20250702 Consistency in [NII] and [SII] BPT

1. 4 catalogs (updated)

I have the QC for each line: $\mathrm{FLUX}/\mathrm{FLUX}_{\mathrm{ERR}} \geq 3$ and $\mathrm{FLUX} \geq 20 \times 10\ \mathrm{erg/s/cm^2}$.

Now I have divided all non-nan spaxels into 4 catalogs (here I use [NII] BPT as an example):

1. `Upper` (in color blue): not detected in Balmer lines, i.e., either Hα or Hβ or both does not pass the QC.
2. `Unclassified` (in color red): detected in Balmer lines, but error bars are too large to locate the spaxel's position on the [NII] BPT diagram.
3. `nonSF` (in color orange): detected in Balmer lines, constrainted on [NII] BPT diagram, and above the Kewley+2001 curve (red curve).
4. `SF` (in color green): detected in Balmer lines, constrainted on [NII] BPT diagram, and below the Kewley+2001 curve (red curve).

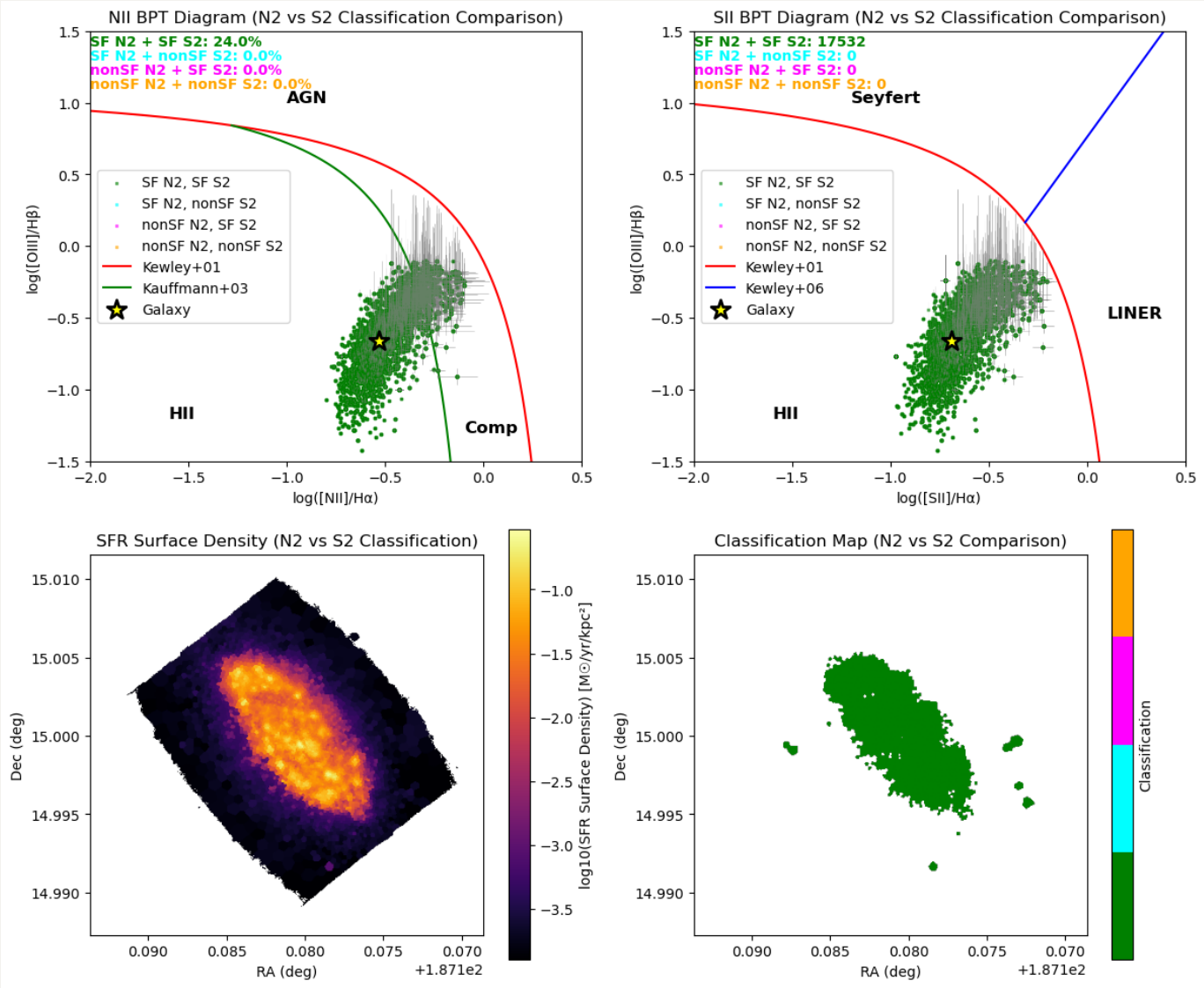
2. Consistency on [NII] and [SII] BPT

Now I want to see if `SF` and `nonSF` are consistent on [NII] and [SII] BPT diagrams, so in the `classified` spaxels in both BPT diagrams, I further have:

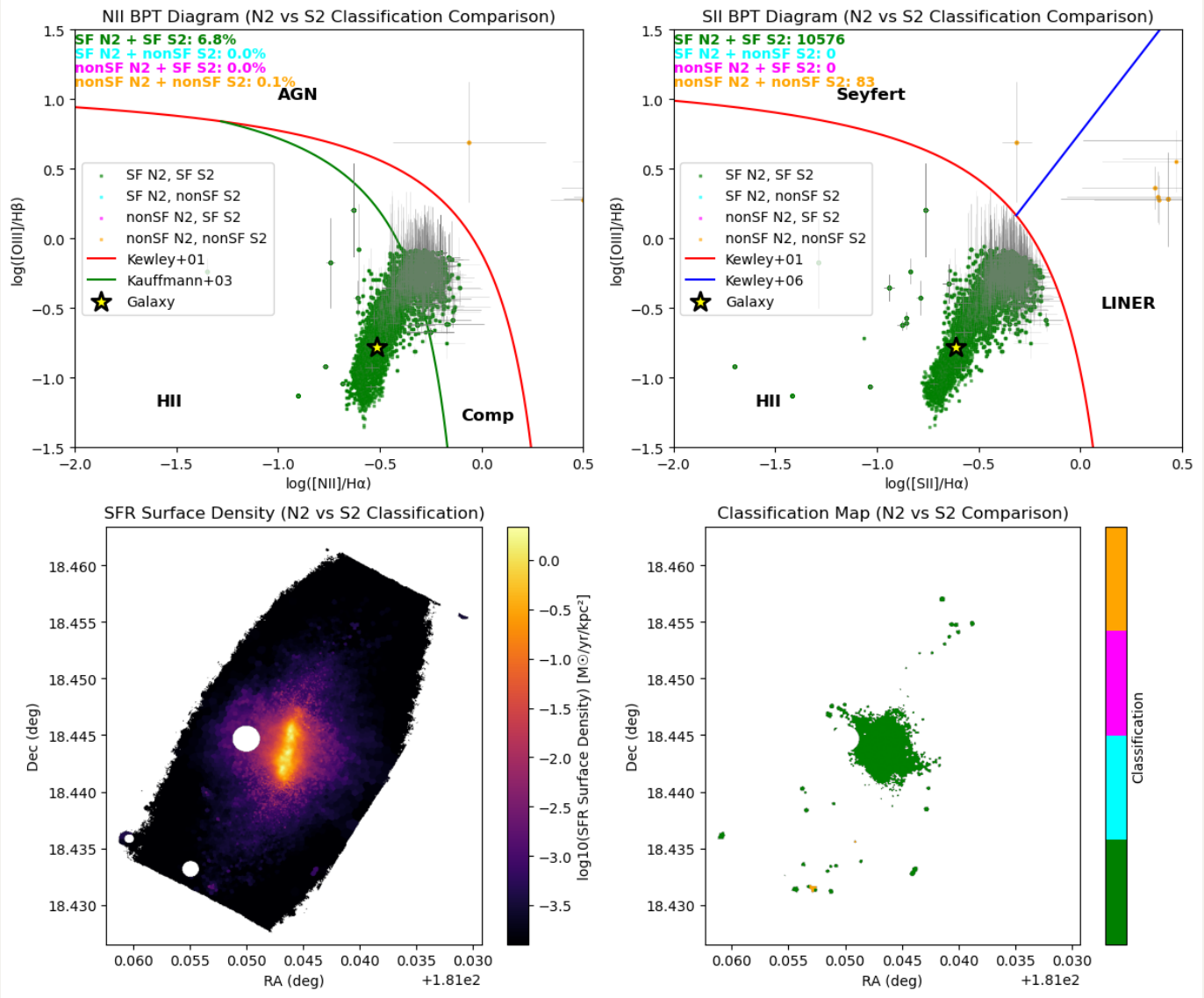
```
mask_SF_N2_SF_S2 = mask_classified_both & mask_SF_N2 & mask_SF_S2
mask_nonSF_N2_nonSF_S2 = mask_classified_both & mask_nonSF_N2 &
mask_nonSF_S2
mask_nonSF_N2_SF_S2 = mask_classified_both & mask_nonSF_N2 &
mask_SF_S2
mask_SF_N2_nonSF_S2 = mask_classified_both & mask_SF_N2 &
mask_nonSF_S2
```

As expected, most of them are `SF` and they are consistent on both [NII] and [SII] BPT (in green), while there is 0 spaxels `SF` on [SII] but `nonSF` on [NII] BPT. However, the case that is `SF` in [NII] but `nonSF` on [SII] BPT become sifnificant in NGC4383, NGC4396, NGC4522. I can see that they are still not far from the boundary between HII and Comp, so I think they may be due to ambigus classification of SF region and harder ionisation.

