SOAR-OSIRIS spectroscopic survey of Galactic massive stars:

Two new O2If/WN6ha stars in the outskirt of Westerlund 2*

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(Universidad de La Serena)

First International Symposium of Science with the SOAR Telescope

May 15-19 – Maresias Beach - Brazil

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Colaborators:

Rodolfo Barbá (ULS)

Nidia Morrell (LCO)

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Outline

- Introduction
- Selection Criteria
- Results
- Concluding remarks and upcoming related work

Introduction

Why to study very massive stars?

They are key actor in the energy balance and chemical evolution of the Galaxy

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On the other hand, their powerful winds and expanding HII regions inject large quantity of momentum and UV photons into the Galactic ISM

Introduction

They are key

n of the Galaxy

They have bee

ose supernovae

On the other h

ons inject large

quar

tic ISM

Introduction

WR67a - An O2If*/WN6ha star in Circinus
(Roman-Lopes 2011 – MNRAS, 410, 161)

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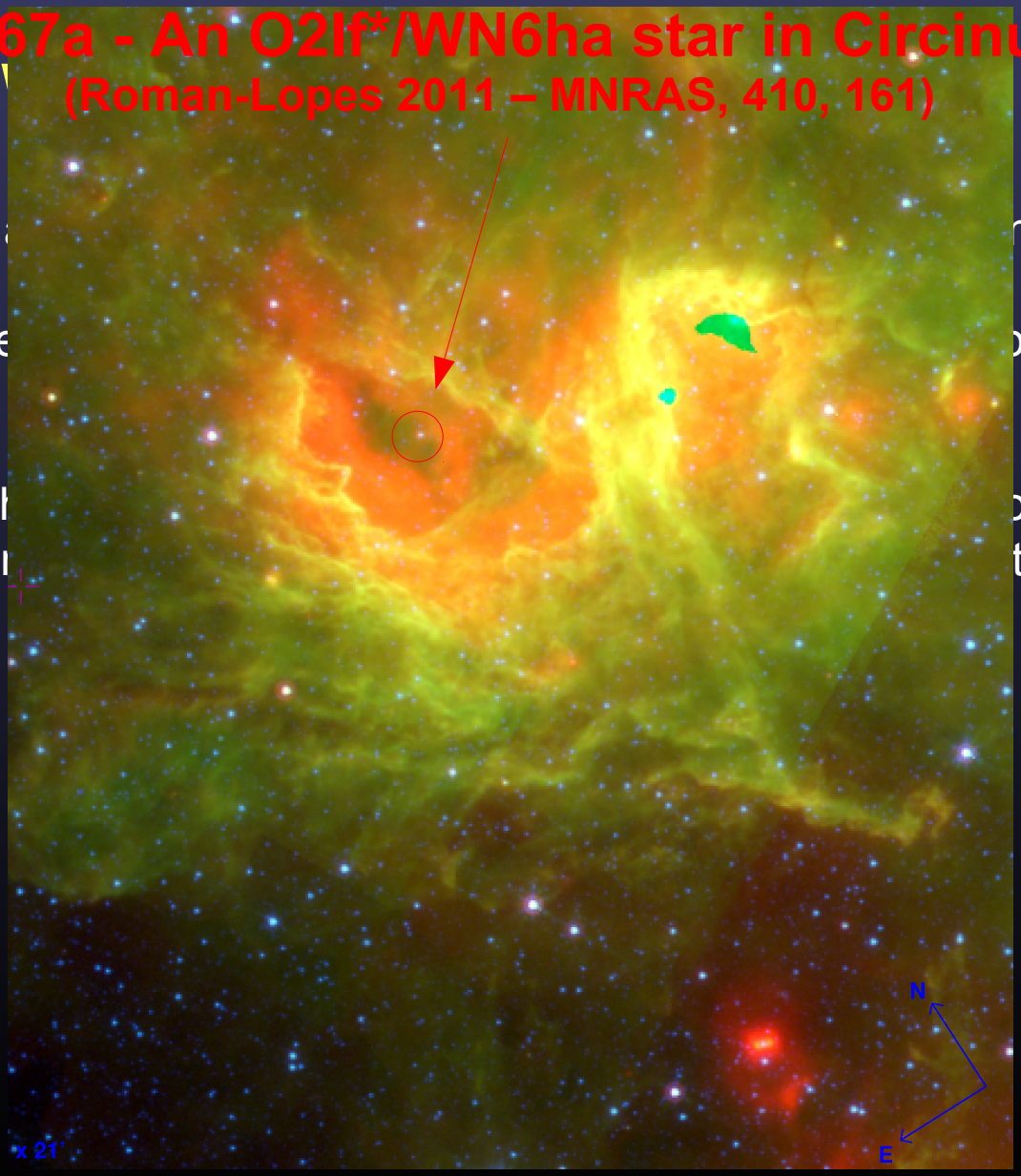

Introduction

WR67a - An O2If*/WN6ha star in Circinus
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They are key … of the Galaxy

They have bee… …ose supernovae

On the other h… …ons inject large

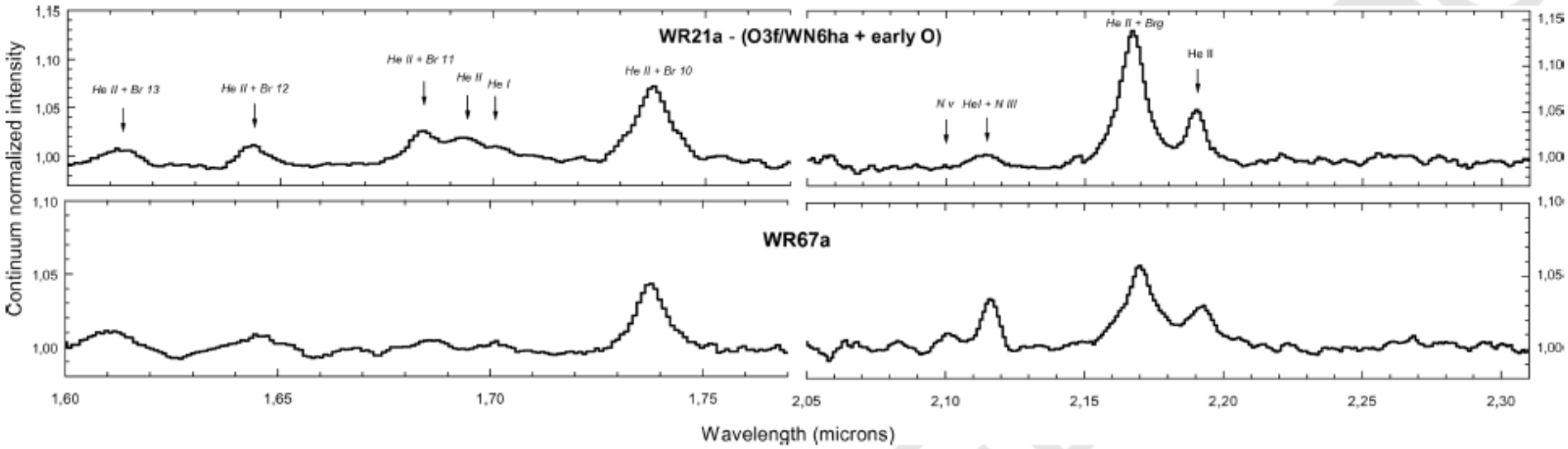

Figure 1. The *H*- and *K*-band continuum-normalized spectra (bottom panel) of the WN 6h star (WR 67a) and the ESO-NTT archival spectra (same instrumental setup as for WR 67a) for the known O3f/WN 6ha+early O very massive (with minimum masses of 87 and 53 $M_{\odot}$, respectively) binary system WR 21a (Niemela et al. 2008). The main H, He and N emission lines are identified by labels. The similarity between the spectra from both sources is remarkable, suggesting that WR 67a is also a very massive star.

Introduction

They a

They ha

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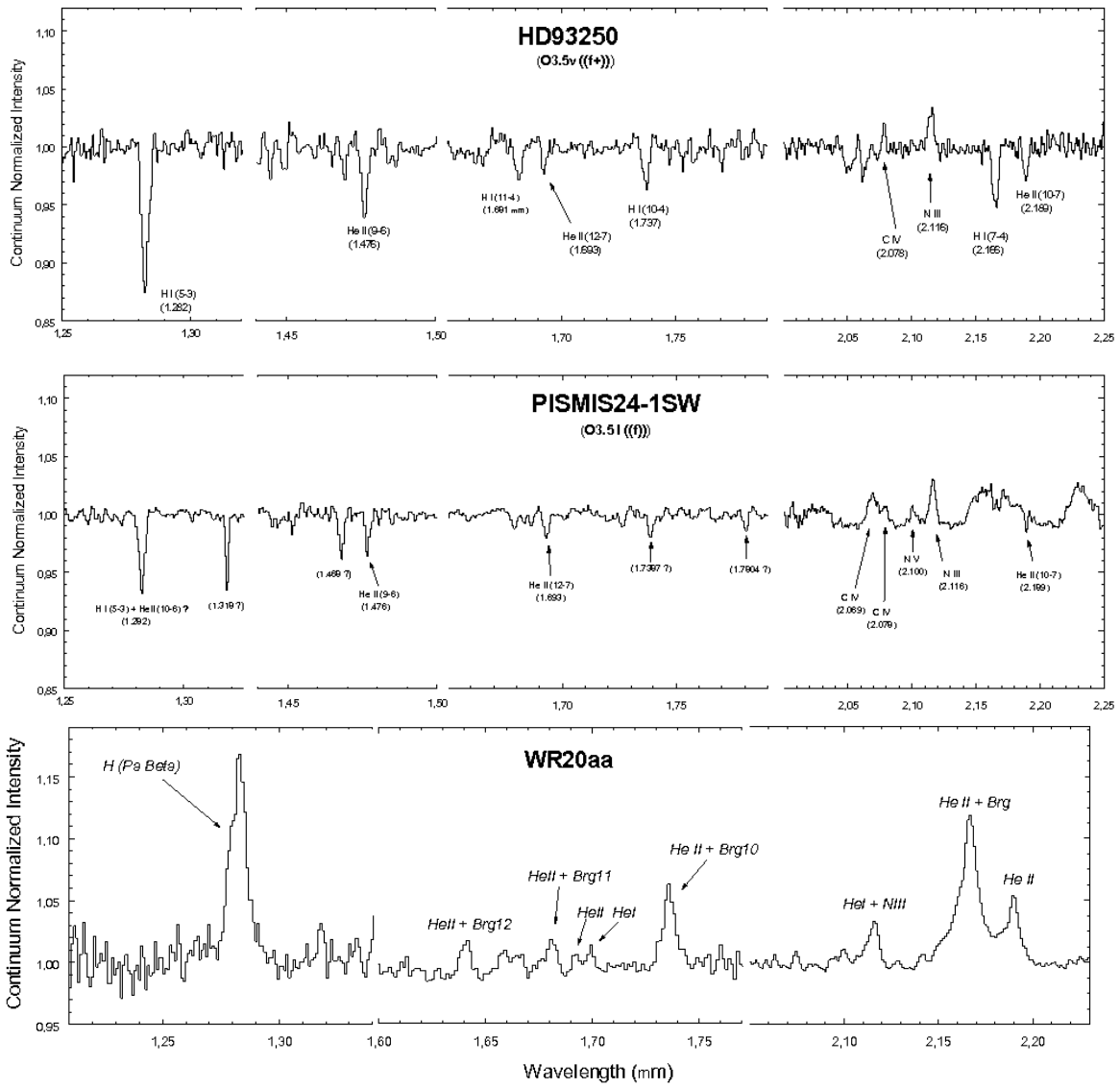

alaxy

novae

large

Introduction

Goal

To identify some of the still unknown very massive Galactic stars ...

