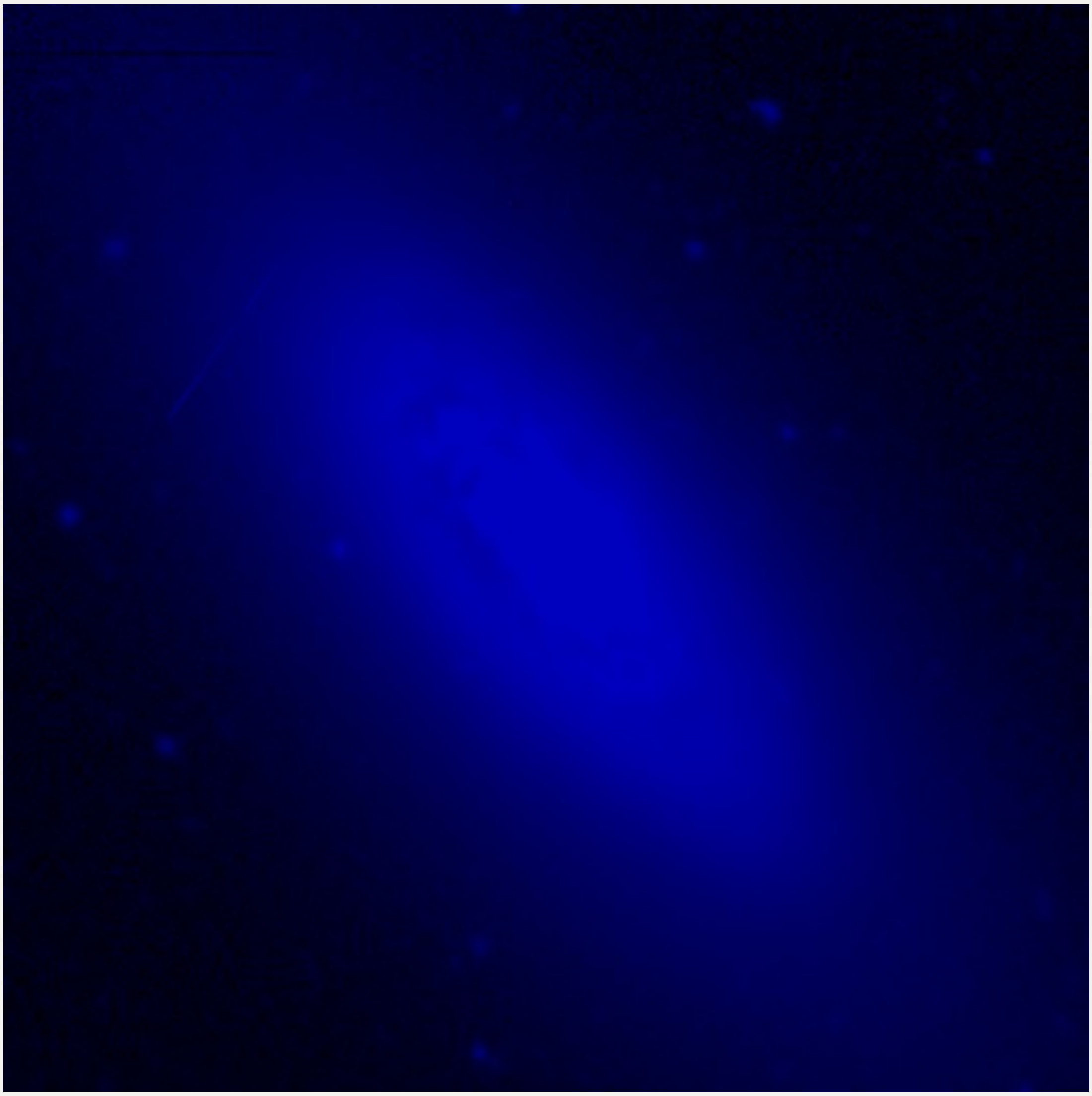
# 20250416 Stellar Mass Map

## IC3392

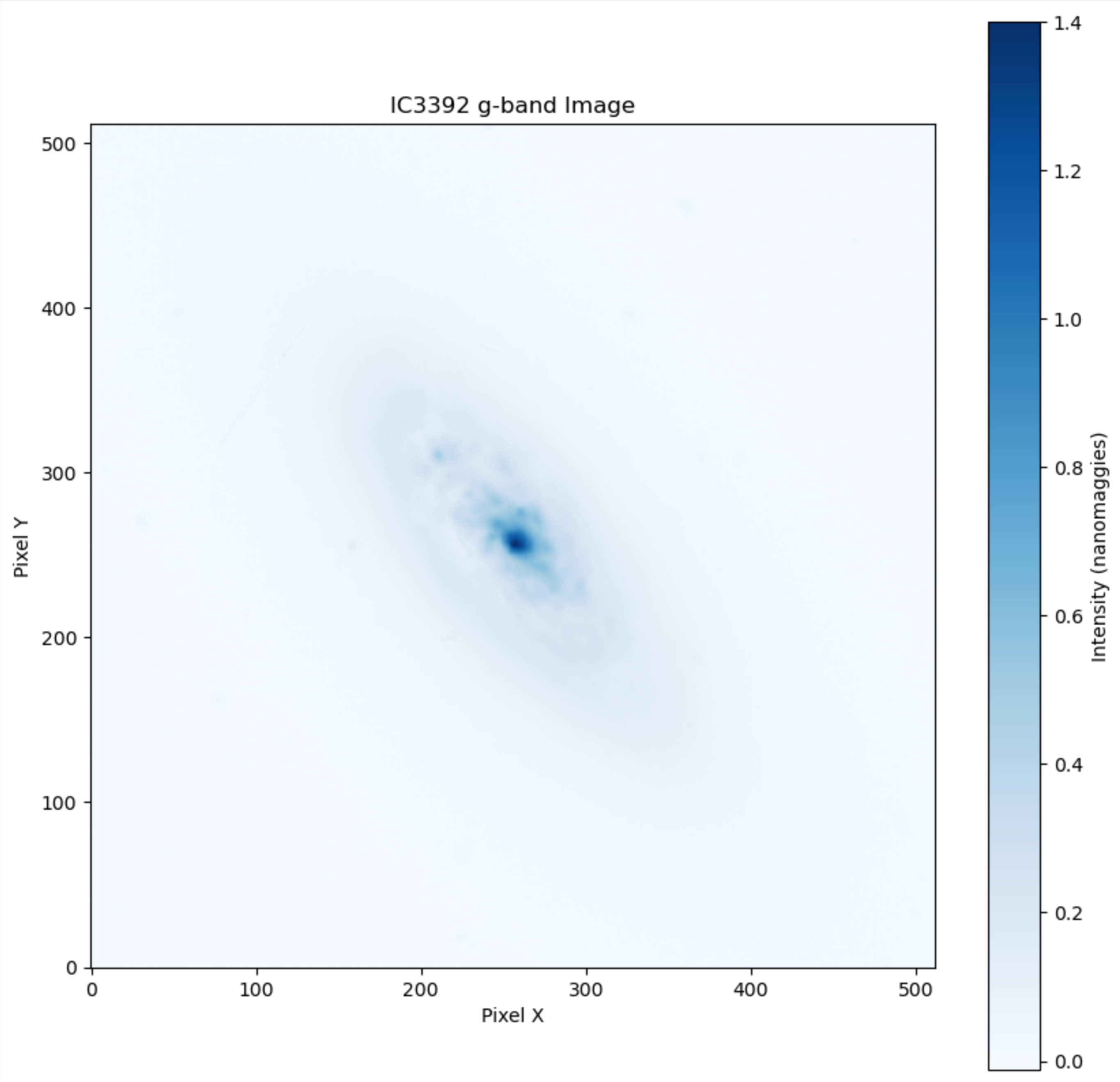
coordiate query by NOIRlab https://astroarchive.noirlab.edu/portal/search/

https://www.legacysurvey.org/viewer/jpeg-cutout?ra=187.18031864729997&dec=14.99943425062&layer=ls-dr10&pixscale=0.262&size=512&bands=g



