2D mapping of the physical and chemical properties of the ionized gas in NGC 5253

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J. Walsh[2], J.M. Vílchez[1]

[1]IAA, [2]ESO

ESTALLIDOS collaboration

(based mainly – but not only – on Monreal-Ibero et al. 2012, A&A, 544, 60)

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Intro: Blue Compact Dwarfs

- Dwarf: $M_B > -18$
- Compact: Ø < 1 kpc
- With bright emission lines similar to those in HII regions
- With massive SF
- Low metallicity

BCDs are ideal laboratories to study the interplay between massive SF and surrounding gas

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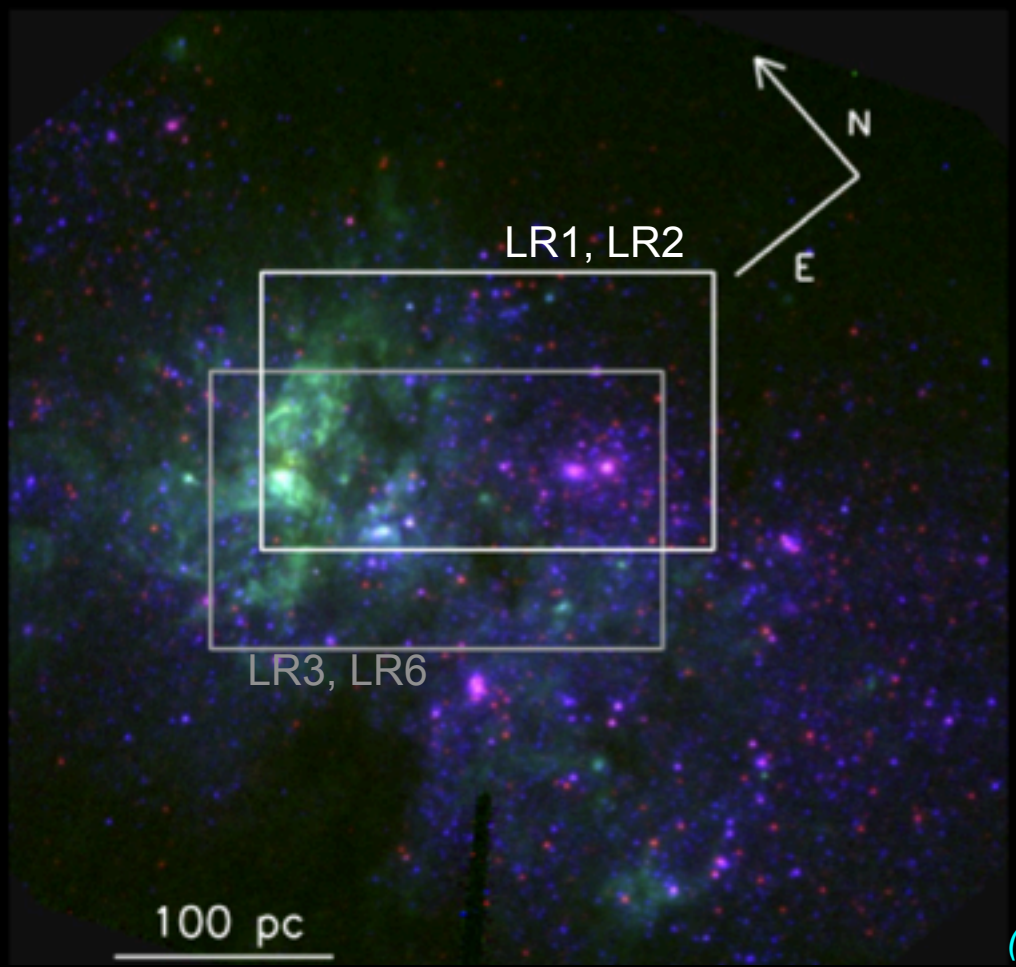
NGC 5253

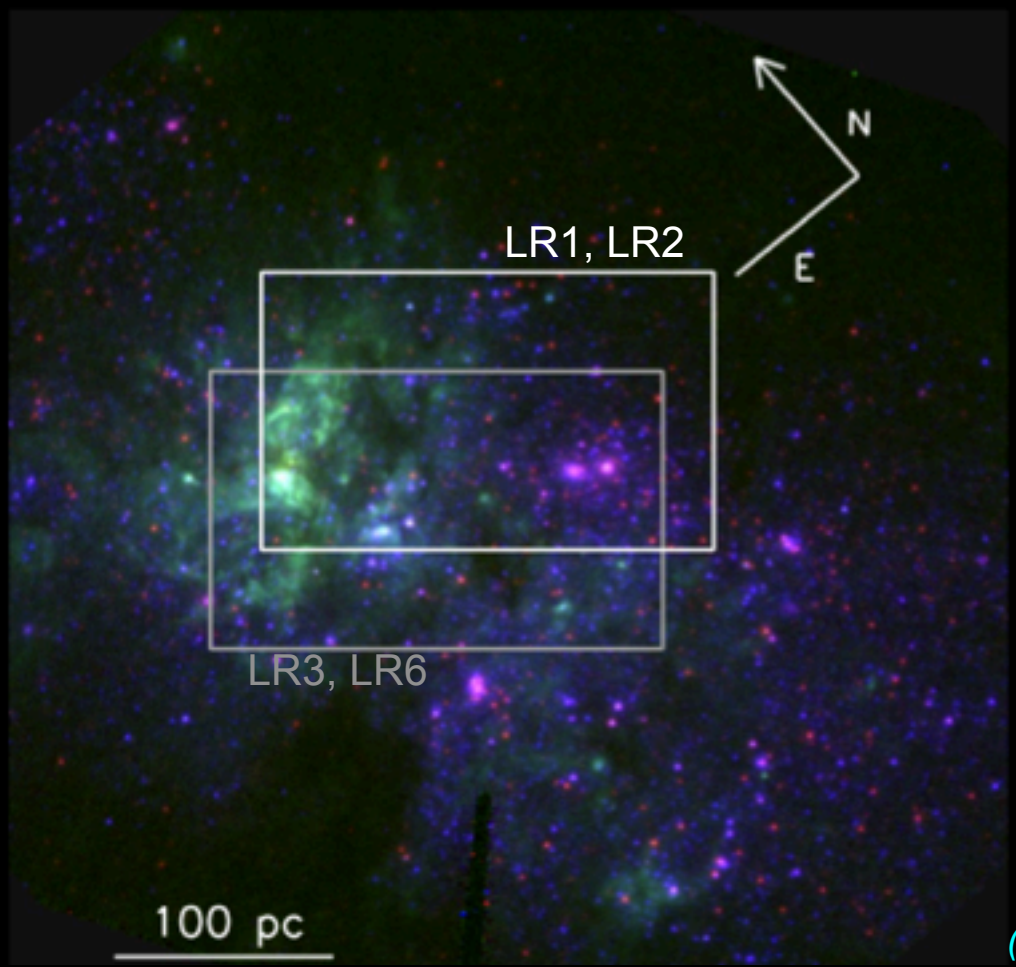


- Very close; D=3.8 Mpc; z=0.001358
- Scale=18.4pc/”
- M_B=-17.13
- M(HI)=1.4x10^{8}M$_\odot$
- Filamentary structure
- Hints of inflows/ouflows
- Reported extra N, WR emission etc.
- Complex kinematics
- Z ~0.3Z$_\odot$

(HST-ACS, I+Hα+B, program 10609, P.I.: Vacca)

We want to see the details. Let’s look at it with IFS.

NGC 5253



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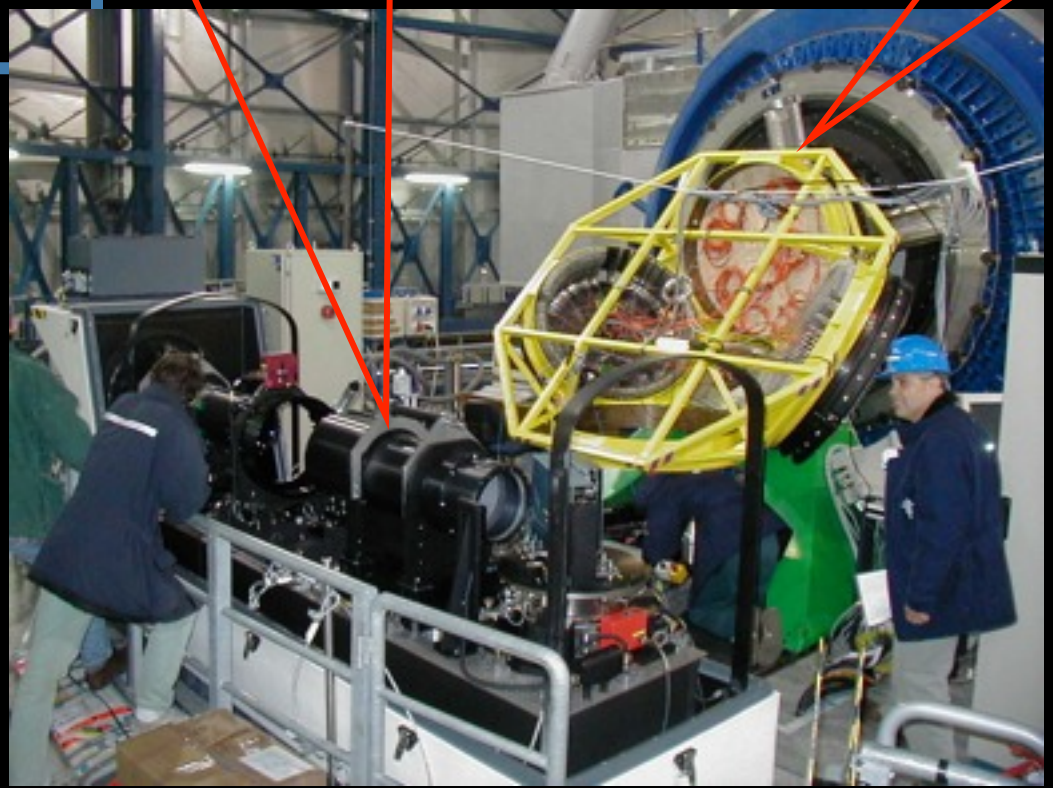
FLAMES@VLT

OzPoz: The fiber positioner

GIRAFFE: The spectrograph



ARGUS mode:
- scaling: 0.52”/spa;
- f.o.v.: 11.5”x7.3”

Grating	R	Δλ (nm)	t_{exp} (s)
LR1	12800	361-408	21x895
LR2	10200	369-456	9x895
LR3	12000	450-508	5x1500
LR6	13700	644-718	5x1500

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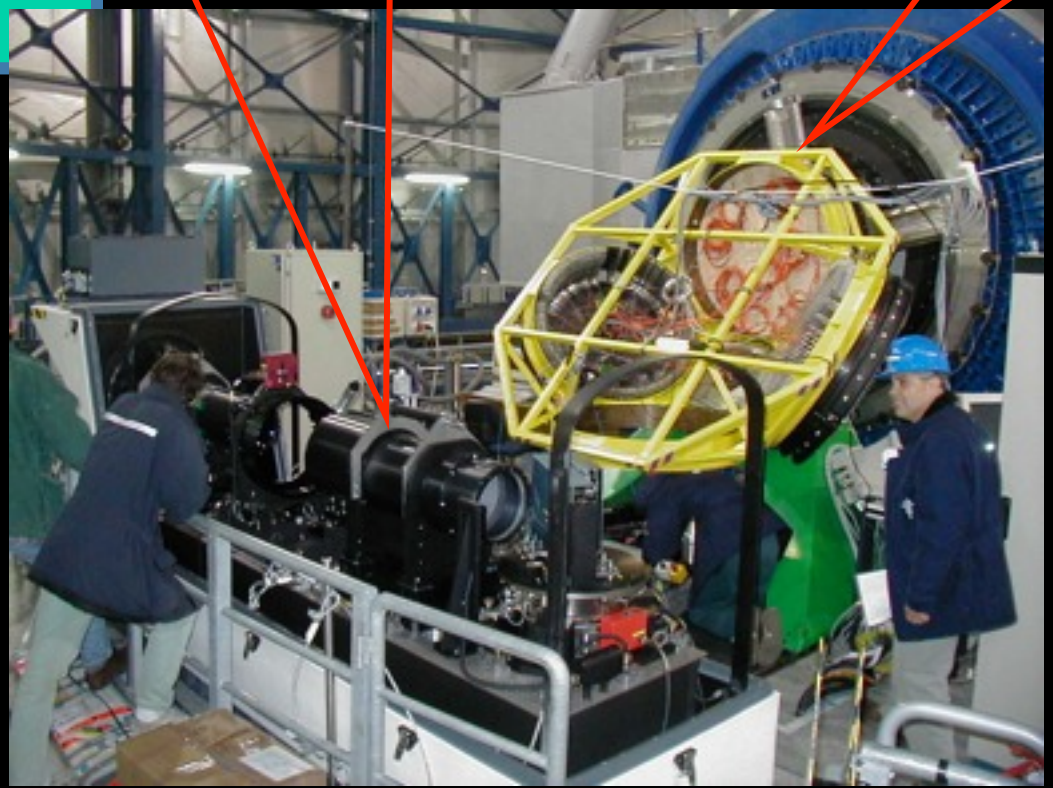

