MUSE observations of 1E 0102.2-7219

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ANU / CAASTRO

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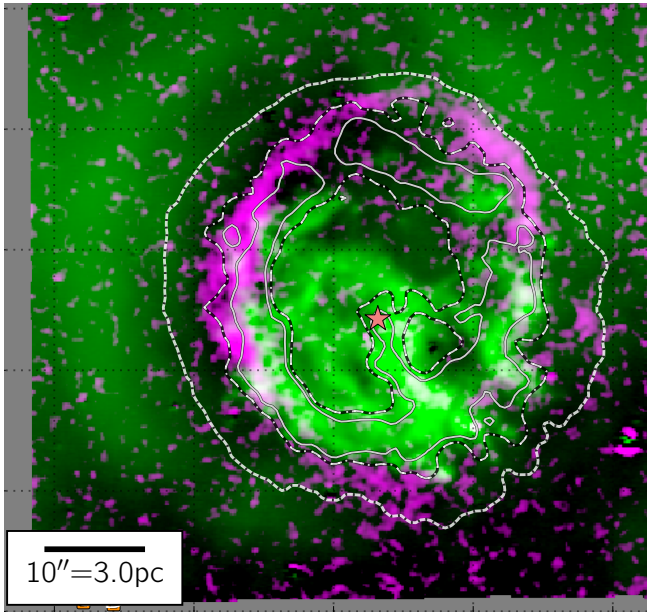

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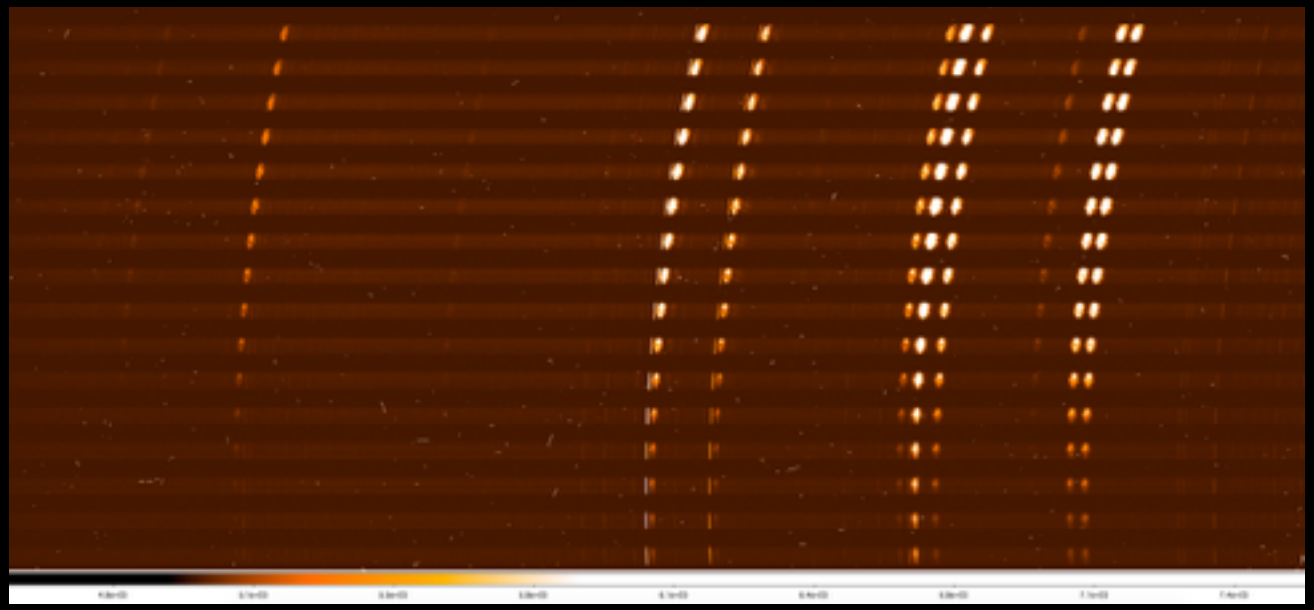
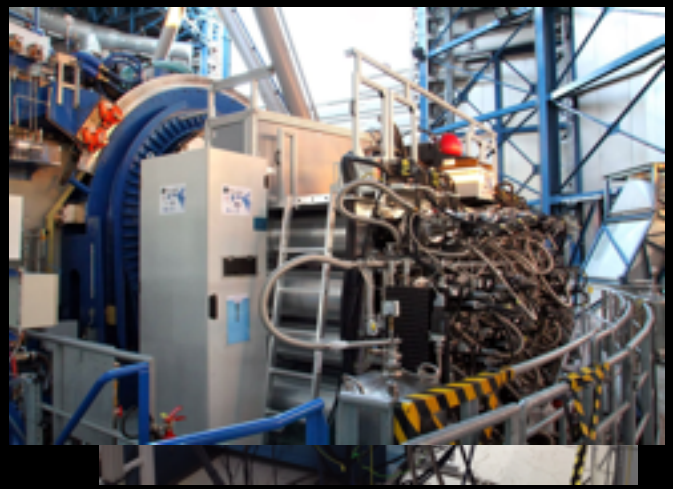
Ashley Ruiter (ANU)
Parviz Ghavamian (Towson U)
Tuguldur Sukhbold (OSU)

Australian Government
Australian Research Council

Integral field spectroscopy of SNRs





Multi Unit Spectroscopic Explorer (MUSE)

ESO Very Large Telescope (VLT)

Wide Field Spectrograph (WiFeS)

(Siding Spring Observatory)

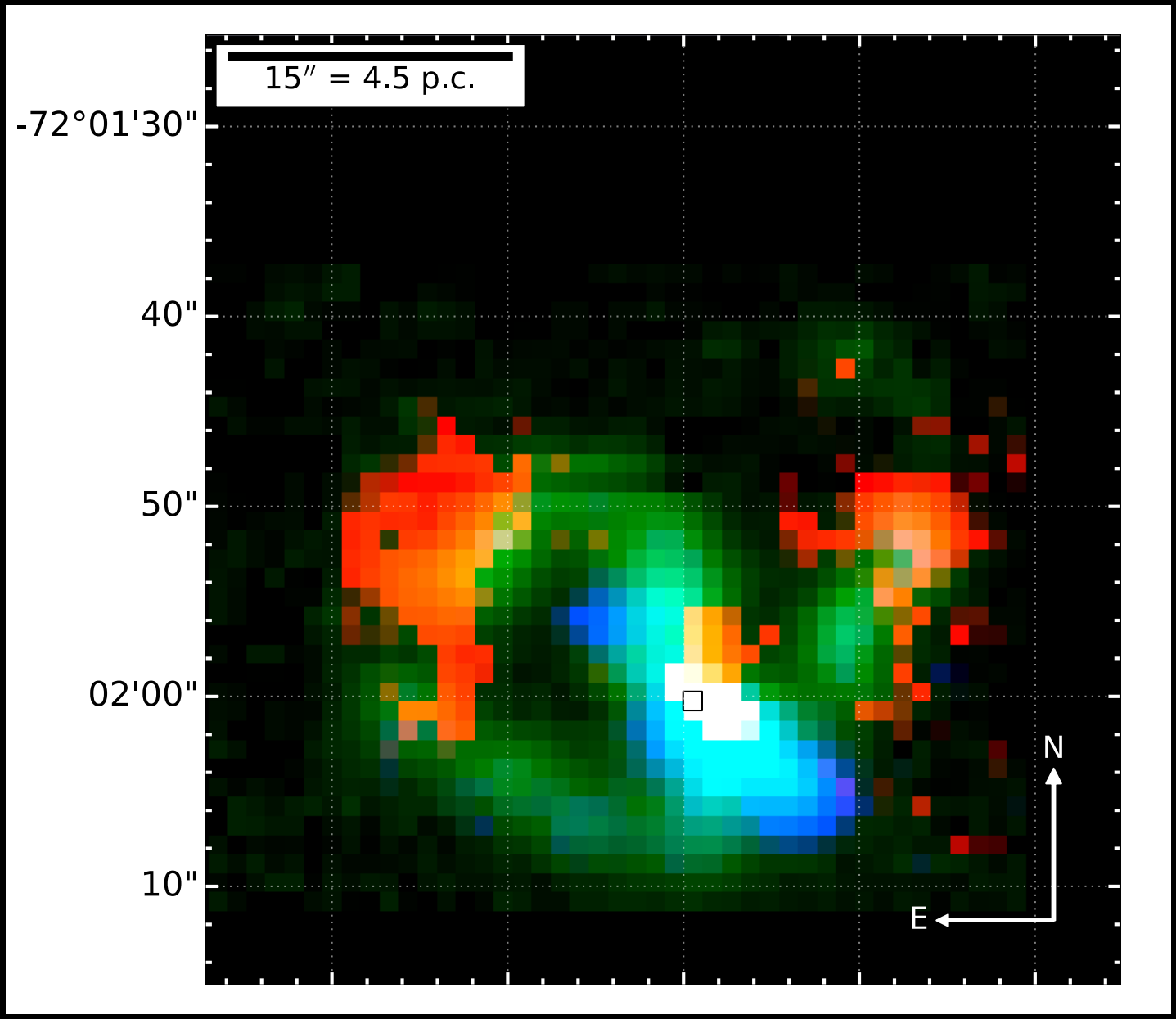
Introduction

- Young (~< 3000 yr), “Oxygen-rich” SNRs are unique to study emission of ejecta in the optical
- Few such SNRs known, including Cas A, Pup A, G292.0+1.8 in the Milky Way, N132D and 0540-69.3 (“Fe-rich”) in the LMC and 1E 0102.2-7219 in the SMC
- Until now no products of O-burning found in 1E 0102
- Integral field spectroscopy to tease out low-surface brightness line emission from fast moving ejecta