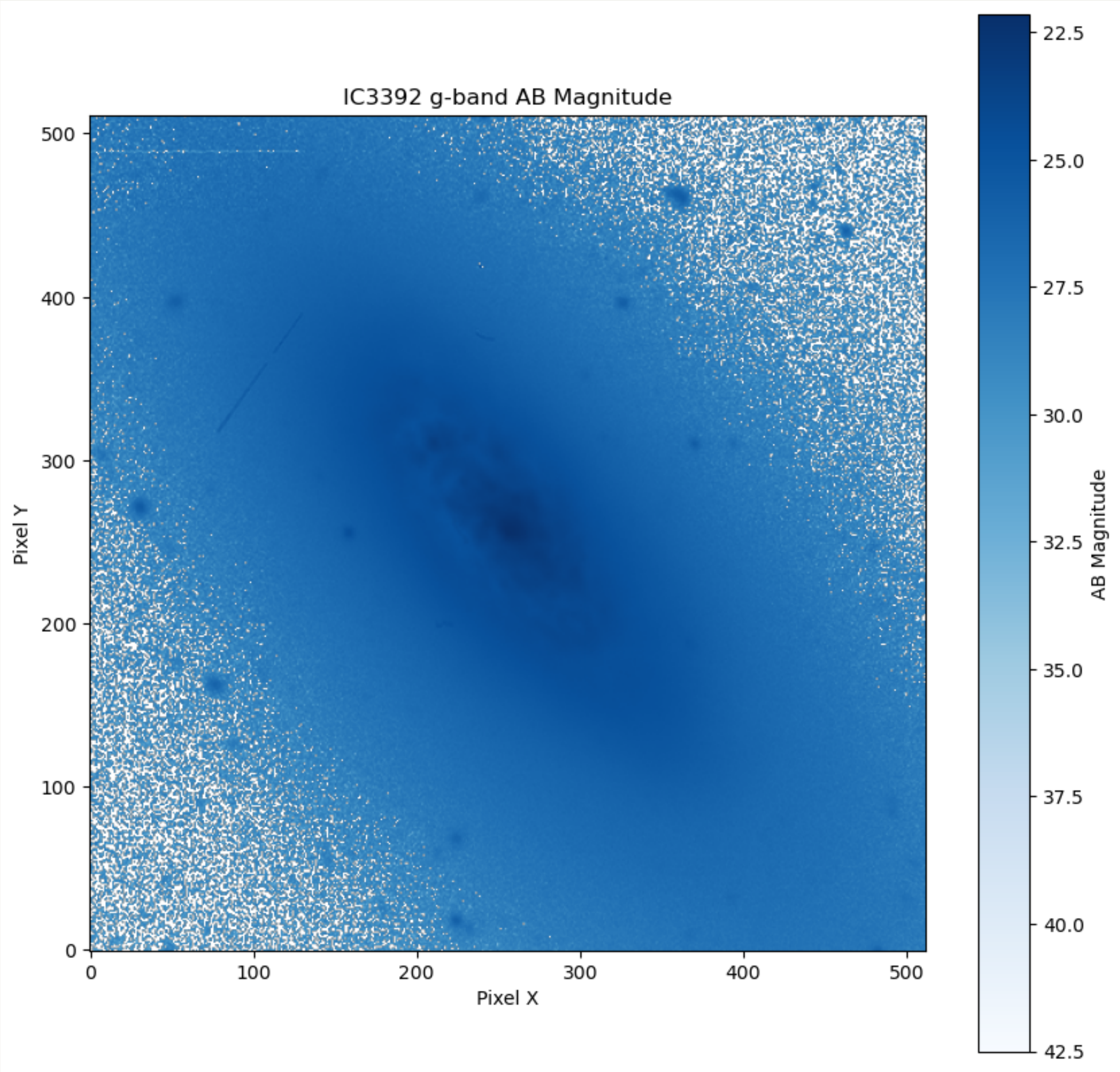
wget "https://www.legacysurvey.org/viewer/fits-cutout?ra=187.18031864729997&dec=14.99943425062&layer=ls-dr10&pixscale=0.262&bands=gi&size=512" -O IC3392_DESI_gi.fits

I extract `.fits` file and check the g band image first:

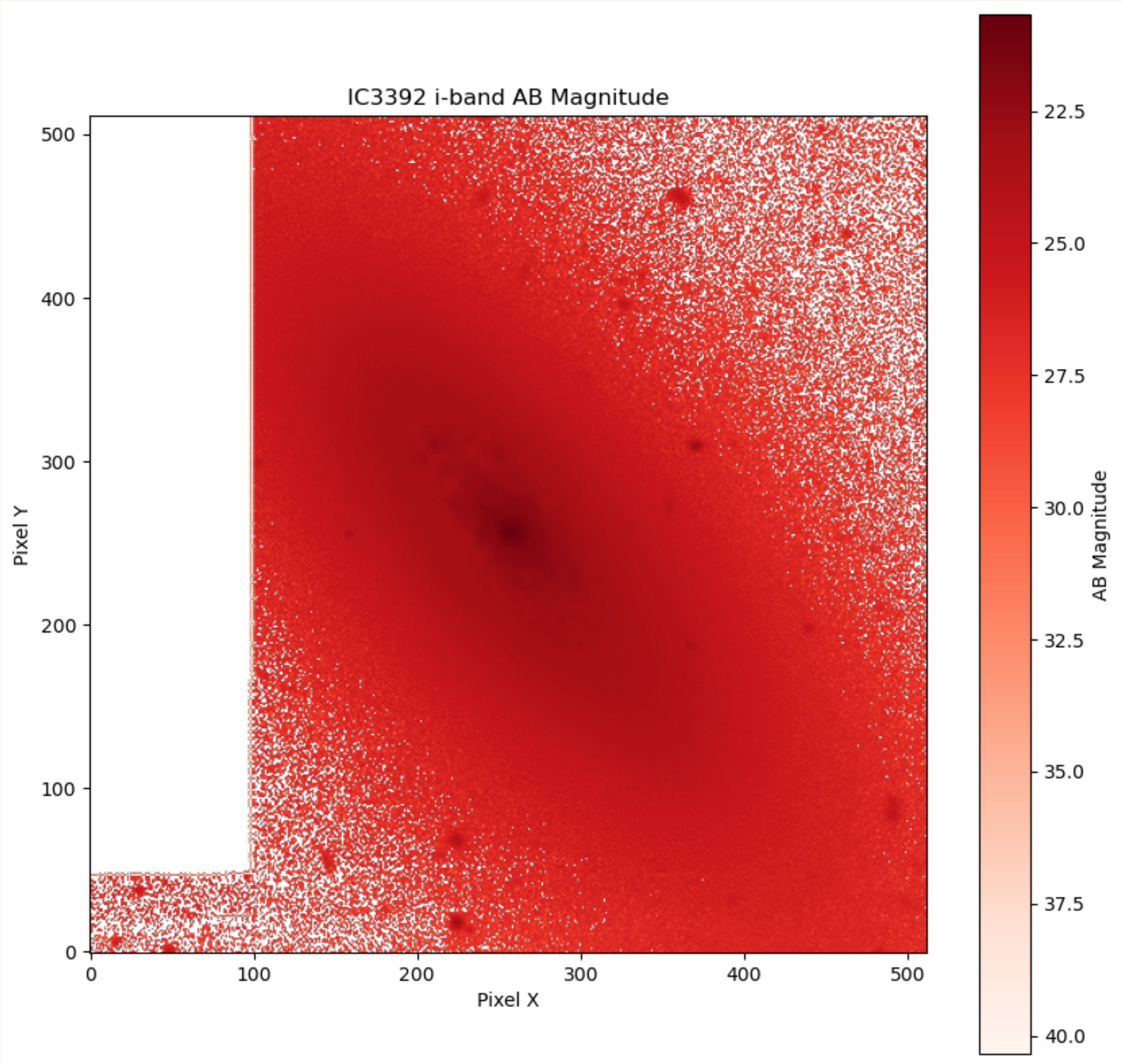



According to the DESI DR10 document, https://www.legacysurvey.org/dr10/description/, the brightnesses of objects are all stored as linear fluxes in units of nanomaggies. The conversion from linear fluxes to magnitudes is $m = 22.5 - 2.5\log_{10}(flux)$.

Then i convert nanomaggies to AB magnitude:




Similarly, I can do for i band:

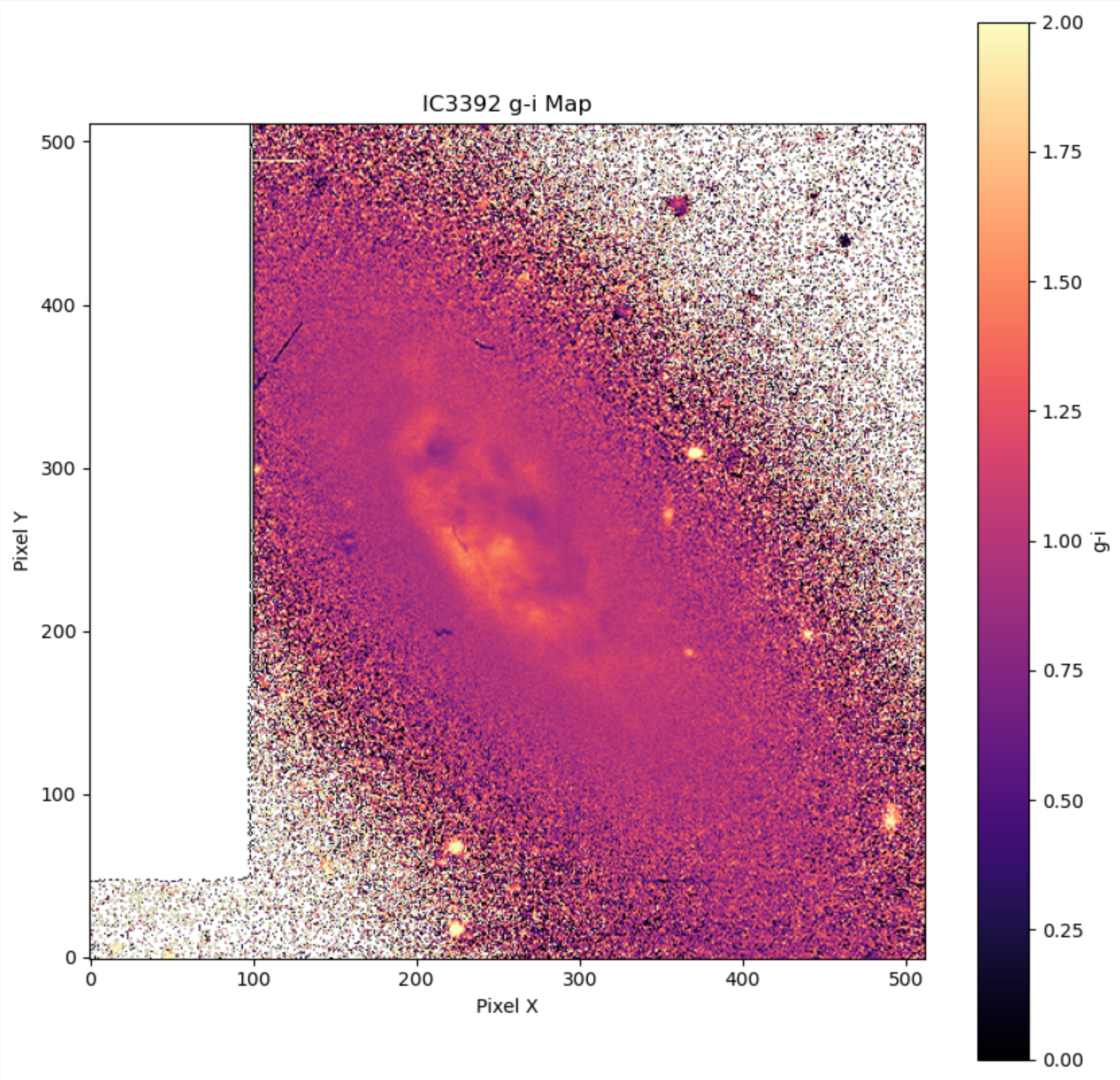



The blank rectangle area is `nan` data (negative flux).