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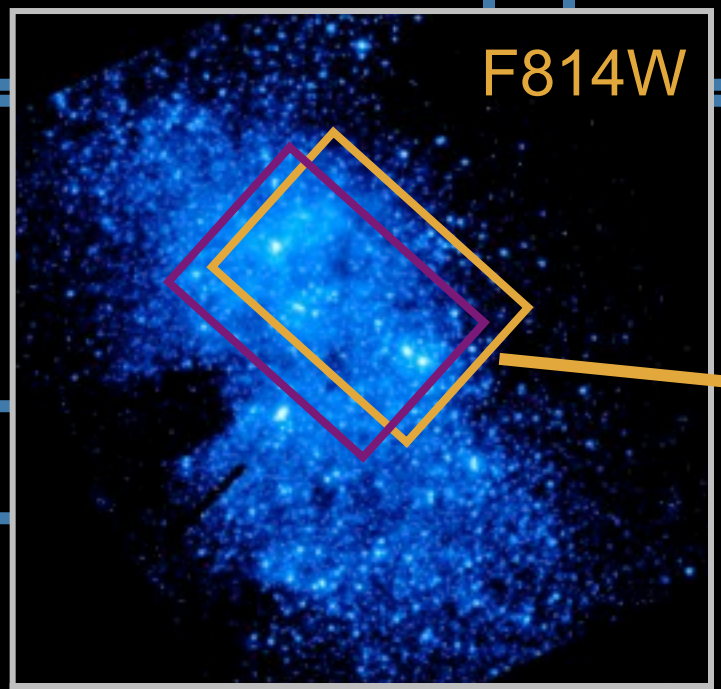
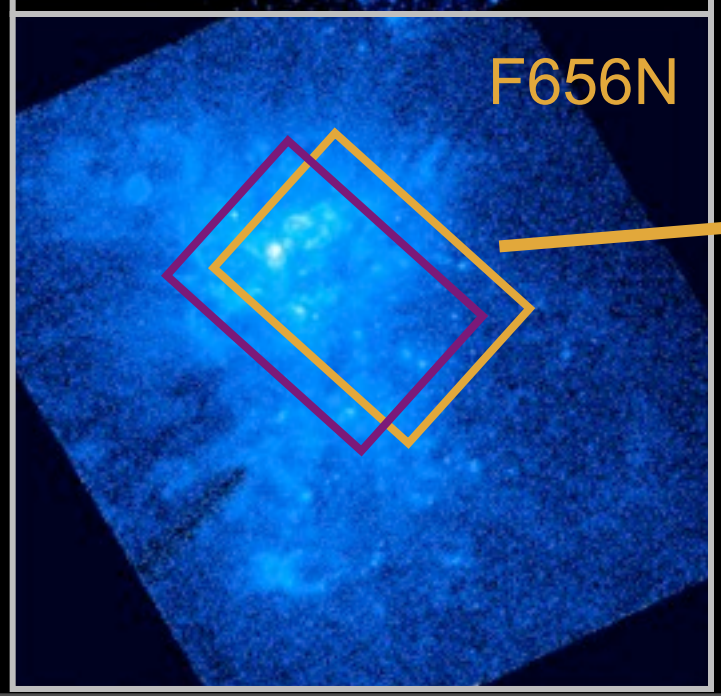
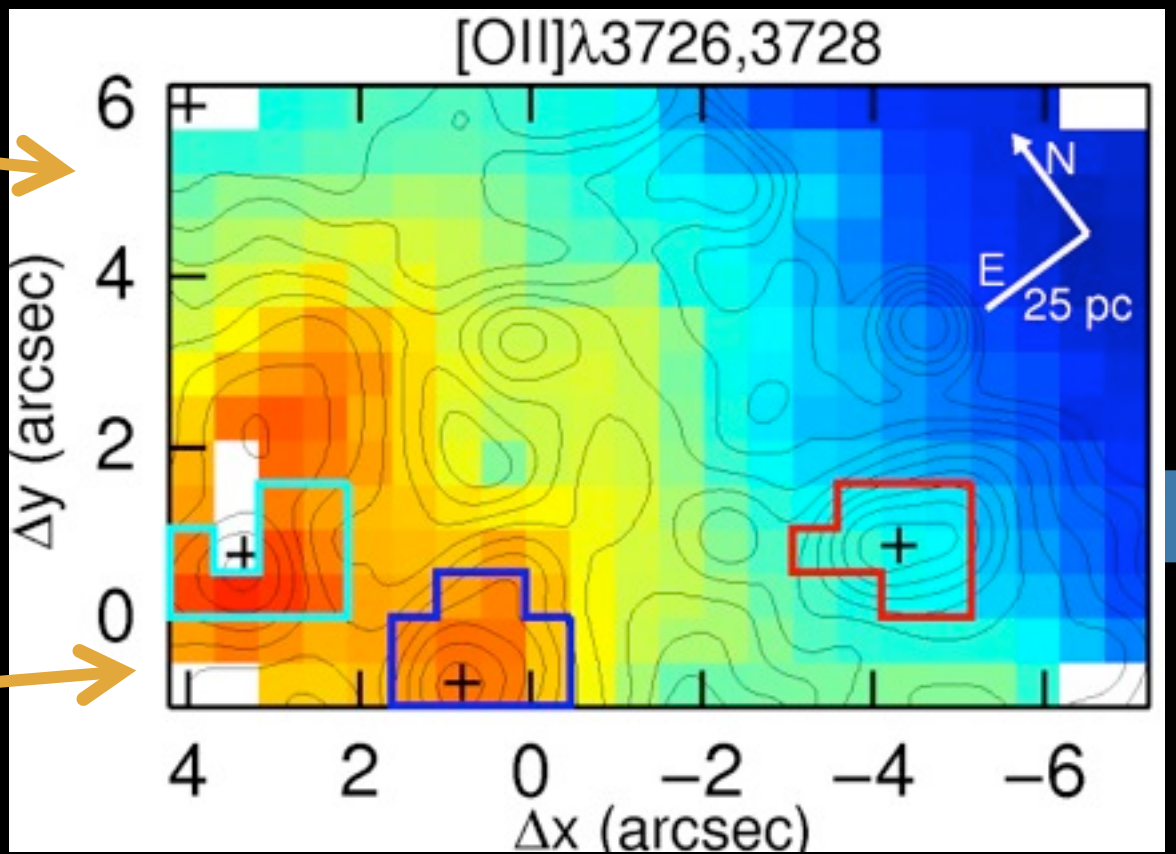
Where are we?







1 spa ~10 pc x 10 pc

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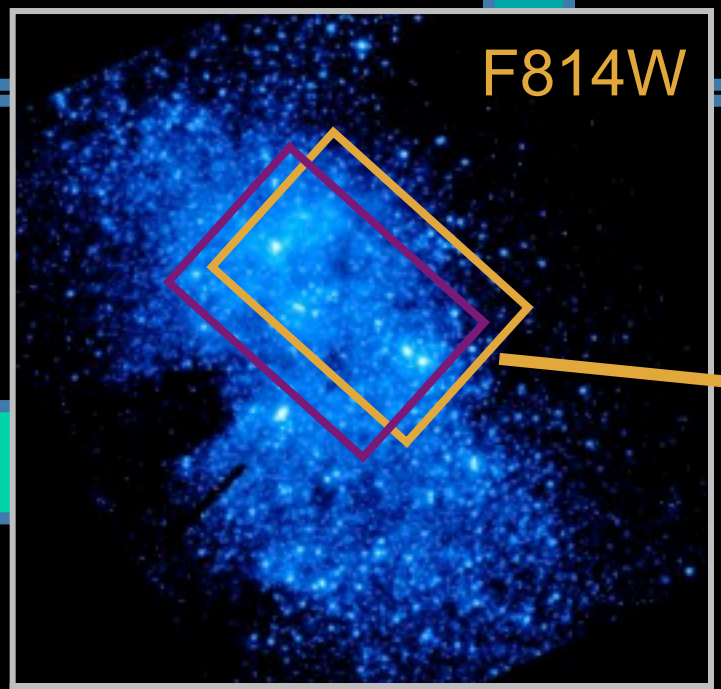
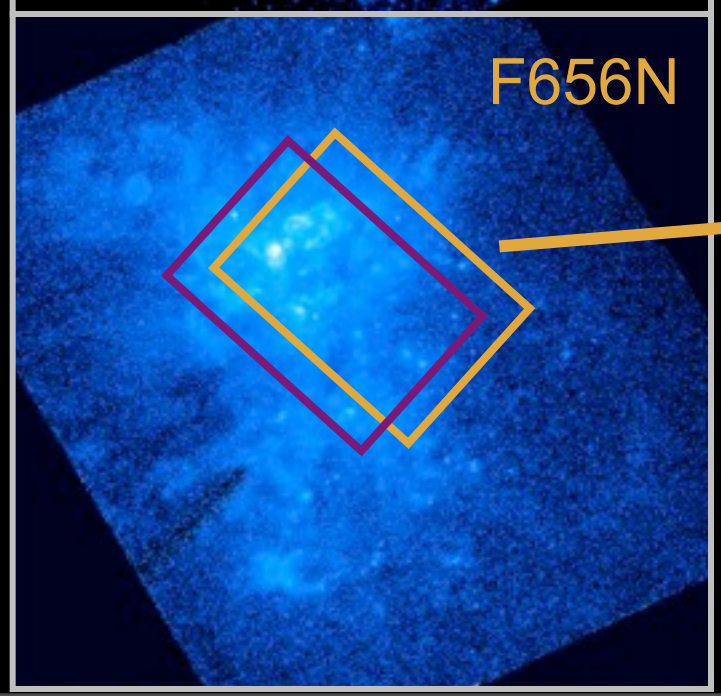
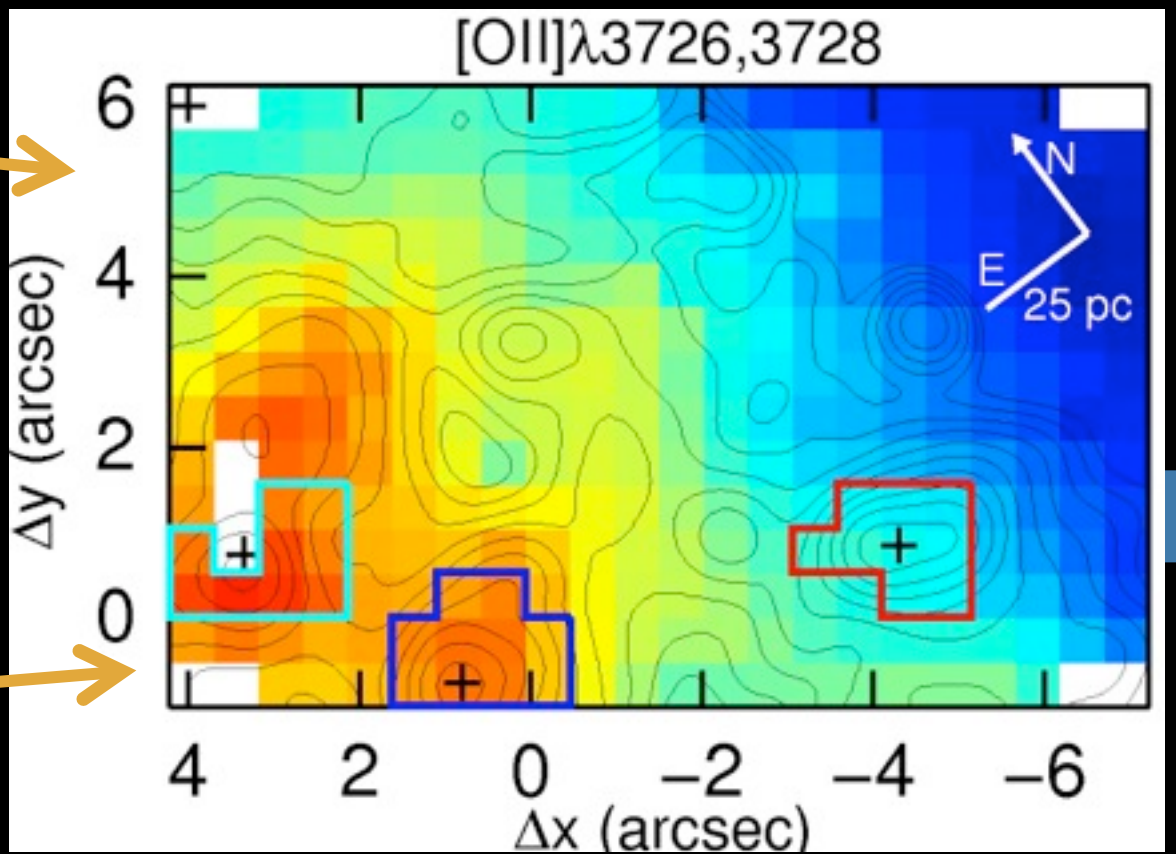
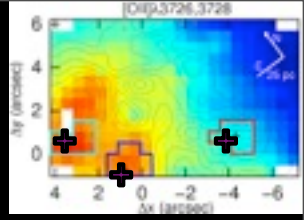


