DEEP-Theory Meeting   22 June 2017

GALFIT-type analysis of VELA simulations using deep learning — Marc Huertas-Company. New paper by Yicheng Guo on clump properties with disk subtraction nearly done.

Deep Learning for Galaxies project: Analysis of VELA Gen3 simulations is ongoing by Raymond Simons at JHU, Christoph Lee and Sean Larkin, along with Avishai's student Tomer Nussbaum: finding all satellites. Christoph is also using the DL code that classified CANDELS images to classify VELA mock galaxy images. Fernando Caro is analyzing Horizon simulations. Marc may have new results to discuss.

Deep Learning for Galaxy Environment project: Fernando Caro is working with David Koo on using DL for this. He may report on this today. James Kakos and Dominic Pasquale plan to use DL for a project to improve z and local environment estimates for galaxies with only photometric redshifts.

Galaxy size vs. local density project — Graham Vanbenthuysen, Viraj Pandya, Christoph Lee, Doug Hellinger, Aldo Rodriguez-Puebla, David Koo — We are measuring λ vs. density by various methods in Aldo's mock catalogs from Bolshoi-Planck and MultiDark-Planck, and SDSS galaxy radii vs. density by the same methods.

Elongated galaxies aligned with cosmic filaments? — Viraj Pandya will report on his work on this.

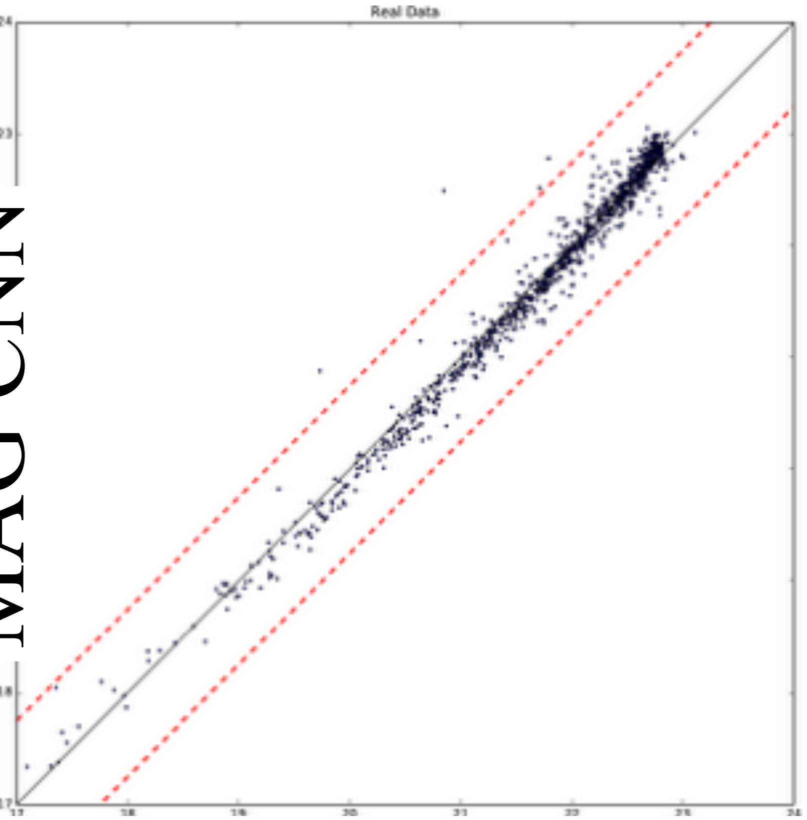
Halo properties like concentration, accretion history, and spin are mainly determined by environmental density rather than by location within the cosmic web — we are finishing the paper led by Tze Goh

DM halo mass loss and **halo radial profile** paper(s?) being drafted — Christoph Lee, Doug Hellinger. Related work this summer by SIP students Shawn Zhang and Peter Wu with Christoph.

Improved Santa Cruz Semi-Analytic Model of galaxy population evolution, including insights from high-resolution hydro simulations — Viraj Pandya, Christoph Lee, Rachel Somerville, Sandy Faber

GALFIT-type analysis of VELA simulations using deep learning Marc Huertas-Company

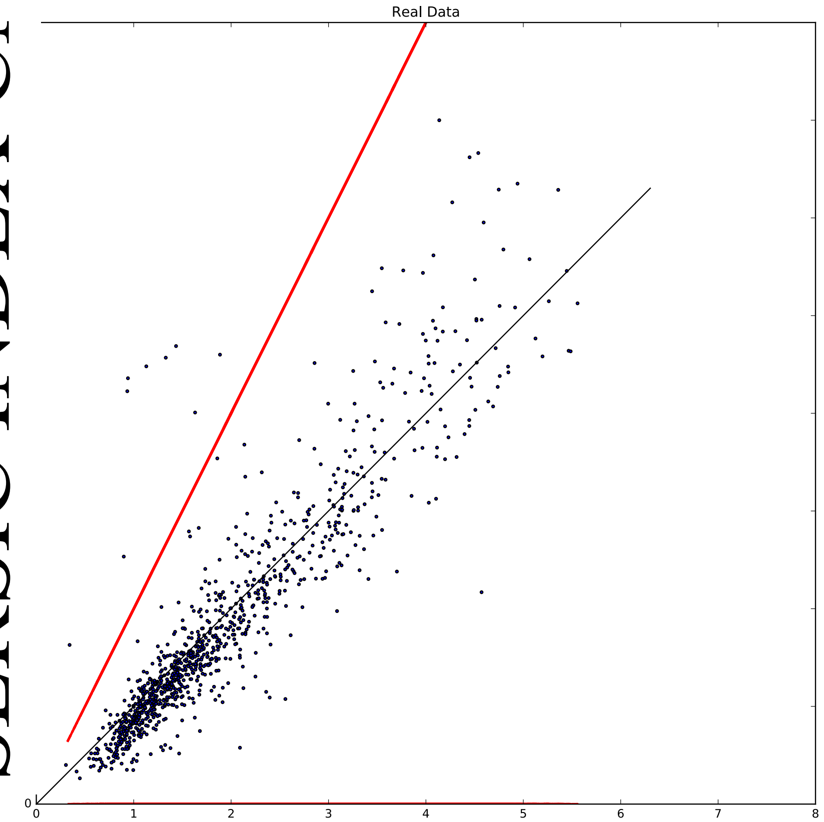
MAG CNN



MAGNITUDE GAFLIT

FITS ALL CANDELS IN FEW SECS!