In Taylor+2011 (https://academic.oup.com/mnras/article/418/3/1587/1060932#91710255), they purpose an empirical relation between (*g*−*i*) colour, *i*-band luminosity and stellar mass as:

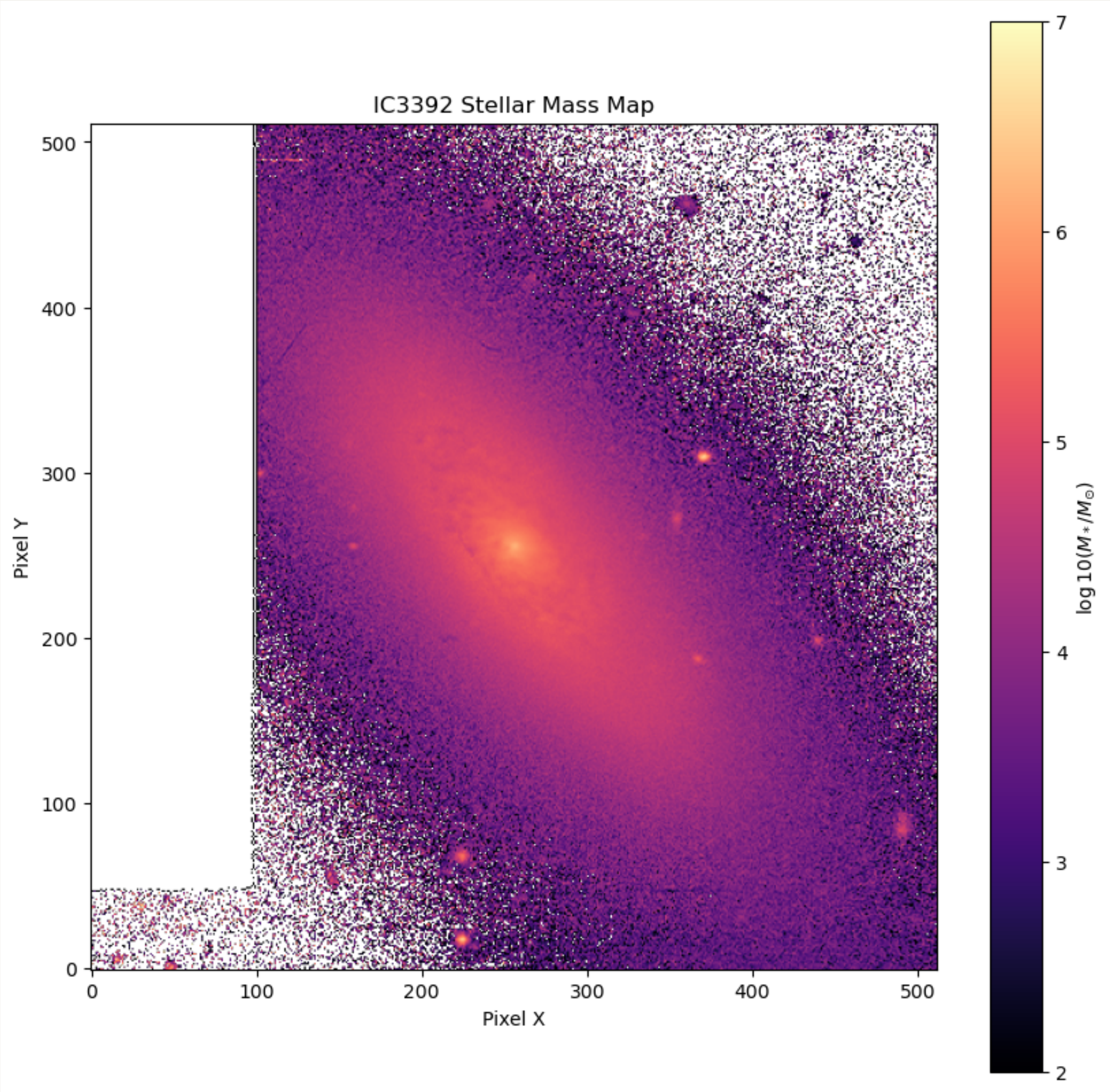
log(M_*/M_sun) = 1.15+0.7(g-i)-0.4M_i, where M_i is the absolute magnitude in the restframe i-band, expressed in the AB system.

Here is the g-i color map:




The distance I use to calculate absolute i band magnitude is 13.63Mpc from Soria+2021: https://academic.oup.com/mnras/article/512/3/3284/6517474. It is a median redshift-independent distance from NED, and standard deviation of the published values.

Now i can derive the stellar mass map, and then sum up to get total stellar mass in solar masses: 4.41e+11, or log10(11.64).



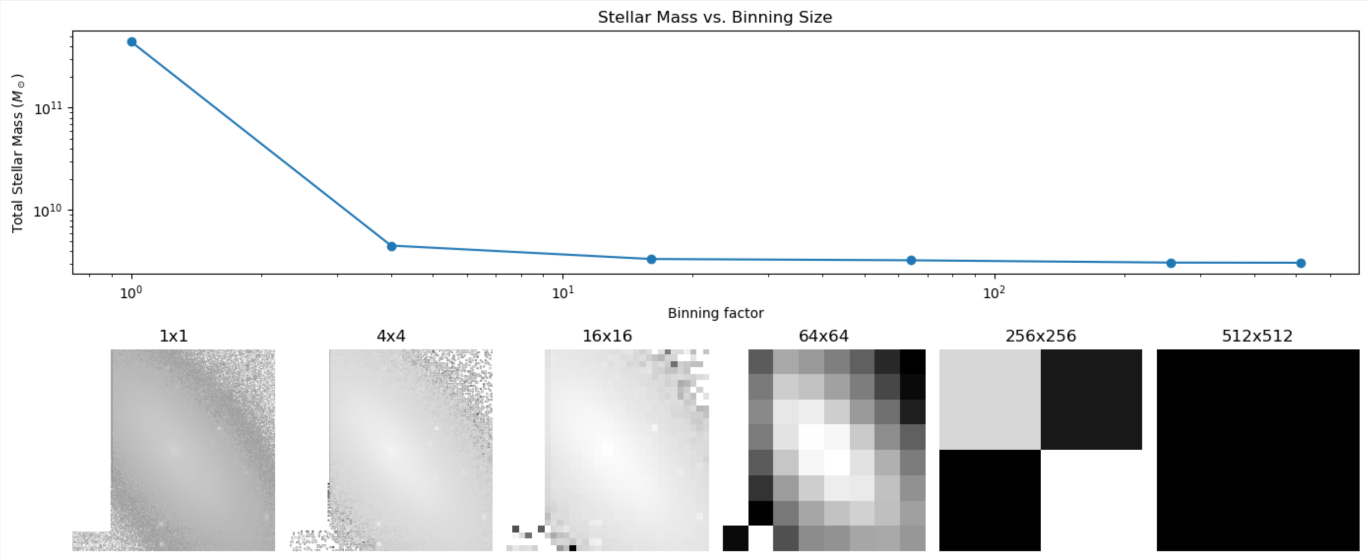

Alternatively, I estimate the stellar mass by intergrating g and i band flux first. In this case, I have total stellar mass (integrated flux): 3.10e+09, or log10(9.49) solar masses, which is quite different from the previous method.