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To identify some of the still unknown very massive Galactic stars …

… confirming their nature from spectroscopic follow-up observations of the best candidates

Selection criteria

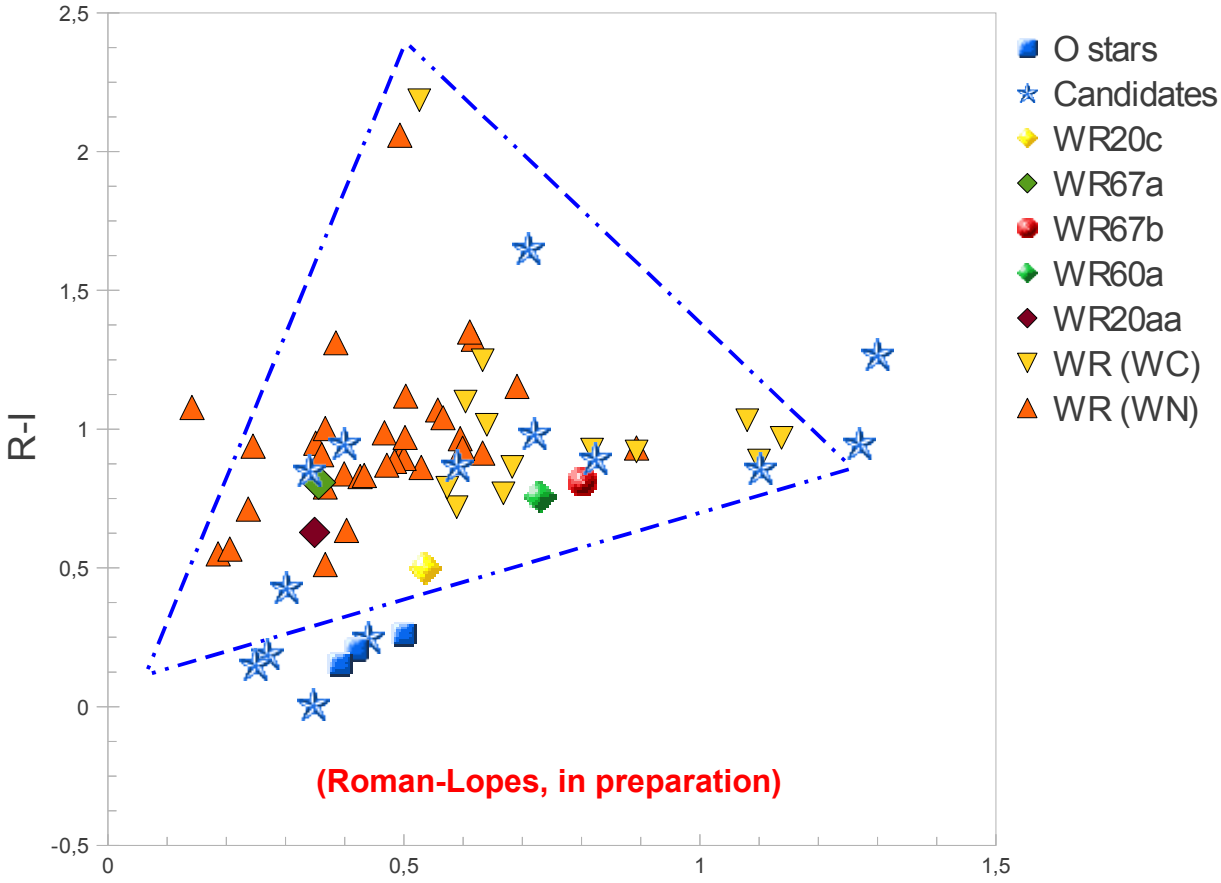
Method

From the use of colour diagnostic diagrams

Searching radius ~ 60 arcmin around known massive star forming sites
(Radio and NIR surveys)

Selection criteria

Method



Selection criteria

Method
Spectroscopic follow-up

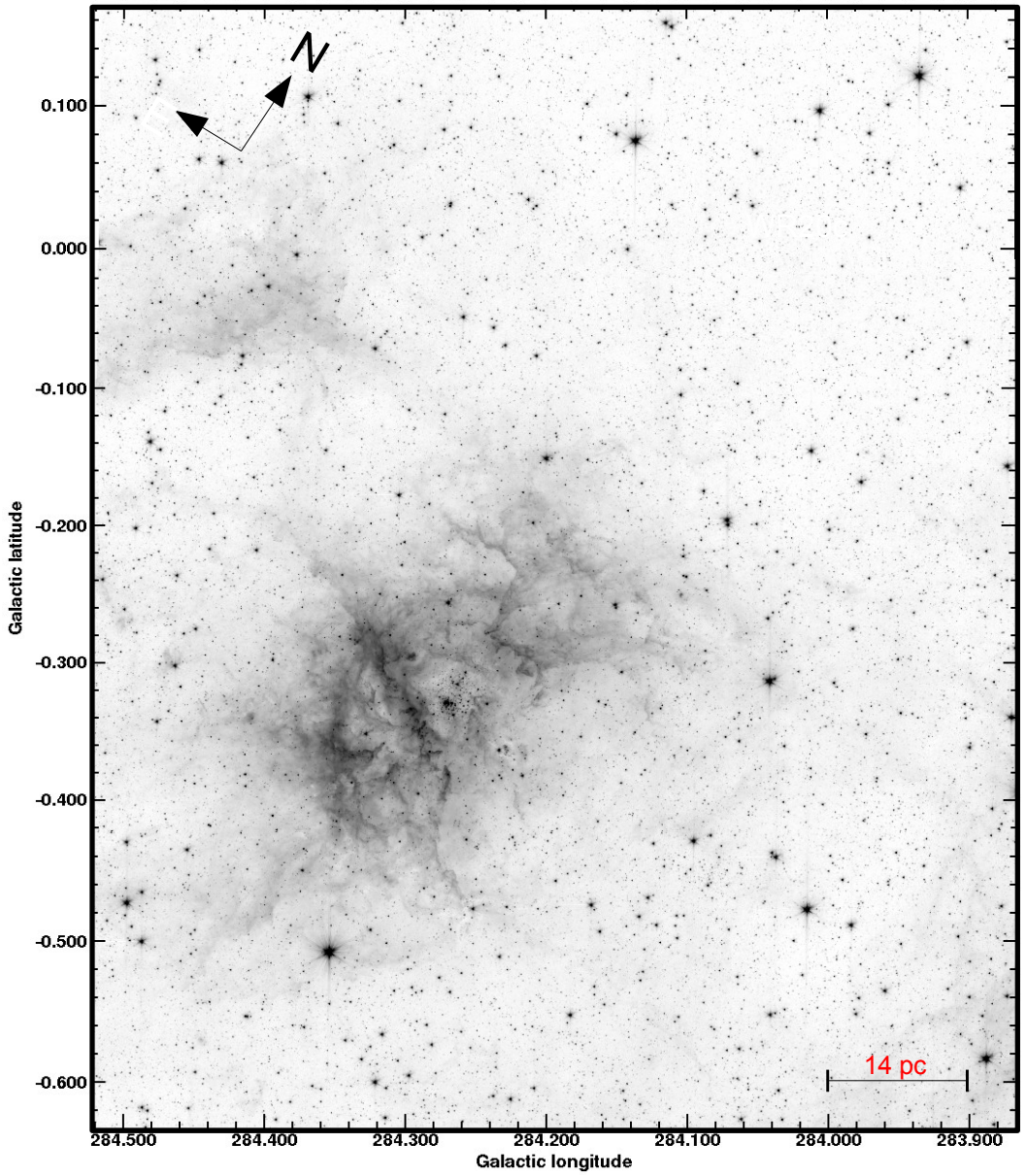
NIR and optical spectroscopic observations
(SOAR-OSIRIS, NTT-SOFI, du Pont-Echelle and CLAY-Mag-E)