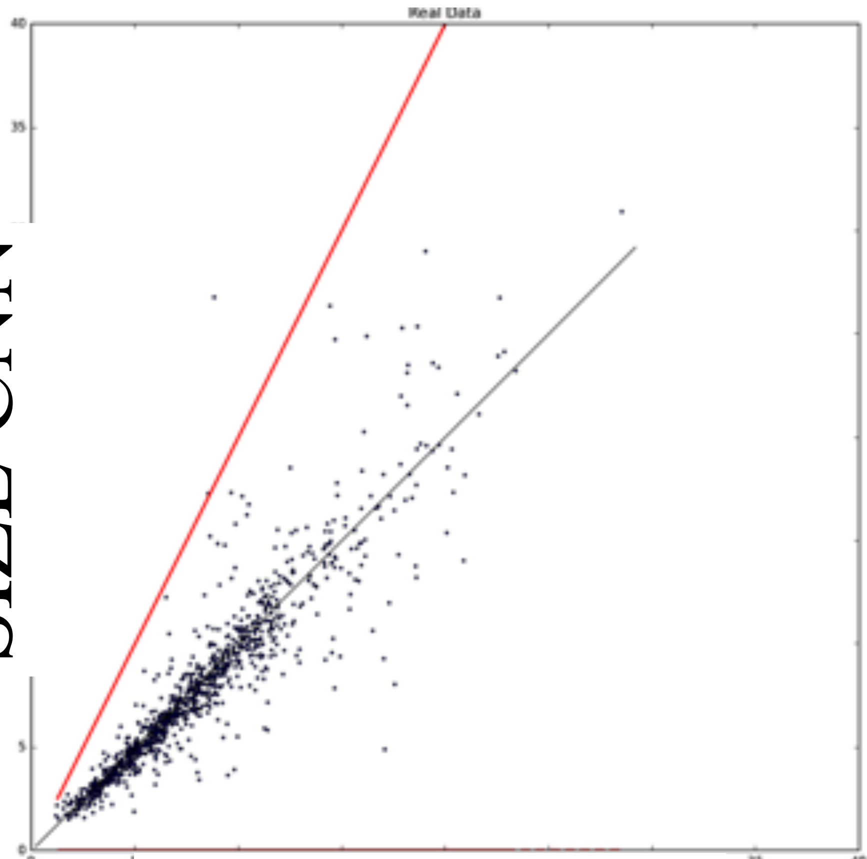
SERSIC INDEX CNN



SERSIC INDEX GALFIT

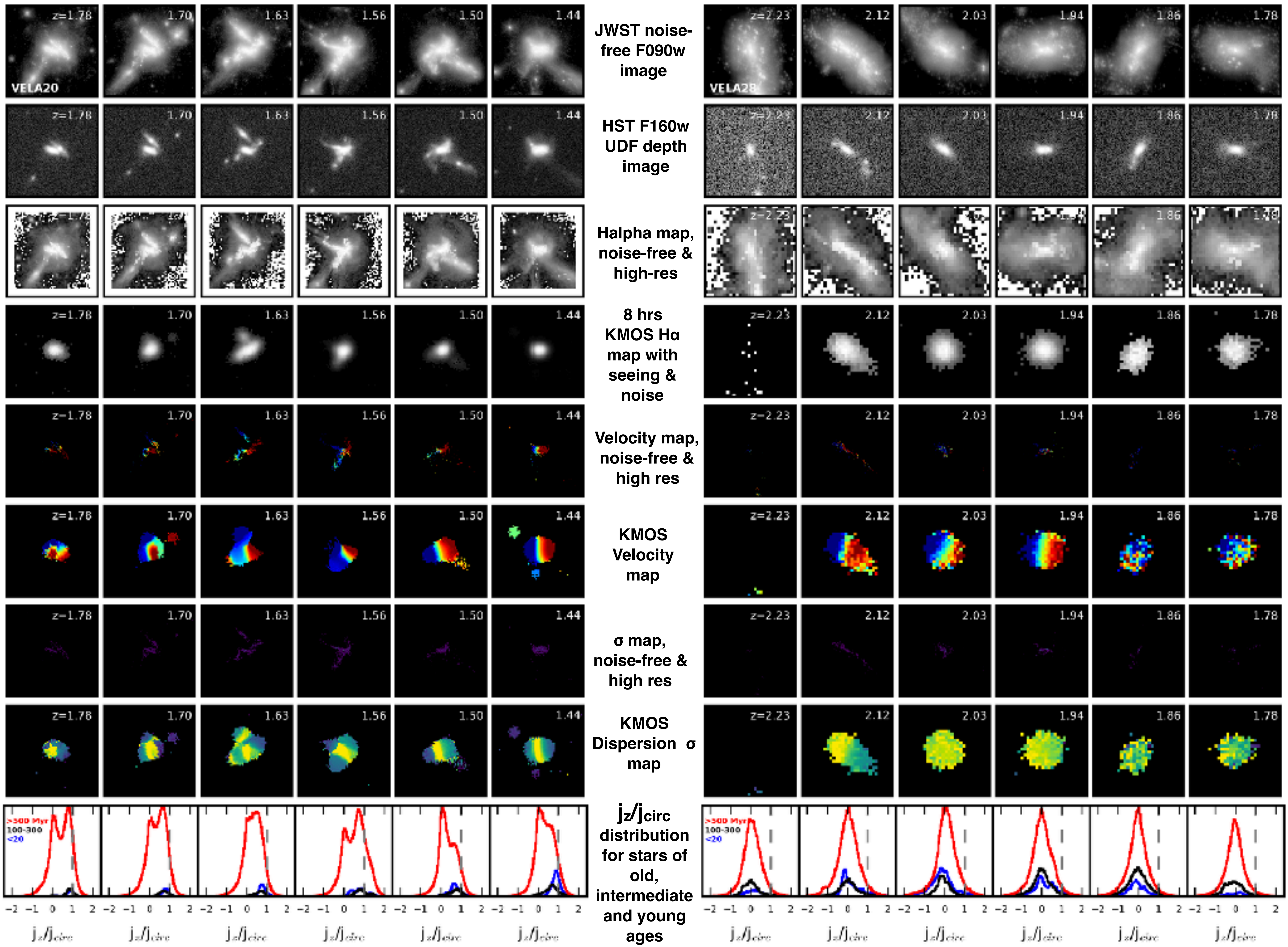
<u>SEE POSTER</u>

SIZE CNN

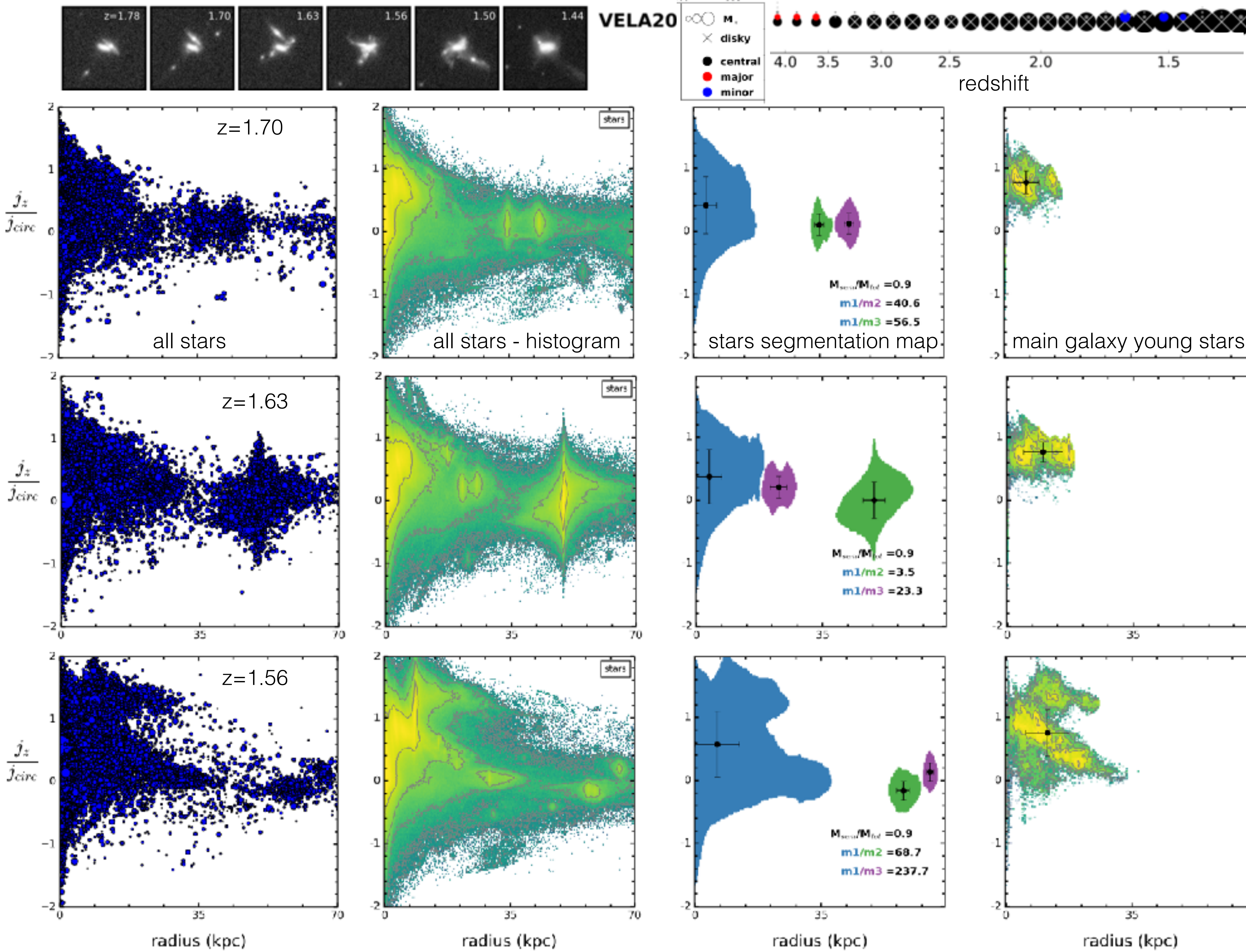


SIZE GALFIT

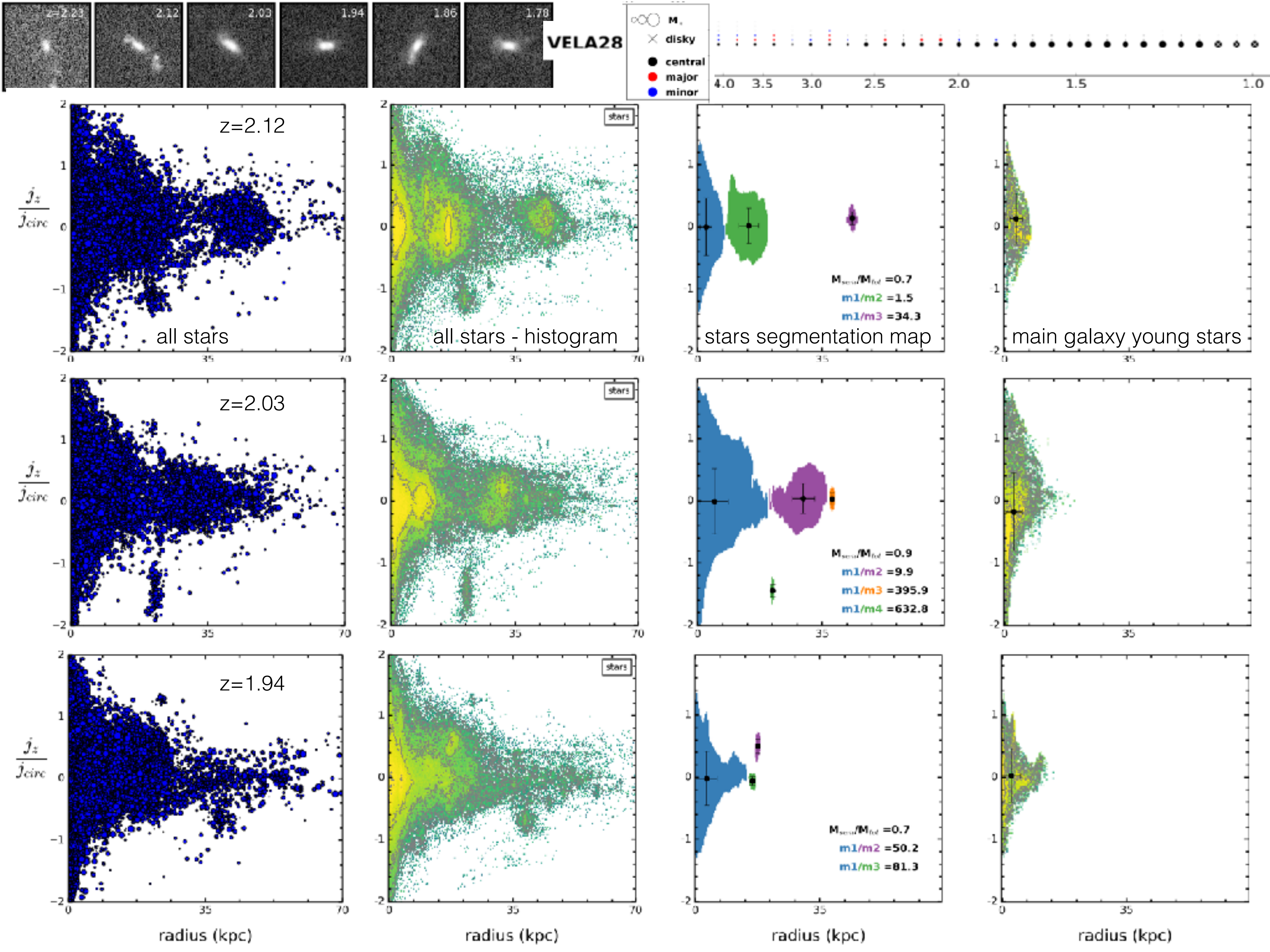