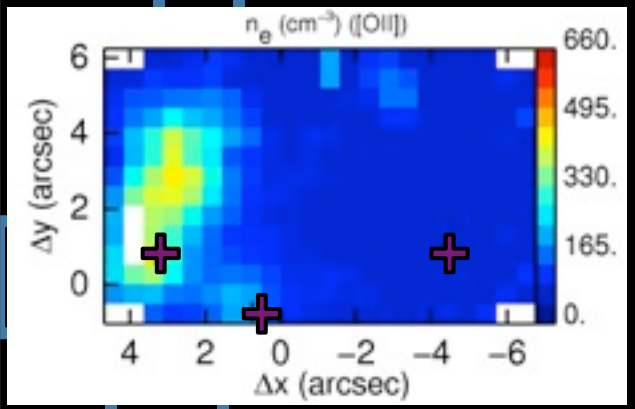




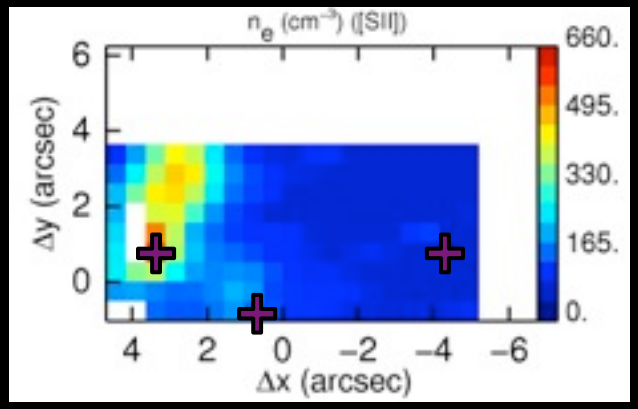
□ 1 spa ~10 pc x 10 pc

Electron density

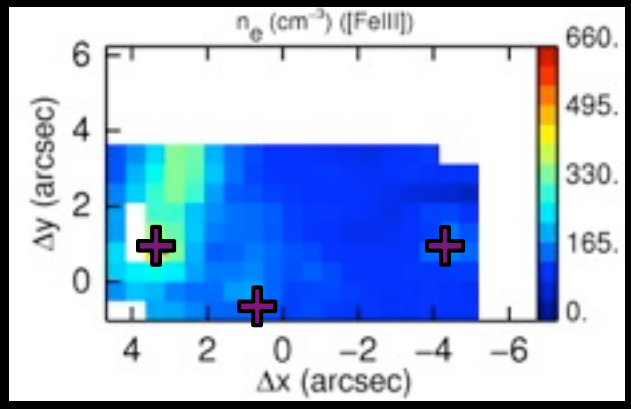




λ3726/λ3729



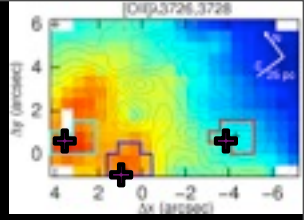
λ6717/λ6731

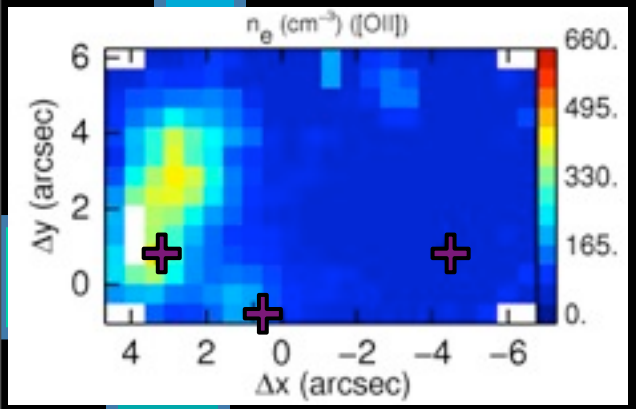


λ4986/λ4658

- Most of the f.o.v.: < low density limit
- Knot 2: ~190 cm^{-3}
- GHIIR: The richest structure
  - the largest n_e.
  - 2 peaks
  - n_e([SII]) > n_e([OII]) ~ n_e([FeIII])

Electron density





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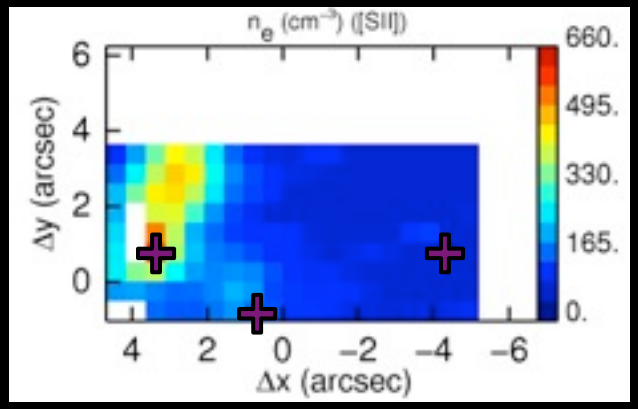

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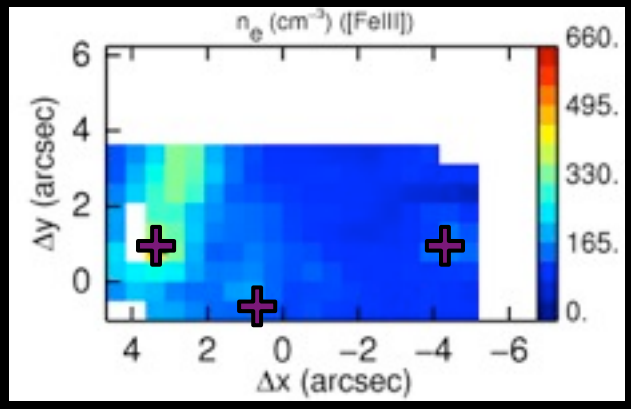

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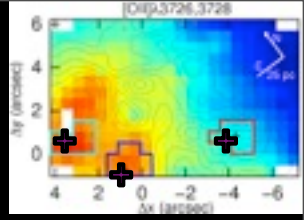

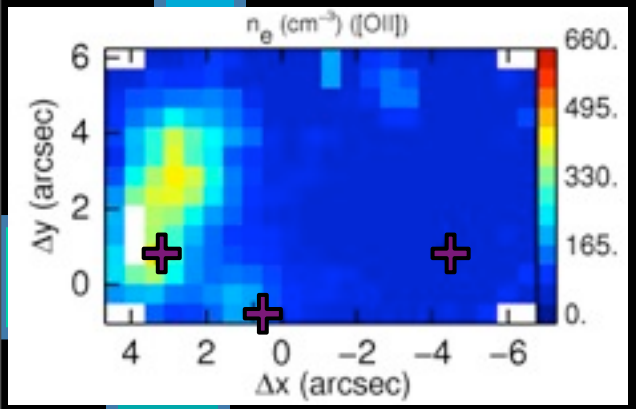

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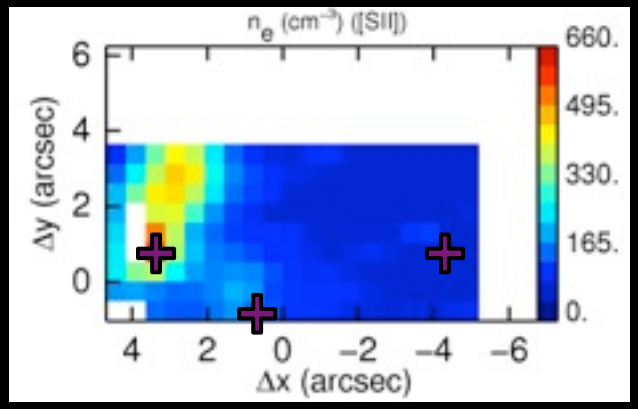

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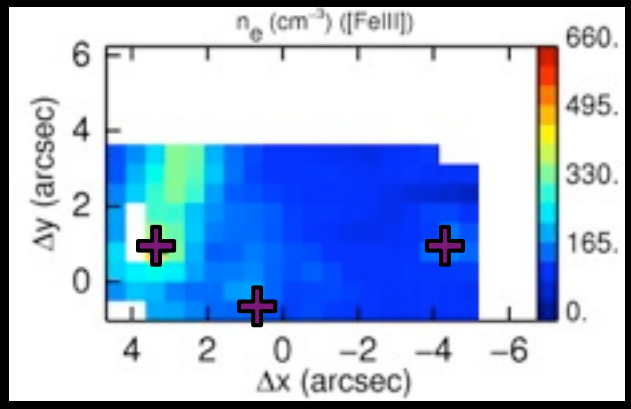

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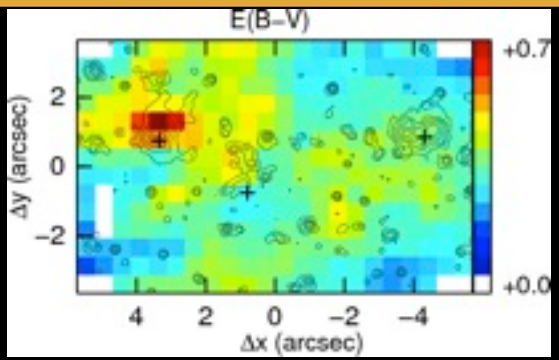
+ heavy extinction in the GHIIR



(Monreal-Ibero et al. 2010, A&A, 517, 27)