Results

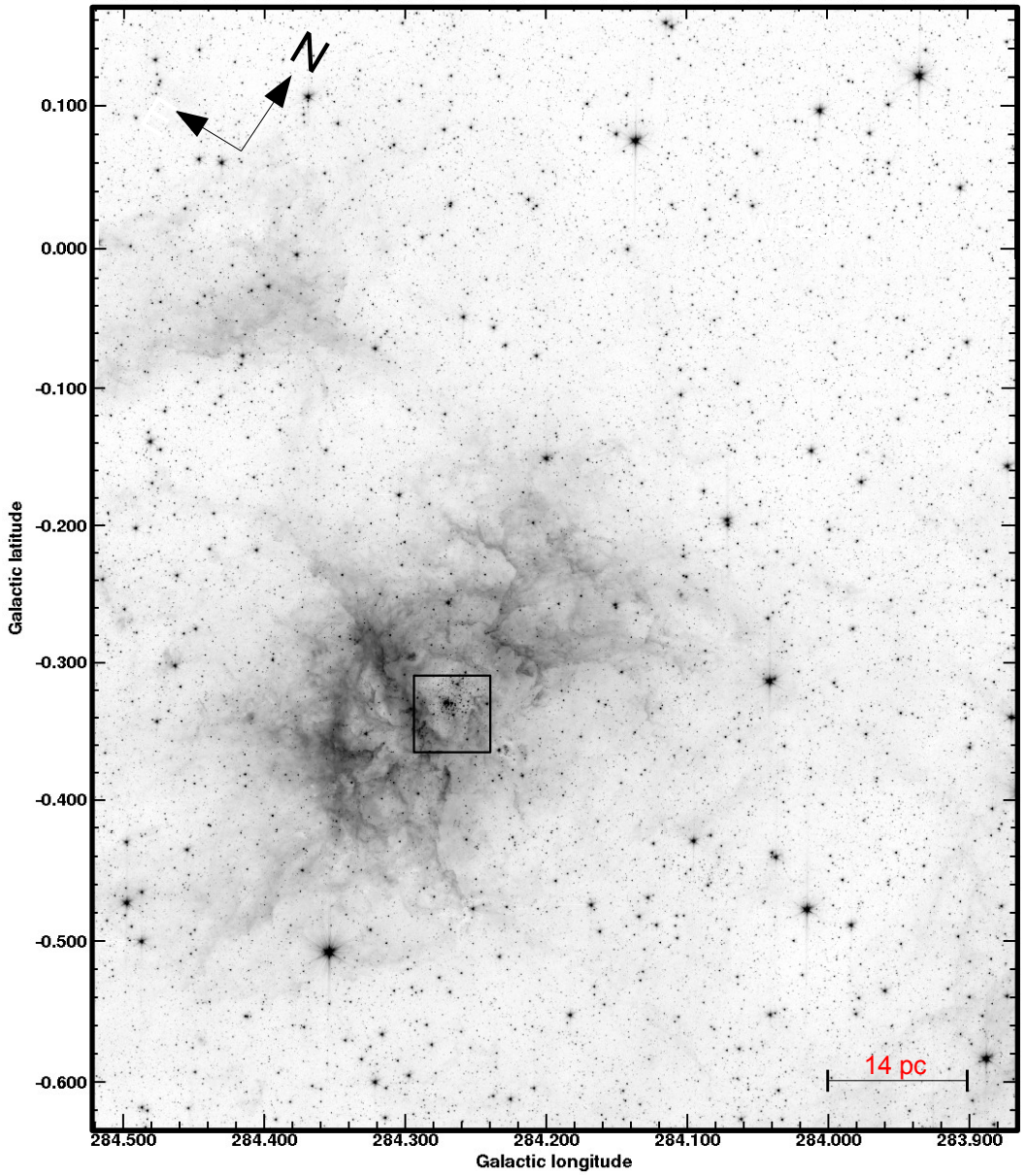
Two new O2If*/WN6h stars identified in the outskirt of Westerlund 2

(Roman-Lopes, Barbá & Morrell 2011, MNRAS, accepted)

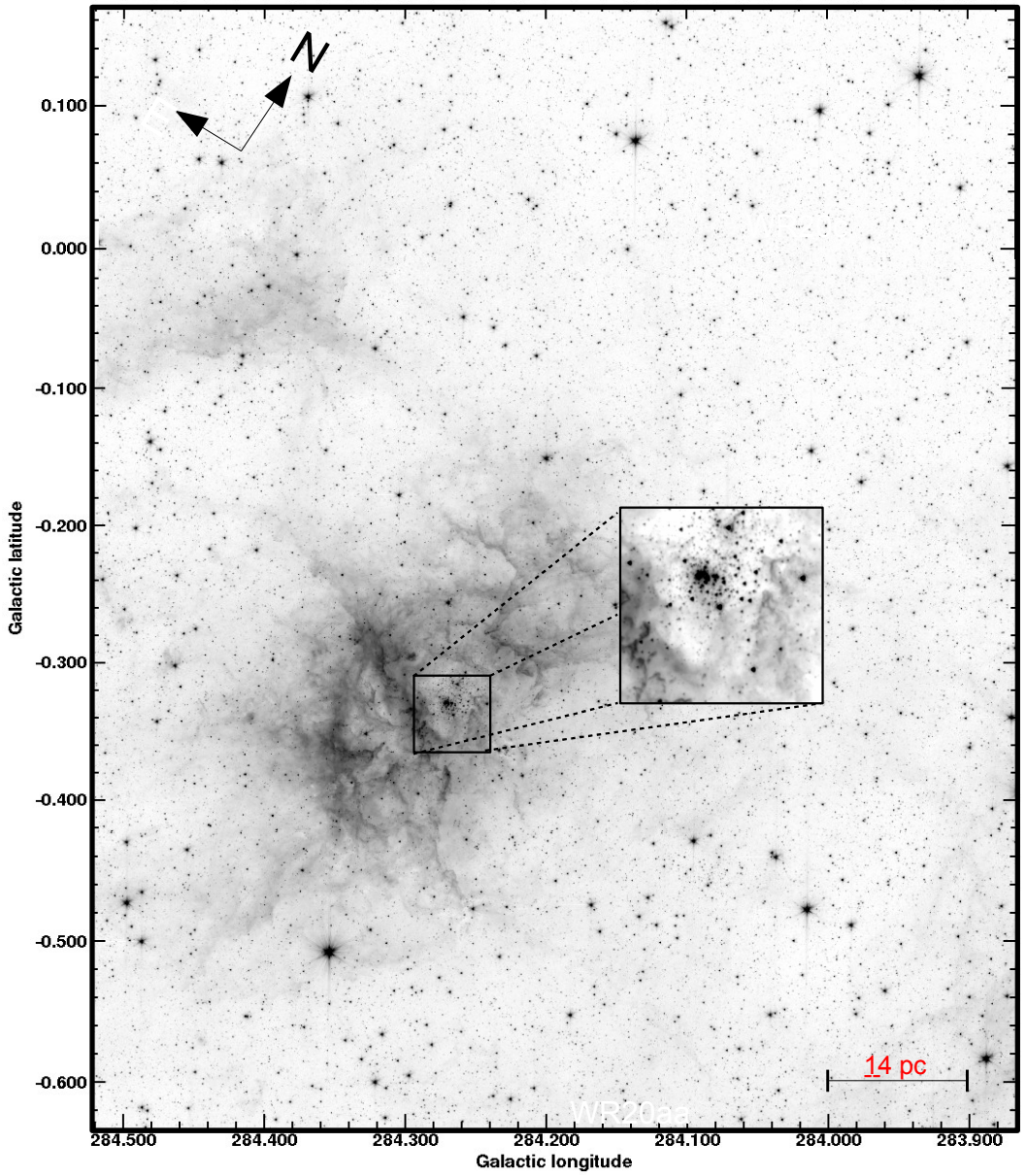
Results


N
0.100
0.000
-0.100
-0.200
-0.300
-0.400
-0.500
-0.600
Galactic latitude
284.500
284.400
284.300
284.200
284.100
284.000
283.900
Galactic longitude
14 pc

Results


N
0.100
0.000
-0.100
-0.200
-0.300
-0.400
-0.500
-0.600
Galactic latitude
284.500
284.400
284.300
284.200
284.100
284.000
283.900
Galactic longitude
14 pc

Results


N
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0.000
-0.100
-0.200
-0.300
-0.400
-0.500
-0.600
Galactic latitude
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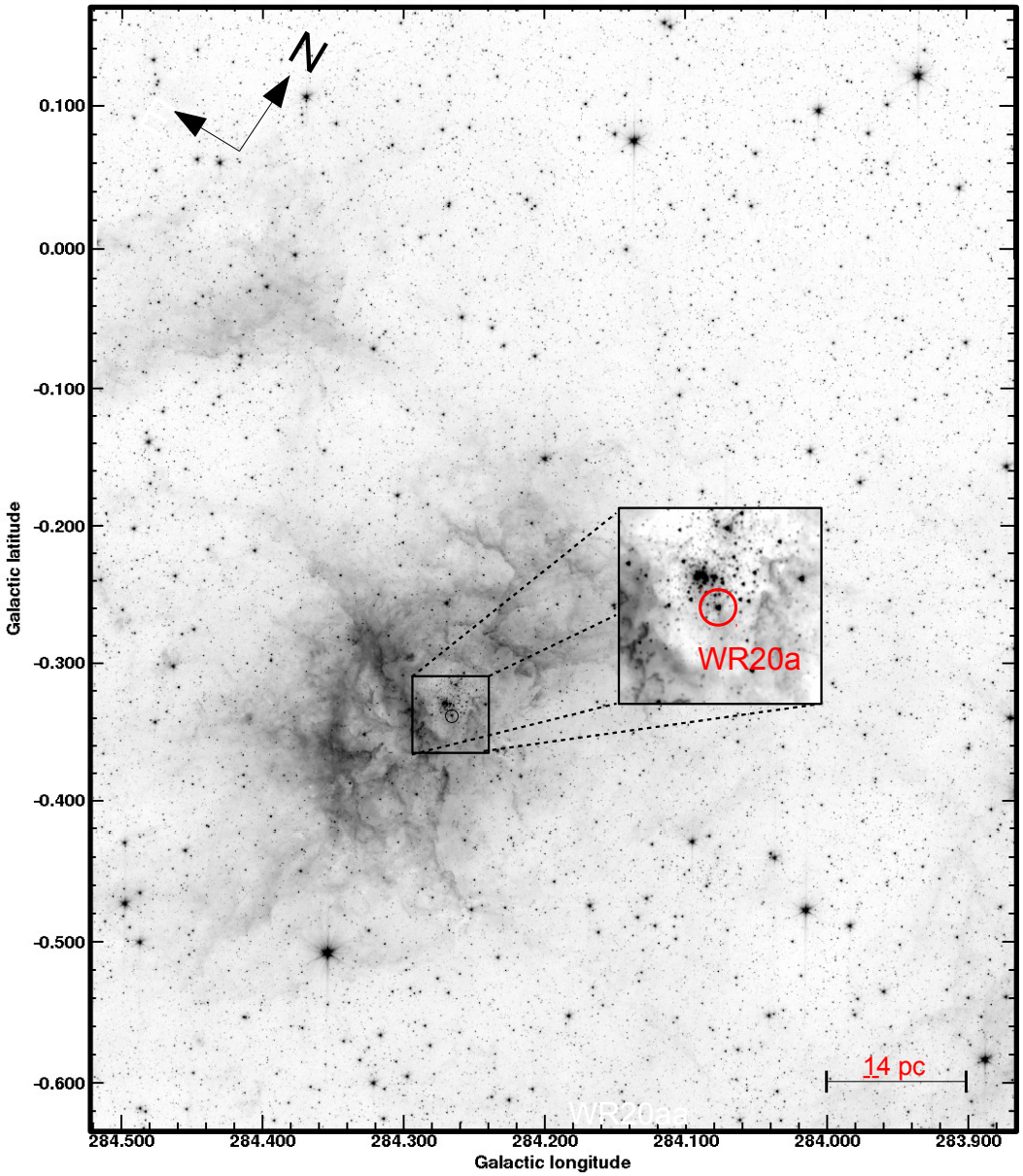
284.400
284.300
284.200
284.100
284.000
283.900
Galactic longitude
14 pc
WR20a