My understanding is that,

1. mathematically, the convertion formula is non-linear, which means $\sum_i M(Flux_i) \neq M(\sum_i Flux_i)$;
2. this empirical relation is calibrated by the total magnitude from the galaxy

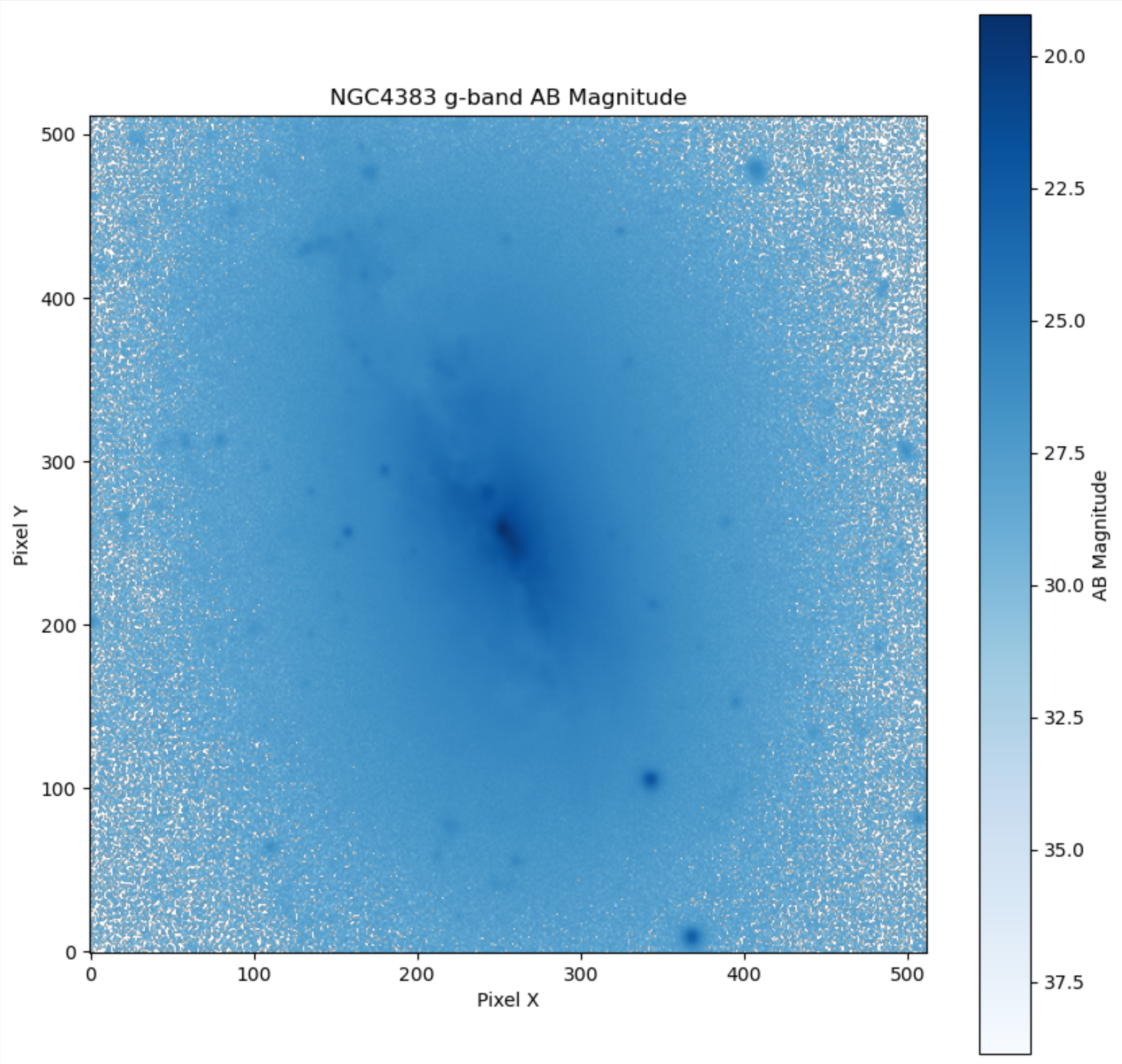
3. when we calcualte the flux from a single pixel, we actually include the flux emitted from adjacent pixels, and so integrating pixel-by-pixel leads to overestimated total magnitude, and thus much higher stellar mass in this case. It is a binning effect.

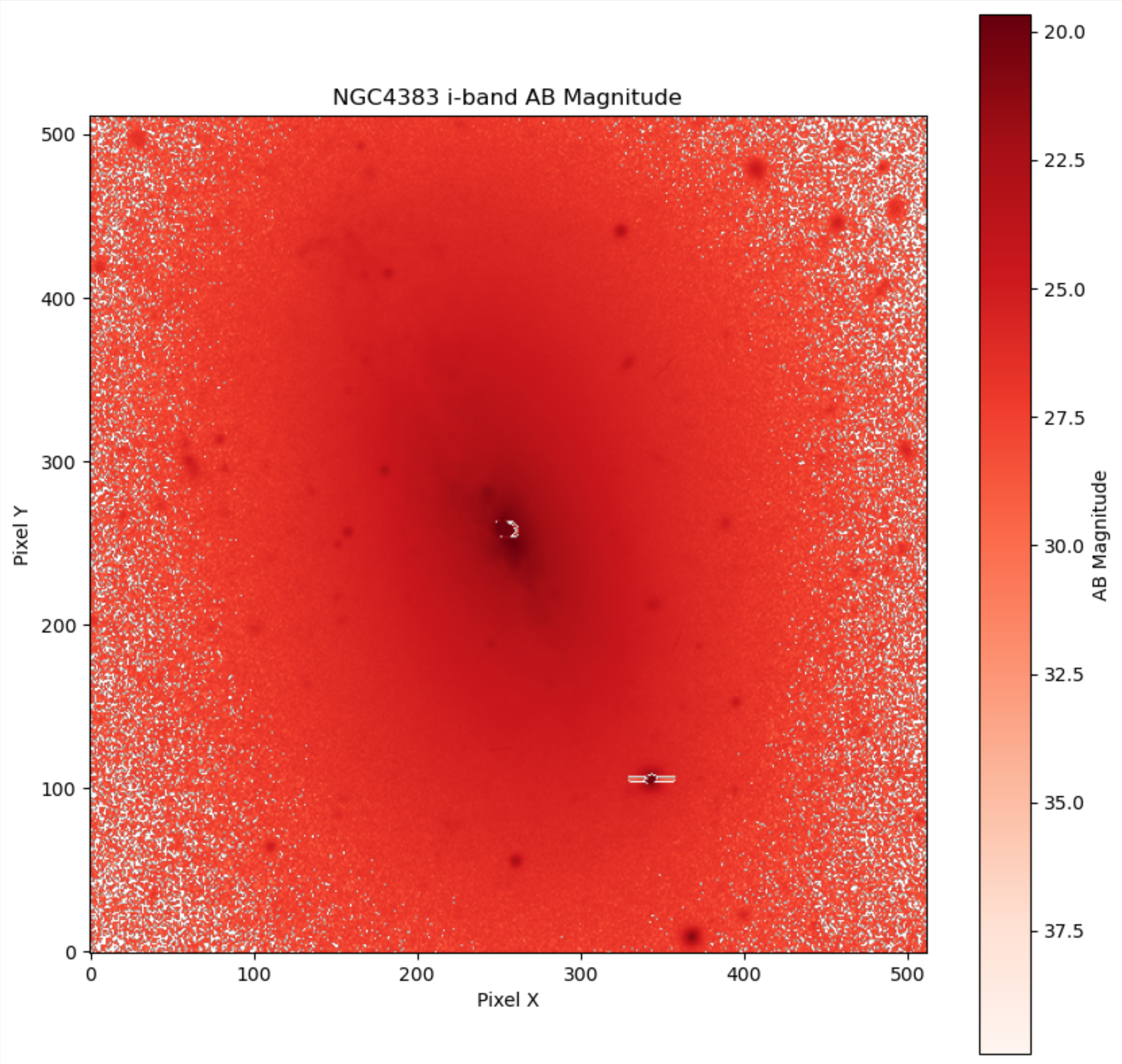
In fact, this should shows a convergence if i choose large bin sizes. Here i choose the bin sizes in $1 \times 1$ (single pixel per bin), $4 \times 4$, $16 \times 16$, $64 \times 64$, $256 \times 256$, and $512 \times 512$ (total galaxy):




And it indeed converges to log(9.49) with increading bin size. As a comparison, the stellar mass in Soria+2021 is log(9.75 ± 0.09), which is derived from WISE W1 and W2 fluxes, as calibrated by Cluver et al. (2014) (see also Jarrett et al. 2019). The median NED distances were adopted.