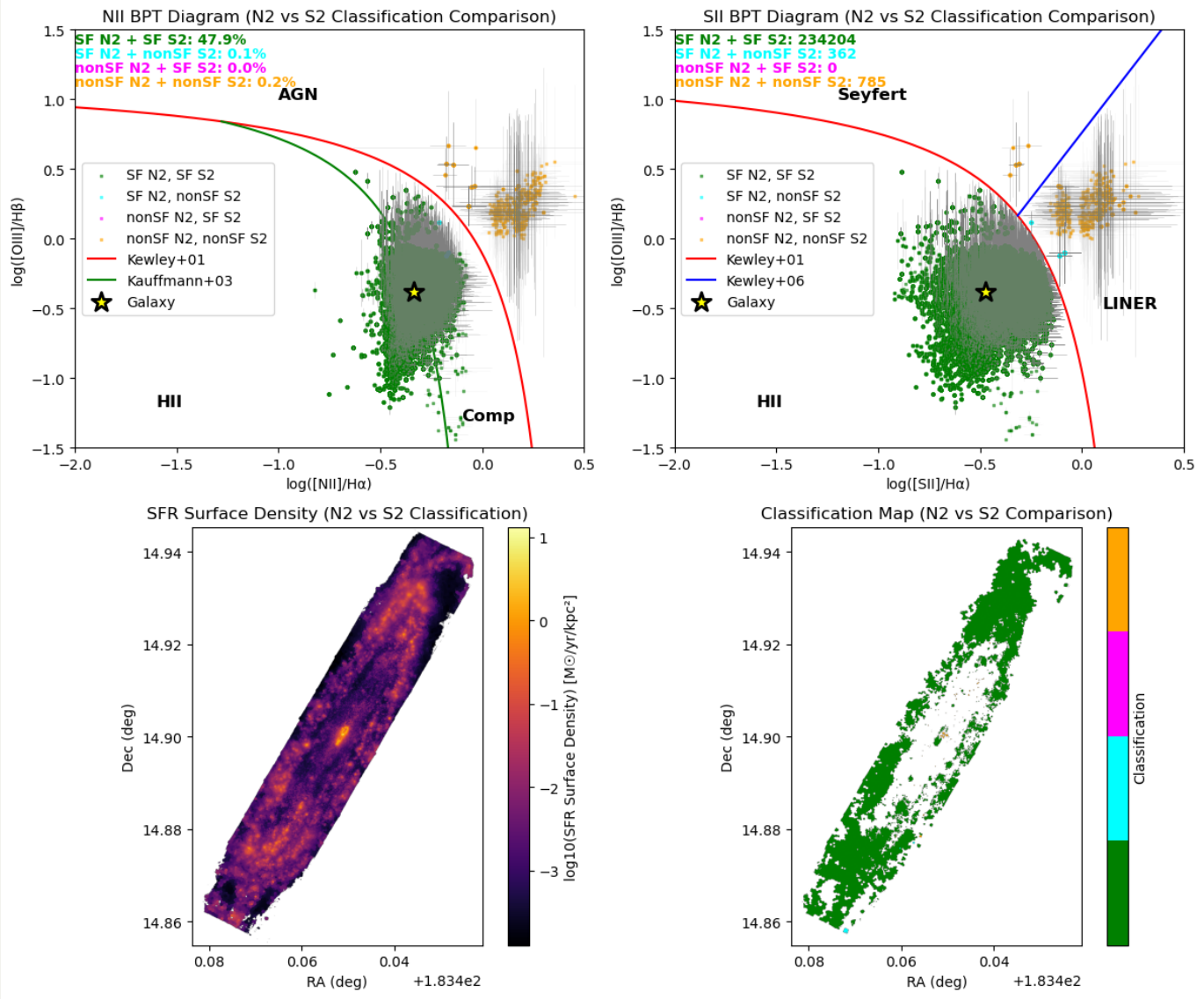
2.1 IC3392



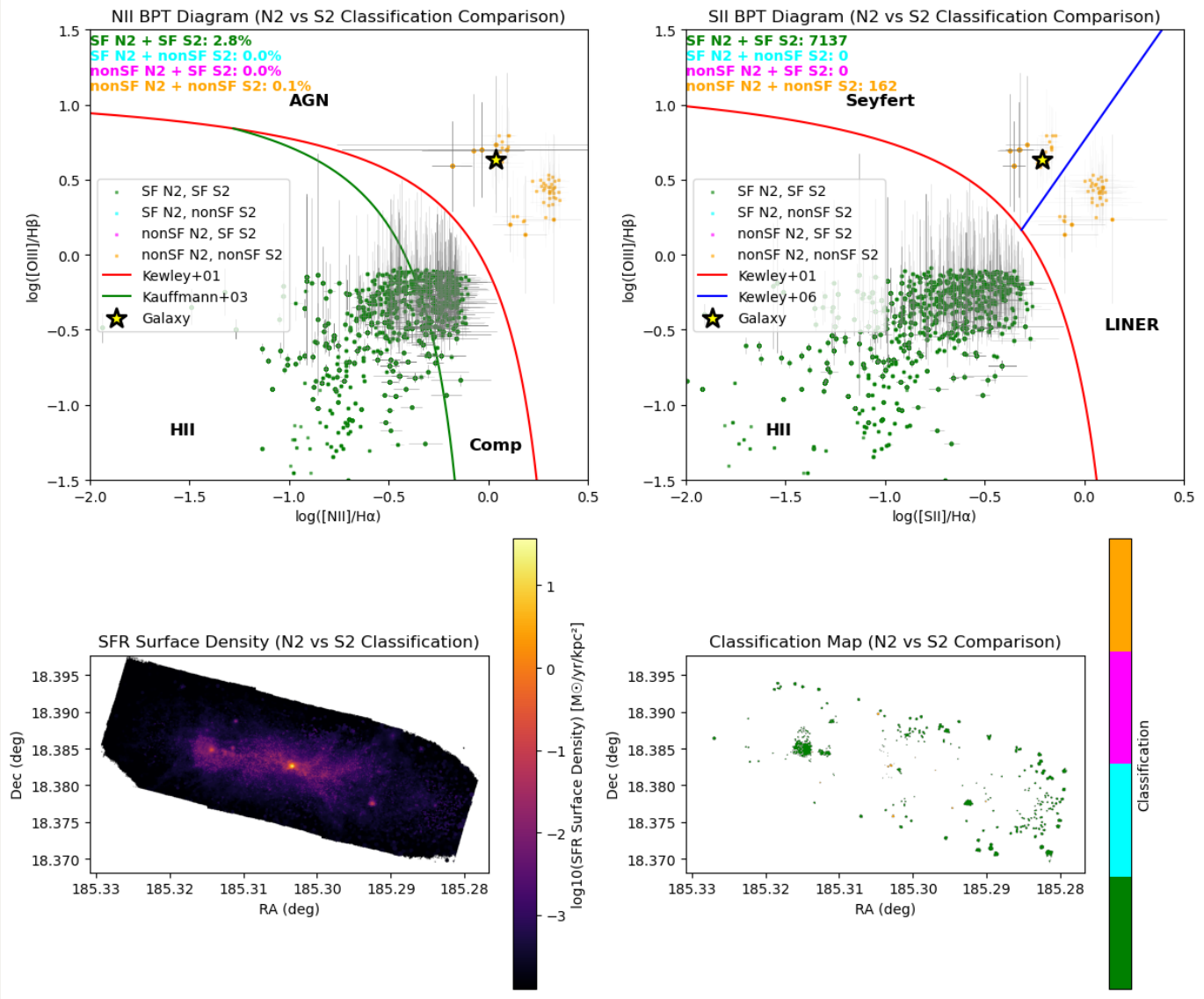
2.2 NGC4064


NII BPT Diagram (N2 vs S2 Classification Comparison)
SF N2 + SF S2: 6.8%
SF N2 + nonSF S2: 0.0%
nonSF N2 + SF S2: 0.0%
nonSF N2 + nonSF S2: 0.1%
AGN
HII
Comp
SF N2, SF S2
SF N2, nonSF S2
nonSF N2, SF S2
nonSF N2, nonSF S2
Kewley+01
Kauffmann+03
Galaxy
log([OIII]/Hβ)
log([NII]/Hα)
SII BPT Diagram (N2 vs S2 Classification Comparison)
SF N2 + SF S2: 10576
SF N2 + nonSF S2: 0
nonSF N2 + SF S2: 0
nonSF N2 + nonSF S2: 83
Seyfert
LINER
HII
Kewley+06
log([SII]/Hα)
SFR Surface Density (N2 vs S2 Classification)
Dec (deg)
RA (deg)
+1.81e2
log10(SFR Surface Density) [M☉/yr/kpc²]
Classification Map (N2 vs S2 Comparison)
Classification