Results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0.000
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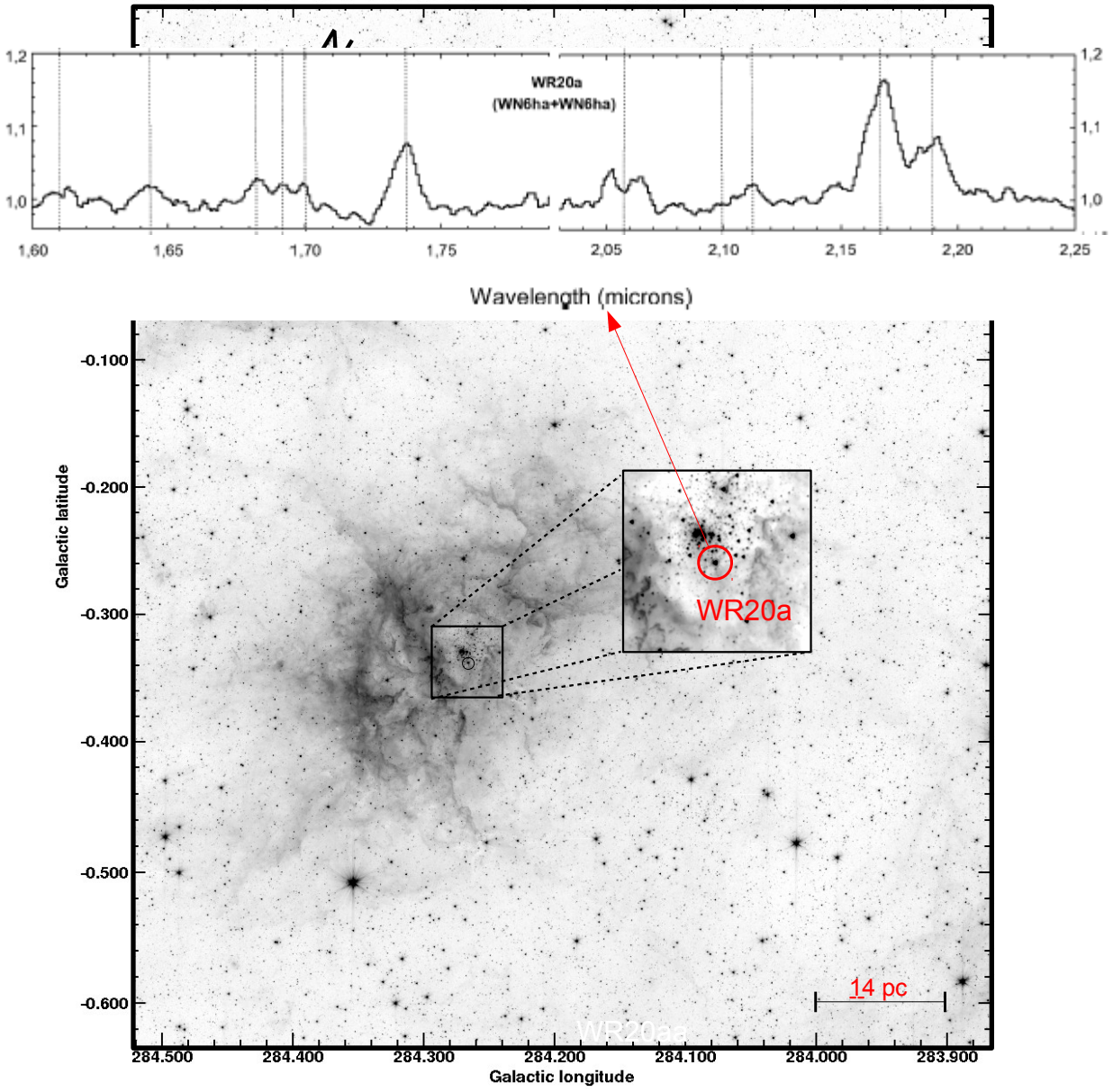
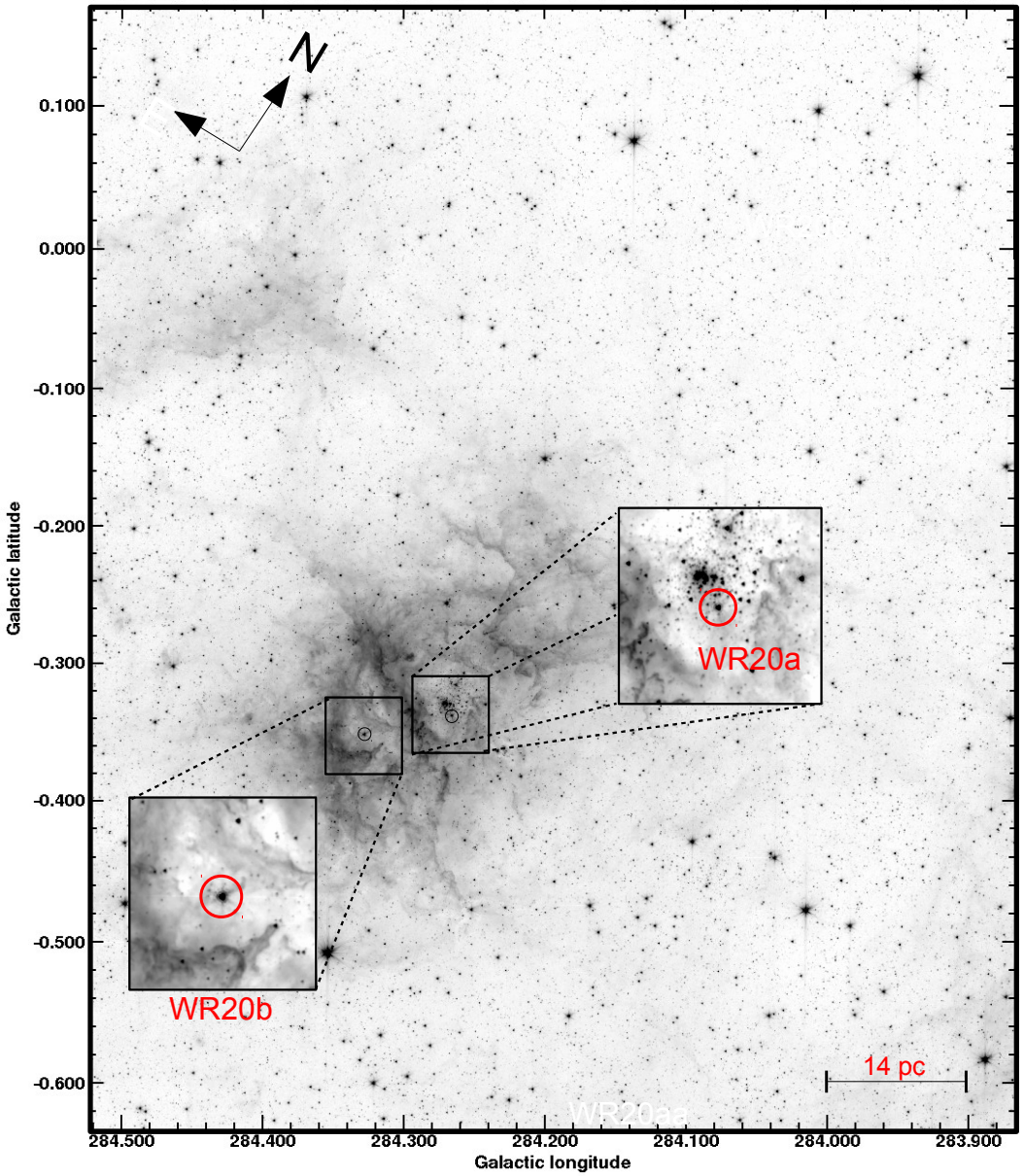
-0.300
-0.400
-0.500
-0.600
Galactic latitude
284.500
284.400
284.300
284.200
284.100
284.000
283.900
Galactic longitude
WR20a
14 pc

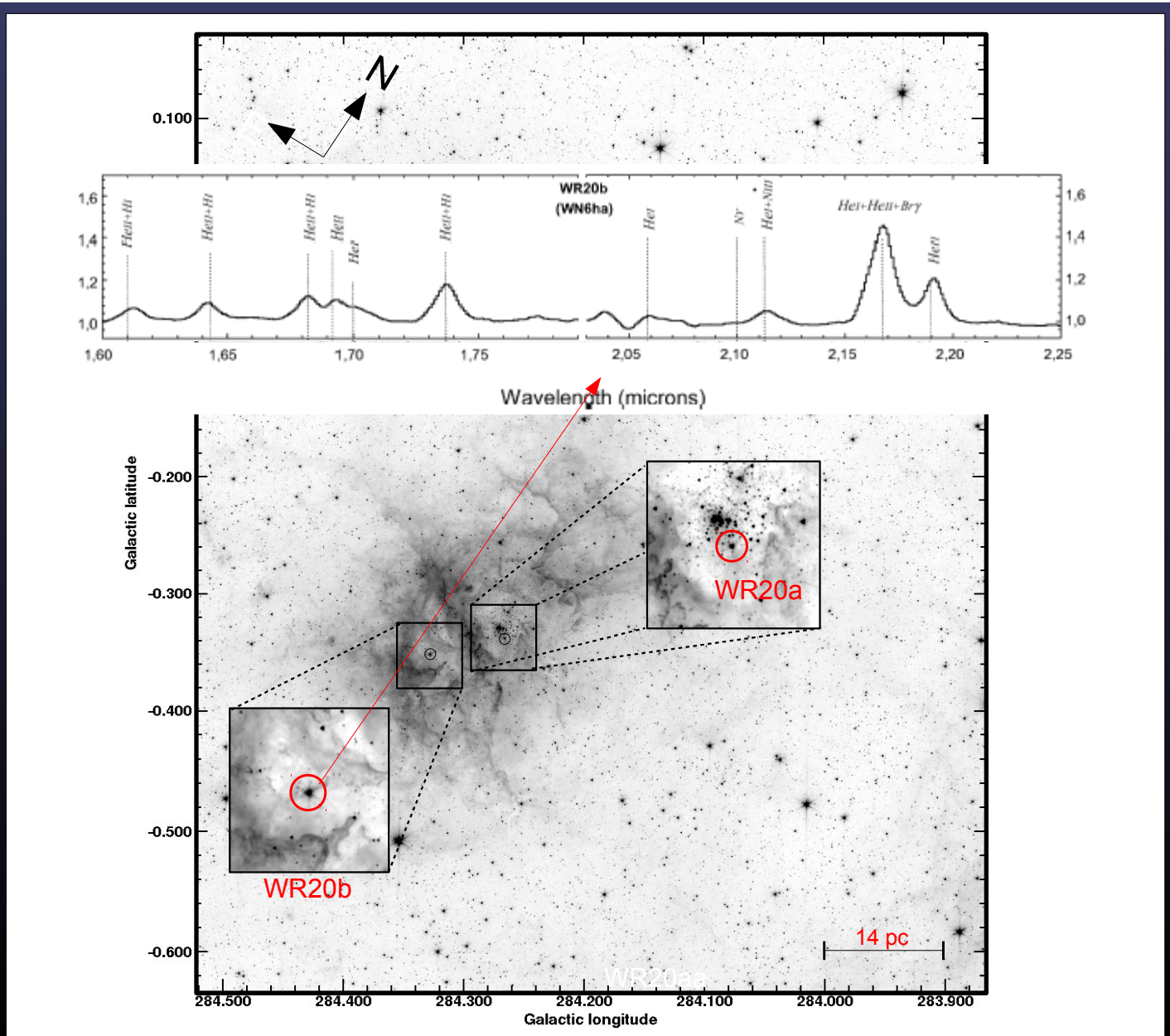
Results


WR20a
(WN6ha+WN6ha)
1,2
1,1
1,0
1,60
1,65
1,70
1,75
2,05
2,10
2,15
2,20
2,25
Wavelength (microns)
-0.100
-0.200
-0.300
-0.400
-0.500
-0.600
Galactic latitude
WR20a
14 pc
284.500
284.400
284.300
284.200
284.100
284.000
283.900
Galactic longitude