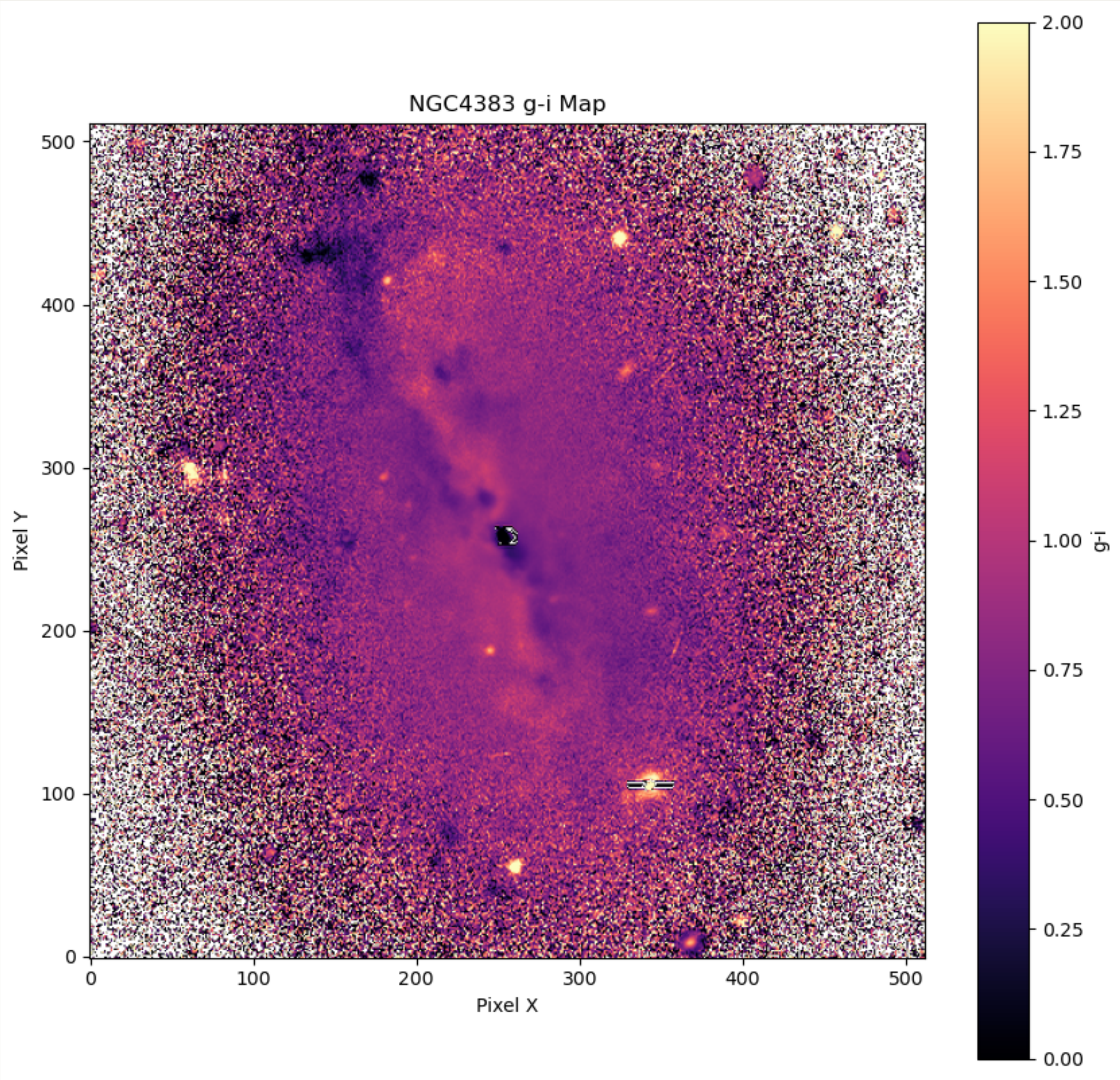
## NGC4383

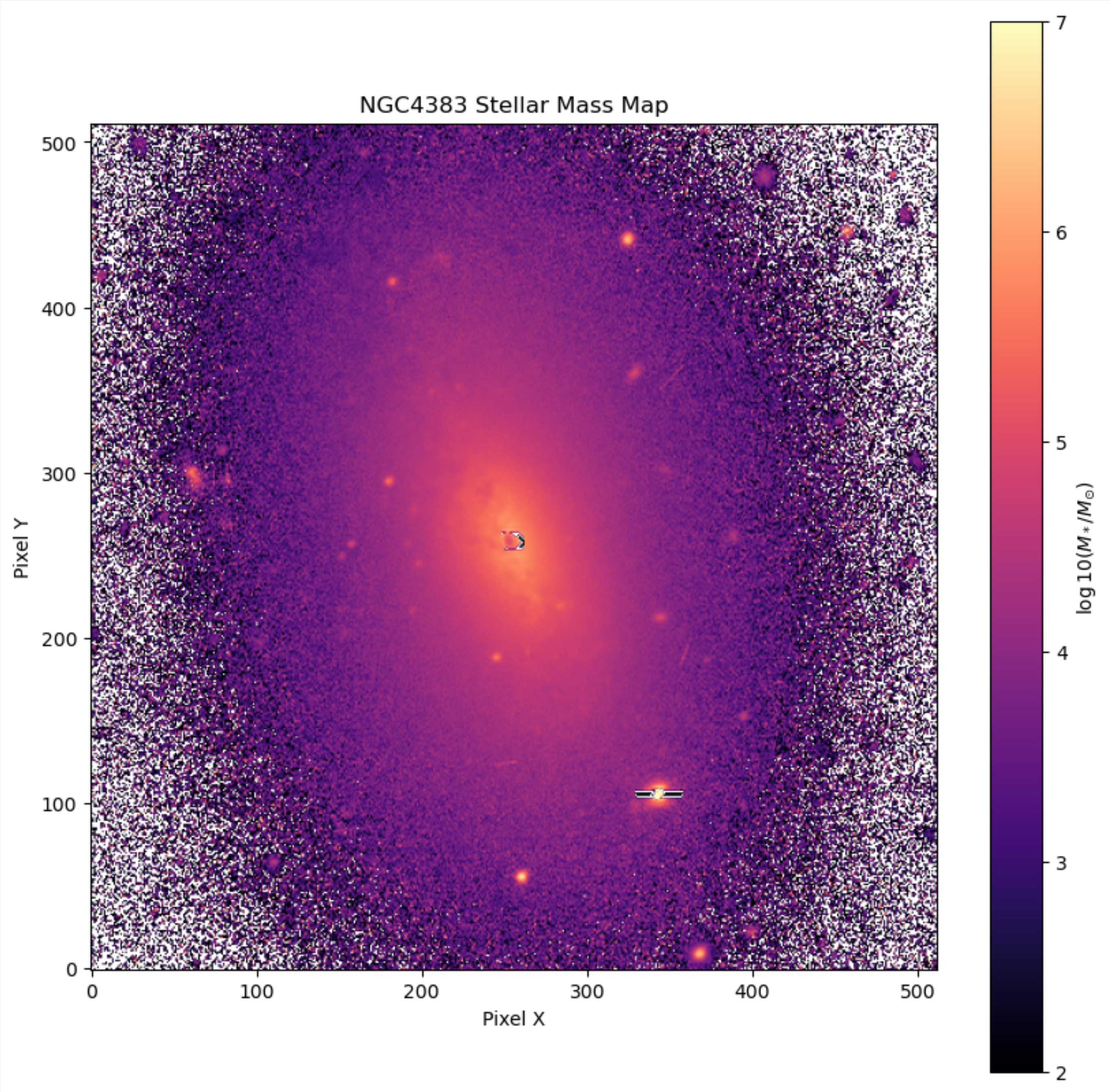

NGC4383 g-band AB Magnitude
Pixel Y
Pixel X
0
100
200
300
400
500
AB Magnitude
20.0
22.5
25.0
27.5
30.0
32.5
35.0
37.5



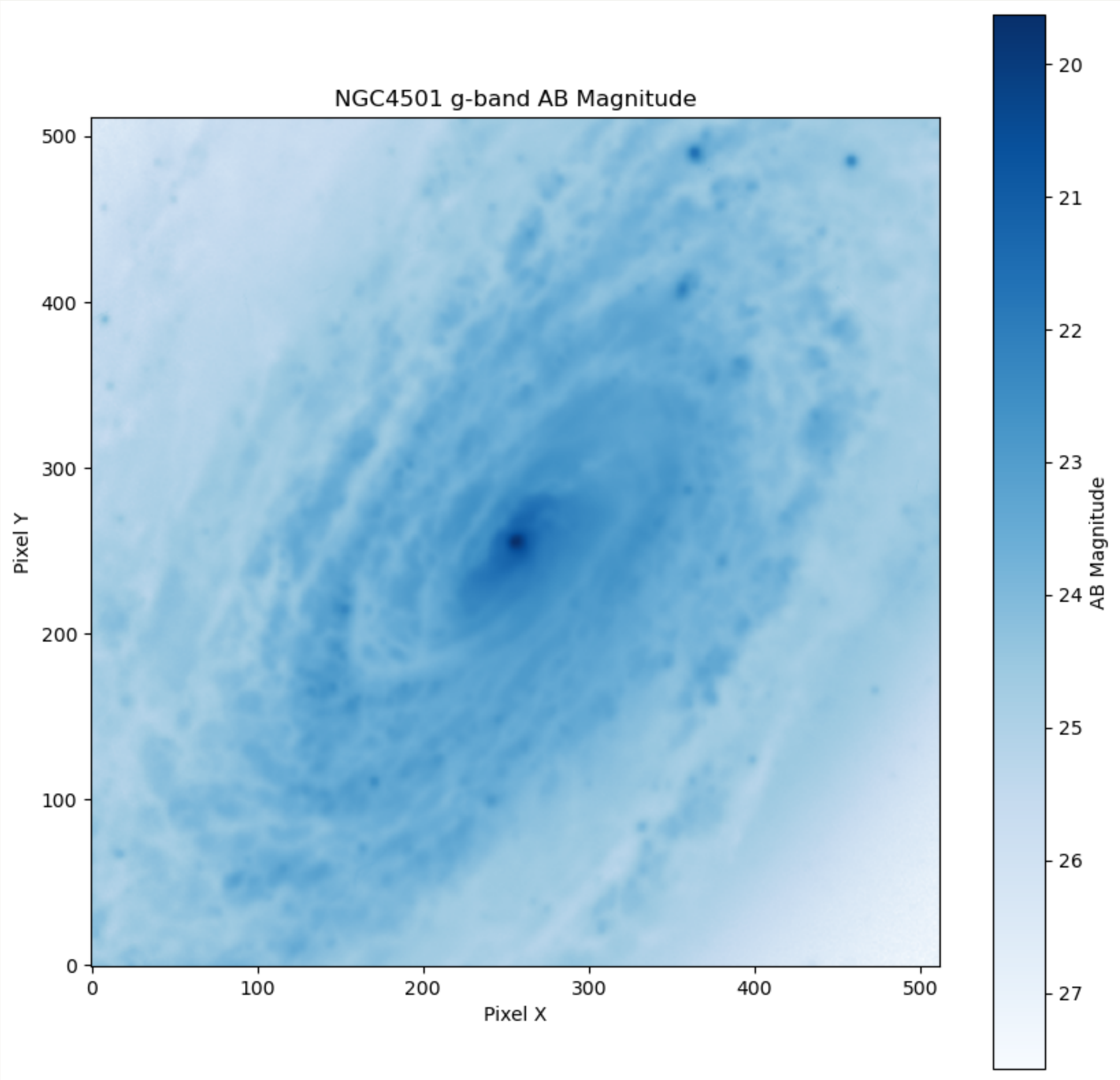

In Adam's paper (https://academic.oup.com/mnras/article/530/2/1968/7642869), he assume that NGC 4383 is at the distance of Virgo, 16.5 Mpc (Mei et al. 2007) and NGC 4383 is an intermediate-mass galaxy ($\log(M_\star/M_\odot) = 9.44$; Leroy et al. 2019).