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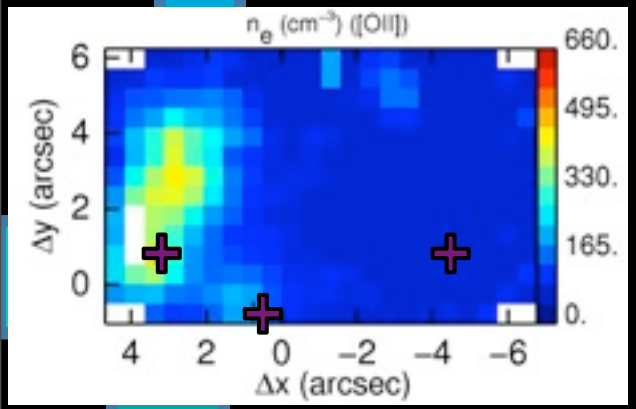

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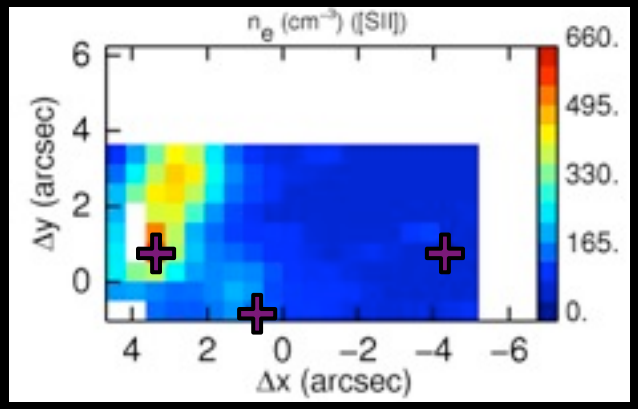

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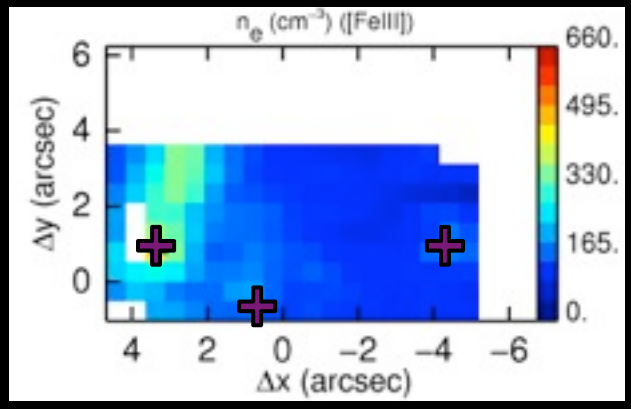

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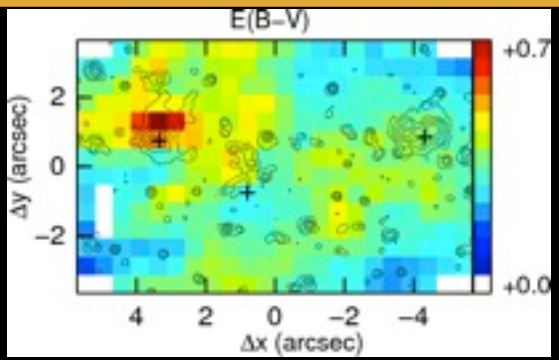
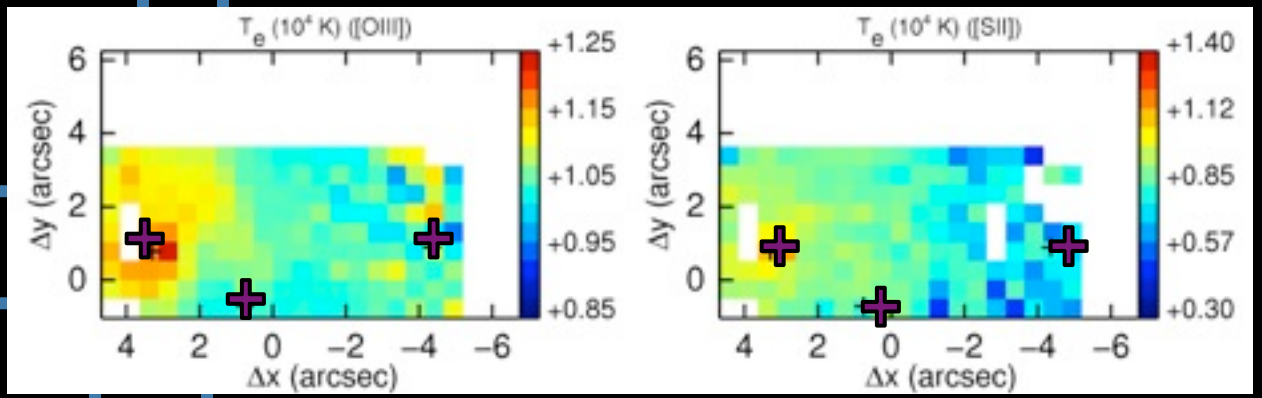


(Monreal-Ibero et al. 2010, A&A, 517, 27)

Results consistent with an onion-like structure where the inner layers are denser than the outer ones.

Electron temperature



λλ4959,5007/λ4343

λλ6717,6731/λλ4069,4076

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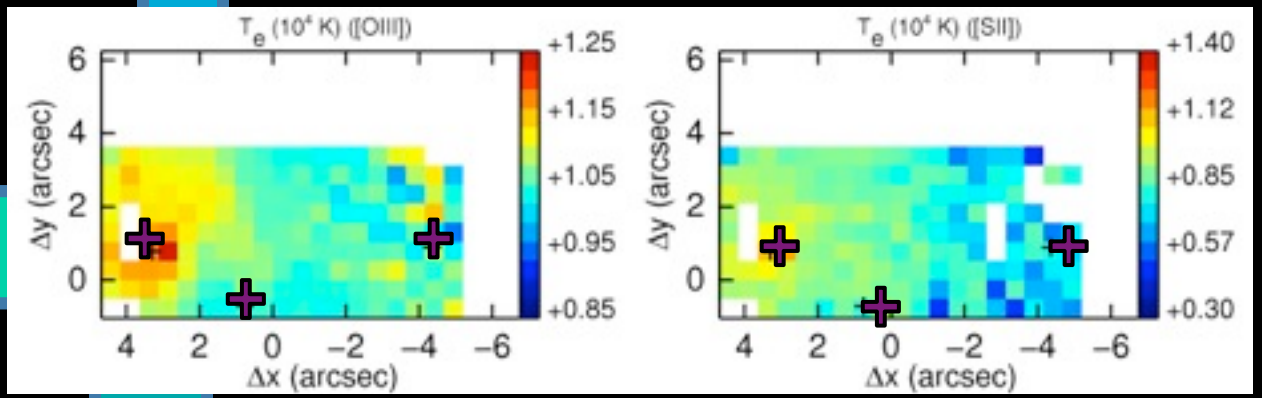

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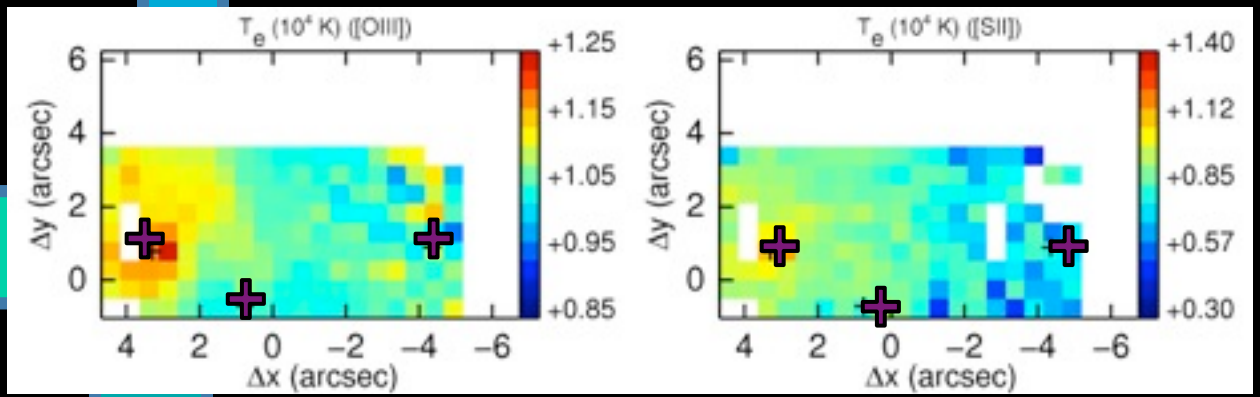

λλ4959,5007/λ4343

λλ6717,6731/λλ4069,4076

- Similar structure in both maps
  - Largest T_e at peak in Hα
  - Decreasing outwards
- T_e([SII]) ~0.6-0.8 T_e([OIII])
  - T_e([OIII]) = 10000 – 12000 K
  - T_e([SII]) = 6000 – 11000K

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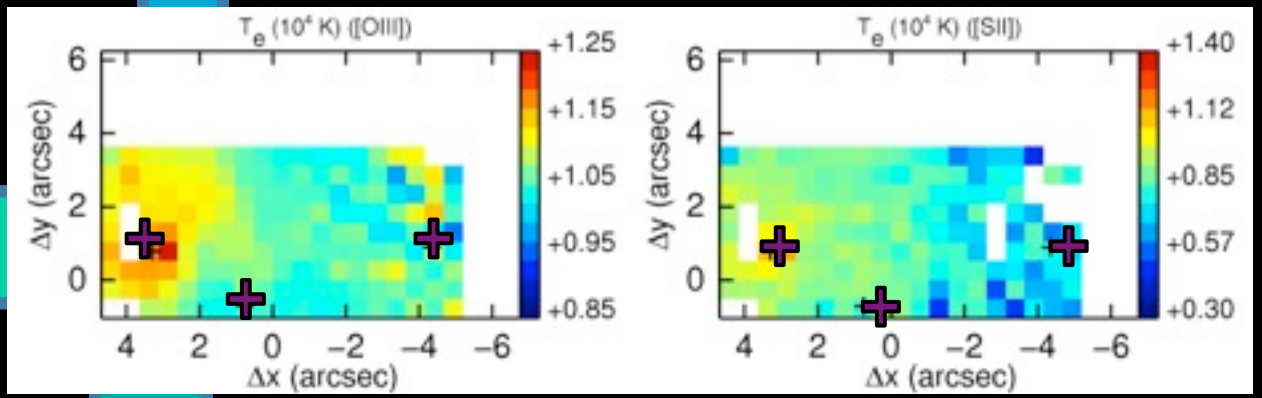

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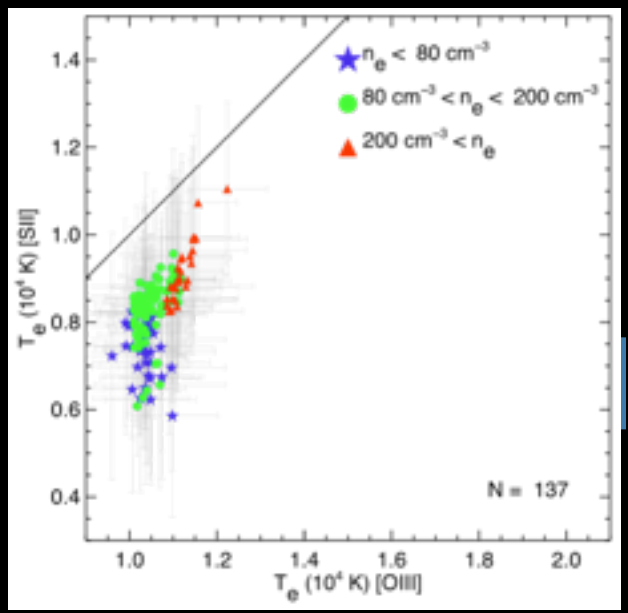