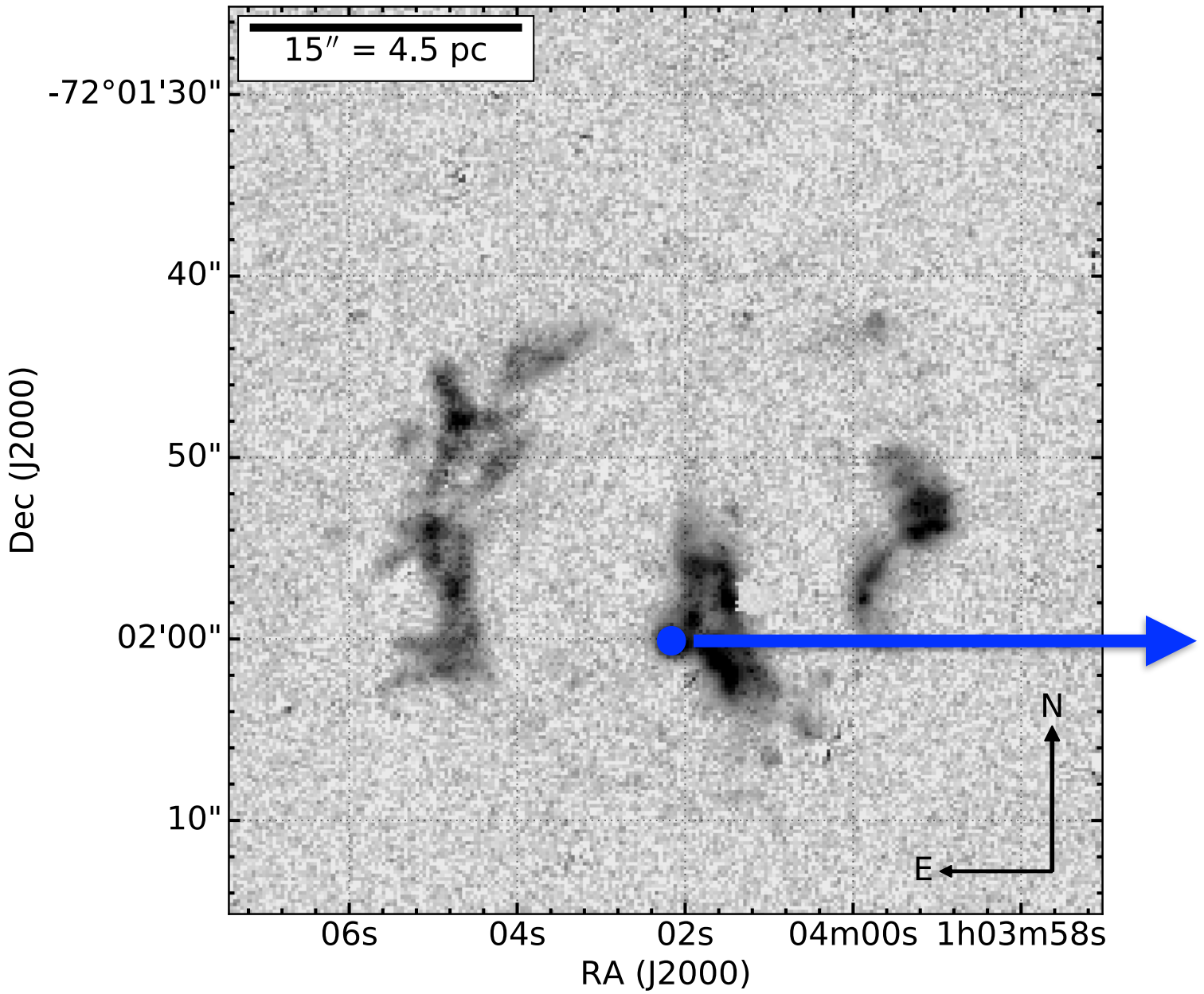
Show 3D model

Discovery of the products of O-burning in the ejecta of 1E0102

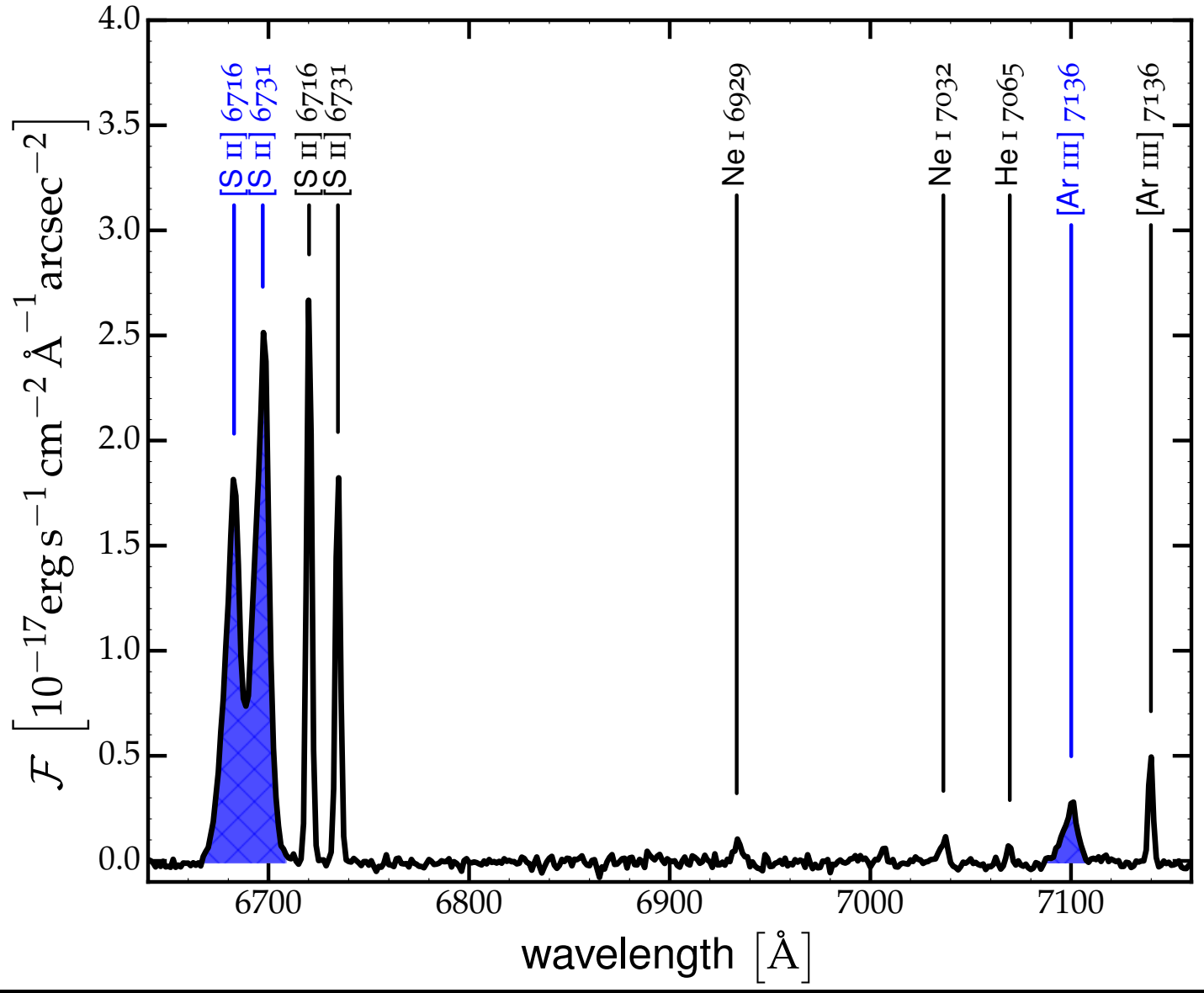
Discovery of [S II] with WiFeS



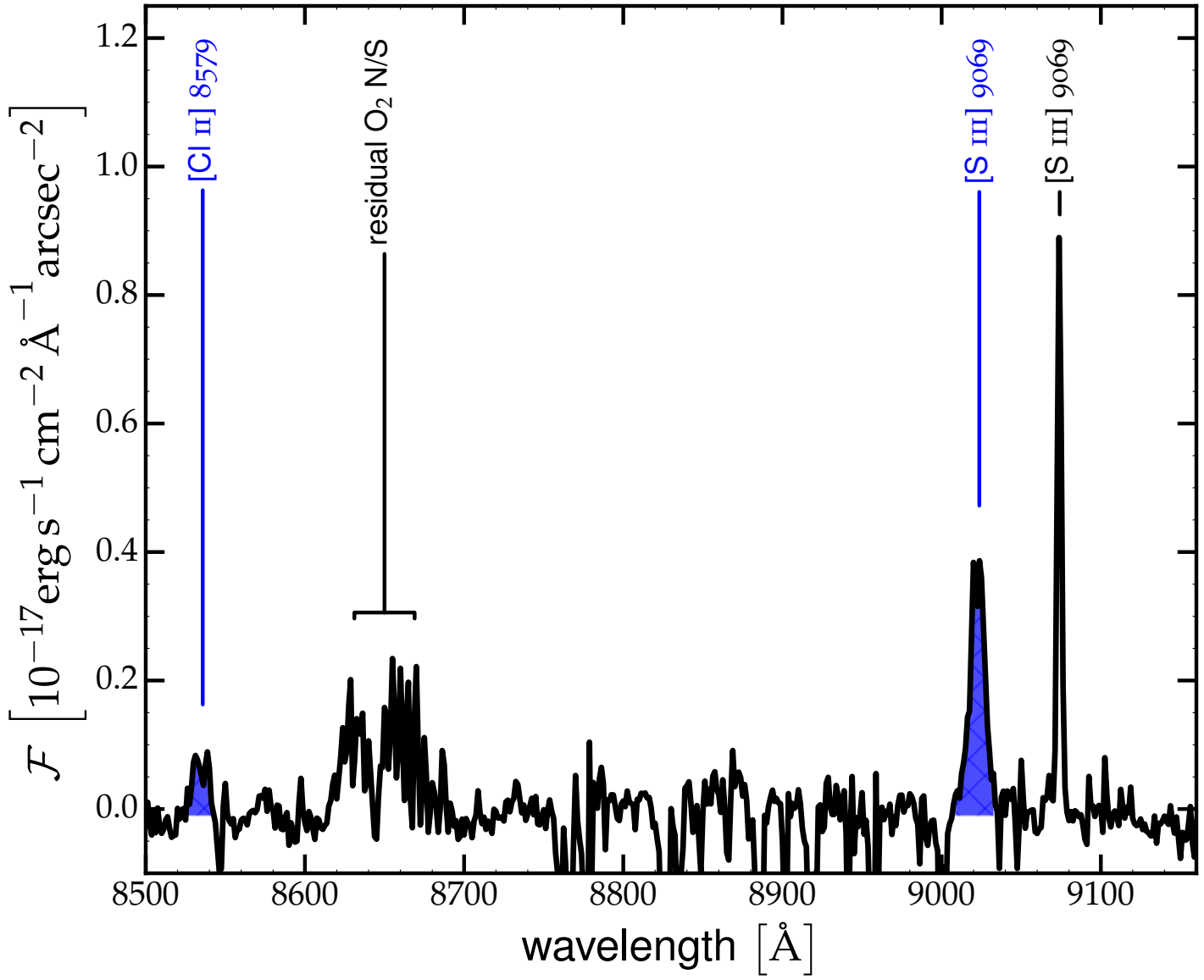
MUSE: fitted red- and blue-shifted [S II]