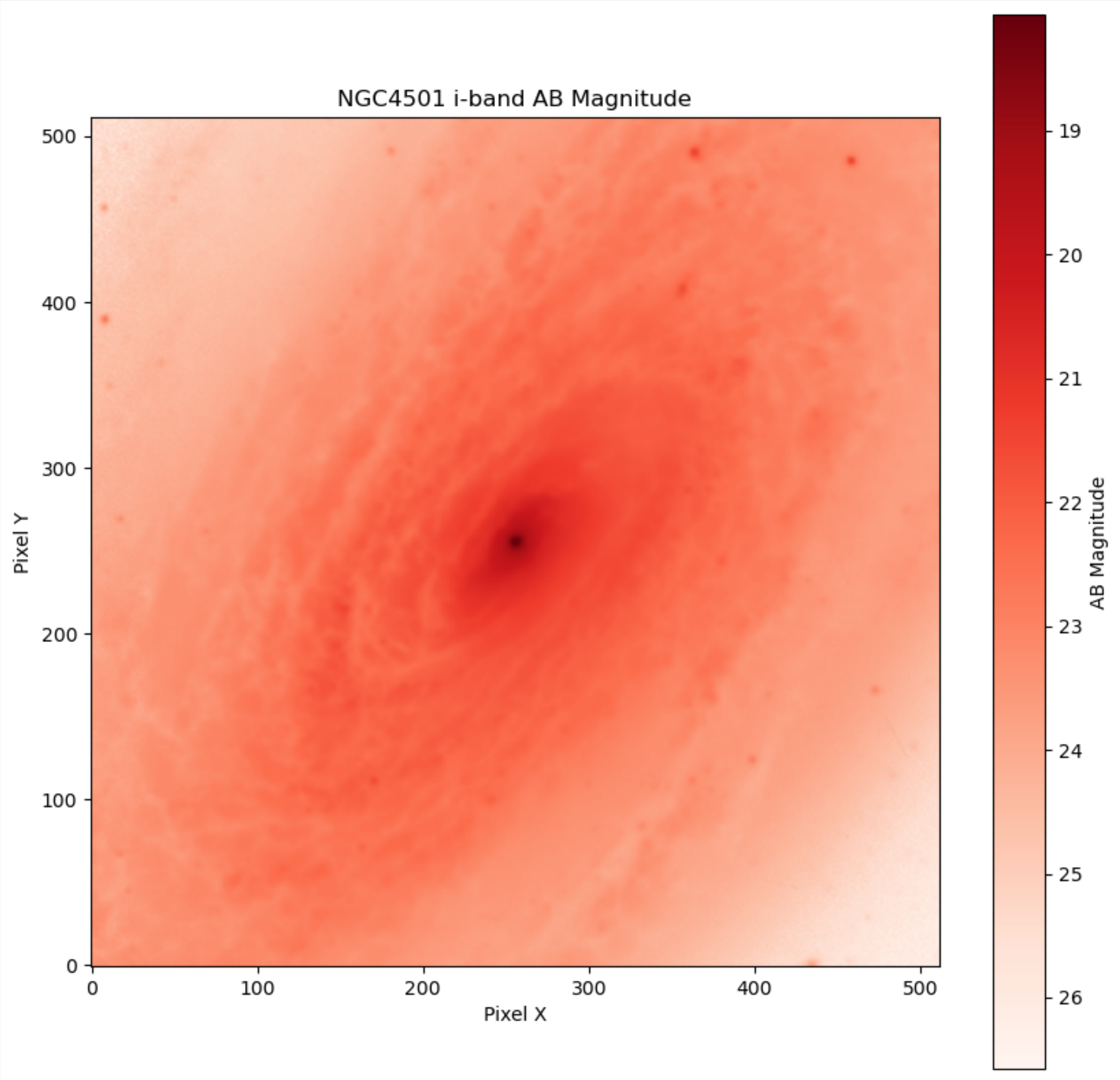
I use the same distance and get log10(9.41) solar masses in total. Below is stellar mass map.


NGC4383 g-i Map
Pixel Y
Pixel X
0
100
200
300
400
500
g-i
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00

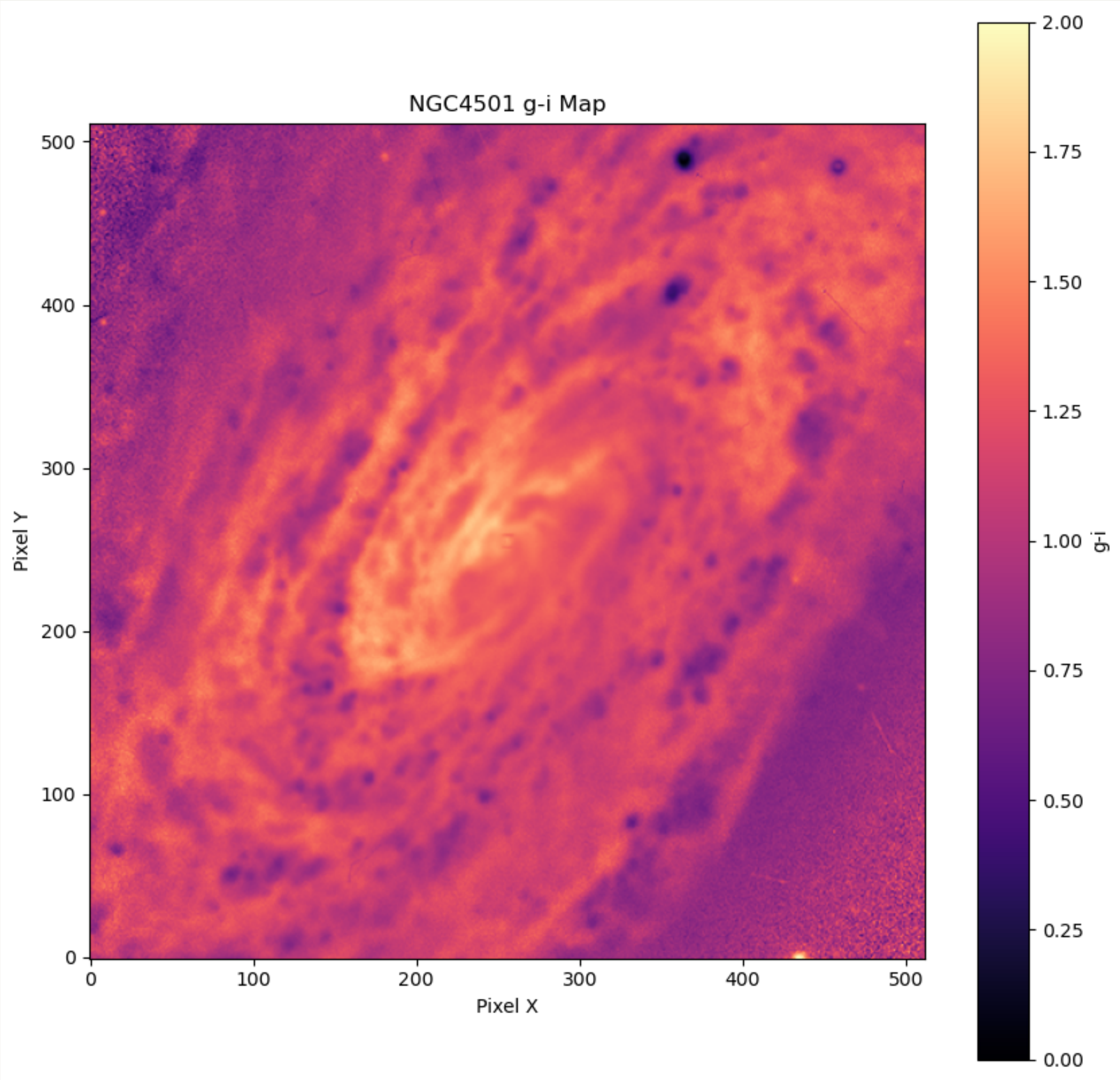

NGC4383 Stellar Mass Map
Pixel Y
Pixel X
log 10($M_*/M_\odot$)
0
100
200
300
400
500
2
3
4
5
6
7