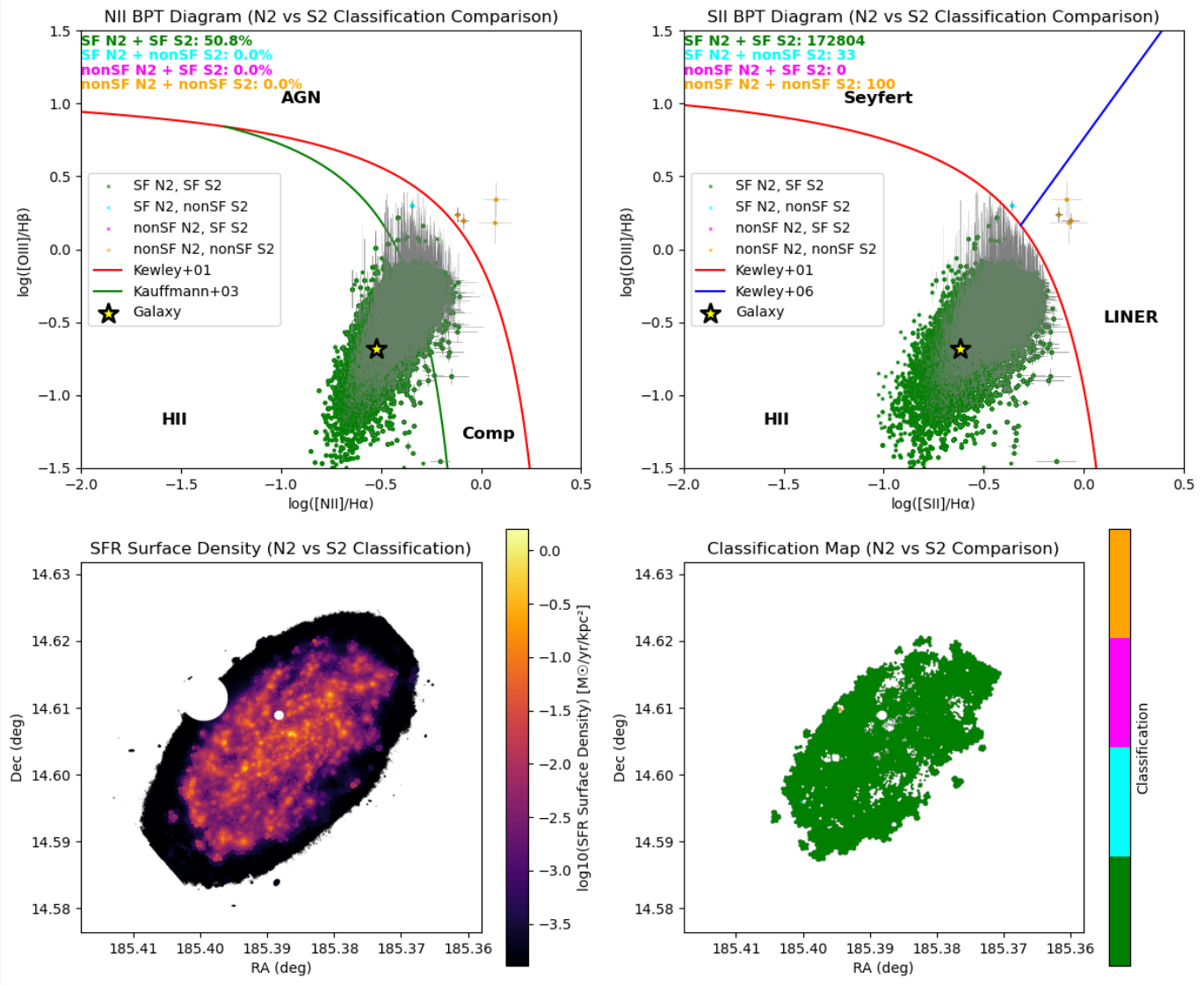
2.3 NGC4192


NII BPT Diagram (N2 vs S2 Classification Comparison)
SF N2 + SF S2: 47.9%
SF N2 + nonSF S2: 0.1%
nonSF N2 + SF S2: 0.0%
nonSF N2 + nonSF S2: 0.2%
AGN
HII
Comp
SF N2, SF S2
SF N2, nonSF S2
nonSF N2, SF S2
nonSF N2, nonSF S2
Kewley+01
Kauffmann+03
Galaxy
log([OIII]/Hβ)
log([NII]/Hα)
SII BPT Diagram (N2 vs S2 Classification Comparison)
SF N2 + SF S2: 234204
SF N2 + nonSF S2: 362
nonSF N2 + SF S2: 0
nonSF N2 + nonSF S2: 785
Seyfert
LINER
HII
Kewley+06
log([SII]/Hα)
SFR Surface Density (N2 vs S2 Classification)
Dec (deg)
RA (deg)
+1.834e2
log10(SFR Surface Density) [M⊙/yr/kpc²]
Classification Map (N2 vs S2 Comparison)
Classification