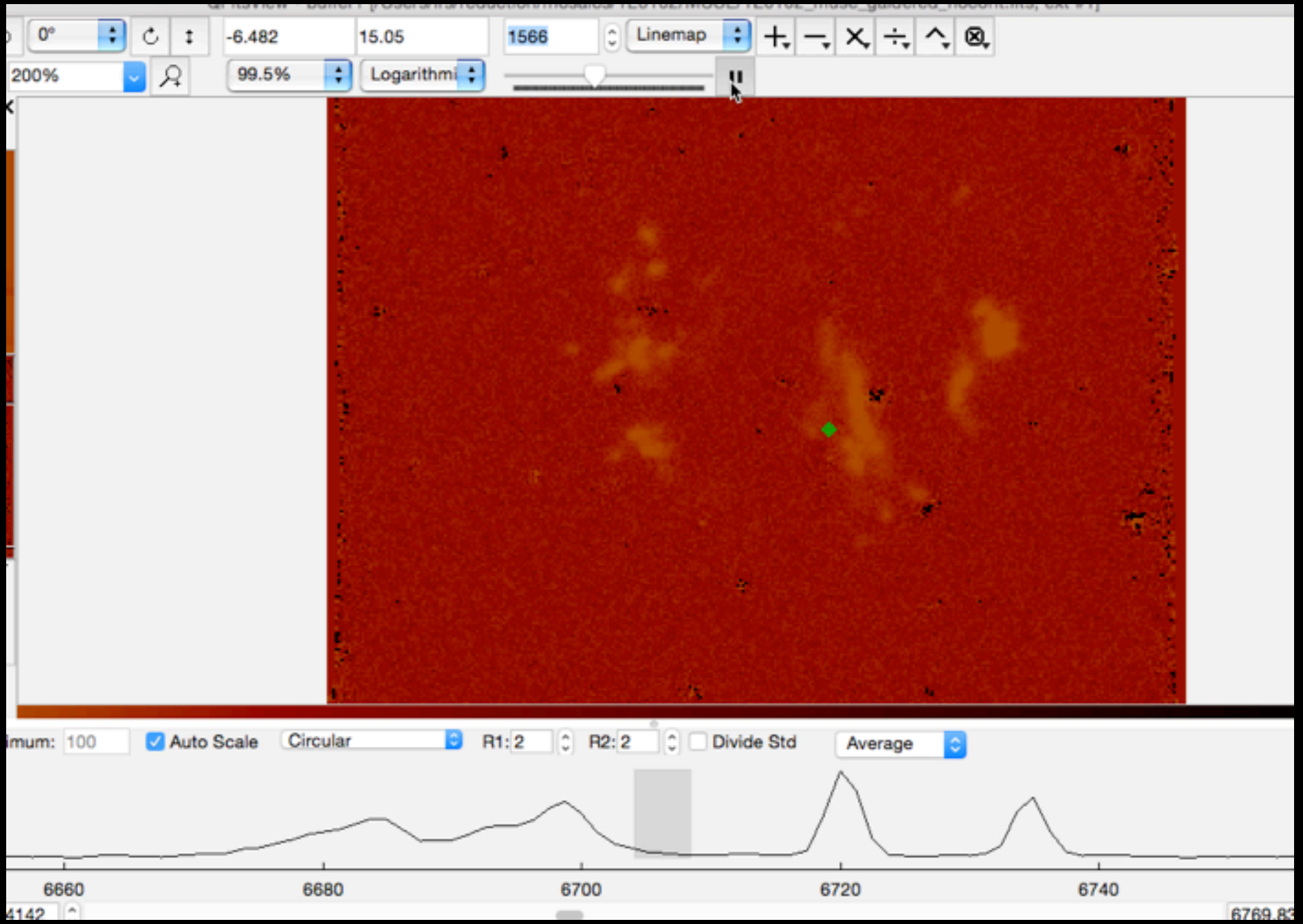


~1650 km/s blue shifted ejecta component



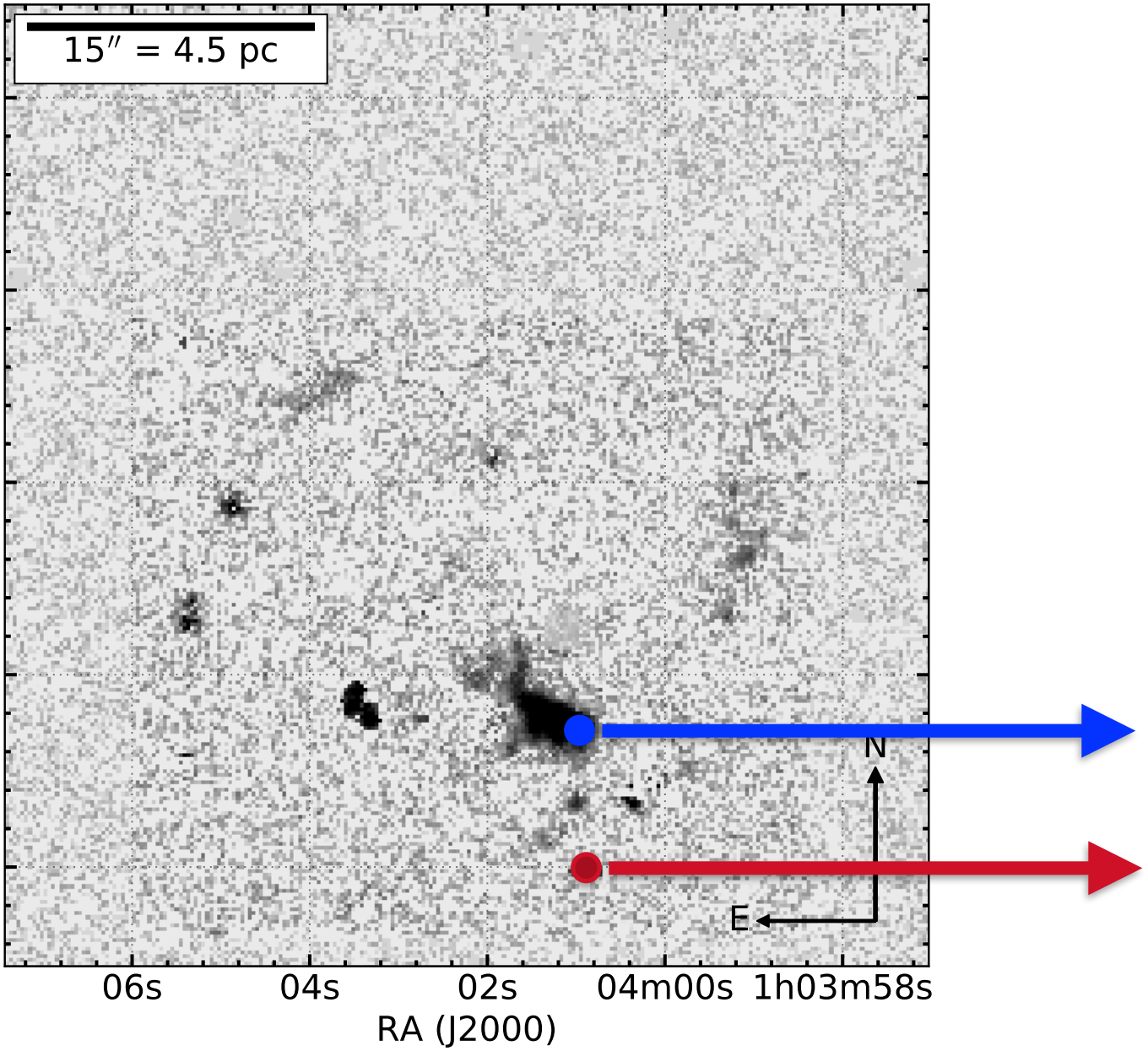
~1650 km/s blue shifted ejecta component

