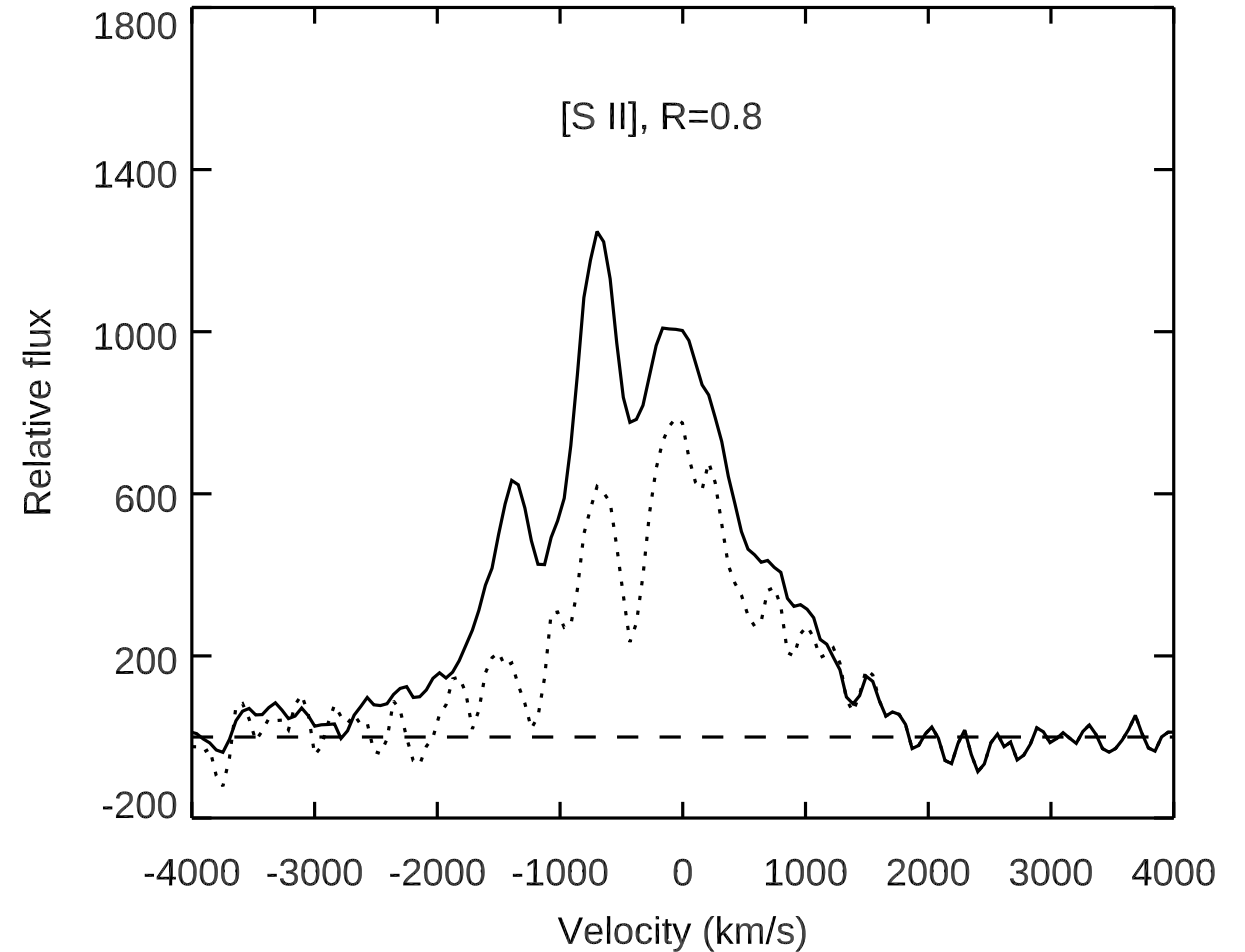
Unfold 6717, 6731 similarly to [O III]