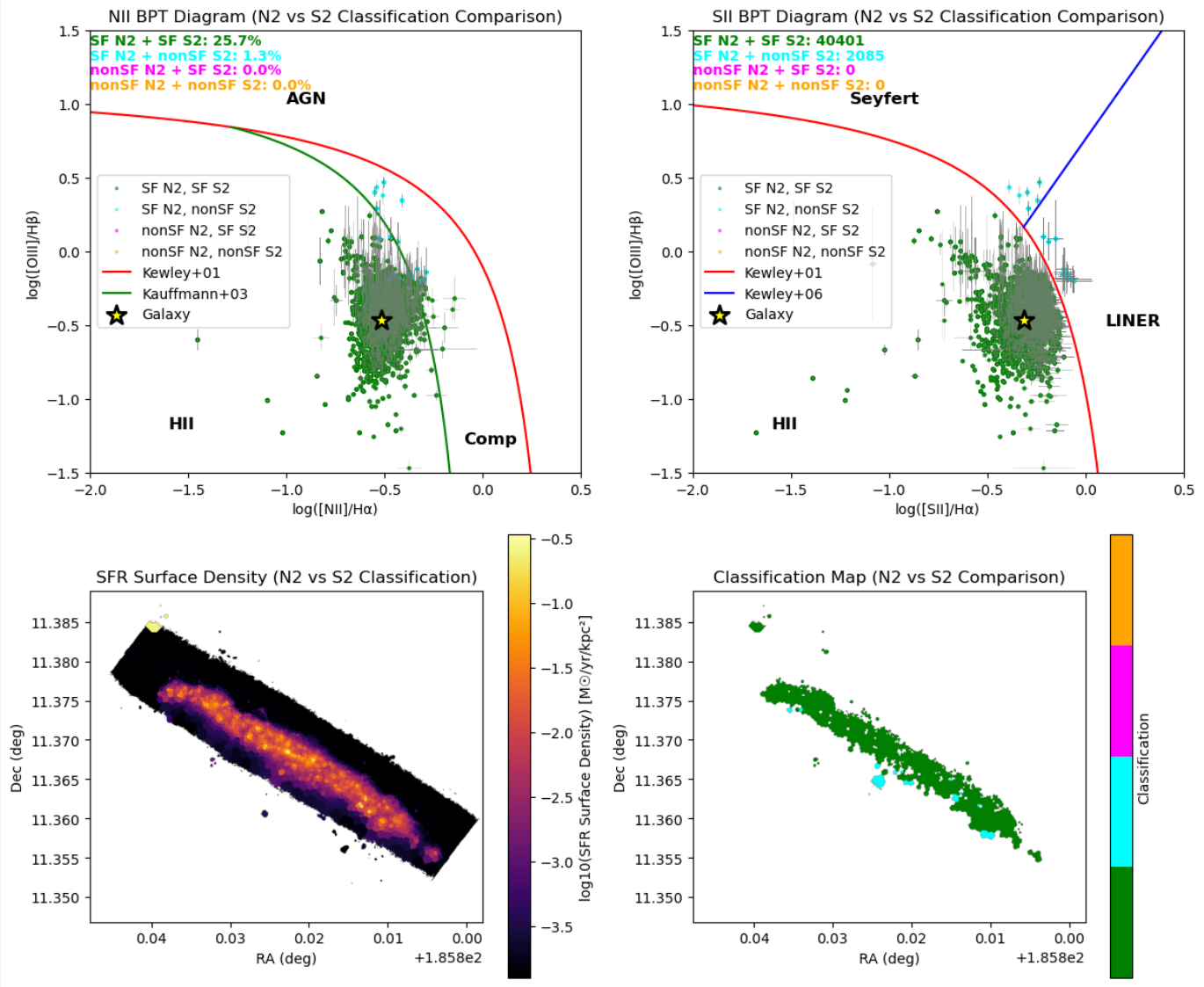
2.4 NGC4293


NII BPT Diagram (N2 vs S2 Classification Comparison)
SF N2 + SF S2: 2.8%
SF N2 + nonSF S2: 0.0%
nonSF N2 + SF S2: 0.0%
nonSF N2 + nonSF S2: 0.1%
AGN
HII
Comp
SF N2, SF S2
SF N2, nonSF S2
nonSF N2, SF S2
nonSF N2, nonSF S2
Kewley+01
Kauffmann+03
Galaxy
log([OIII]/Hβ)
log([NII]/Hα)
SII BPT Diagram (N2 vs S2 Classification Comparison)
SF N2 + SF S2: 7137
SF N2 + nonSF S2: 0
nonSF N2 + SF S2: 0
nonSF N2 + nonSF S2: 162
Seyfert
LINER
HII
Kewley+06
log([SII]/Hα)
SFR Surface Density (N2 vs S2 Classification)
Dec (deg)
RA (deg)
log10(SFR Surface Density) [M☉/yr/kpc²]
Classification Map (N2 vs S2 Comparison)
Classification

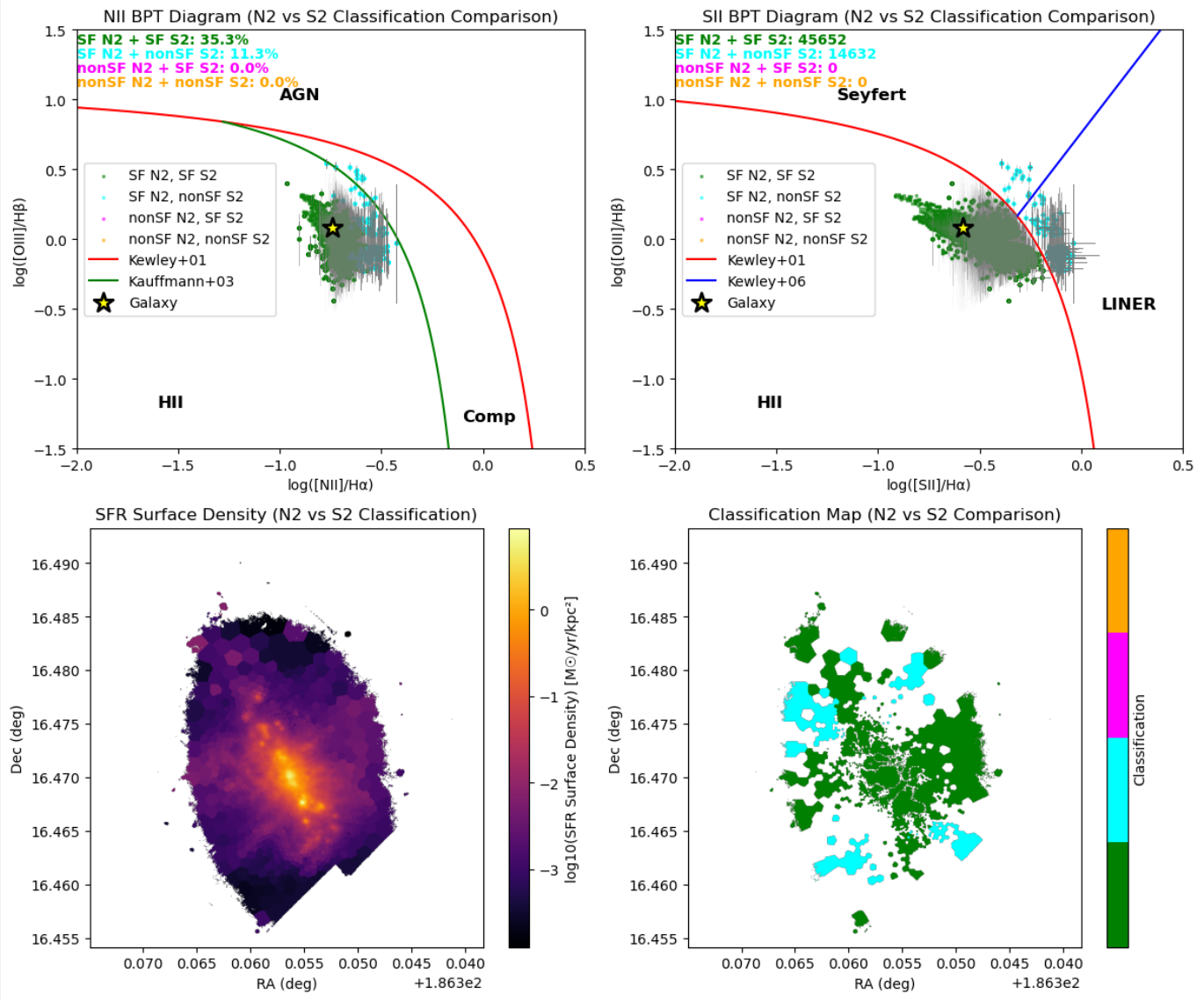
2.5 NGC4298


NII BPT Diagram (N2 vs S2 Classification Comparison)
SF N2 + SF S2: 50.8%
SF N2 + nonSF S2: 0.0%
nonSF N2 + SF S2: 0.0%
nonSF N2 + nonSF S2: 0.0%
AGN
HII
Comp
SF N2, SF S2
SF N2, nonSF S2
nonSF N2, SF S2
nonSF N2, nonSF S2
Kewley+01
Kauffmann+03
Galaxy
log([OIII]/Hβ)
log([NII]/Hα)
SII BPT Diagram (N2 vs S2 Classification Comparison)
SF N2 + SF S2: 172804
SF N2 + nonSF S2: 33
nonSF N2 + SF S2: 0
nonSF N2 + nonSF S2: 100
Seyfert
LINER
HII
Kewley+01
Kewley+06
log([SII]/Hα)
SFR Surface Density (N2 vs S2 Classification)
Dec (deg)
RA (deg)
log10(SFR Surface Density) [M☉/yr/kpc²]
Classification Map (N2 vs S2 Comparison)
Classification