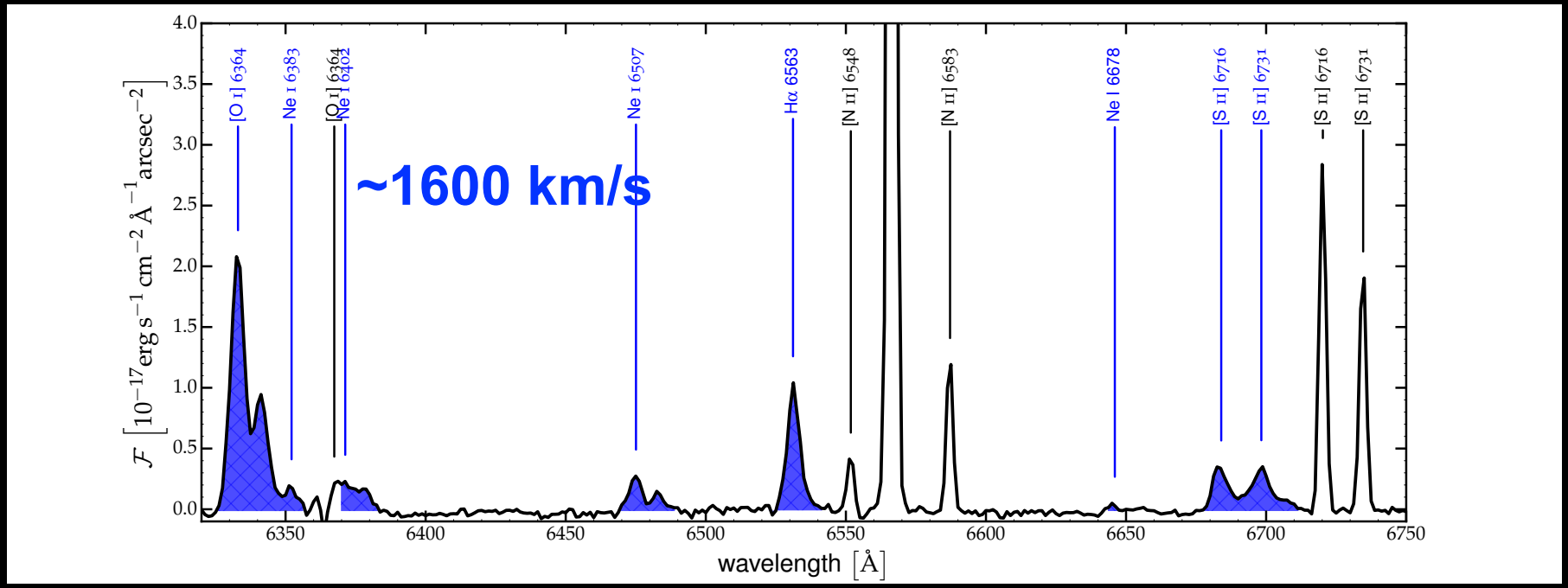


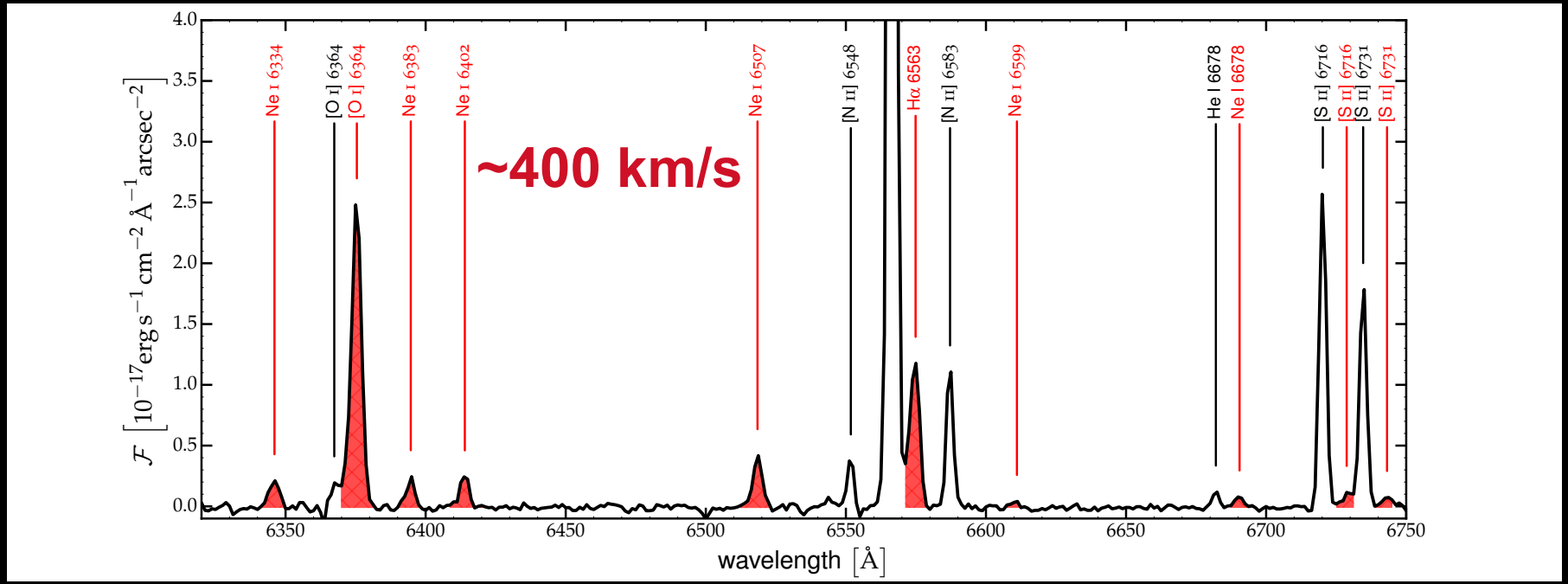

0°
-6.482
15.05
1566
Linemap
200%
99.5%
Logarithmi
Auto Scale
Circular
R1: 2
R2: 2
Divide Std
Average
6660
6680
6700
6720
6740