Tuccillo, MHC+17



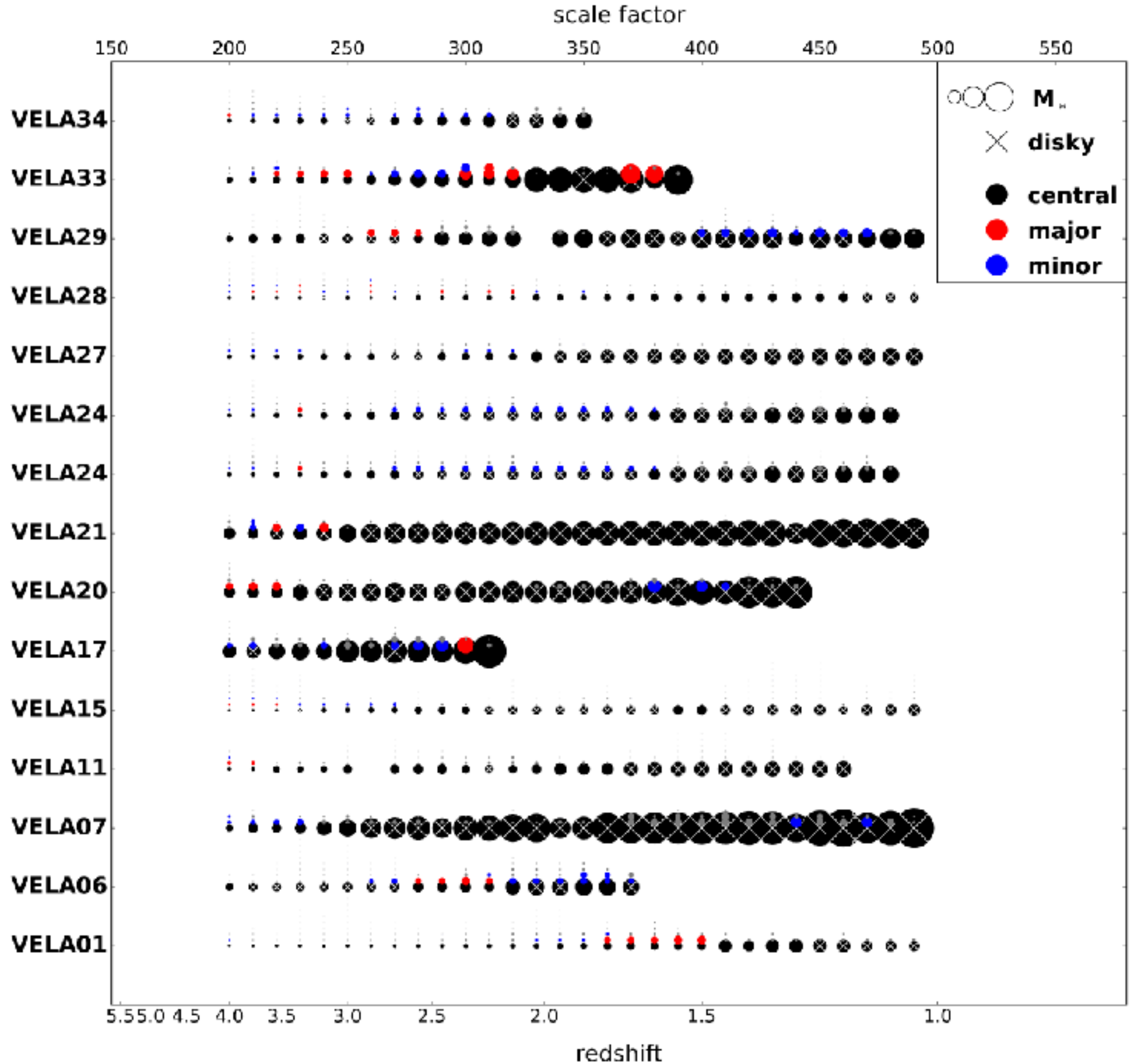
JWST noise-free F090w image
HST F160w UDF depth image
Halpha map, noise-free & high-res
8 hrs KMOS Hα map with seeing & noise
Velocity map, noise-free & high res
KMOS Velocity map
σ map, noise-free & high res
KMOS Dispersion σ map
jz/jcirc distribution for stars of old, intermediate and young ages
VELA20
VELA28
z=1.78
1.70
1.63
1.56
1.50
1.44
z=2.23
2.12
2.03
1.94
1.86
1.78
>500 Myr
100-300
<20
-2 -1 0 1 2
jz/jcirc