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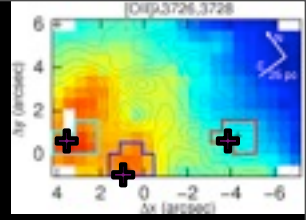
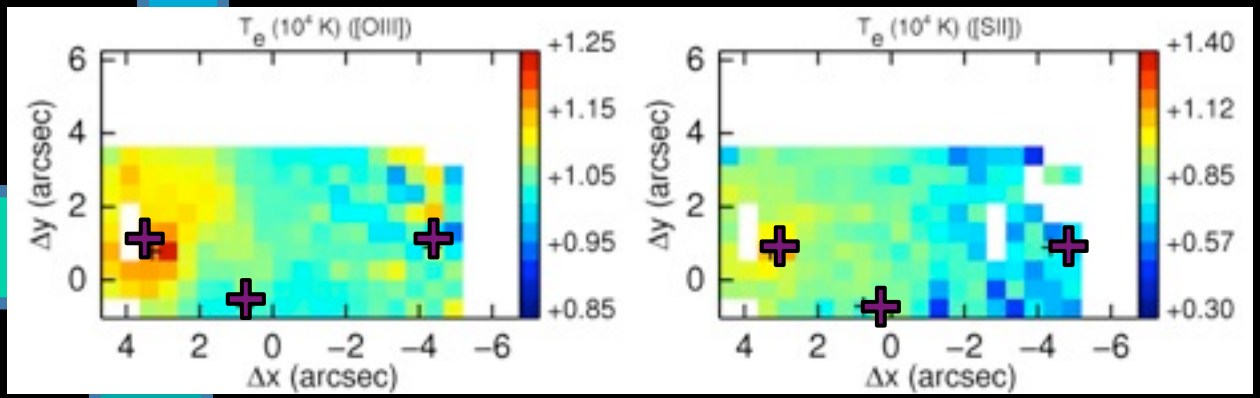


(1) (2)



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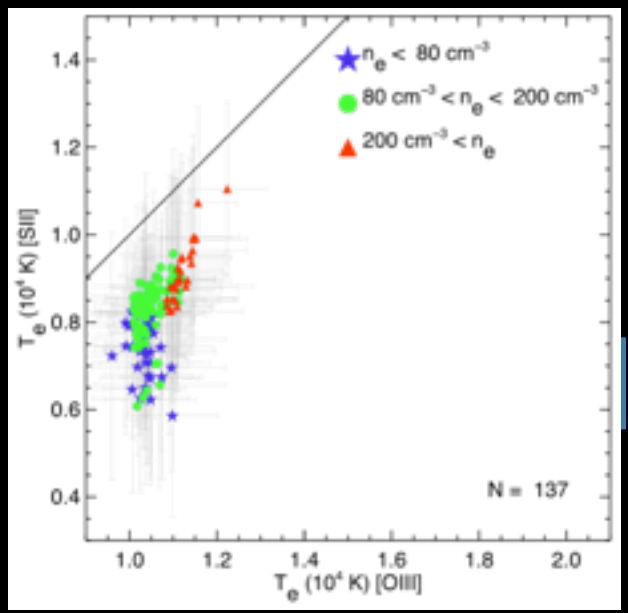

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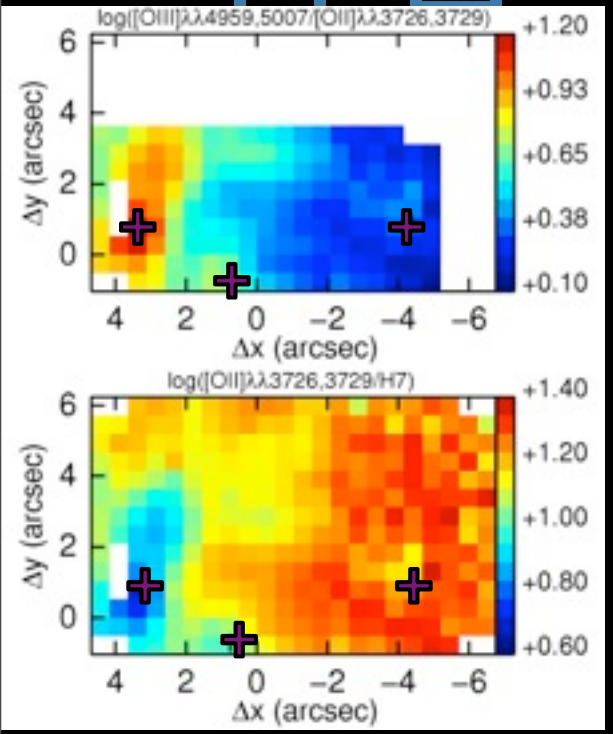
Both, (1) and (2) are consistent with a T_e structure in 3D with higher temperatures close to the main ionizing source surrounded by a more diffuse component of ionized gas at lower T_e.

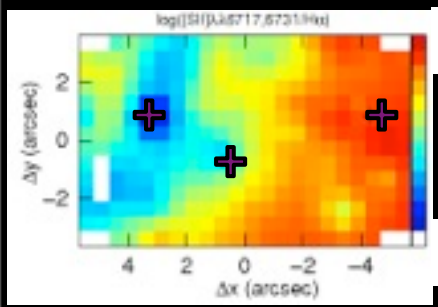
Local ionization degree



(1)

(2)

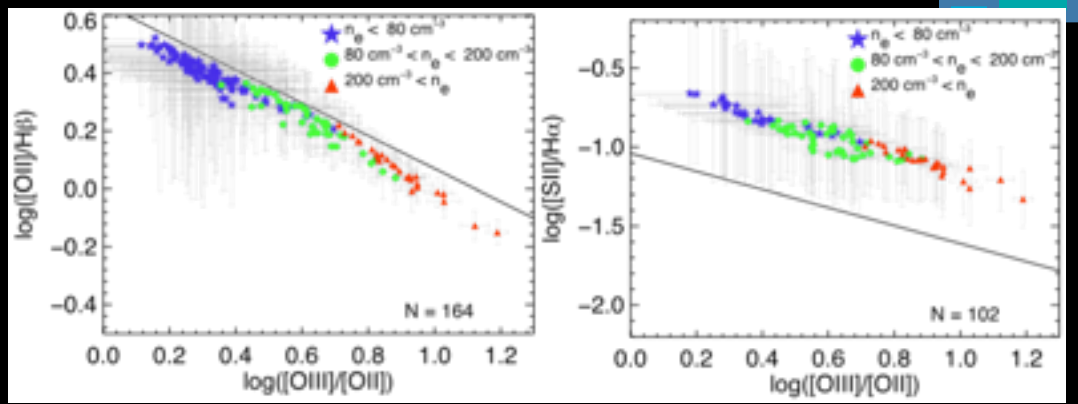
- The ionization structure reproduces the morphology observed for the ionized gas
- Similar structure in all the 3 utilized maps suggest a lack of any metallicity gradient.
- When comparing with models from literature, [SII]/Ha disagrees



-0.5

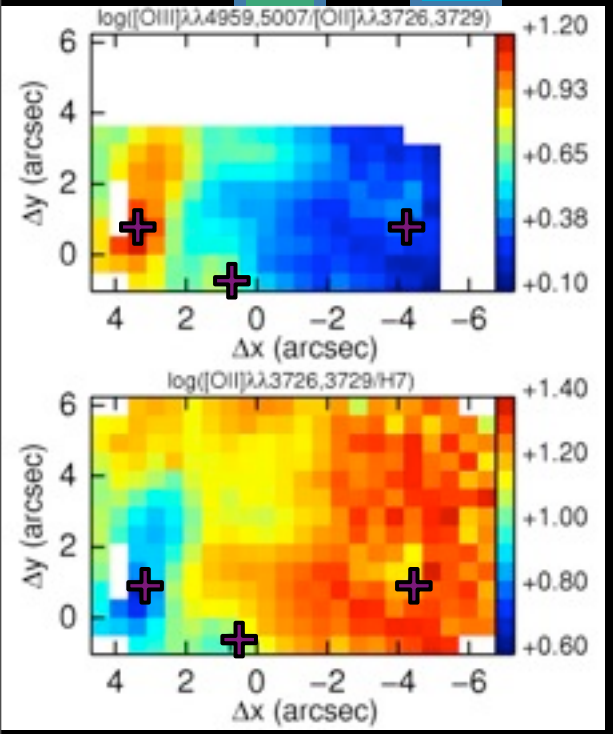
(Monreal-Ibero et al. 2010, A&A, 517, 27)

-1.4



A possible 3D interpretation of (1) and (2) is that we are seeing how the lower ionizations species delineate the more extended diffuse component.

Local ionization degree



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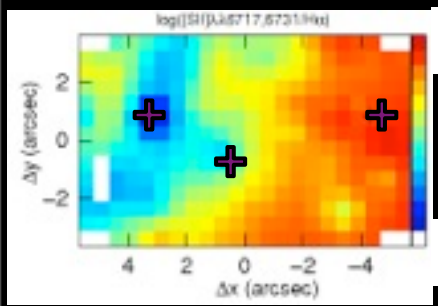

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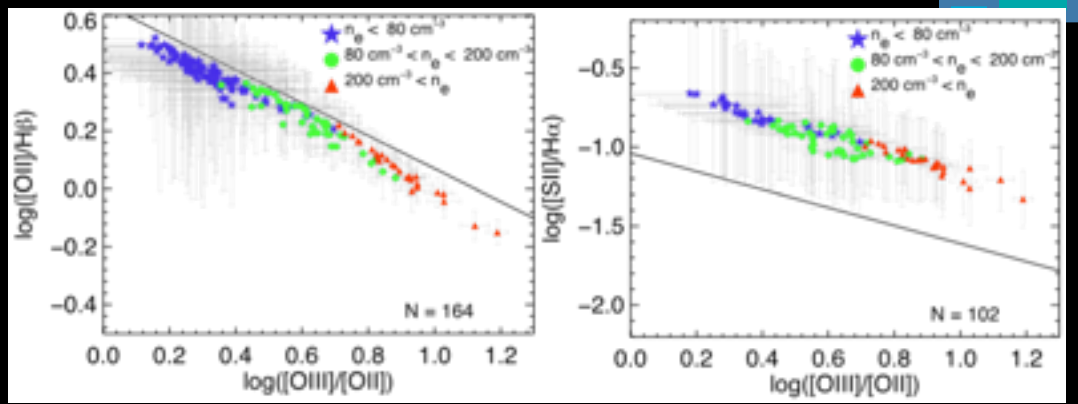

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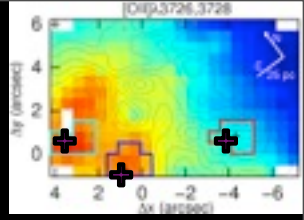
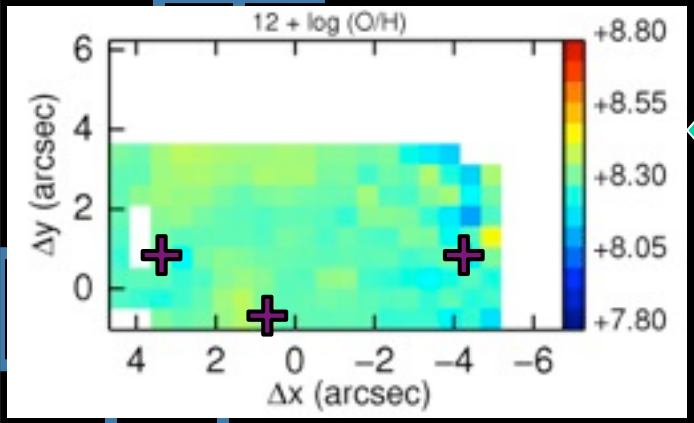
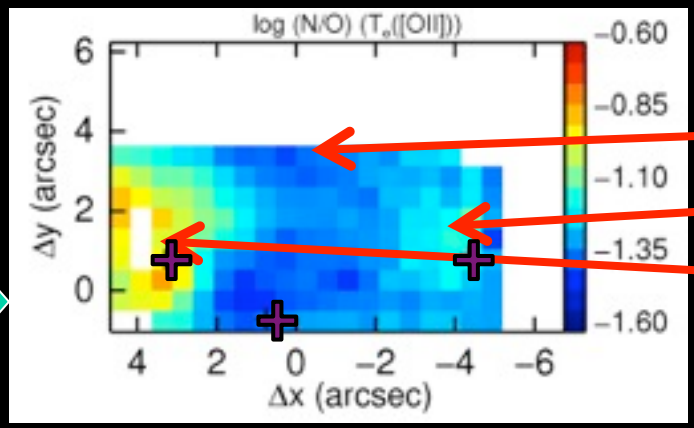
Abundances of heavy elements