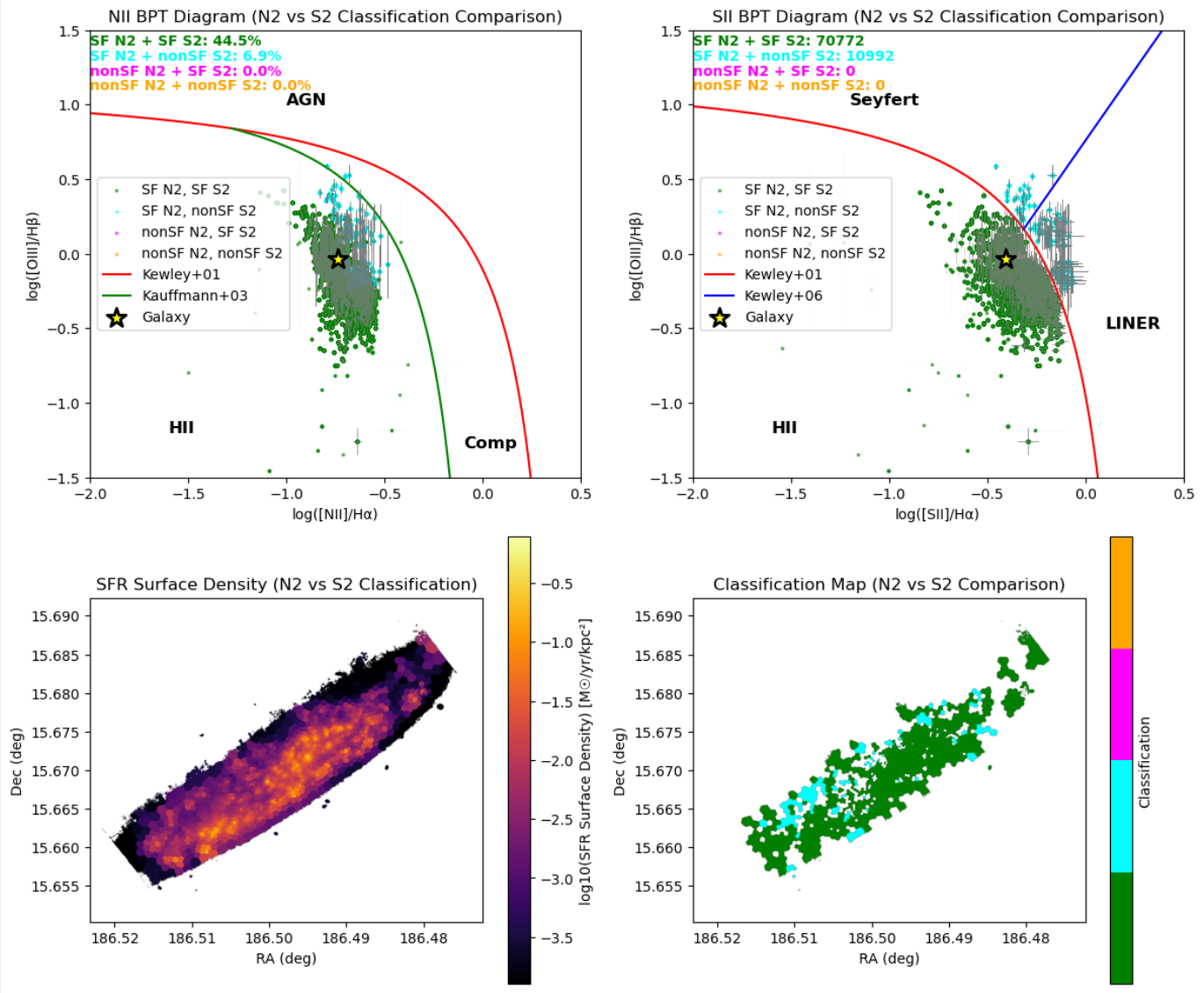
2.6 NGC4330


NII BPT Diagram (N2 vs S2 Classification Comparison)
SF N2 + SF S2: 25.7%
SF N2 + nonSF S2: 1.3%
nonSF N2 + SF S2: 0.0%
nonSF N2 + nonSF S2: 0.0%
AGN
HII
Comp
SF N2, SF S2
SF N2, nonSF S2
nonSF N2, SF S2
nonSF N2, nonSF S2
Kewley+01
Kauffmann+03
Galaxy
log([OIII]/Hβ)
log([NII]/Hα)
SII BPT Diagram (N2 vs S2 Classification Comparison)
SF N2 + SF S2: 40401
SF N2 + nonSF S2: 2085
nonSF N2 + SF S2: 0
nonSF N2 + nonSF S2: 0
Seyfert
LINER
HII
Kewley+06
log([SII]/Hα)
SFR Surface Density (N2 vs S2 Classification)
Dec (deg)
RA (deg)
+1.858e2
log10(SFR Surface Density) [M☉/yr/kpc²]
Classification Map (N2 vs S2 Comparison)
Classification

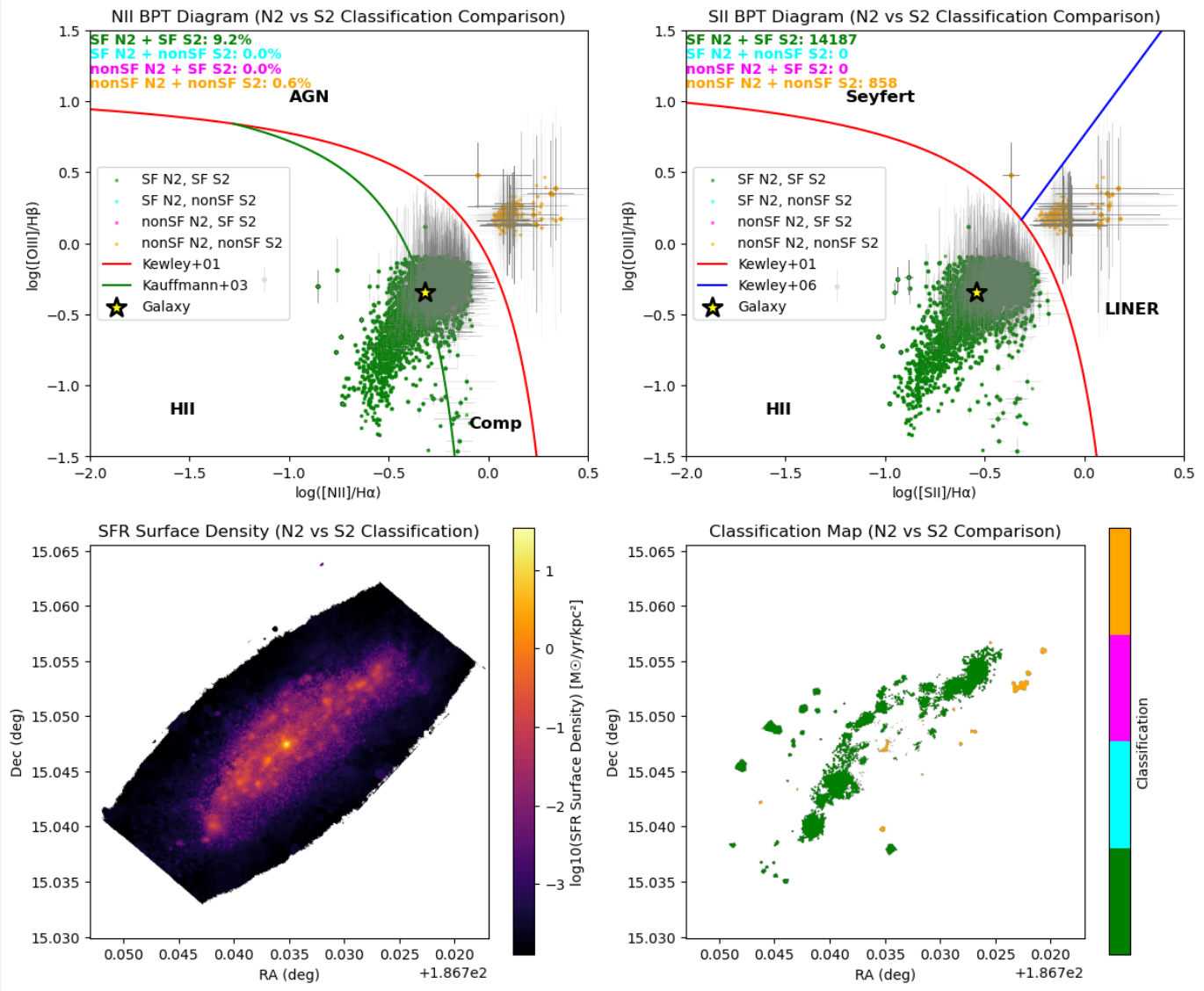
2.7 NGC4383


NII BPT Diagram (N2 vs S2 Classification Comparison)
SF N2 + SF S2: 35.3%
SF N2 + nonSF S2: 11.3%
nonSF N2 + SF S2: 0.0%
nonSF N2 + nonSF S2: 0.0%
AGN
HII
Comp
SF N2, SF S2
SF N2, nonSF S2
nonSF N2, SF S2
nonSF N2, nonSF S2
Kewley+01
Kauffmann+03
Galaxy
log([OIII]/Hβ)
log([NII]/Hα)
SII BPT Diagram (N2 vs S2 Classification Comparison)
SF N2 + SF S2: 45652
SF N2 + nonSF S2: 14632
nonSF N2 + SF S2: 0
nonSF N2 + nonSF S2: 0
Seyfert
LINER
HII
Kewley+06
log([SII]/Hα)
SFR Surface Density (N2 vs S2 Classification)
Dec (deg)
RA (deg)
+1.863e2
log10(SFR Surface Density) [M⊙/yr/kpc²]
Classification Map (N2 vs S2 Comparison)
Classification