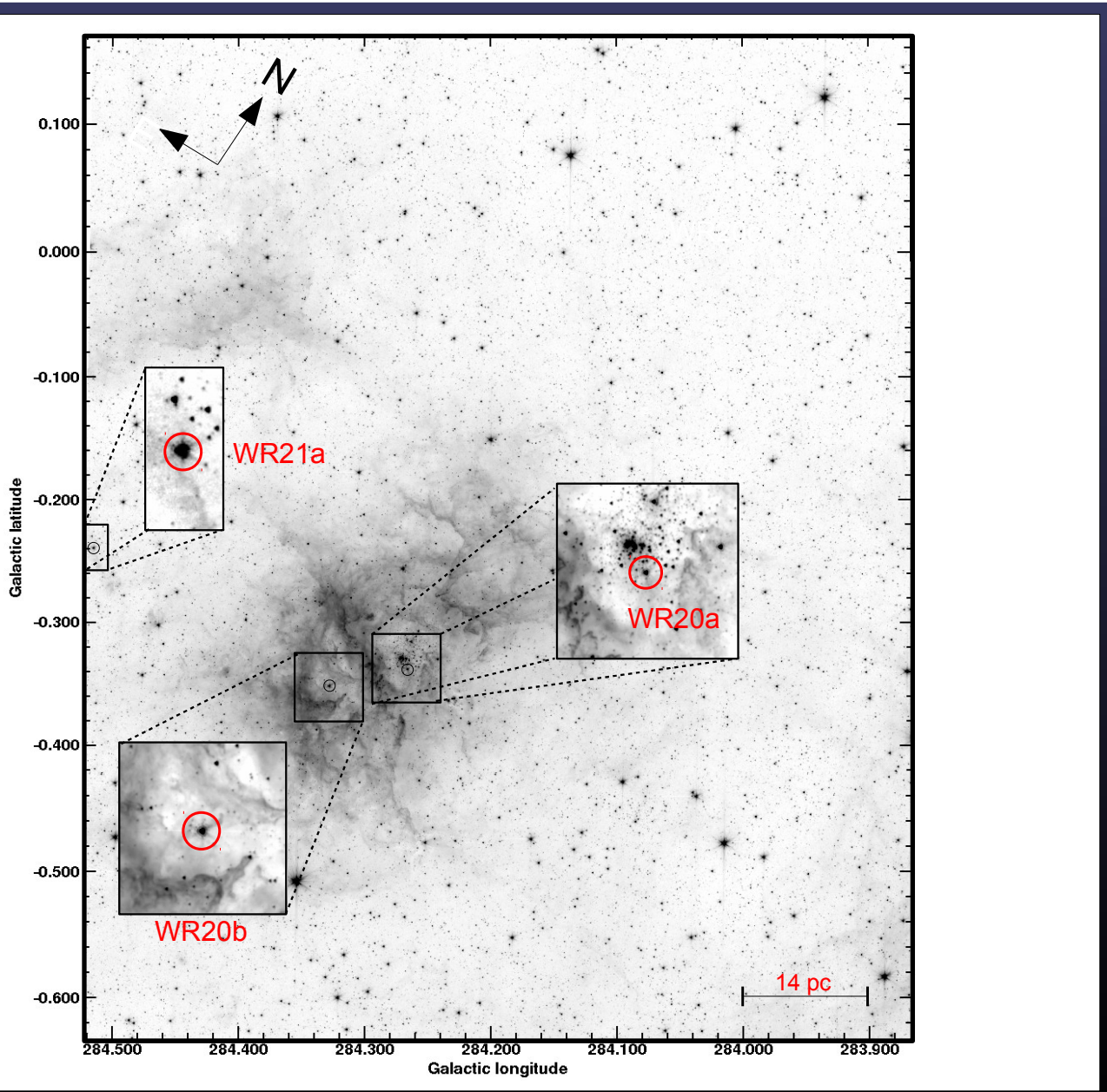
Results


N
0.100
0.000
-0.100
-0.200
-0.300
-0.400
-0.500
-0.600
Galactic latitude
284.500
284.400
284.300
284.200
284.100
284.000
283.900
Galactic longitude
WR20a
WR20b
14 pc

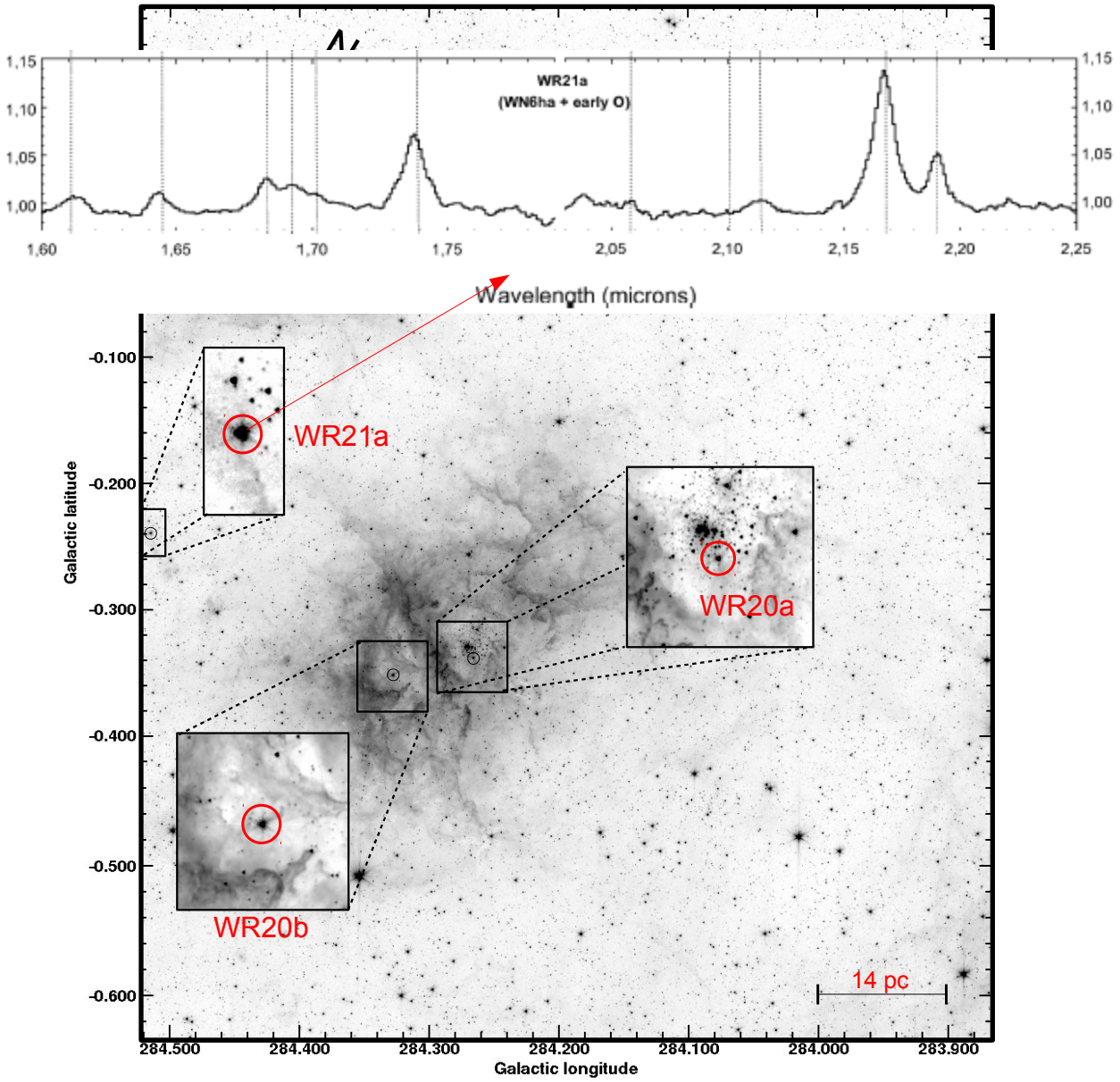
Results


N
0.100
WR20b
(WN6ha)
HeI+HI
HeII+HI
HeII+HI
HeII
HeI
HeII+HI
HeI
NV
HeI+NIII
HeI+HeII+Brγ
HeI
1,6
1,4
1,2
1,0
1,60
1,65
1,70
1,75
2,05
2,10
2,15
2,20
2,25
Wavelength (microns)
Galactic latitude
-0.200
-0.300
-0.400
-0.500
-0.600
WR20a
WR20b
14 pc
284.500
284.400
284.300
284.200
284.100
284.000
283.900
Galactic longitude