Hydrogen

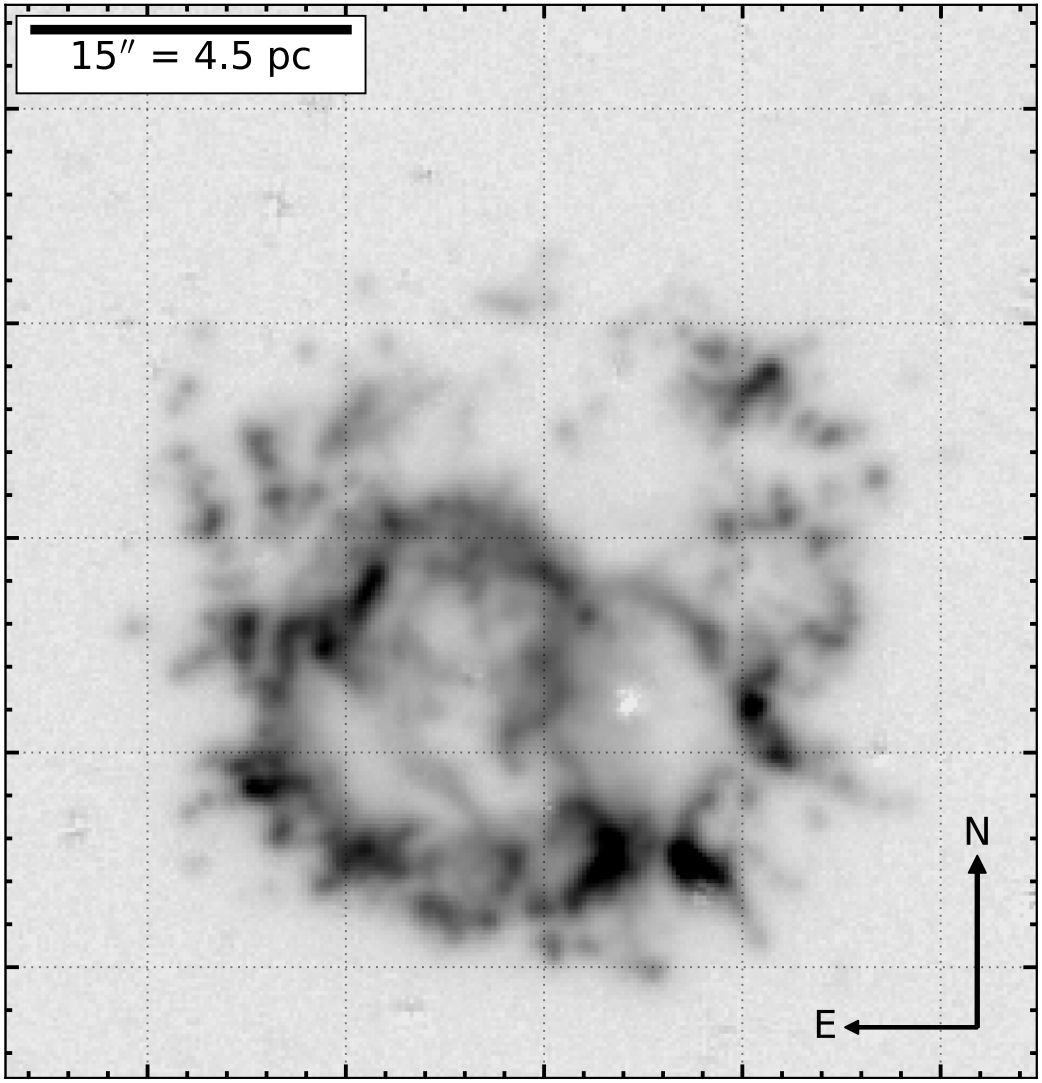
Fitted red- and blue-shifted H-alpha

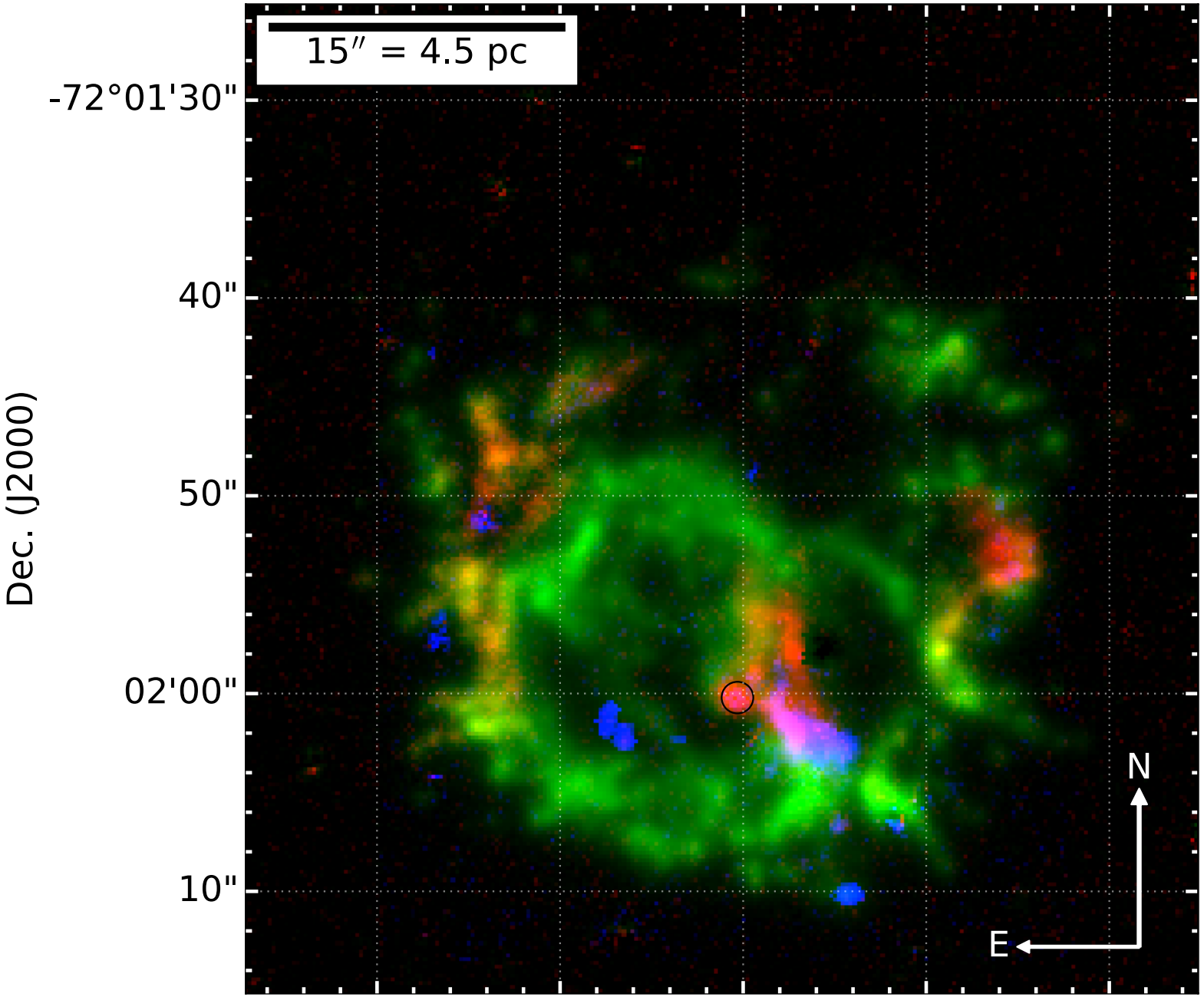



~1600 km/s
[O I] 6364
Ne I 6383
[O I] 6364
Ne I 6402
Ne I 6507
Hα 6563
[N II] 6548
[N II] 6583
Ne I 6678
[S II] 6716
[S II] 6731
[S II] 6716
[S II] 6731
wavelength [Å]


~400 km/s
Ne I 6334
[O I] 6364
[O I] 6364
Ne I 6383
Ne I 6402
Ne I 6507
[N II] 6548
Hα 6563
[N II] 6583
Ne I 6599
He I 6678
Ne I 6678
[S II] 6716
[S II] 6716
[S II] 6731
[S II] 6731
wavelength [Å]