z=1.78
1.70
1.63
1.56
1.50
1.44
VELA20
M*
disky
central
major
minor
4.0
3.5
3.0
2.5
2.0
1.5
redshift
z=1.70
all stars
stars
all stars - histogram
M_{seg}/M_{tot} =0.9
m1/m2 =40.6
m1/m3 =56.5
stars segmentation map
main galaxy young stars
z=1.63
M_{seg}/M_{tot} =0.9
m1/m2 =3.5
m1/m3 =23.3
z=1.56
M_{seg}/M_{tot} =0.9
m1/m2 =68.7
m1/m3 =237.7
$\frac{j_z}{j_{circ}}$
radius (kpc)



z=2.23
2.12
2.03
1.94
1.86
1.78
VELA28
M_*
disky
central
major
minor
4.0
3.5
3.0
2.5
2.0
1.5
1.0
z=2.12
all stars
all stars - histogram
stars
stars segmentation map
M_{sec}/M_{tot} =0.7
m1/m2 =1.5
m1/m3 =34.3
main galaxy young stars
z=2.03
M_{sec}/M_{tot} =0.9
m1/m2 =9.9
m1/m3 =395.9
m1/m4 =632.8
z=1.94
M_{sec}/M_{tot} =0.7
m1/m2 =50.2
m1/m3 =81.3
$\frac{j_z}{j_{circ}}$
radius (kpc)



scale factor
150
200
250
300
350
400
450
500
550
VELA34
VELA33
VELA29
VELA28
VELA27
VELA24
VELA24
VELA21
VELA20
VELA17
VELA15
VELA11
VELA07
VELA06
VELA01
M*
disky
central
major
minor
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
redshift

Some useful files from Raymond Simons

Sightlines

#(0) scale factor
#(1) camera number
#(2) field of view (kpc)
#(3) CAMPOSX (X position of camera in kpc; coordinate system centered on galaxy)
#(4) CAMPOSY
#(5) CAMPOSZ
#(6) CAMDIRX (X comp of camera viewing dir, normalized)
#(7) CAMDIRY
#(8) CAMDIRZ
#(9) CAMUPX (orientation of image-up)
#(10) CAMUPY
#(11) CAMUPZ

0.400	00	100.0	55156.609	-78470.582	-26245.057	-0.562	0.785	0.262	0.8274	0.5326	0.1781
0.400	01	100.0	-71089.962	-61986.836	33224.23	0.711	0.62	-0.332	-0.5616	0.7847	0.2625
0.400	02	100.0	-55156.609	78470.582	26245.057	0.562	-0.785	-0.262	0.6667	-0.6667	0.3333
0.400	03	100.0	71089.962	61986.836	-33224.23	-0.711	-0.62	0.332	-0.5616	0.7847	0.2625
0.400	04	100.0	-10559.475	-99318.392	4935.021	0.106	0.993	-0.049	-0.8998	0.1166	0.4205
0.400	05	100.0	-0.0	-0.0	100000.0	0.0	0.0	-1.0	-0.582	0.8132	0.0
0.400	06	100.0	-0.0	-100000.0	-0.0	0.0	1.0	0.0	-0.9059	0.0	0.4234
0.400	07	100.0	-100000.0	-0.0	-0.0	1.0	0.0	0.0	0.0	0.9484	0.3172
0.400	08	100.0	94215.506	29037.01	15269.04	-0.942	-0.290	-0.153	-0.3324	0.0902	0.3117
0.400	09	100.0	20753.95	93369.534	-29178.323	-0.208	-0.934	0.292	-0.8	0.3337	0.4987
0.400	10	100.0	79244.317	59703.634	12482.558	-0.792	-0.597	-0.125	-0.6071	0.7523	0.2558
0.400	11	100.0	59678.998	17290.861	-78354.6	-0.597	-0.173	0.784	-0.3498	0.9349	-0.0601
0.400	12	100.0	70818.563	49990.08	-49857.025	-0.708	-0.5	0.499	-0.4694	0.8609	0.1963
0.400	13	100.0	-15033.059	3475.392	-90002.474	0.15	-0.035	0.900	-0.5902	0.7906	0.1179
0.400	14	100.0	-60927.997	53397.663	-58621.401	0.609	-0.534	0.586	-0.2411	0.5795	0.7785
0.400	15	100.0	-62373.249	-19918.474	75583.28	0.624	0.199	-0.756	-0.3445	0.9381	-0.0371
0.400	16	100.0	-1758.208	-93767.284	34706.915	0.018	0.938	-0.347	-0.7413	0.2452	0.6248
0.400	17	100.0	-95359.088	-26211.855	14818.332	0.954	0.262	-0.148	-0.2259	0.9482	0.2236
0.400	18	100.0	-87554.36	42460.962	23049.952	0.876	-0.425	-0.23	0.4595	0.8793	0.1256

Camera Orientations

As with the full SUNRISE suite, the general camera positions follow the scheme:

(0)	face-on
(1)	edge-on
(2)	reverse face-on
(3)	reverse edge-on
(4)	45 degrees
(5)	Z-axis
(6)	Y-axis
(7)	X-axis
(8-11)	random and fixed to simulation box, same snapshot to snapshot
(12-18)	random between snapshots

Some useful files from Raymond Simons

Central Galaxy and Merging Satellites (file is called Mergers)

#(0) scale
#(1) mean jz/jcirc of young stars in central galaxy
#(2) std jz/jcirc of young stars in central galaxy
#(3) mean location of young stars in central galaxy (kpc)
#(4) std location of young stars in central galaxy (kpc)
#(5) central stellar mass (1.e10 Msun)
#(6) central mean location (kpc)
#(7) central std location (kpc)
#(8) central mean jz/jcirc
#(9) central std jz/jcirc