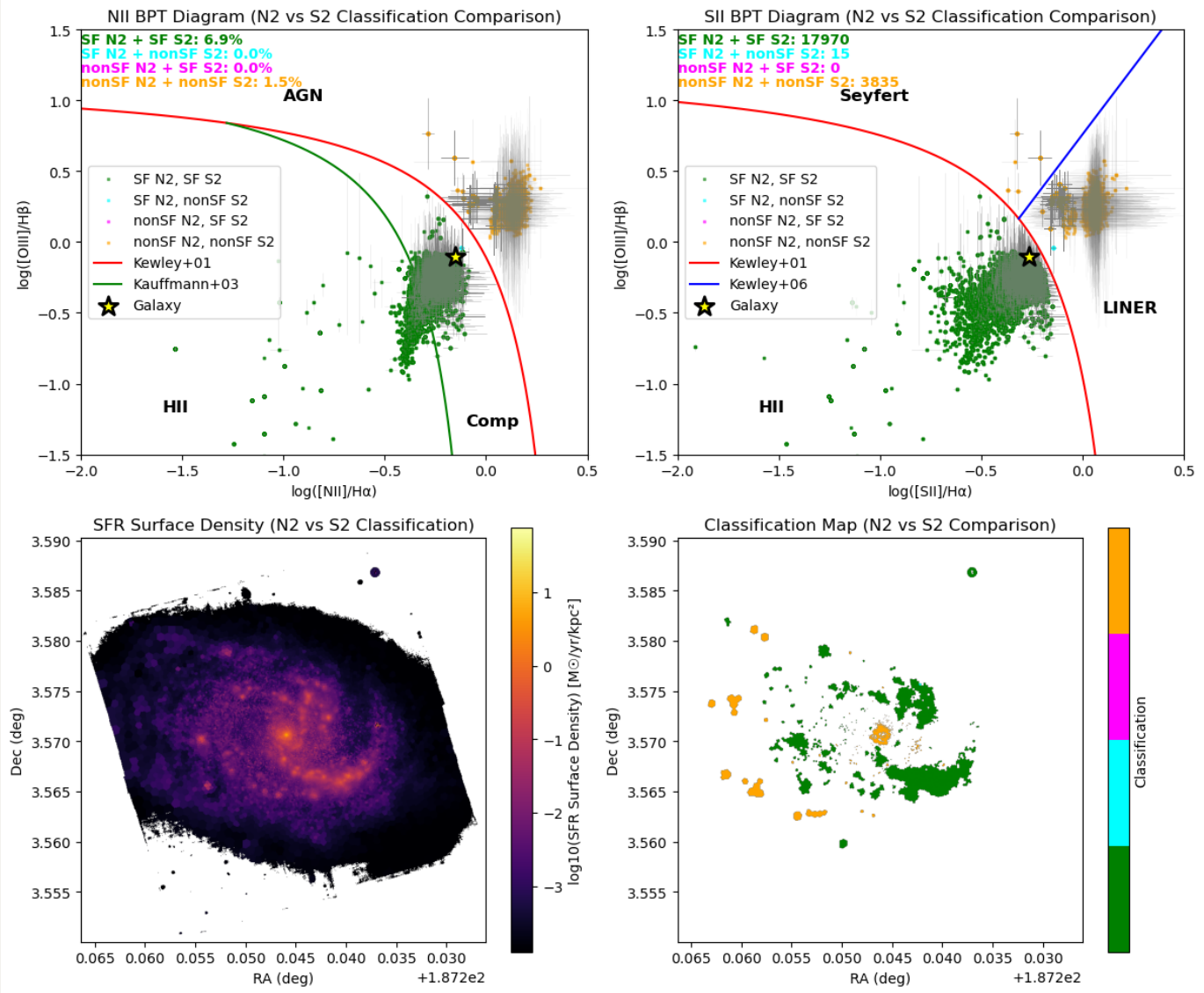
2.8 NGC4396


NII BPT Diagram (N2 vs S2 Classification Comparison)
SF N2 + SF S2: 44.5%
SF N2 + nonSF S2: 6.9%
nonSF N2 + SF S2: 0.0%
nonSF N2 + nonSF S2: 0.0%
AGN
HII
Comp
SF N2, SF S2
SF N2, nonSF S2
nonSF N2, SF S2
nonSF N2, nonSF S2
Kewley+01
Kauffmann+03
Galaxy
log([OIII]/Hβ)
log([NII]/Hα)
SII BPT Diagram (N2 vs S2 Classification Comparison)
SF N2 + SF S2: 70772
SF N2 + nonSF S2: 10992
nonSF N2 + SF S2: 0
nonSF N2 + nonSF S2: 0
Seyfert
LINER
HII
Kewley+06
log([SII]/Hα)
SFR Surface Density (N2 vs S2 Classification)
Dec (deg)
RA (deg)
log10(SFR Surface Density) [M⊙/yr/kpc²]
Classification Map (N2 vs S2 Comparison)
Classification

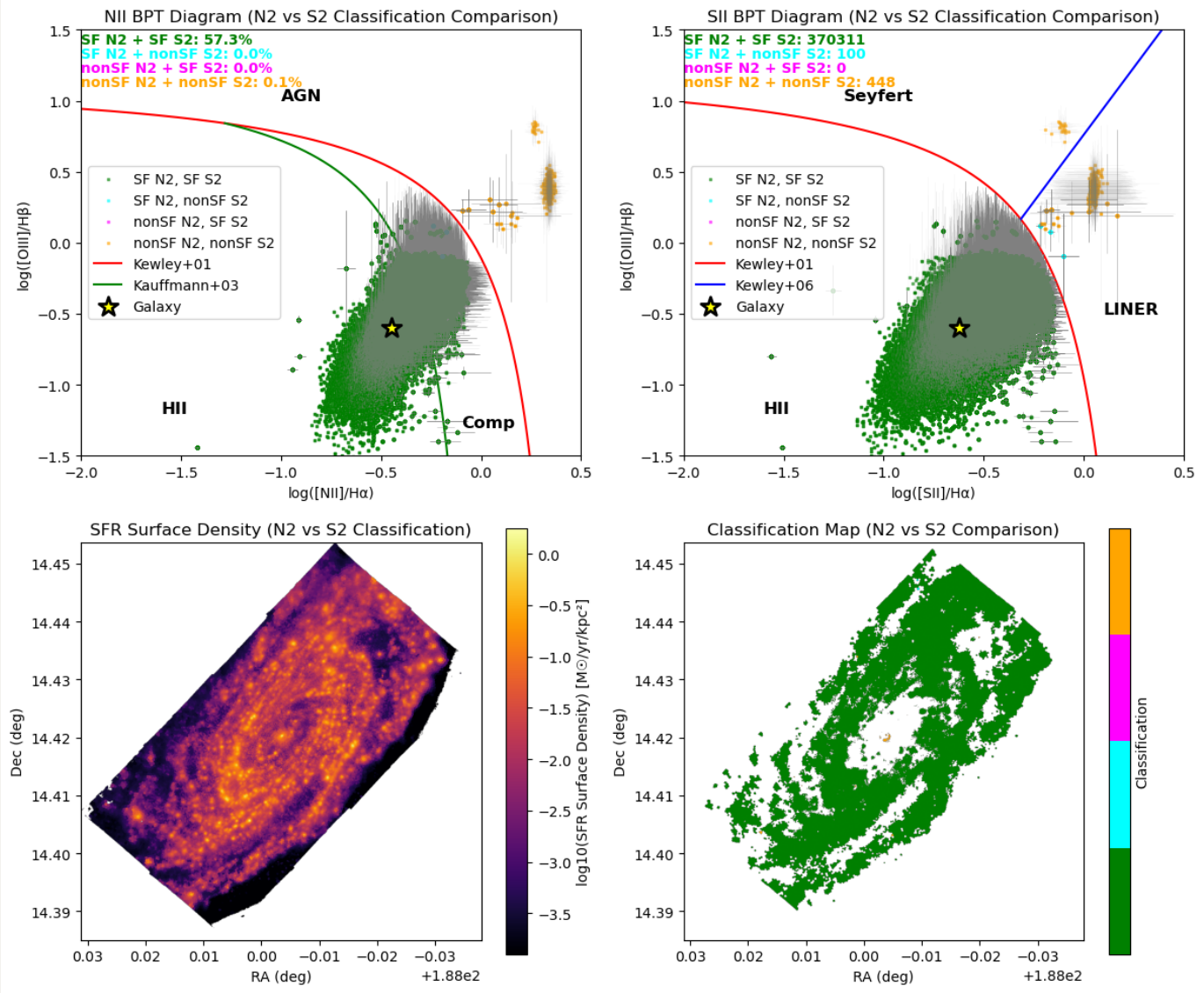
2.9 NGC4419


NII BPT Diagram (N2 vs S2 Classification Comparison)
SF N2 + SF S2: 9.2%
SF N2 + nonSF S2: 0.0%
nonSF N2 + SF S2: 0.0%
nonSF N2 + nonSF S2: 0.6%
AGN
HII
Comp
SF N2, SF S2
SF N2, nonSF S2
nonSF N2, SF S2
nonSF N2, nonSF S2
Kewley+01
Kauffmann+03
Galaxy
log([OIII]/Hβ)
log([NII]/Hα)
SII BPT Diagram (N2 vs S2 Classification Comparison)
SF N2 + SF S2: 14187
SF N2 + nonSF S2: 0
nonSF N2 + SF S2: 0
nonSF N2 + nonSF S2: 858
Seyfert
LINER
HII
Kewley+06
log([SII]/Hα)
SFR Surface Density (N2 vs S2 Classification)
Dec (deg)
RA (deg)
+1.867e2
log10(SFR Surface Density) [M☉/yr/kpc²]
Classification Map (N2 vs S2 Comparison)
Classification