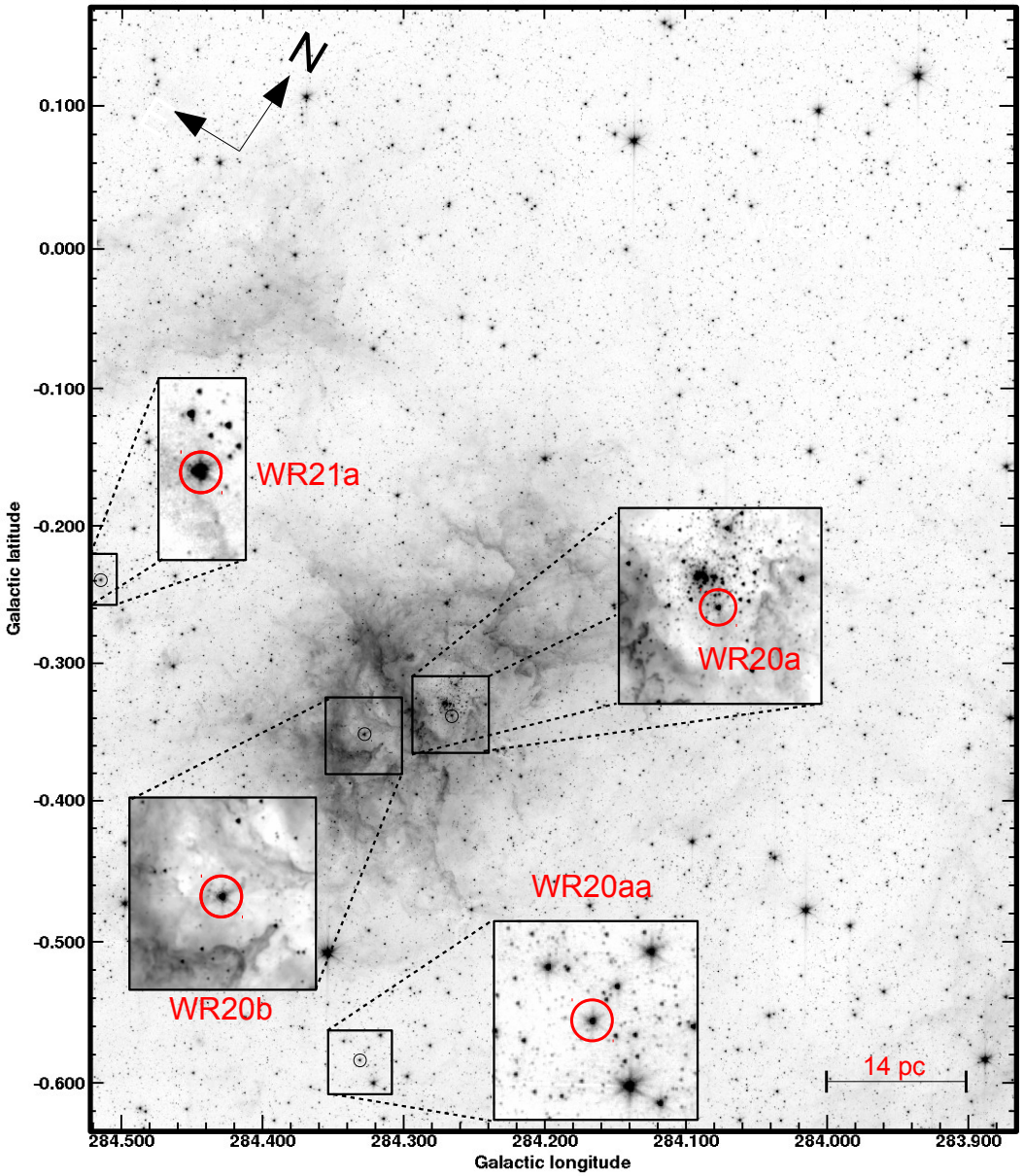
Results


N
WR21a
WR20a
WR20b
14 pc
Galactic latitude
Galactic longitude
0.100
0.000
-0.100
-0.200
-0.300
-0.400
-0.500
-0.600
284.500
284.400
284.300
284.200
284.100
284.000
283.900

Results


WR21a
(WN6ha + early O)
1,15
1,10
1,05
1,00
1,60
1,65
1,70
1,75
2,05
2,10
2,15
2,20
2,25
Wavelength (microns)
WR21a
WR20a
WR20b
14 pc
-0.100
-0.200
-0.300
-0.400
-0.500
-0.600
Galactic latitude
284.500
284.400
284.300
284.200
284.100
284.000
283.900
Galactic longitude

Results


N
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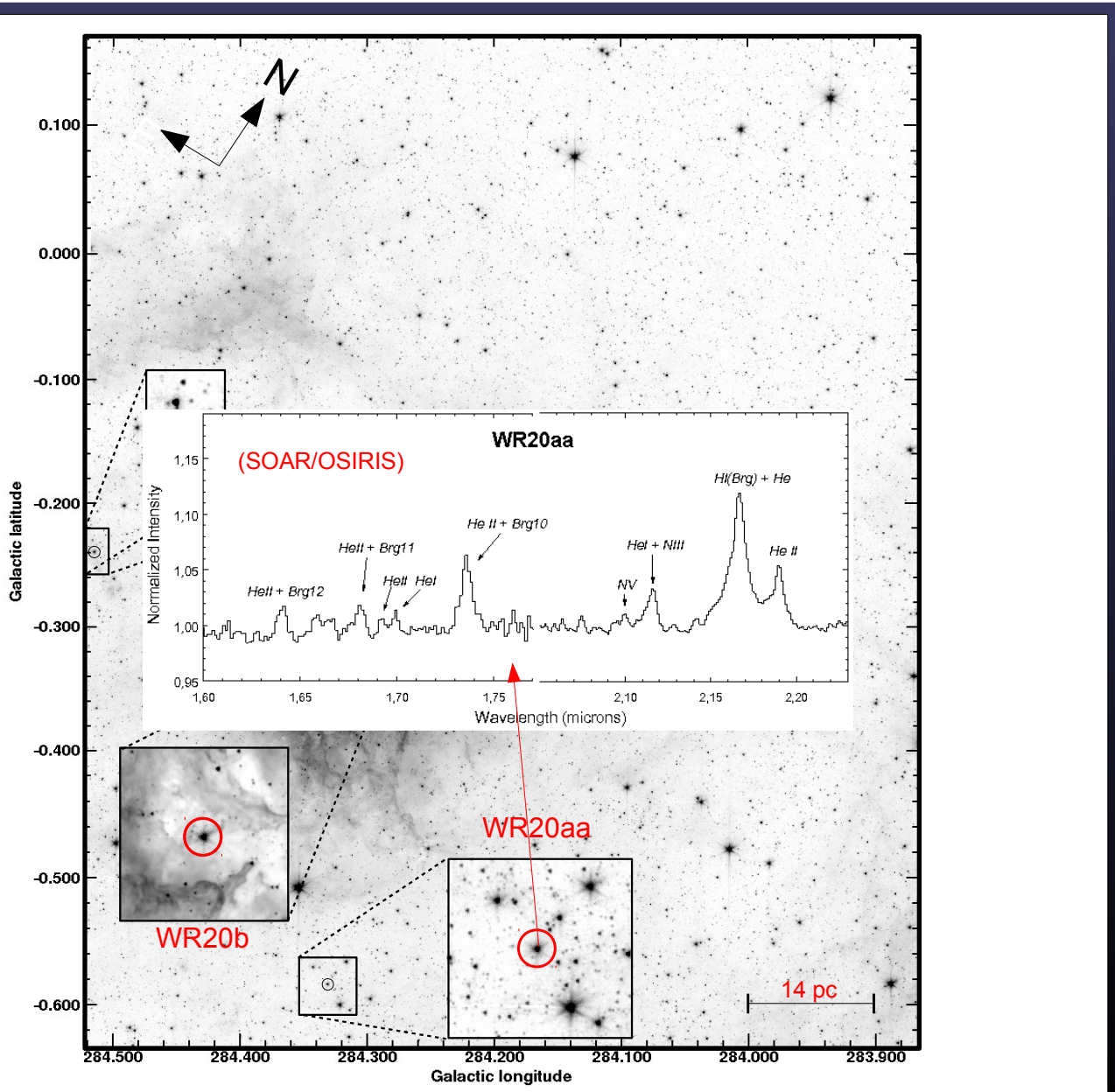
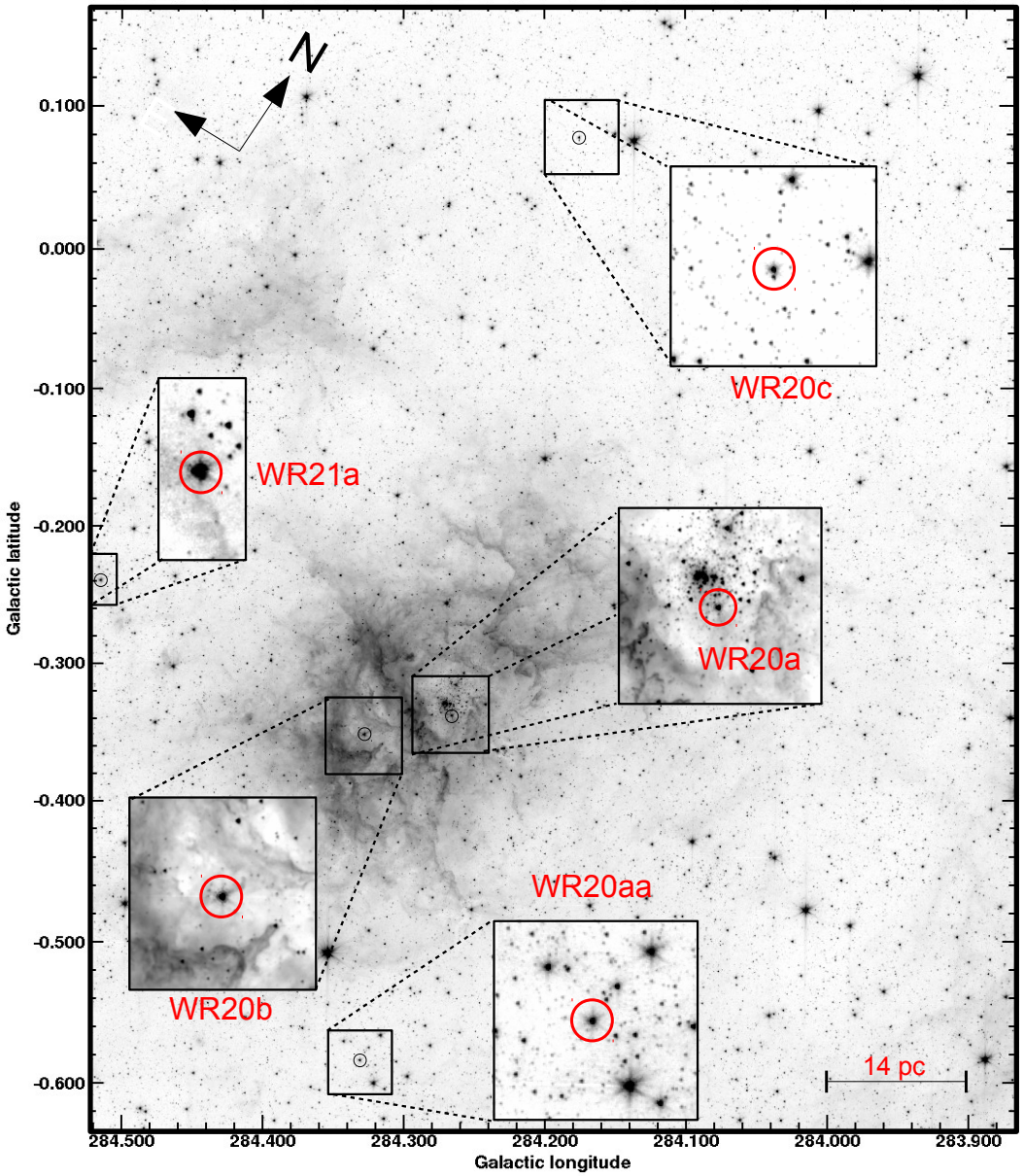
0.000
-0.100
-0.200
-0.300
-0.400
-0.500
-0.600
Galactic latitude
284.500
284.400
284.300
284.200
284.100
284.000
283.900
Galactic longitude
WR21a
WR20a
WR20aa
WR20b
14 pc