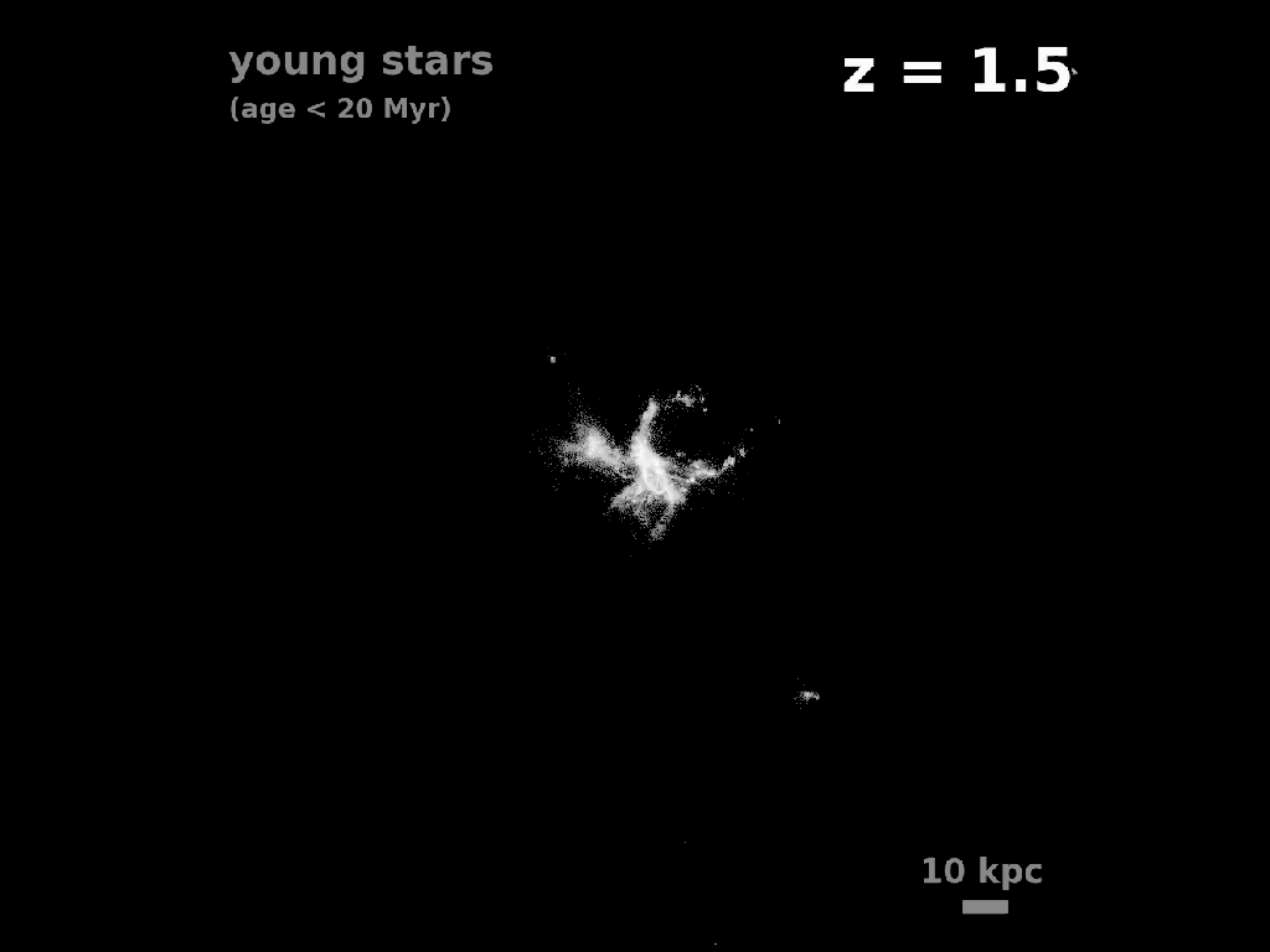
#(10) merger 1 stellar mass (1.e10 Msun)
#(11) merger 1 mean location (kpc)
#(12) merger 1 std location (kpc)
#(13) merger 1 mean jz/jcirc
#(14) merger 1 std jz/jcirc
#(15) merger 2 stellar mass (1.e10 Msun)
#(16) merger 2 mean location (kpc)
#(17) merger 2 std location (kpc)
#(18) merger 2 mean jz/jcirc
#(19) merger 2 std jz/jcirc
#(20:) etc.