[O III] 5007



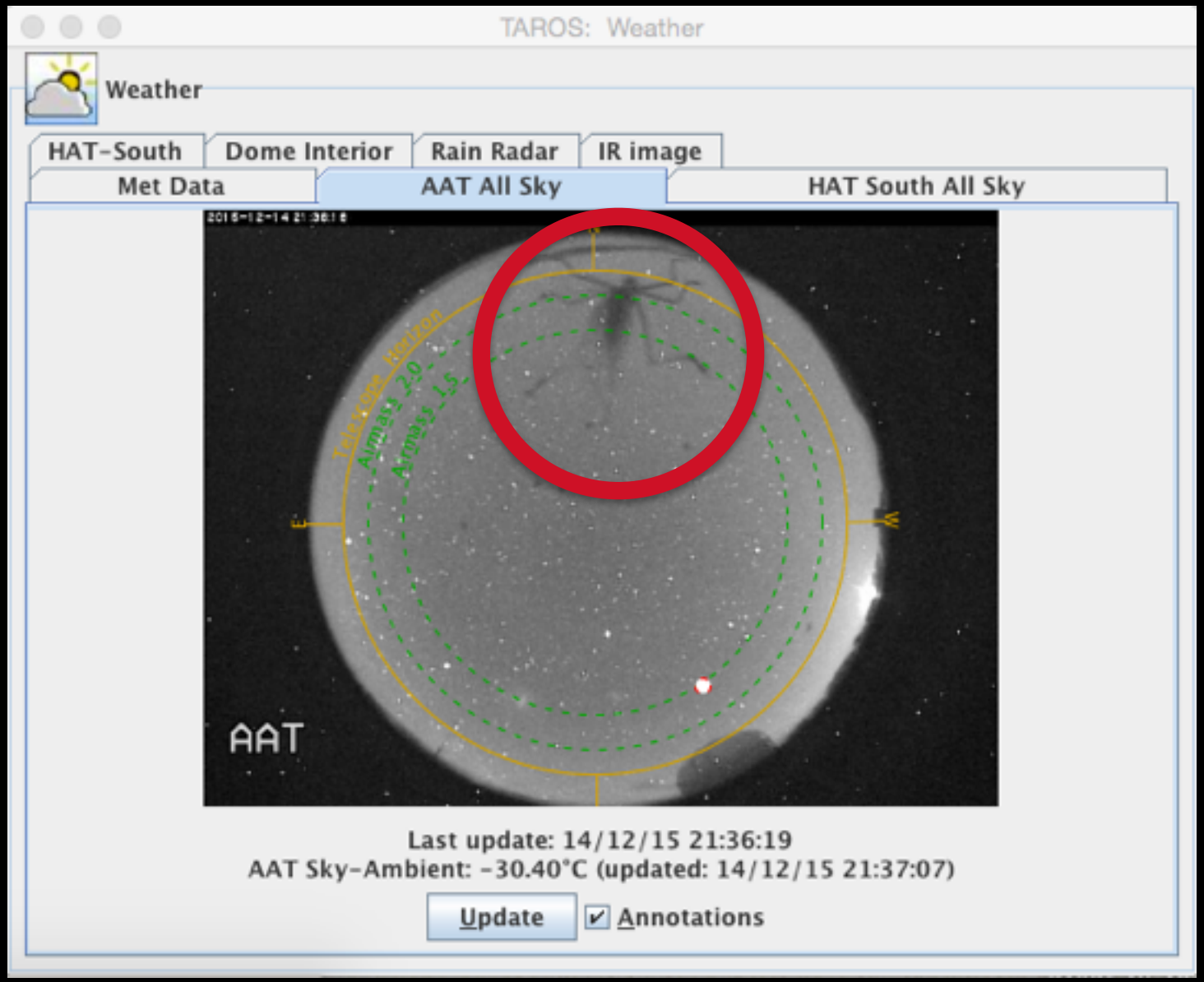

15″ = 4.5 pc
-72°01'30"
40"
50"
02'00"
10"
Dec. (J2000)
N
E

line	wavelength [Å]	$\mathcal{R}_{\rm observed}$	$\mathcal{R}_{\rm model}$	rel. abundance
H	4861	0.062	0.045	1.0
	6563	0.2	–	...
O I	7774	0.64	0.7	57.5
	8446	0.093	0.4	...
	9263	0.24	–	...
[O I]	5577	0.1	0.04	...
	6300	4.6	2.5	...
	6364	1.4	0.9	...
[O II]	3726	104	–	...
	3728	83.8	–	...
	7319	1.1	2	...
	7330	2.3	–	...
[O III]	4363	3.6	–	...
	4959	32.4	–	...
	5007	100	100	...
[Ne III]	3869	17.5	20	57.5
	3967	6.1	–	...
[S II]	6717	2.78	0.92	0.158
	6731	3.75	0.66	...
[S III]	9069	0.67	0.59	...
[Ar III]	7136	0.34	0.23	0.04
[Cl II]	8579	0.13	–	–