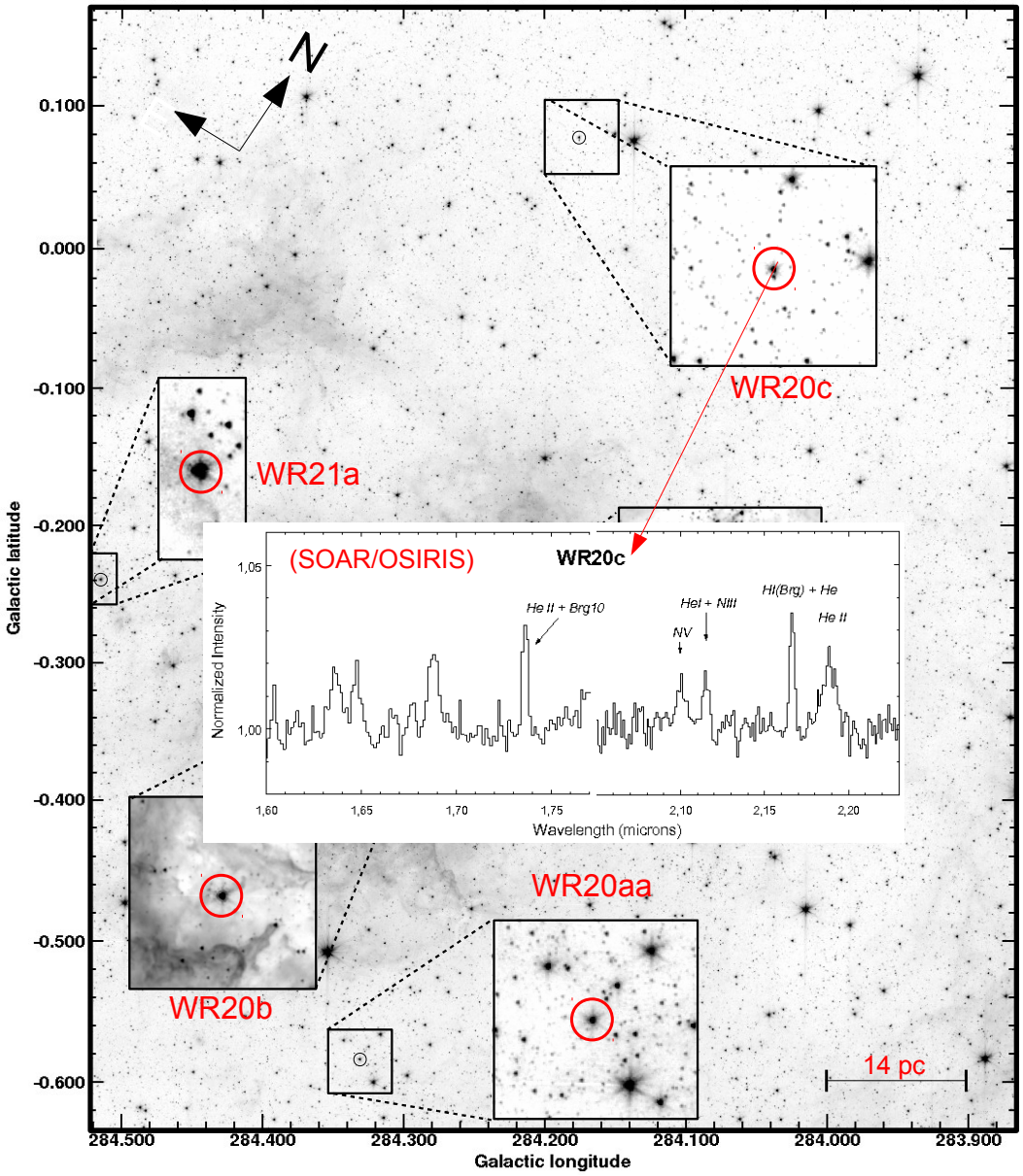
Results


N
0.100
0.000
-0.100
-0.200
-0.300
-0.400
-0.500
-0.600
Galactic latitude
284.500
284.400
284.300
284.200
284.100
284.000
283.900
Galactic longitude
WR20aa
(SOAR/OSIRIS)
Normalized Intensity
1,15
1,10
1,05
1,00
0,95
HeII + Brg12
HeII + Brg11
HeII HeI
He II + Brg10
HeI + NIII
NV
HI(Brg) + He
He II
1,60
1,65
1,70
1,75
2,10
2,15
2,20
Wavelength (microns)
WR20aa
WR20b
14 pc

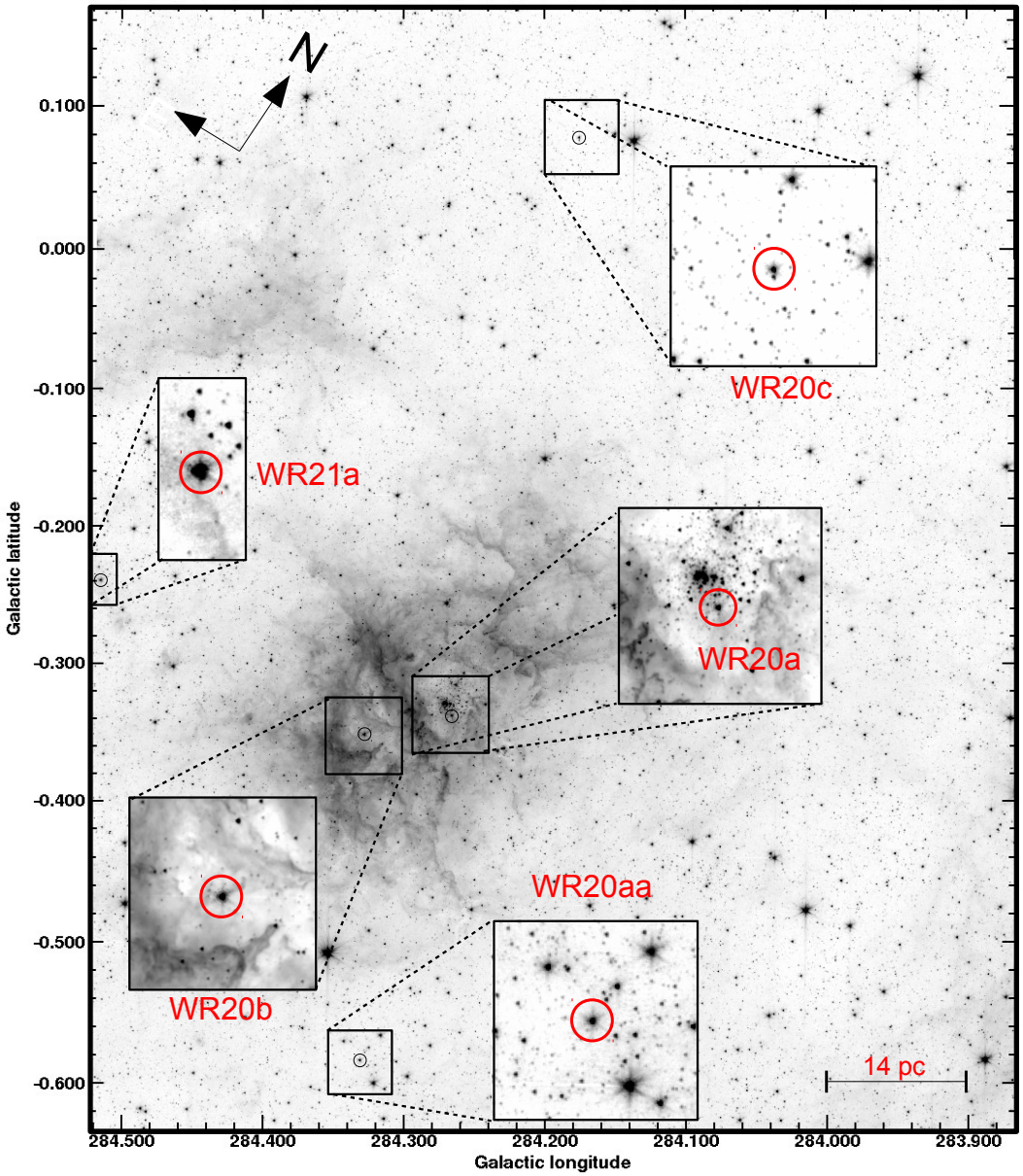
Results


N
WR20c
WR21a
WR20a
WR20aa
WR20b
14 pc
Galactic latitude
Galactic longitude
0.100
0.000
-0.100
-0.200
-0.300
-0.400
-0.500
-0.600
284.500
284.400
284.300
284.200
284.100
284.000
283.900