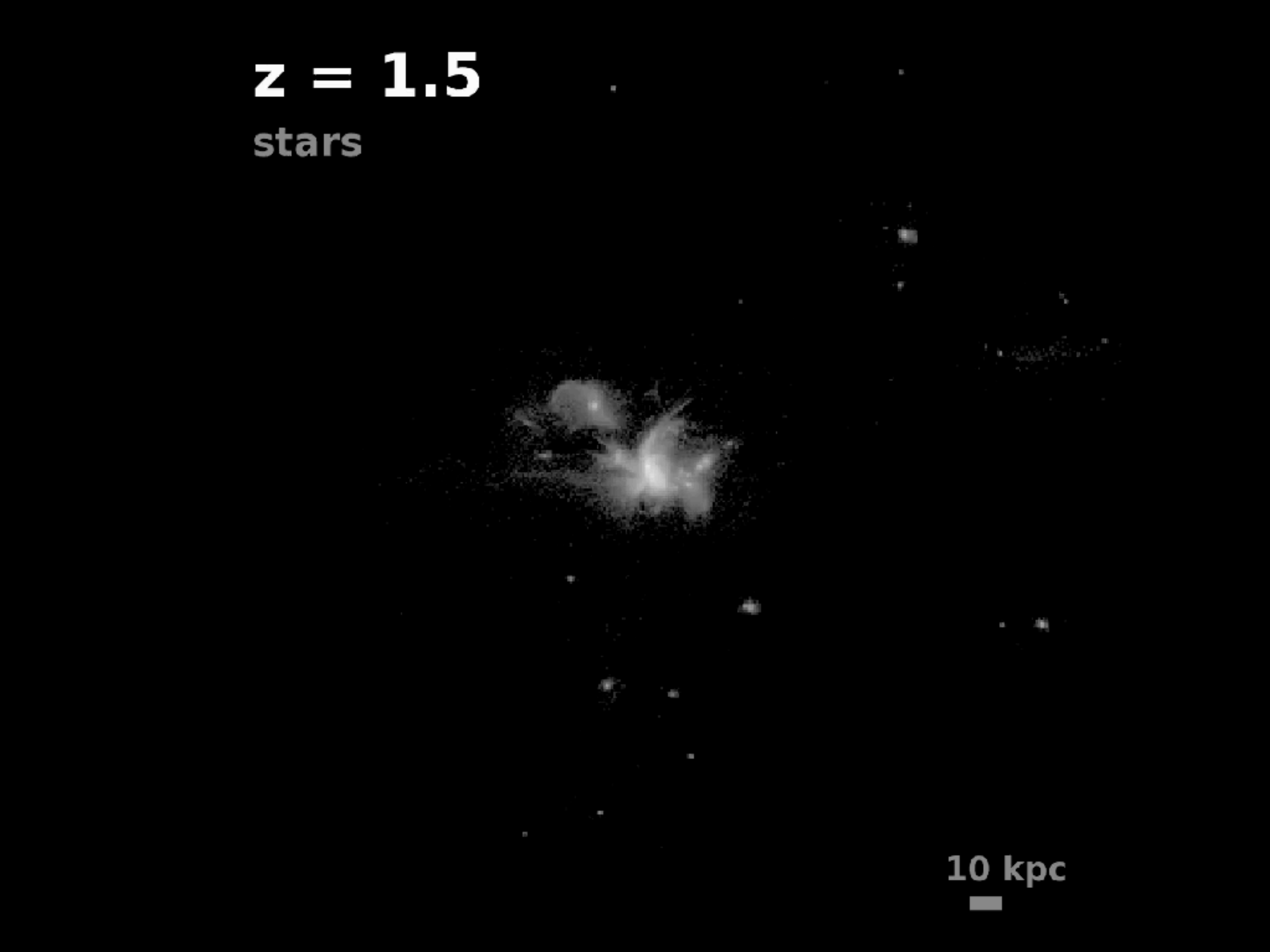
Example from VELA 20 at a=0.20

0		1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30	31
32	33	34								

200		0.73	0.29	1.70	1.93	0.805	1.34	2.36	0.46	0.47
0.342	25.91	1.87	-0.65	0.53	0.051	53.14	3.44	-0.03	0.20	0.0016
42.84	0.39	-0.08	0.11	0.001	14.90	0.80	-0.82	0.07	0.001	34.71
0.30	-0.97	0.10	nan	nan	nan	nan	nan	nan	nan	nan

Unfortunately the Mergers file only includes mergers, not all satellites — but Raymond told me that he will send all the satellite data within 2 weeks


young stars
(age < 20 Myr)
z = 1.5
10 kpc


z = 1.5
stars
10 kpc

Deep Learning for Galaxy Environment project: James Kakos and Dominic Pasquale plan to use DL for a project to improve z and local environment estimates for galaxies with only photometric redshifts. Fernando Caro and David Koo are also using DL for this. Fernando may report on this here.

From David Koo - recent astrophs on photometric redshifts and machine or deep learning

arXiv:1706.02467 **Photometric redshift estimation via deep learning** Antonio D'Isanto, Kai Lars Polsterer

arXiv:1703.01979 Uncertain Photometric Redshifts with Deep Learning Methods Antonio D'Isanto

arXiv:1608.08016 Uncertain Photometric Redshifts Kai Lars Polsterer, Antonio D'Isanto, Fabian Gieseke

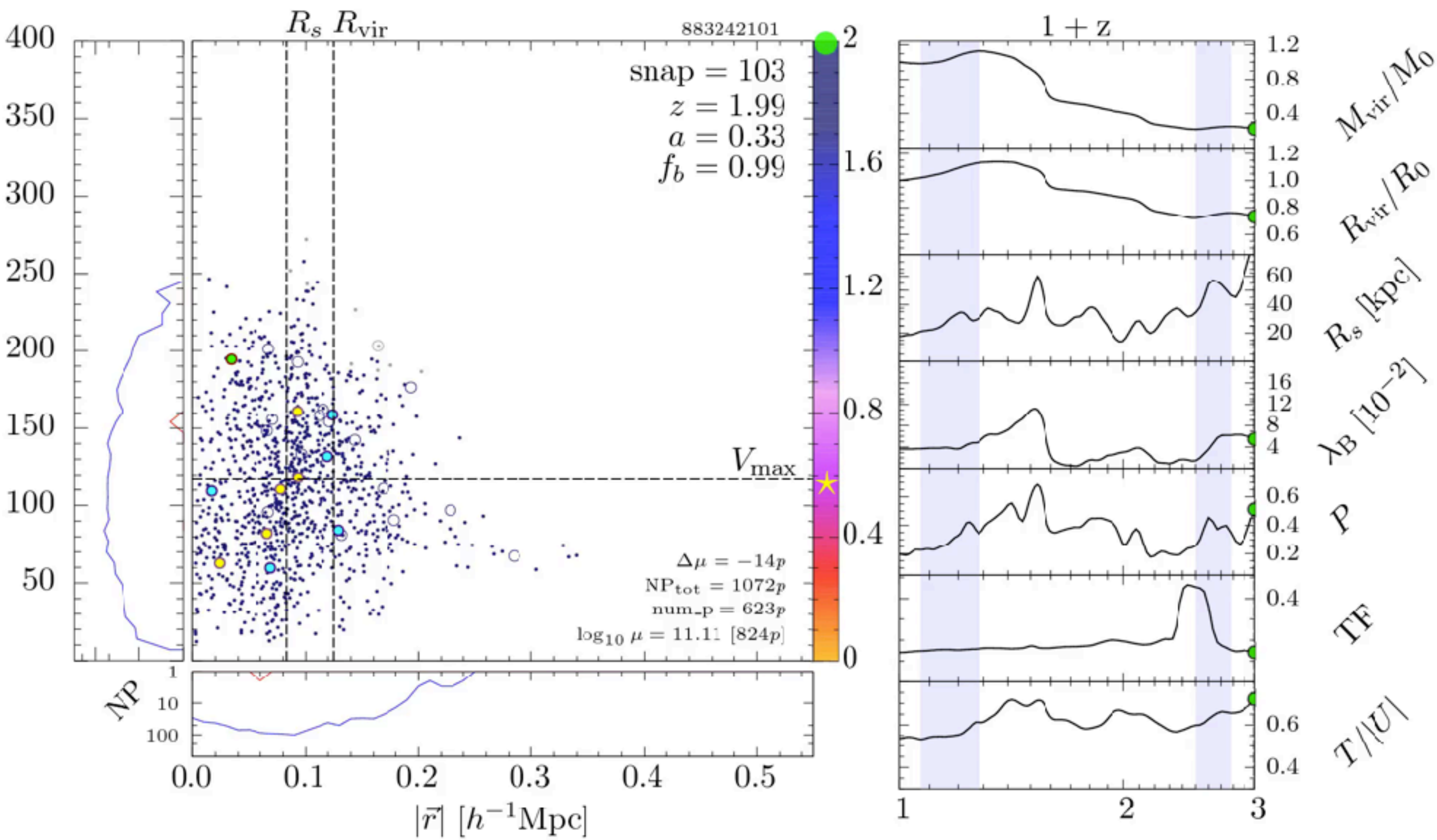
arXiv:1706.03501 Probability density estimation of photometric redshifts based on machine learning Stefano Cavuoti, Massimo Brescia, Valeria Amaro, Civita Vellucci, Giuseppe Longo, Crescenzo Tortora Comments: 2016 IEEE Symposium Series on Computational Intelligence