Overlap is worse; Separation is 640 km/s

Ratio is not known and may not be constant

Some ratios give negative emission

Best fit ratio is 0.8 – 1000-3000 cm^{-3}



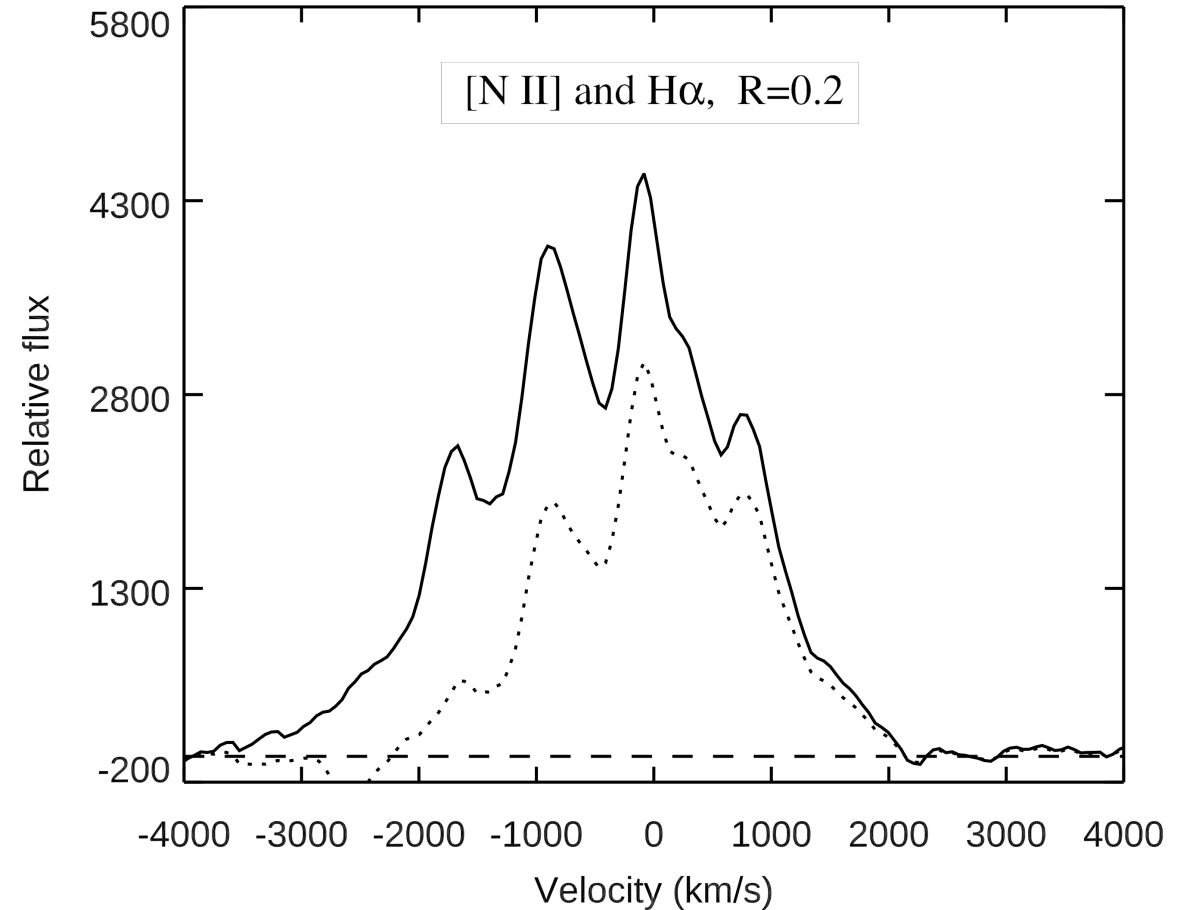
[N II] and H α Profile

Also severe overlap: 1620 km/s separation and 3:1 ratio of [N II] 6584:6548

But H α lies between and ratio is not known.

Try different H α /[N II] and get best fit of 0.1-0.2, as expected from H β .

Peaks at -800, 0, +750



Comparison to Eta Car

Profile:

Peaks 0 and symmetric ± 800 km/s compared to ± 650

Diffuse profile extending to ~ 2000 km/s compared to > 1000

Abundances:

Extremely N-rich compared to N-rich

Sounds like Eta Car, but

No central star

Diameter ~ 12 pc.

X-rays: $L_x \sim 10^{36}$ erg/s Kaaret 2002

Schematic Picture

Older Eta Car?

Slow reverse shock in ejecta to make optical.

ISM would have to be very low density for $\rho_1 V_1^2 = \rho_2 V_2^2$

Hard to explain X-rays

Young SNR expanding into Eta Car-like shell?

V_2 can be smaller, ρ_2 can be higher, X-rays can be explained

Will Eta Car Actually Explode?

~ 100 M_{SUN} --- might collapse directly to BH

Sukhbold et al. 2016 find that SN is possible

Binary evolution might drastically modify things

Companion star might explode

Progenitor of WB92-26 could be less massive

Eta Car is unique in our Galaxy. WB92-26 is unique in M31.

**Might be others in other galaxies mis-classified because apparent
[S II]/H α < 0.4**