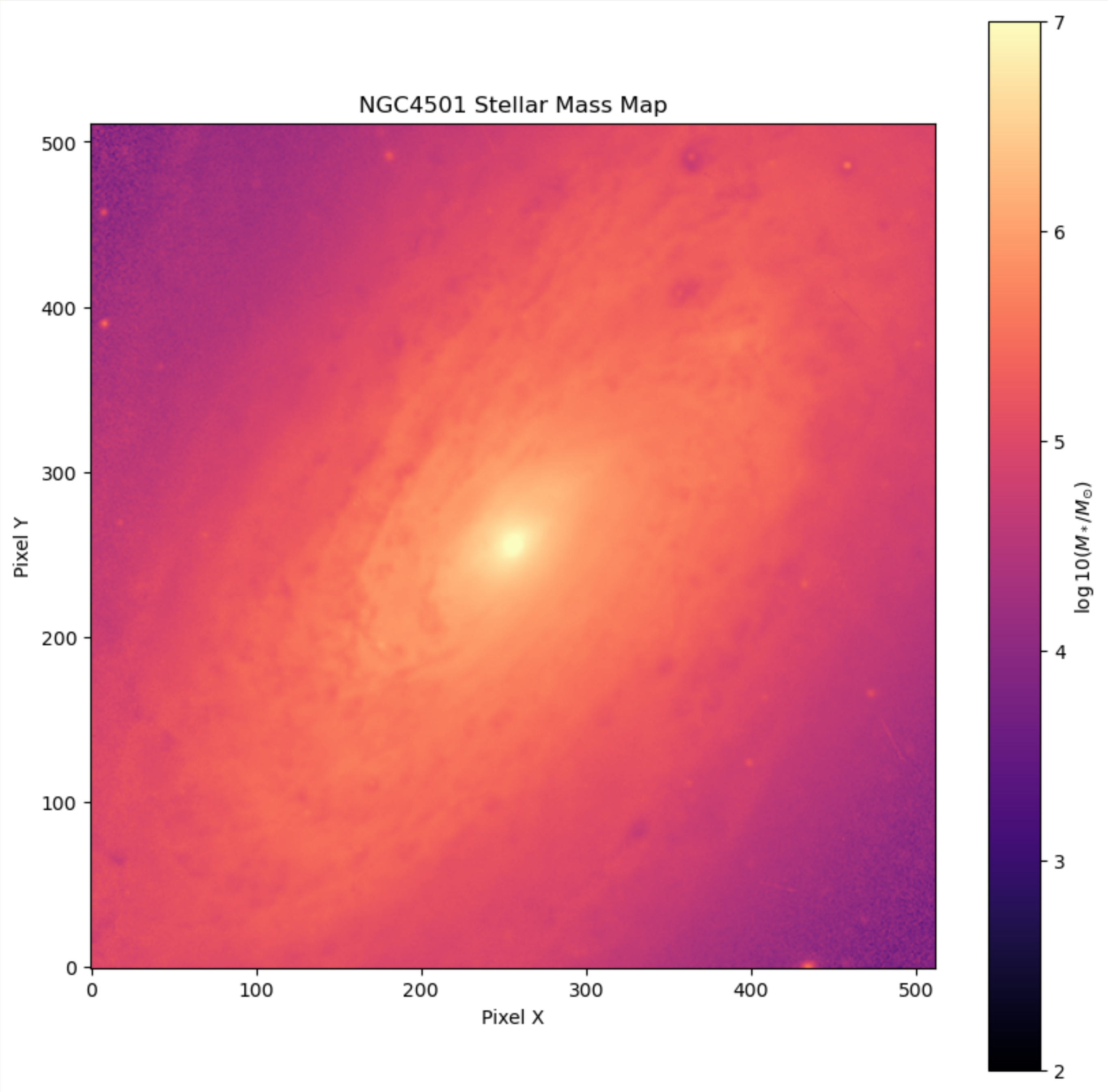
## NGC4501


NGC4501 g-band AB Magnitude
Pixel Y
Pixel X
0
100
200
300
400
500
AB Magnitude
20
21
22
23
24
25
26
27

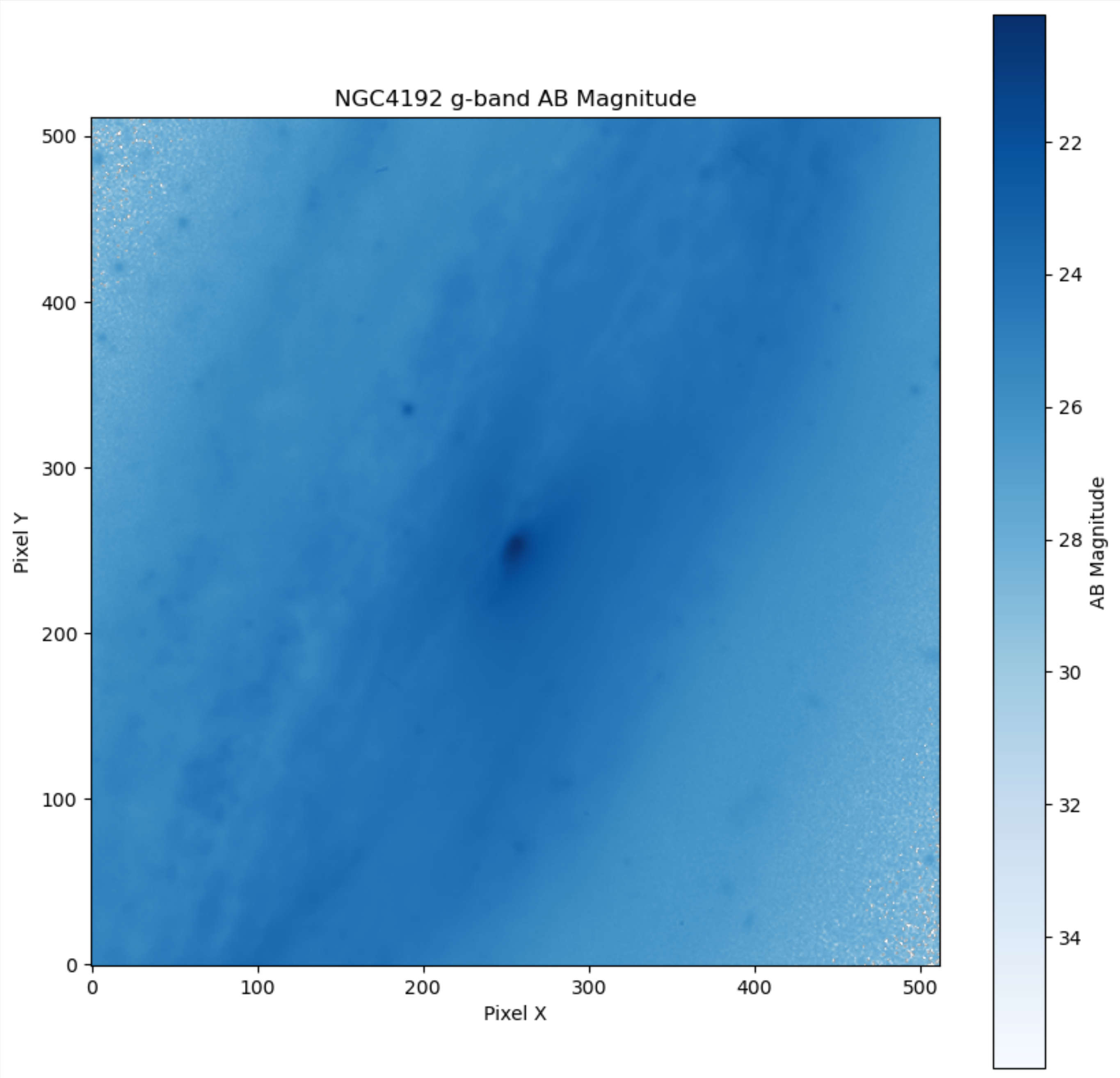


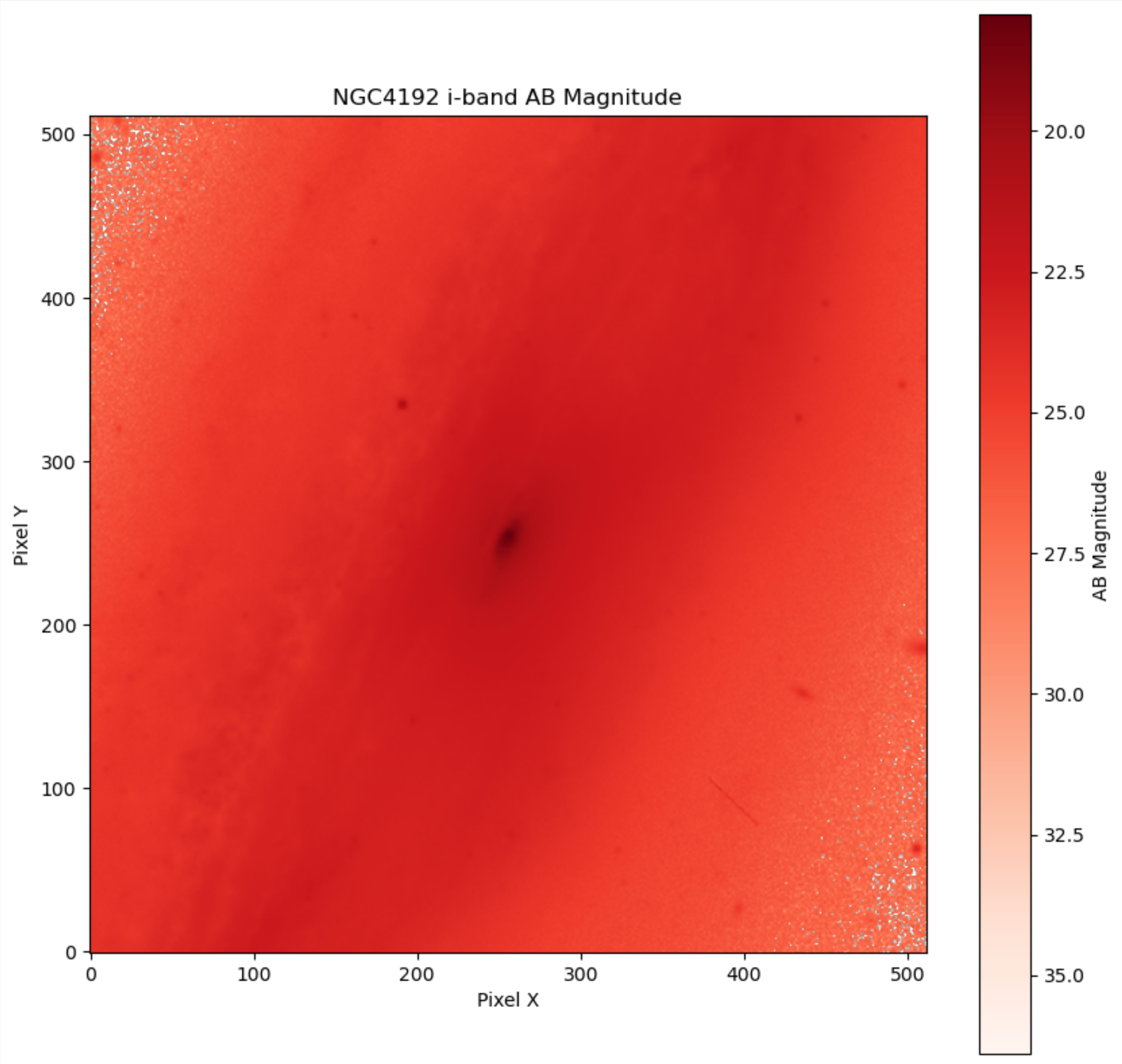

In Soria+2021, they have 17.10 ± 4.58Mpc and log(11.03 ± 0.09) solar masses, while I get log(10.75).