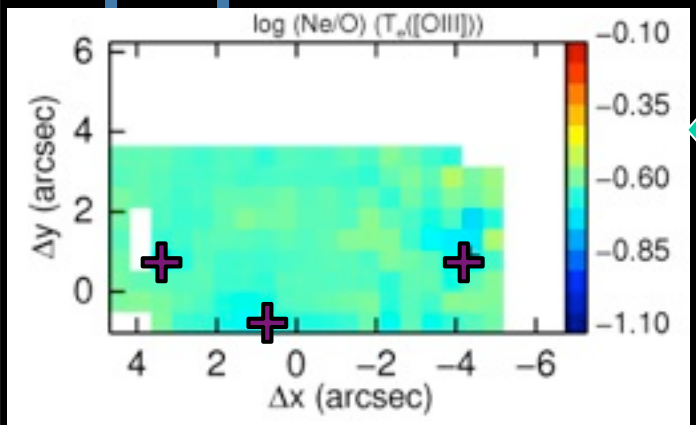


12+log(O/H)
8.26±0.04

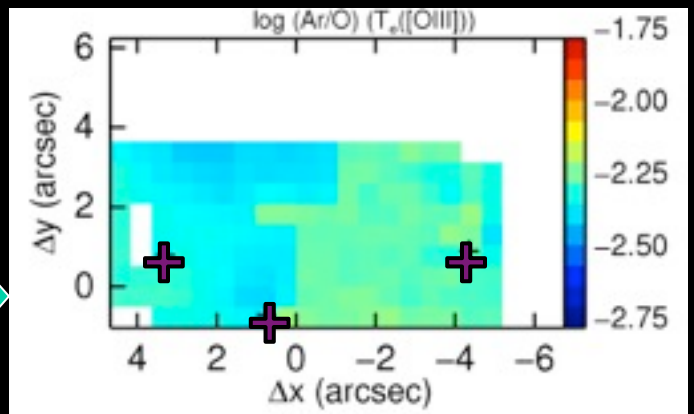


-1.32±0.05
-1.17±0.07
-0.95±0.03

log(N/O)
-1.26±0.14



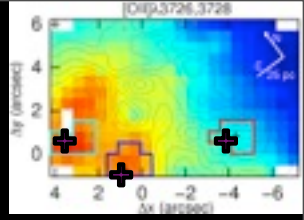
log(Ne/O)
-0.64±0.03

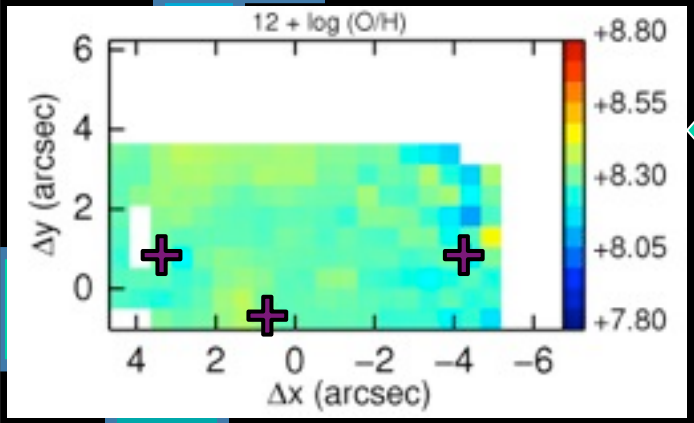


log(Ar/O)
-2.32±0.05

- Oxygen, neon, and argon present homogeneous abundances within 0.1 dex
- Nitrogen abundance has a complex structure with two areas of N-enhancement

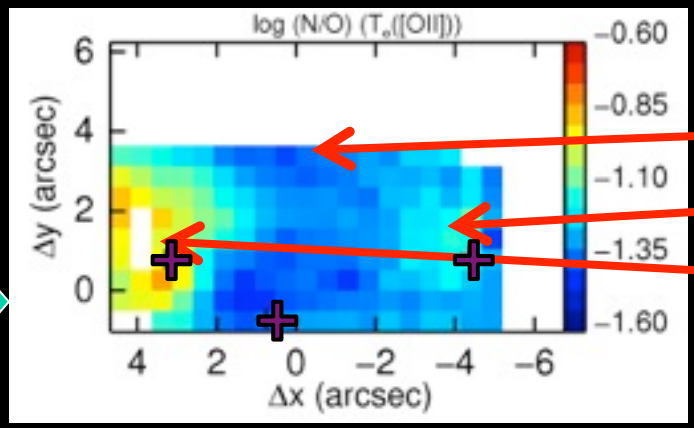
Abundances of heavy elements





12+log(O/H)
8.26±0.04

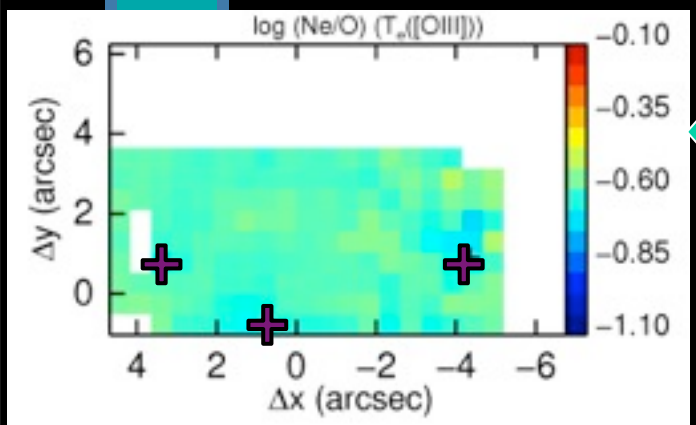
log(N/O)
-1.26±0.14



-1.32±0.05

-1.17±0.07

-0.95±0.03



log(Ne/O)
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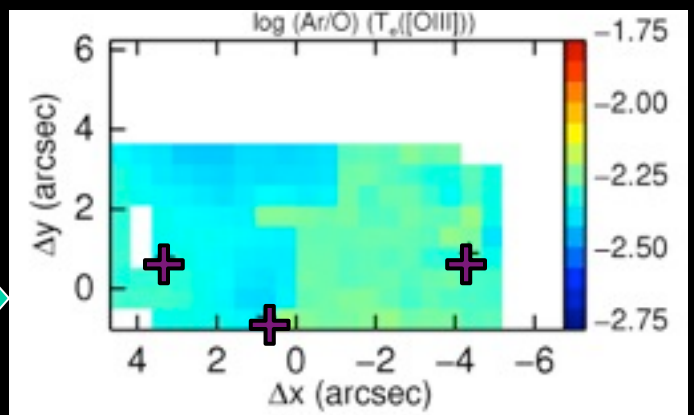
log(Ar/O)
-2.32±0.05



- Oxygen, neon, and argon present homogeneous abundances within 0.1 dex
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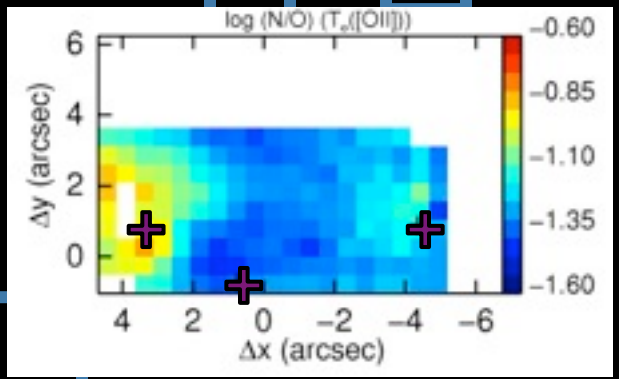
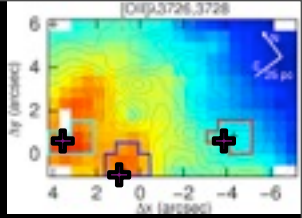
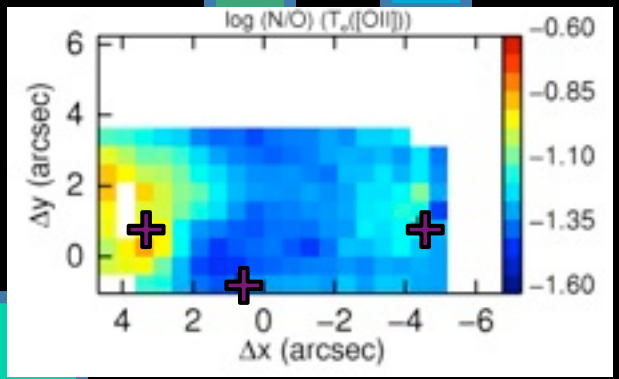
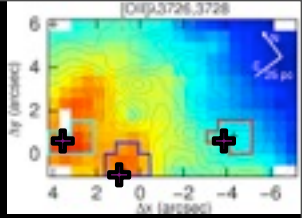
N/O: strong line methods





N/O: strong line methods





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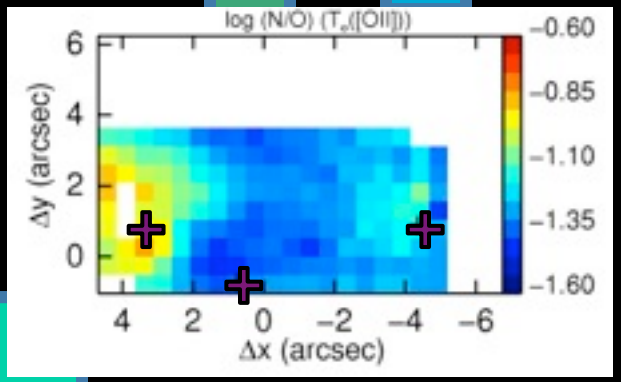
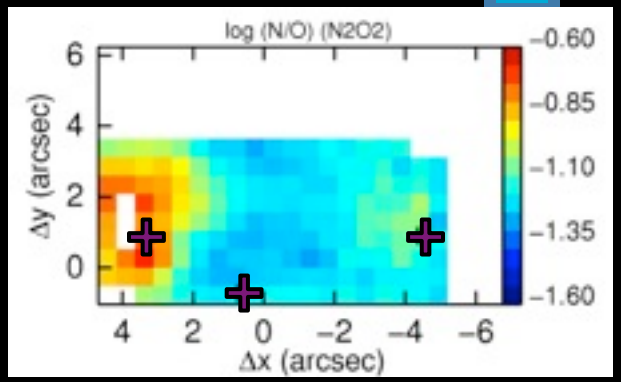
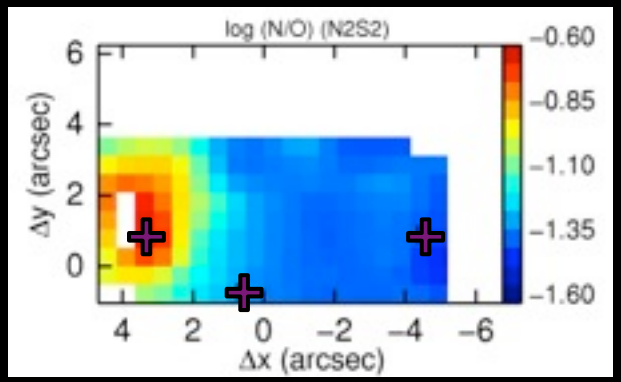
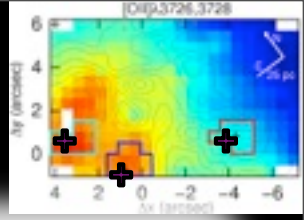
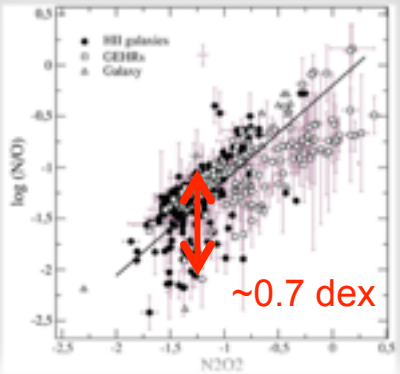
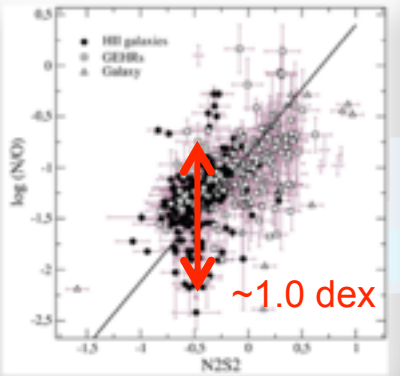