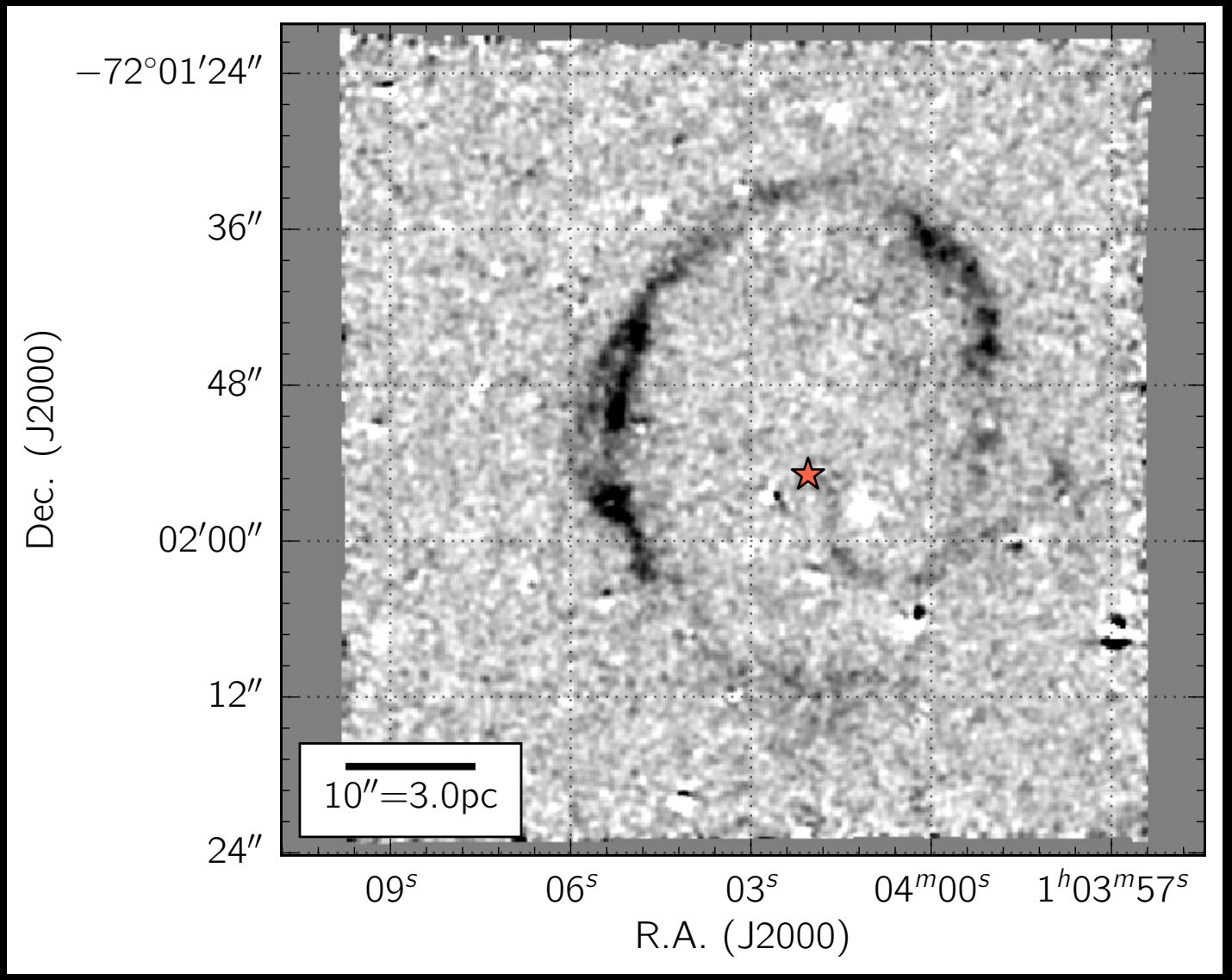
very preliminary

More things…

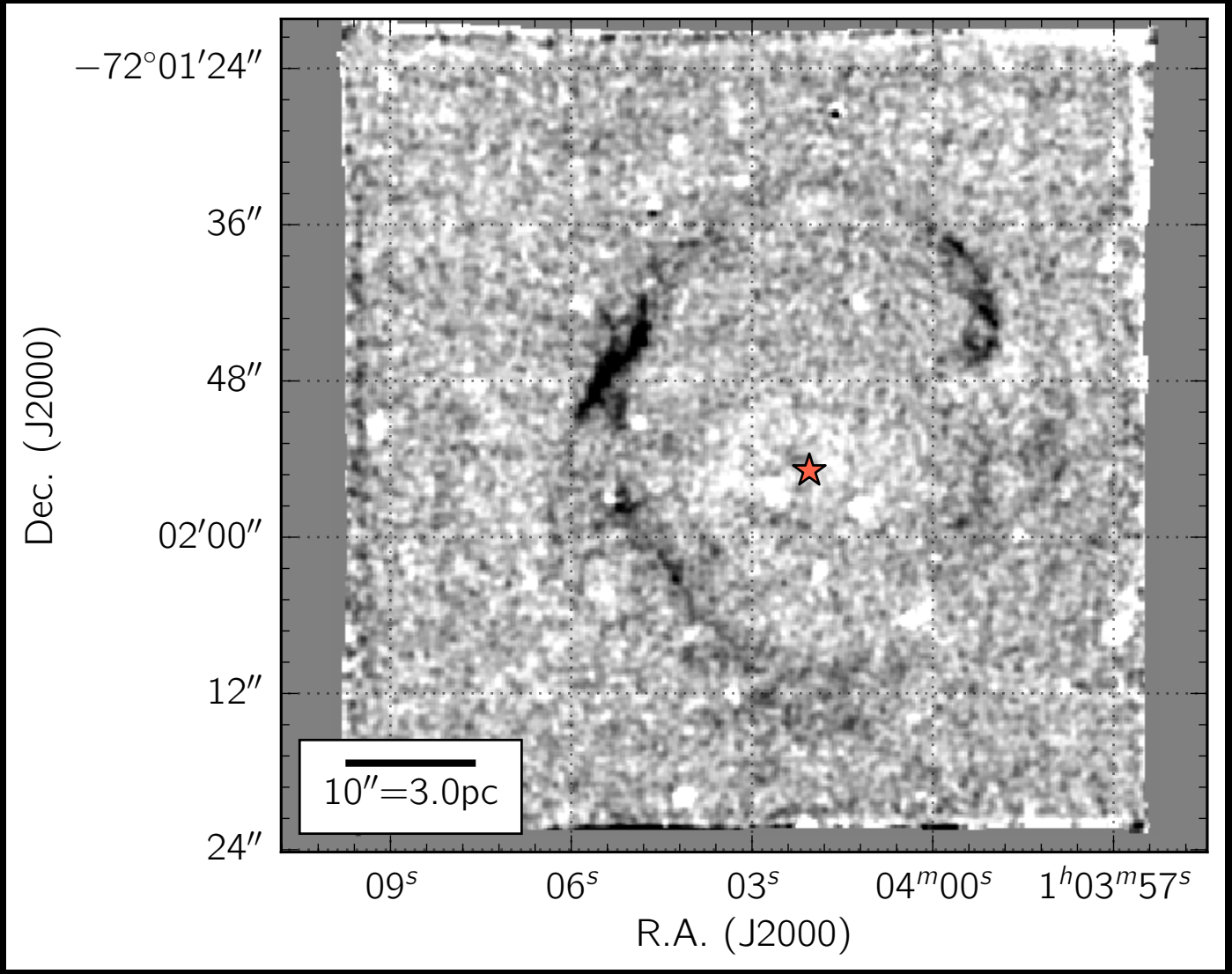
Aliens!?!


TAROS: Weather
Weather
HAT-South
Dome Interior
Rain Radar
IR image
Met Data
AAT All Sky
HAT South All Sky
AAT
Last update: 14/12/15 21:36:19
AAT Sky-Ambient: -30.40°C (updated: 14/12/15 21:37:07)
Update
Annotations