NGC4501 g-i Map
Pixel Y
Pixel X
g-i
0
100
200
300
400
500
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00

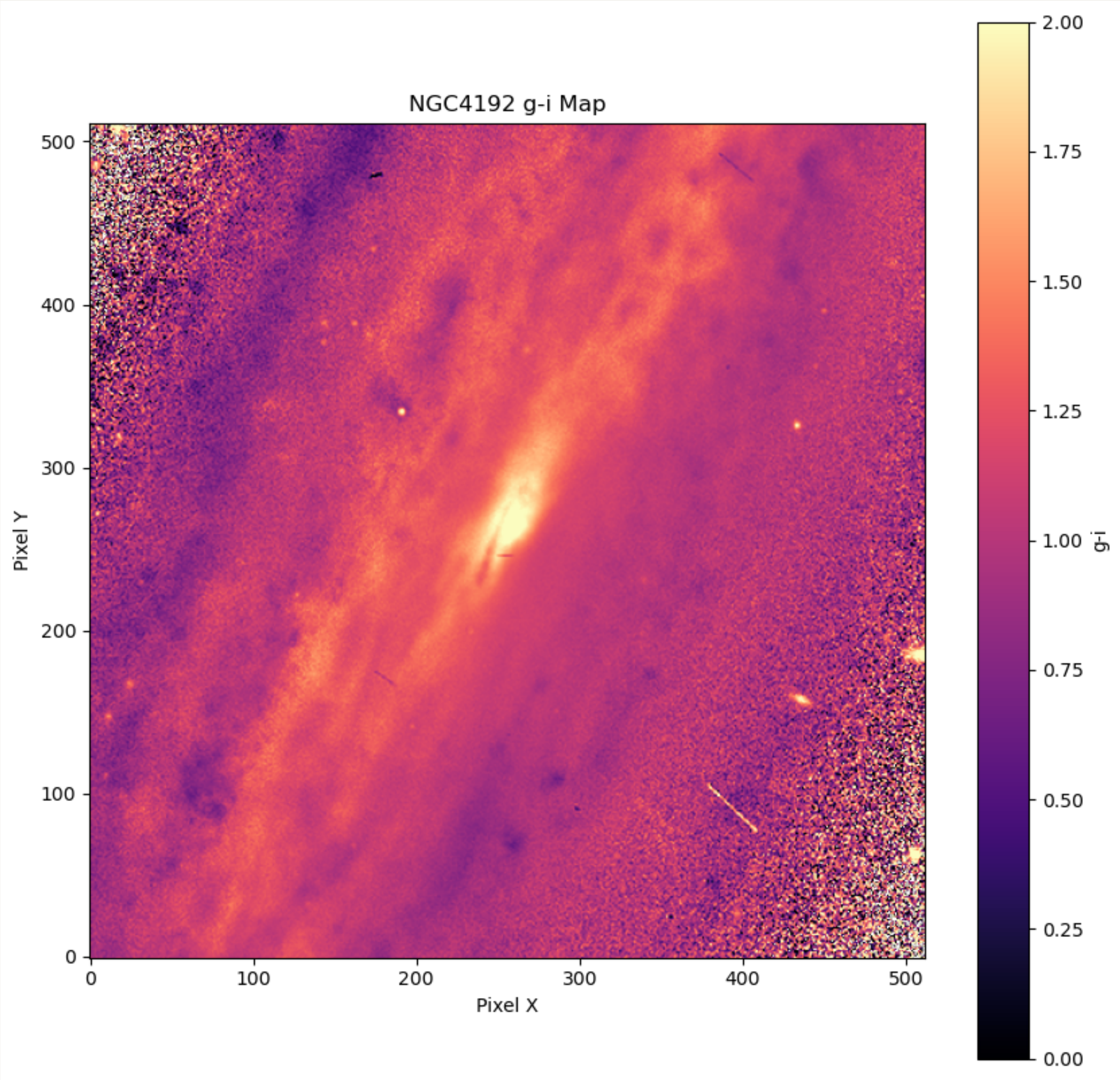

NGC4501 Stellar Mass Map
Pixel Y
Pixel X
0
100
200
300
400
500
log10($M_*/M_\odot$)
2
3
4
5
6
7

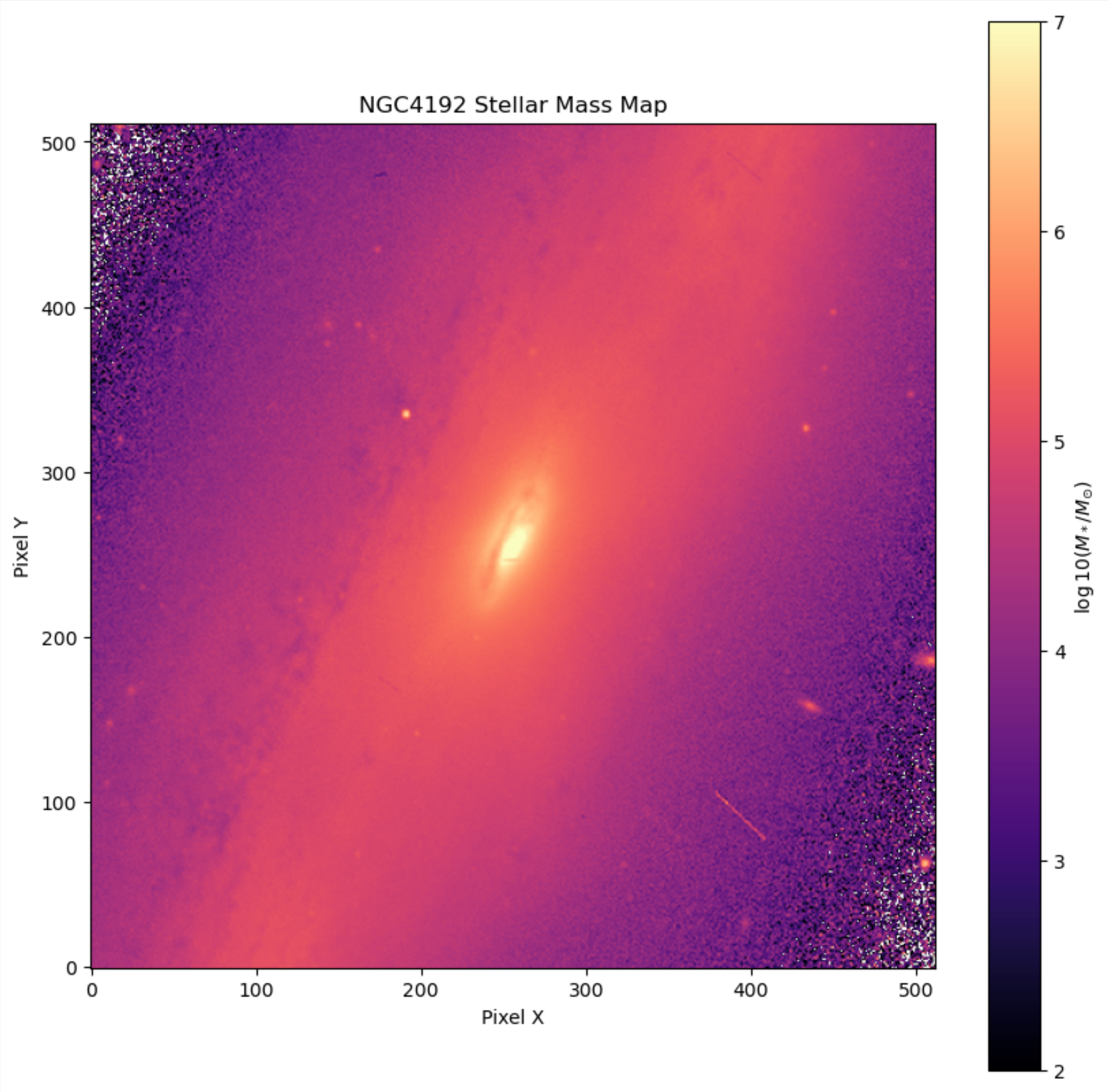
## NGC4192


NGC4192 g-band AB Magnitude
Pixel Y
Pixel X
AB Magnitude
0
100
200
300
400
500
22
24
26
28
30
32
34




In Soria+2021, they have 13.55 ± 2.93Myr and log(10.63 ± 0.09) solar masses, while I get log(10.25).


NGC4192 g-i Map
Pixel X
Pixel Y
g-i
0
100
200
300
400
500
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00


NGC4192 Stellar Mass Map
Pixel Y
Pixel X
0
100
200
300
400
500
2
3
4
5
6
7
$\log 10(M_*/M_\odot)$