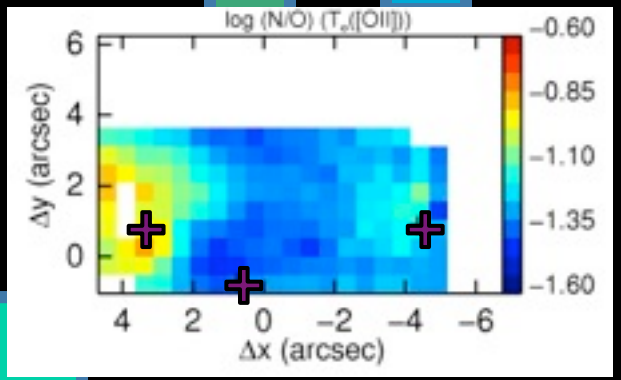


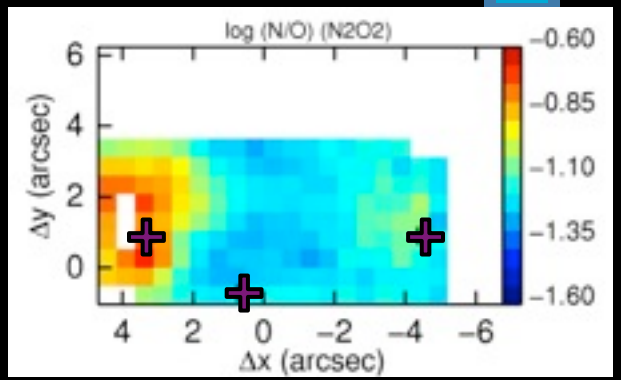


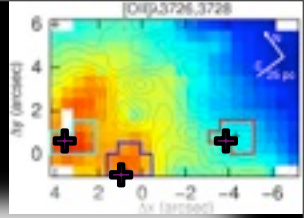


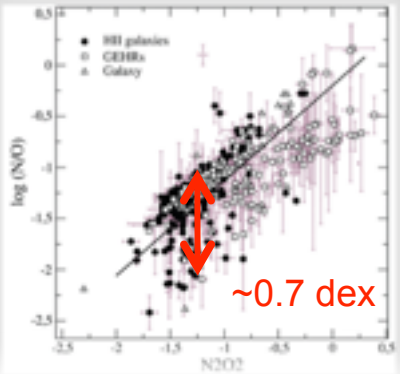
(Pérez-Montero & Contini 2009,MNRAS, 398, 949)

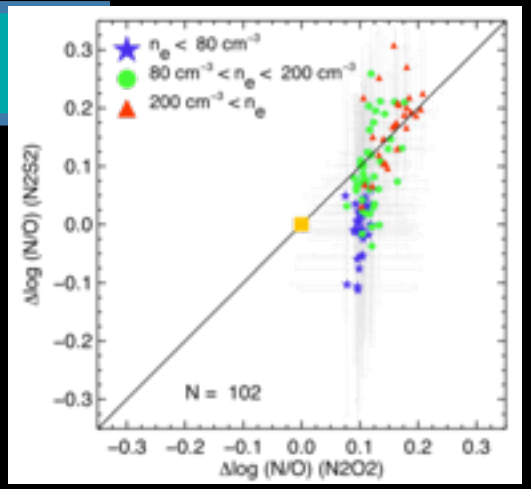
N/O: strong line methods

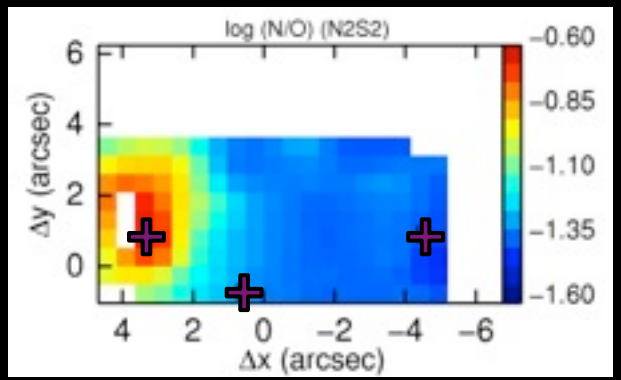


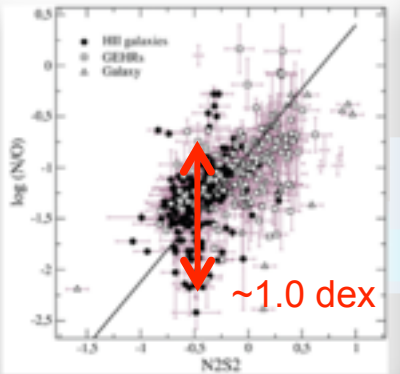






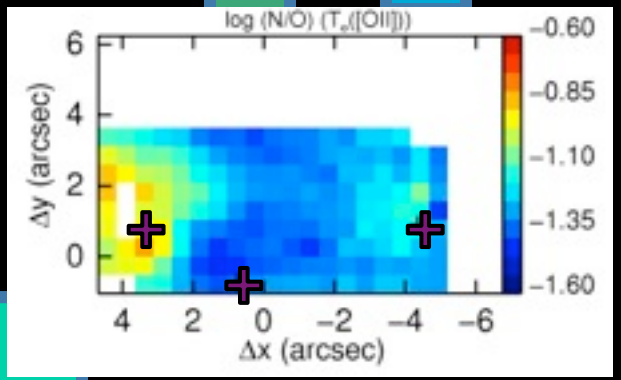


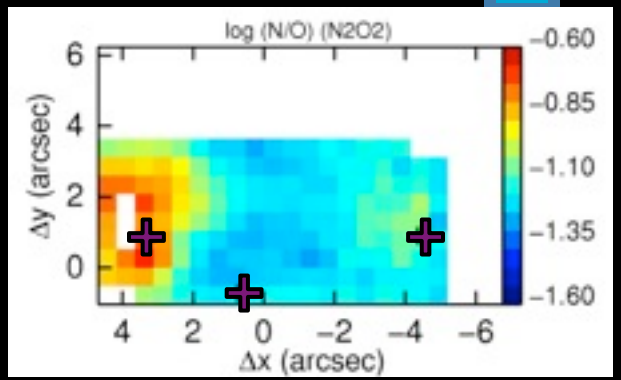


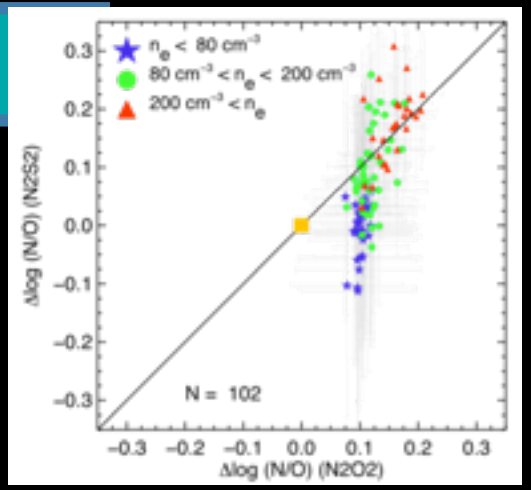


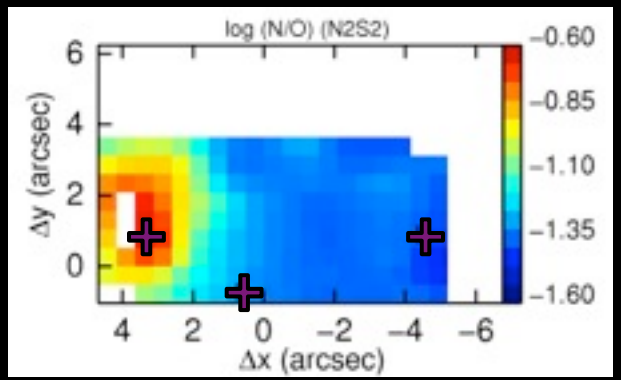
(Pérez-Montero & Contini 2009,MNRAS, 398, 949)

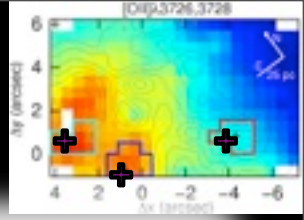
N/O: strong line methods

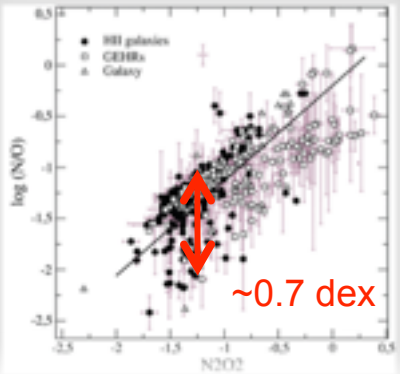


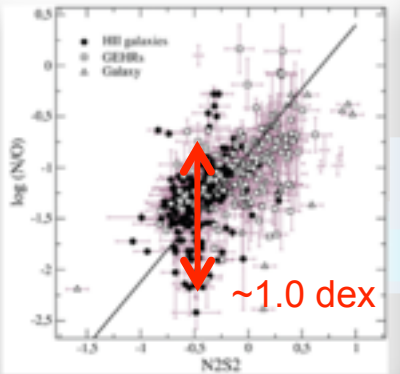










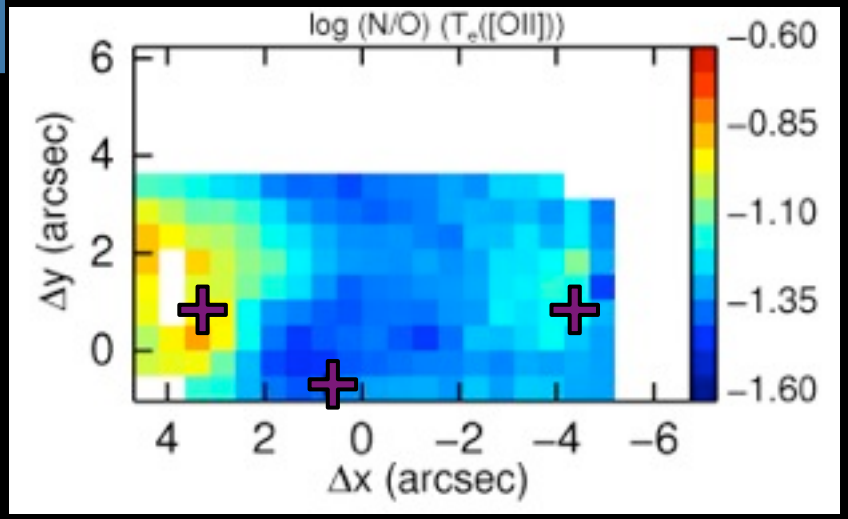


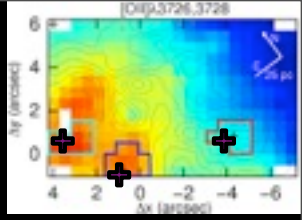
(Pérez-Montero & Contini 2009,MNRAS, 398, 949)

- N2O2 seems more sensitive to small inhomogeneities than N2S2
- N2O2 seems less sensitive to any physical condition than N2S2

Our results support the use of N2O2 over N2S2 to look for N/O inhomogeneities *within* a galaxy