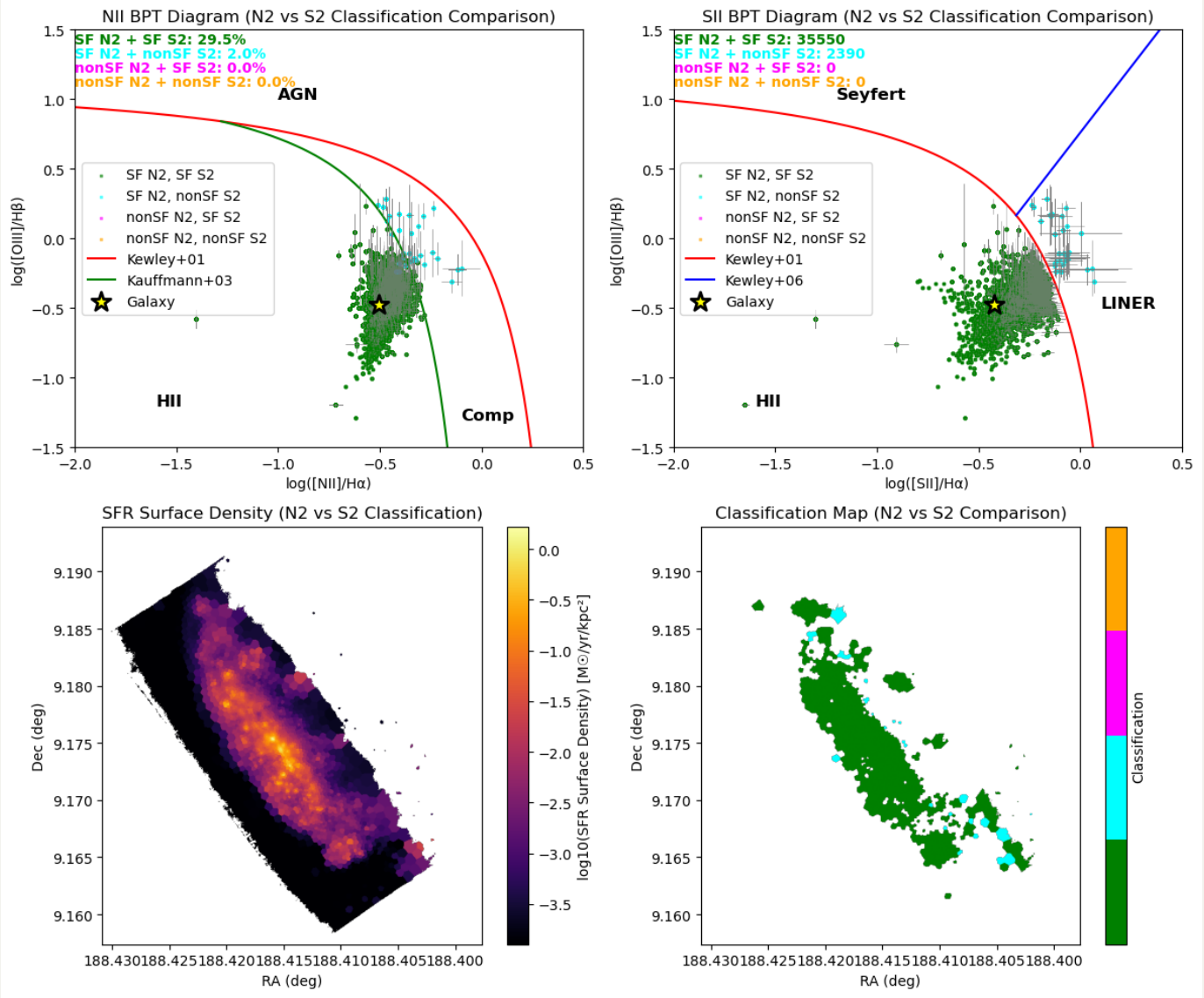
2.10 NGC4457


NII BPT Diagram (N2 vs S2 Classification Comparison)
SF N2 + SF S2: 6.9%
SF N2 + nonSF S2: 0.0%
nonSF N2 + SF S2: 0.0%
nonSF N2 + nonSF S2: 1.5%
AGN
HII
Comp
SF N2, SF S2
SF N2, nonSF S2
nonSF N2, SF S2
nonSF N2, nonSF S2
Kewley+01
Kauffmann+03
Galaxy
log([OIII]/Hβ)
log([NII]/Hα)
SII BPT Diagram (N2 vs S2 Classification Comparison)
SF N2 + SF S2: 17970
SF N2 + nonSF S2: 15
nonSF N2 + SF S2: 0
nonSF N2 + nonSF S2: 3835
Seyfert
LINER
HII
Kewley+06
log([SII]/Hα)
SFR Surface Density (N2 vs S2 Classification)
Dec (deg)
RA (deg)
+1.872e2
log10(SFR Surface Density) [M⊙/yr/kpc²]
Classification Map (N2 vs S2 Comparison)
Classification