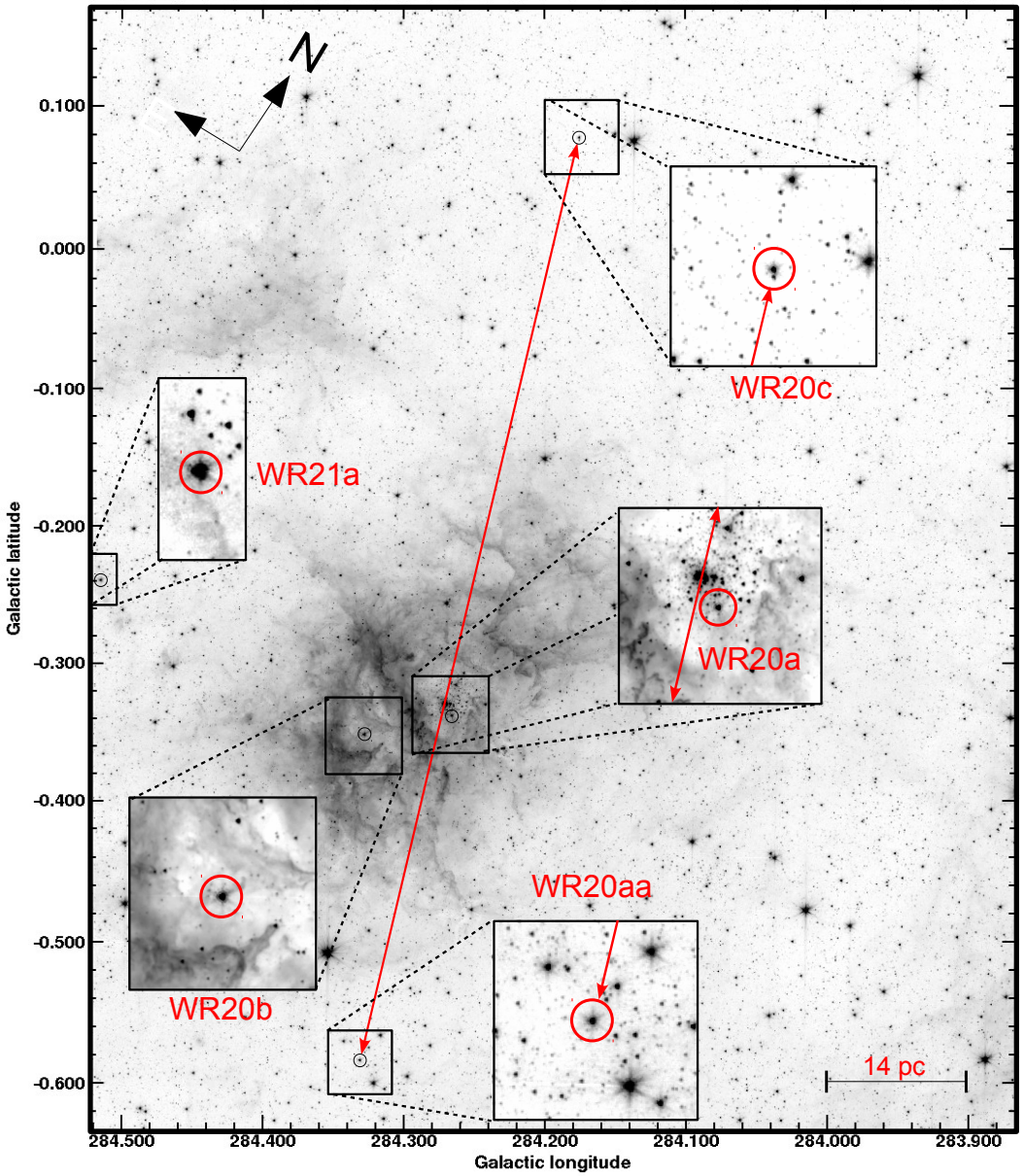
Results


N
WR20c
WR21a
(SOAR/OSIRIS)
WR20c
He II + Brg10
HeI + NIII
NV
HI(Brg) + He
He II
Normalized Intensity
1,05
1,00
1,60
1,65
1,70
1,75
2,10
2,15
2,20
Wavelength (microns)
WR20aa
WR20b
14 pc
Galactic latitude
0.100
0.000
-0.100
-0.200
-0.300
-0.400
-0.500
-0.600
284.500
284.400
284.300
284.200
284.100
284.000
283.900
Galactic longitude

Results


N
WR20c
WR21a
WR20a
WR20aa
WR20b
14 pc
Galactic latitude
Galactic longitude
0.100
0.000
-0.100
-0.200
-0.300
-0.400
-0.500
-0.600
284.500
284.400
284.300
284.200
284.100
284.000
283.900

Results


N
WR20c
WR21a
WR20a
WR20aa
WR20b
14 pc
Galactic latitude
Galactic longitude
0.100
0.000
-0.100
-0.200
-0.300
-0.400
-0.500
-0.600
284.500
284.400
284.300
284.200
284.100
284.000
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Concluding remarks and upcoming work

Two new O2If*/WN6ha stars in Westerlund 2

Apparently Isolated in the field

Concluding remarks and upcoming work

Two new O2If*/WN6ha stars in Westerlund 2

Apparently Isolated in the field

How did they arrive there?

Concluding remarks and upcoming work

Two new O2If*/WN6ha stars in Westerlund 2

Apparently Isolated in the field

How did they arrive there?

Isolated formation?

Ejection from their birthplace?

Concluding remarks and upcoming work

Two proposals accepted - 2011A

Magellan – Clay - MagE

Concluding remarks and upcoming work

Two proposals accepted - 2011A

Magellan – Clay - MagE

(one night – Feb 15th 2011)

Preliminary results:

twelve new early and late-O stars
one WC 8 (WR60a)
Two new LBVs candidates

Concluding remarks and upcoming work

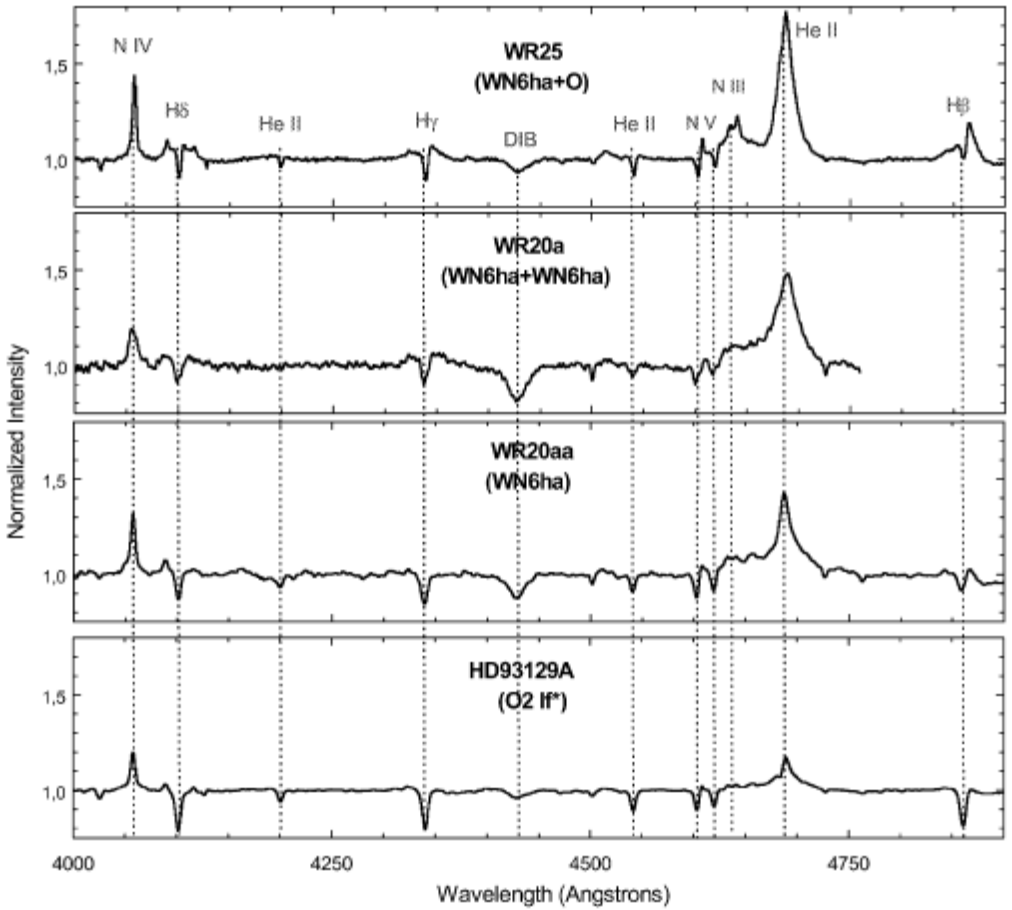
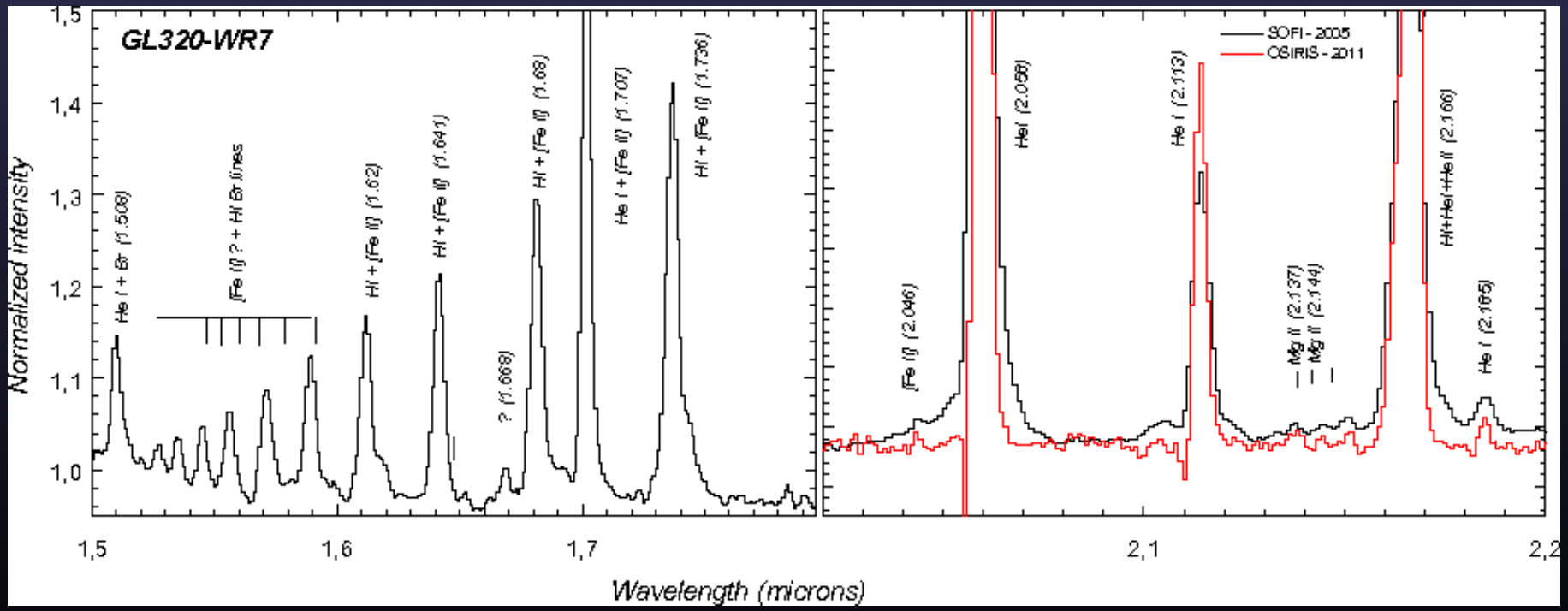


Figure 2. The optical spectrum of WR20aa, together with that for HD 93129A (O2 If*), WR 25 (WN6ha + O), and WR20a (WN6ha + WN6ha). A comparison with the spectrum of HD93129A and that for WR20a shows that the optical spectrum of WR20aa approximates better to the later.

Concluding remarks and upcoming work

Two proposals accepted - 2011A



Thanks !