N/O: extra N and WR





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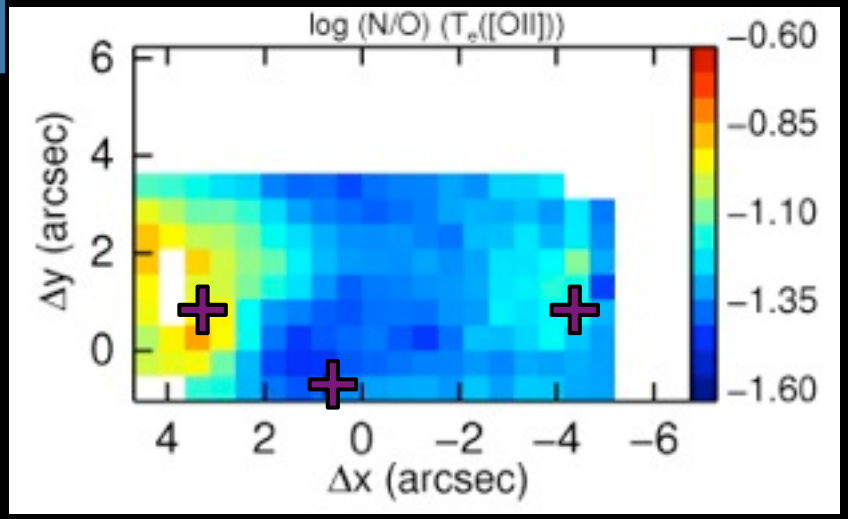

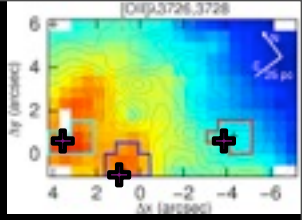

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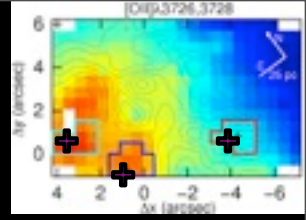
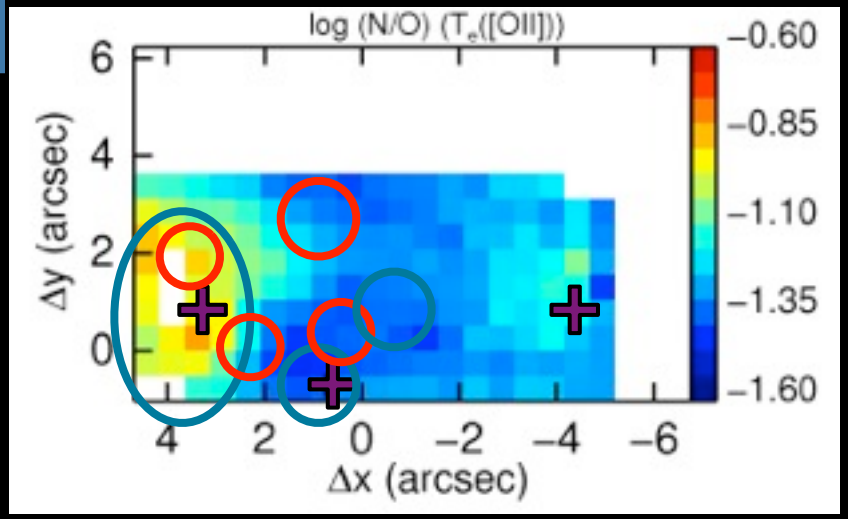


WN

WC



(WN from Monreal-Ibero et al. 2010, A&A, 517, A27
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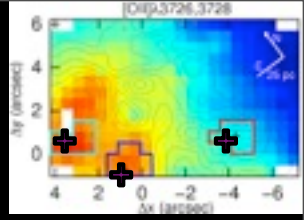

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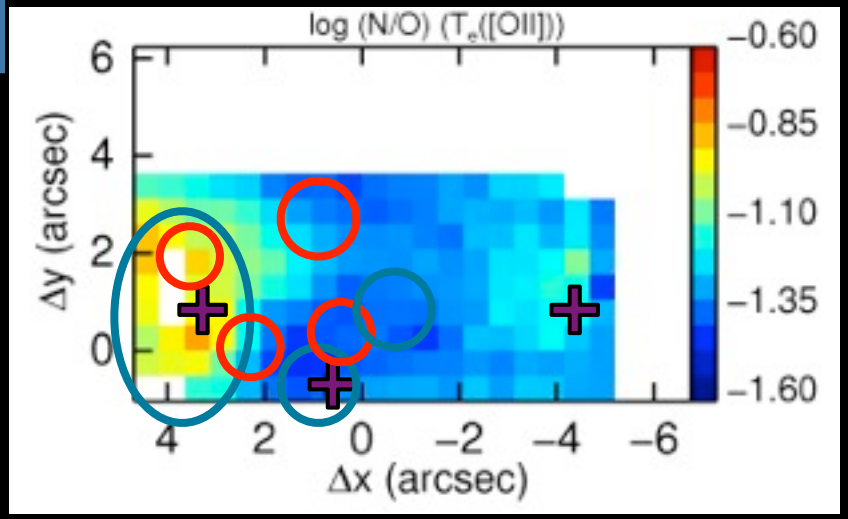


(WN from Monreal-Ibero et al. 2010, A&A, 517, A27 and WC from Westmoquette et al. In prep)

- C3: 4.2x10^4 M$_\odot$; 8 Myr
- C5: 2.1x10^4 M$_\odot$; 11 Myr
- No WR emission
- With extra-N

#3

- C4: 2.7x10^4 M$_\odot$; 1 Myr
- C8: 1.3x10^4 M$_\odot$; 5 Myr
- With WR emission
- No extra-N

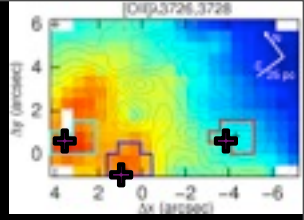
#2

(ages and masses from Harris et al. 2004, ApJ, 603, 503, and Alonso-Herrero et al. 2004, ApJ, 612, 222)

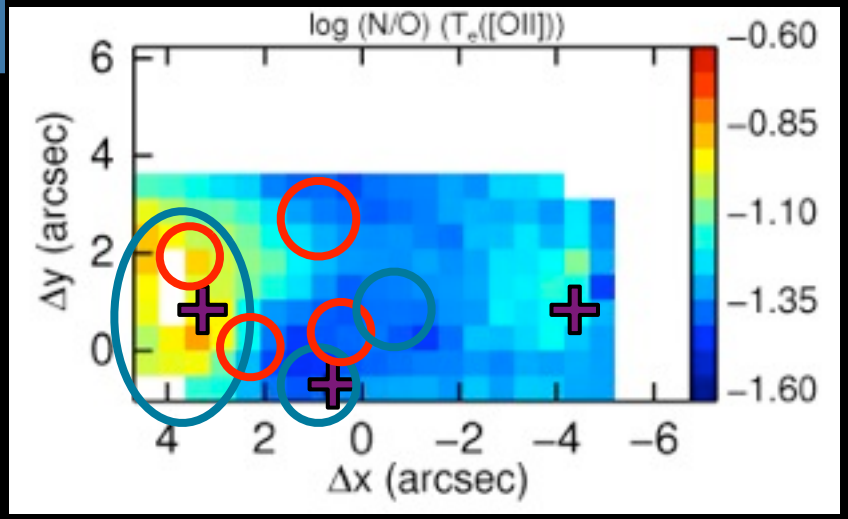
- C1: 5x10^4 M$_\odot$; 3 Myr
- C2: ~1.0x10^6 M$_\odot$; 3 Myr
- With WR emission
- With extra-N

#1

N/O: extra N and WR



WN
WC



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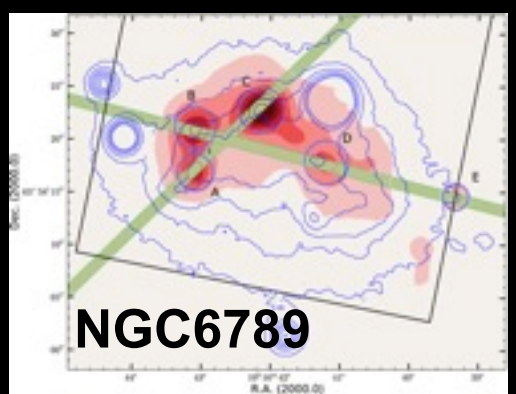

- C1: 5×10^3 $M_\odot$; 3 Myr
- No WR emission
- With extra-N

(García-Benito & Pérez-Montero 2012, MNRAS, 423, 406)

- C1: 5×10^4 $M_\odot$; 3 Myr
- C2: ~1.0×10^6 $M_\odot$; 3 Myr
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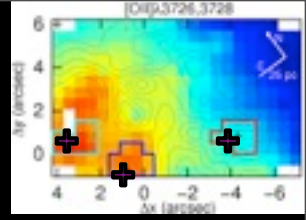
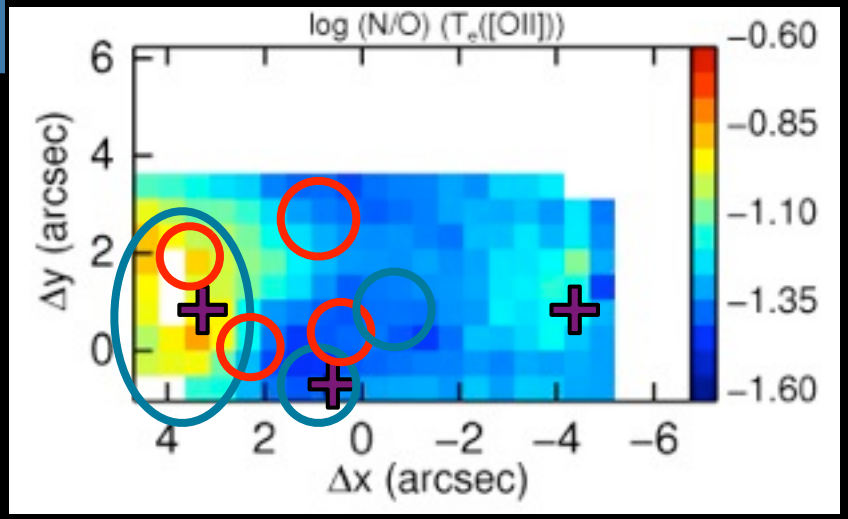
#1

N/O: extra N and WR



WN
WC



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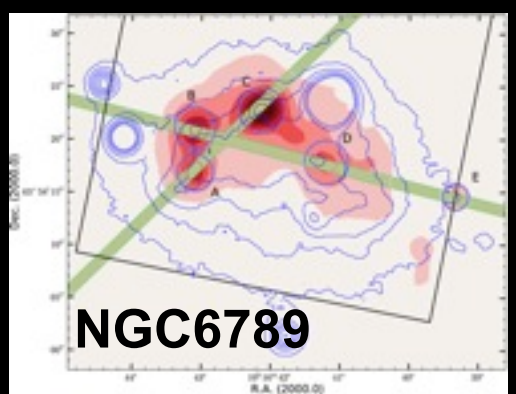

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- C1: 5x10^4 M$_\odot$; 3 Myr
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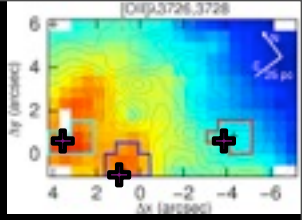
- With WR emission
- With extra-N

#1

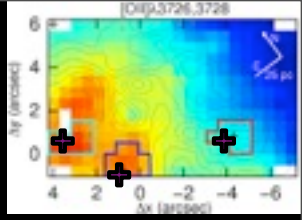
Relationship between WR and N-enhancement is complex

Summary



- Use of 3 n_e tracers allows us to see the 3D structure in n_e. This is “onion-like”. Inner layers denser than outer ones.
- Use of 2 T_e tracers allows us to see the 3D structure in T_e. Higher T_e in the inner layers than in the outer ones.
- Homogeneous abundances for O, Ne, and Ar within <0.1dex
- Two areas of extra N, one of them reported here for the first time.
- N2O2 better than N2S2 to look for local inhomogeneities.
- Relationship between WR stars and N

Summary



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