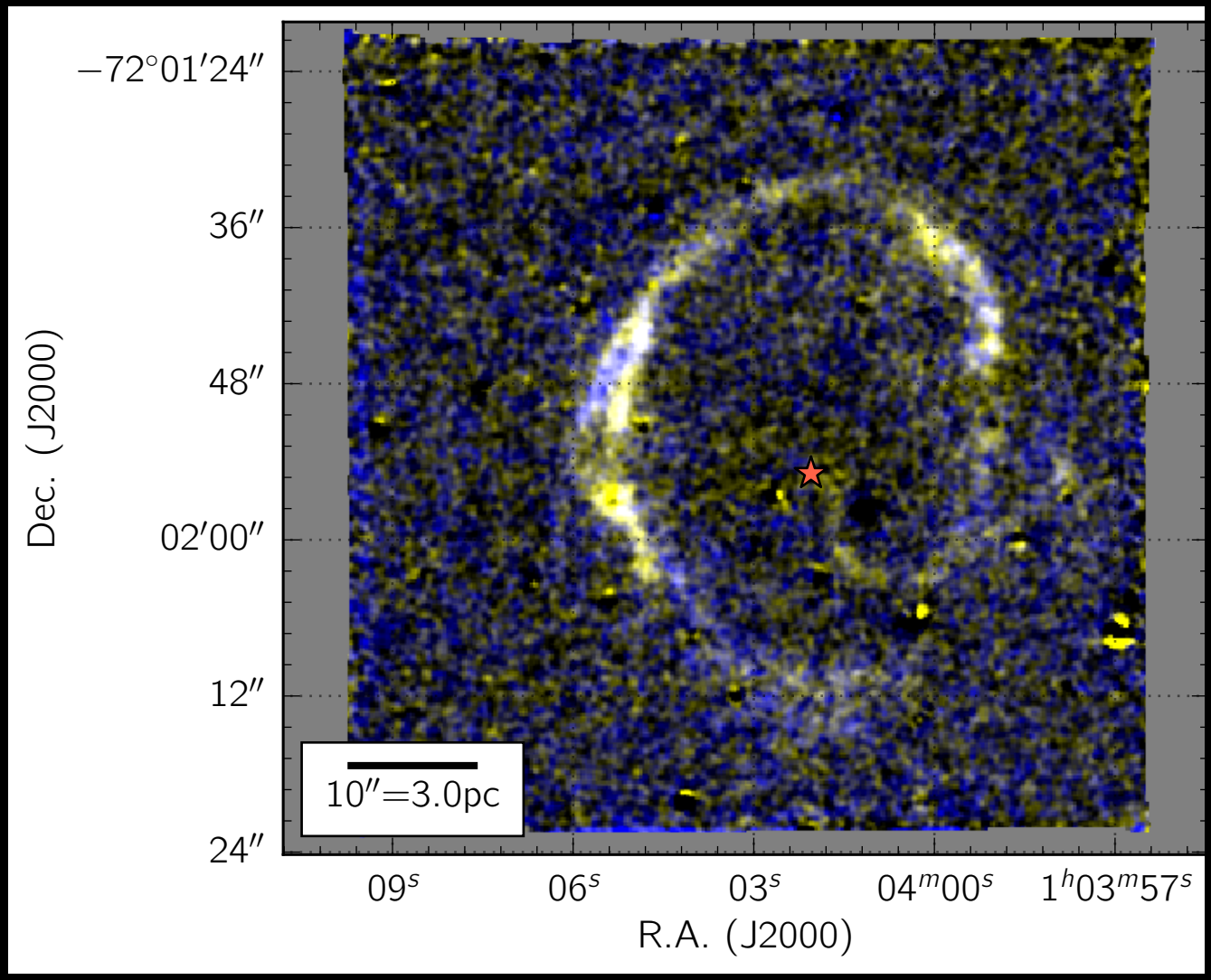
[Fe XIV] 5303

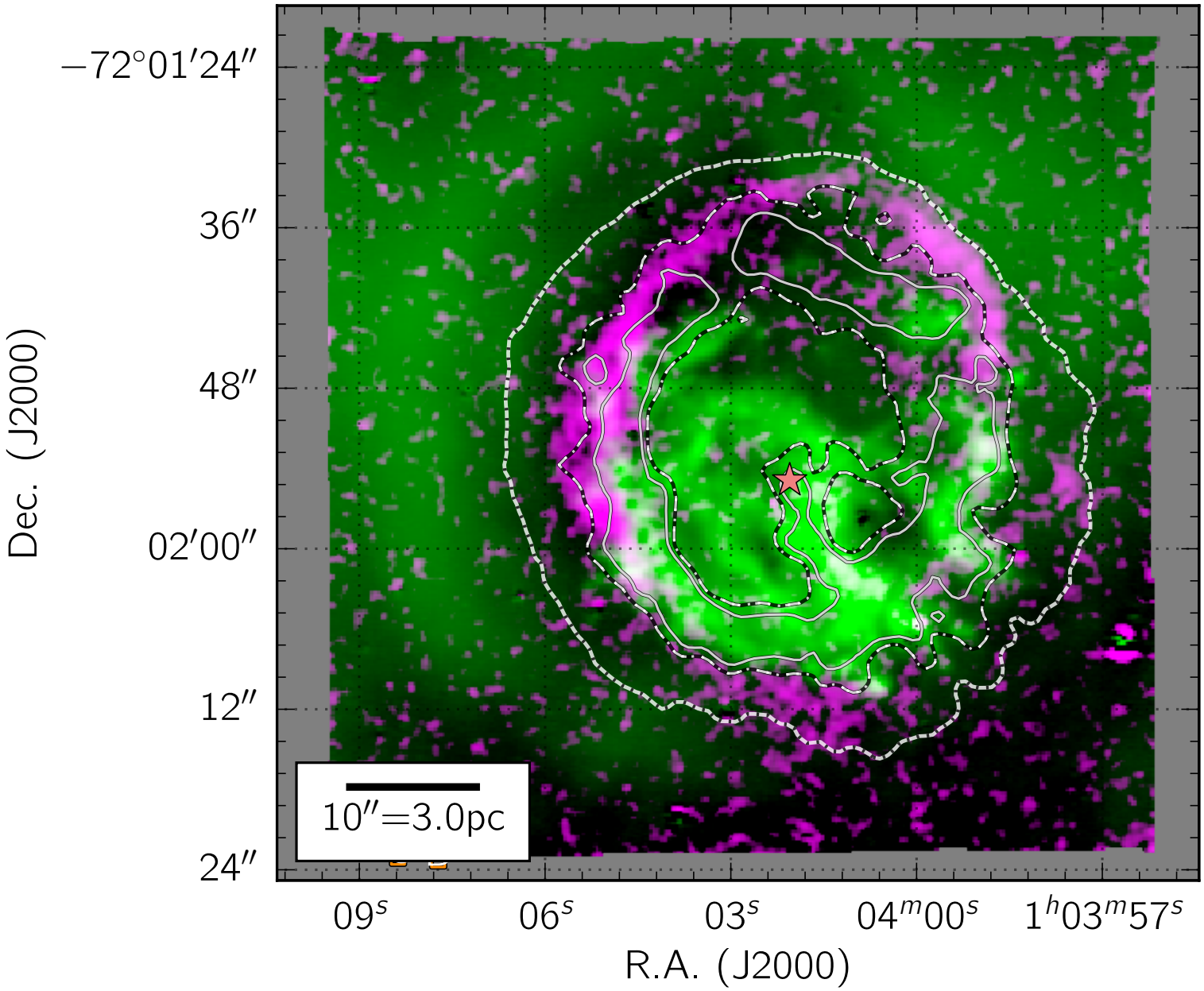

−72°01′24″
36″
48″
02′00″
12″
24″
Dec. (J2000)
10″=3.0pc
09s
06s
03s
04m00s
1h03m57s
R.A. (J2000)

[Fe XI] 7892

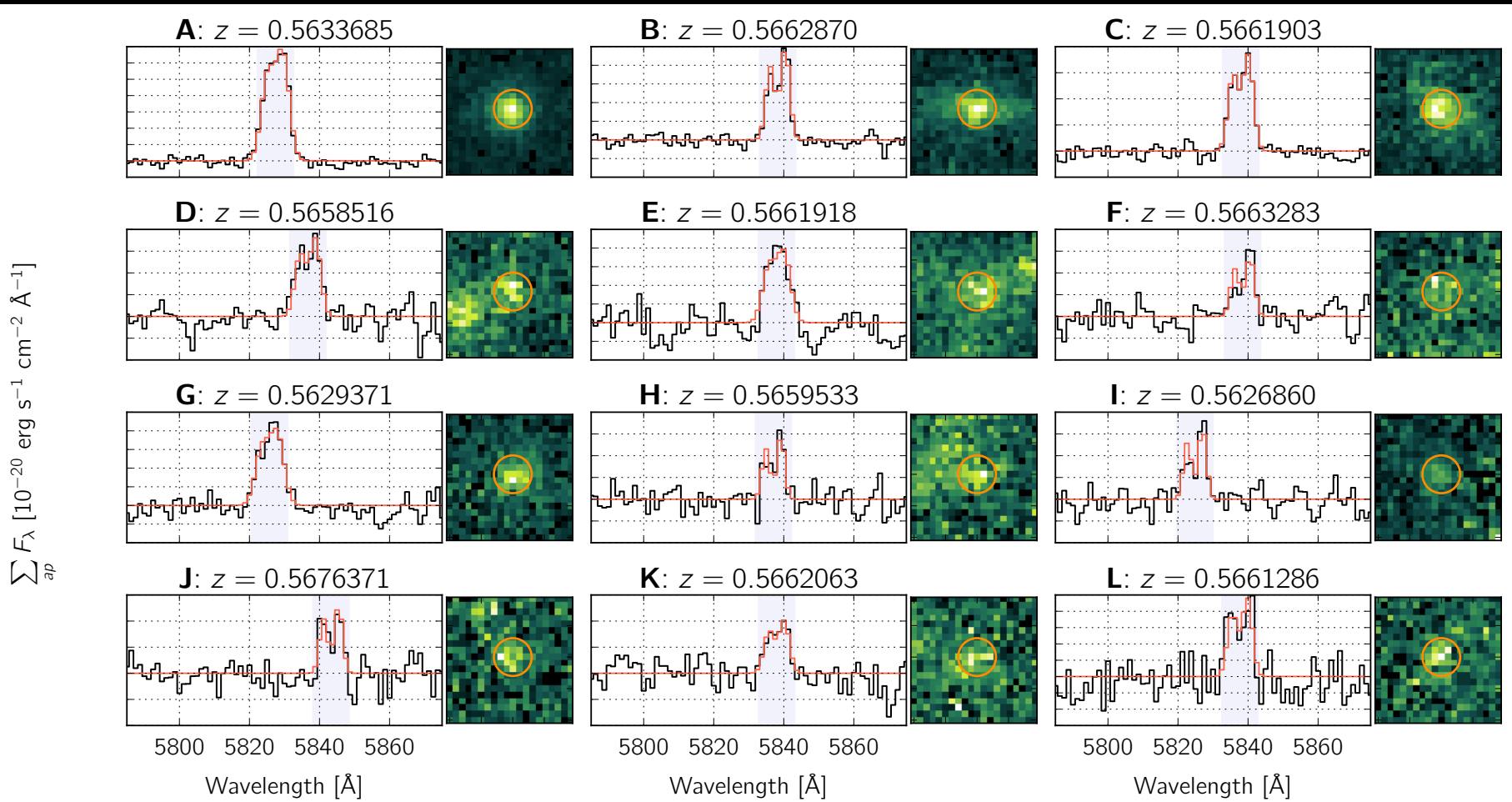

−72°01′24″
36″
48″
02′00″
12″
24″
Dec. (J2000)
10″=3.0pc
09^s
06^s
03^s
04^m00^s
1^h03^m57^s
R.A. (J2000)

[Fe XI] 7892


−72°01′24″
36″
48″
02′00″
12″
24″
Dec. (J2000)
10″=3.0pc
09s
06s
03s
04m00s
1h03m57s
R.A. (J2000)


−72°01′24″
36″
48″
02′00″
12″
24″
Dec. (J2000)
09^s
06^s
03^s
04^m00^s
1^h03^m57^s
R.A. (J2000)
10″=3.0pc

z=0.566 galaxy cluster



Summary

- **Fast moving (ejecta) S, Ar, Cl in SNR 1E 0102.2-7219**
- **Products of explosive O-burning appear more asymmetric than products of explosive C-burning**
- **Fast moving H, but no N detected (low Z effect?)**
- **Can provide to theorists/modellers 3D model of emission, assuming free, radial expansion**
- **Progenitor of 1E0102 probably a Type IIb CC SN** (just like Cas A, Pup A)