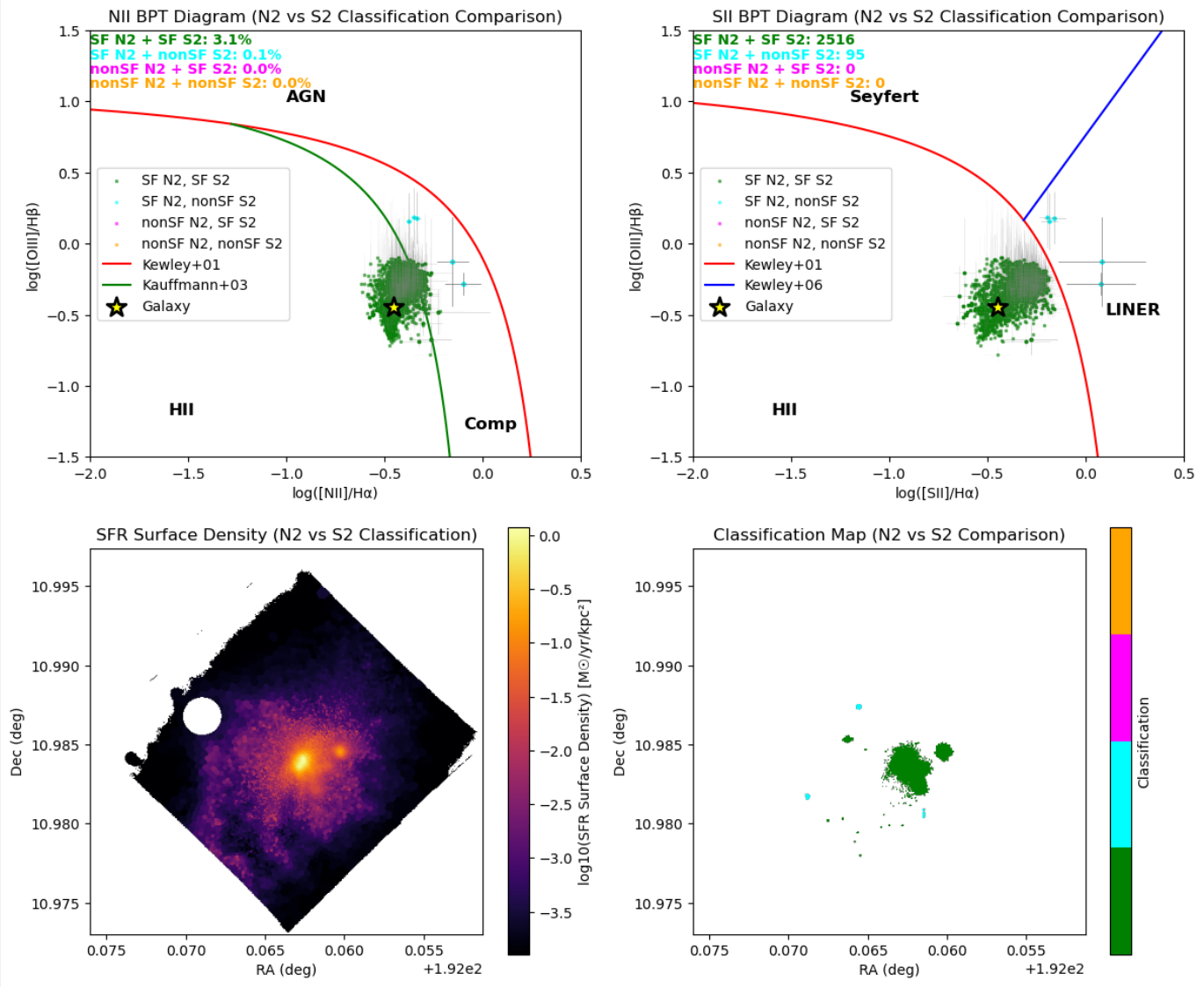
2.11 NGC4501


NII BPT Diagram (N2 vs S2 Classification Comparison)
SF N2 + SF S2: 57.3%
SF N2 + nonSF S2: 0.0%
nonSF N2 + SF S2: 0.0%
nonSF N2 + nonSF S2: 0.1%
AGN
HII
Comp
SF N2, SF S2
SF N2, nonSF S2
nonSF N2, SF S2
nonSF N2, nonSF S2
Kewley+01
Kauffmann+03
Galaxy
log([OIII]/Hβ)
log([NII]/Hα)
SII BPT Diagram (N2 vs S2 Classification Comparison)
SF N2 + SF S2: 370311
SF N2 + nonSF S2: 100
nonSF N2 + SF S2: 0
nonSF N2 + nonSF S2: 448
Seyfert
LINER
HII
Kewley+06
log([SII]/Hα)
SFR Surface Density (N2 vs S2 Classification)
Dec (deg)
RA (deg)
+1.88e2
log10(SFR Surface Density) [M⊙/yr/kpc²]
Classification Map (N2 vs S2 Comparison)
Classification

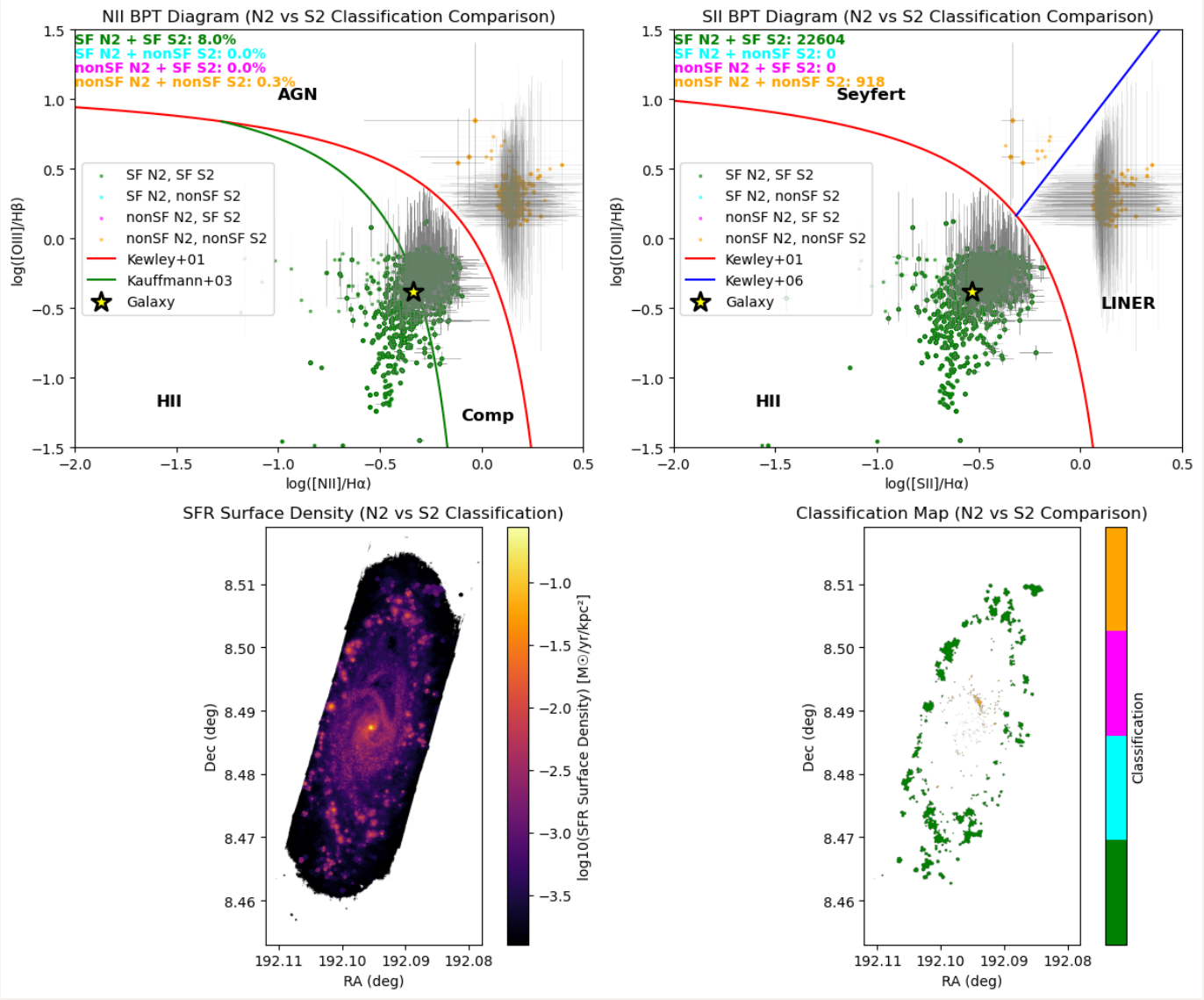
2.12 NGC4522


NII BPT Diagram (N2 vs S2 Classification Comparison)
SF N2 + SF S2: 29.5%
SF N2 + nonSF S2: 2.0%
nonSF N2 + SF S2: 0.0%
nonSF N2 + nonSF S2: 0.0%
AGN
HII
Comp
SF N2, SF S2
SF N2, nonSF S2
nonSF N2, SF S2
nonSF N2, nonSF S2
Kewley+01
Kauffmann+03
Galaxy
log([OIII]/Hβ)
log([NII]/Hα)
SII BPT Diagram (N2 vs S2 Classification Comparison)
SF N2 + SF S2: 35550
SF N2 + nonSF S2: 2390
nonSF N2 + SF S2: 0
nonSF N2 + nonSF S2: 0
Seyfert
LINER
HII
Kewley+06
log([SII]/Hα)
SFR Surface Density (N2 vs S2 Classification)
Dec (deg)
RA (deg)
log10(SFR Surface Density) [M⊙/yr/kpc²]
Classification Map (N2 vs S2 Comparison)
Classification

2.13 NGC4694


NII BPT Diagram (N2 vs S2 Classification Comparison)
SF N2 + SF S2: 3.1%
SF N2 + nonSF S2: 0.1%
nonSF N2 + SF S2: 0.0%
nonSF N2 + nonSF S2: 0.0%
AGN
HII
Comp
SF N2, SF S2
SF N2, nonSF S2
nonSF N2, SF S2
nonSF N2, nonSF S2
Kewley+01
Kauffmann+03
Galaxy
log([OIII]/Hβ)
log([NII]/Hα)
SII BPT Diagram (N2 vs S2 Classification Comparison)
SF N2 + SF S2: 2516
SF N2 + nonSF S2: 95
nonSF N2 + SF S2: 0
nonSF N2 + nonSF S2: 0
Seyfert
LINER
HII
Kewley+06
log([SII]/Hα)
SFR Surface Density (N2 vs S2 Classification)
Dec (deg)
RA (deg)
+1.92e2
log10(SFR Surface Density) [M☉/yr/kpc²]
Classification Map (N2 vs S2 Comparison)
Classification

2.14 NGC4698


NII BPT Diagram (N2 vs S2 Classification Comparison)
SF N2 + SF S2: 8.0%
SF N2 + nonSF S2: 0.0%
nonSF N2 + SF S2: 0.0%
nonSF N2 + nonSF S2: 0.3%
AGN
HII
Comp
SF N2, SF S2
SF N2, nonSF S2
nonSF N2, SF S2
nonSF N2, nonSF S2
Kewley+01
Kauffmann+03
Galaxy
log([OIII]/Hβ)
log([NII]/Hα)
SII BPT Diagram (N2 vs S2 Classification Comparison)
SF N2 + SF S2: 22604
SF N2 + nonSF S2: 0
nonSF N2 + SF S2: 0
nonSF N2 + nonSF S2: 918
Seyfert
LINER
HII
Kewley+06
log([SII]/Hα)
SFR Surface Density (N2 vs S2 Classification)
Dec (deg)
RA (deg)
log10(SFR Surface Density) [M⊙/yr/kpc²]
Classification Map (N2 vs S2 Comparison)
Classification