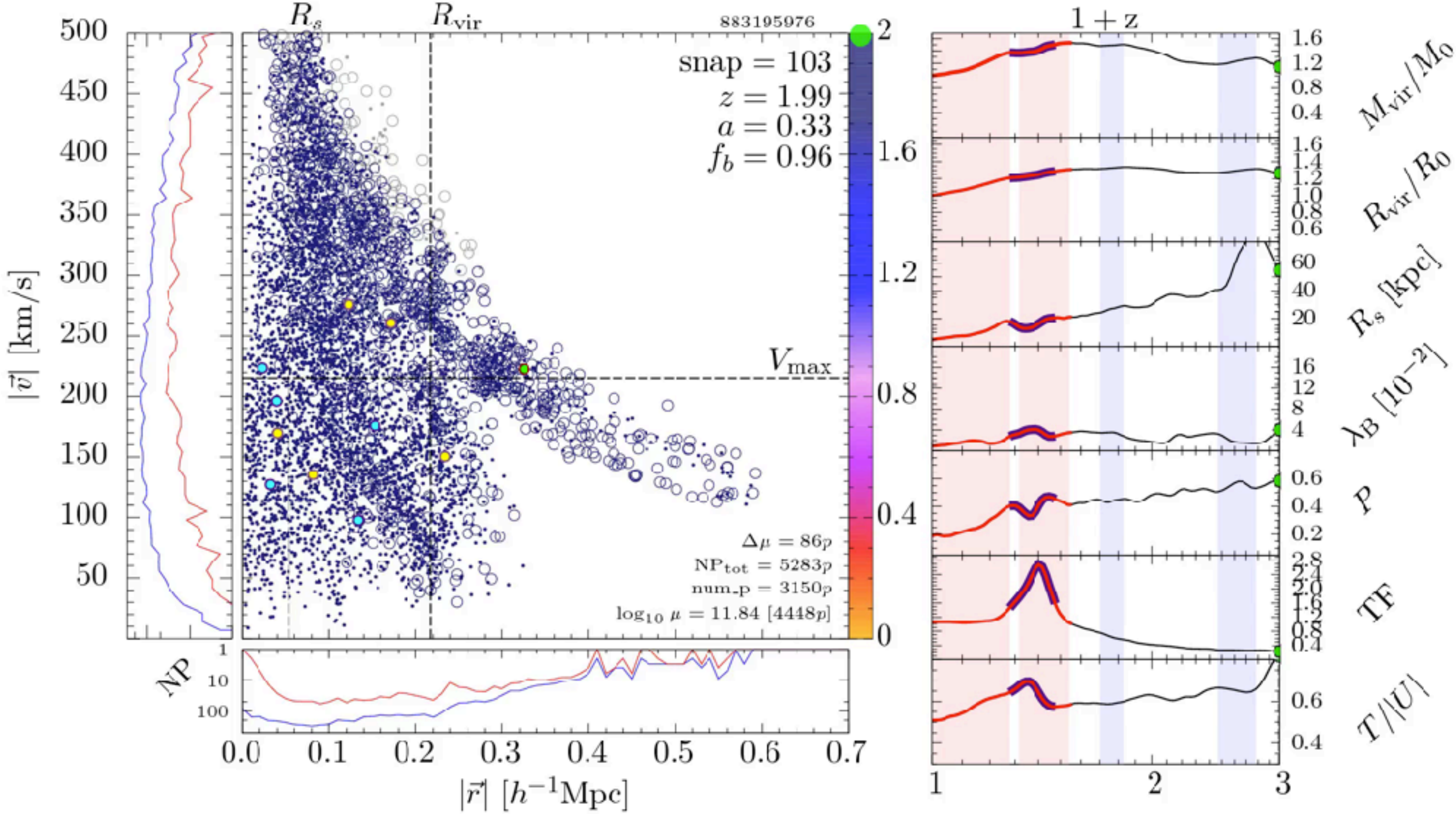
arXiv:1703.02292 METAPHOR: Probability density estimation for machine learning based photometric redshifts Valeria Amaro, Stefano Cavuoti, Massimo Brescia, Civita Vellucci, Crescenzo Tortora, Giuseppe Longo

arXiv:1701.08120 Cooperative photometric redshift estimation Stefano Cavuoti, Crescenzo Tortora, Massimo Brescia, Giuseppe Longo, Mario Radovich, Nicola R. Napolitano, Valeria Amaro, Civita Vellucci

arXiv:1612.02173 A cooperative approach among methods for photometric redshifts estimation: an application to KiDS data Stefano Cavuoti, Crescenzo Tortora, Massimo Brescia, Giuseppe Longo, Mario Radovich, Nicola R. Napolitano, Valeria Amaro, Civita Vellucci, Francesco La Barbera, Fedor Getman, Aniello Grado Accepted by MNRAS

DM halo mass loss and **halo radial profile** paper(s?) being drafted — Christoph Lee, Doug Hellinger.
Related work this summer by SIP students Shawn Zhang and Peter Wu with Christoph.



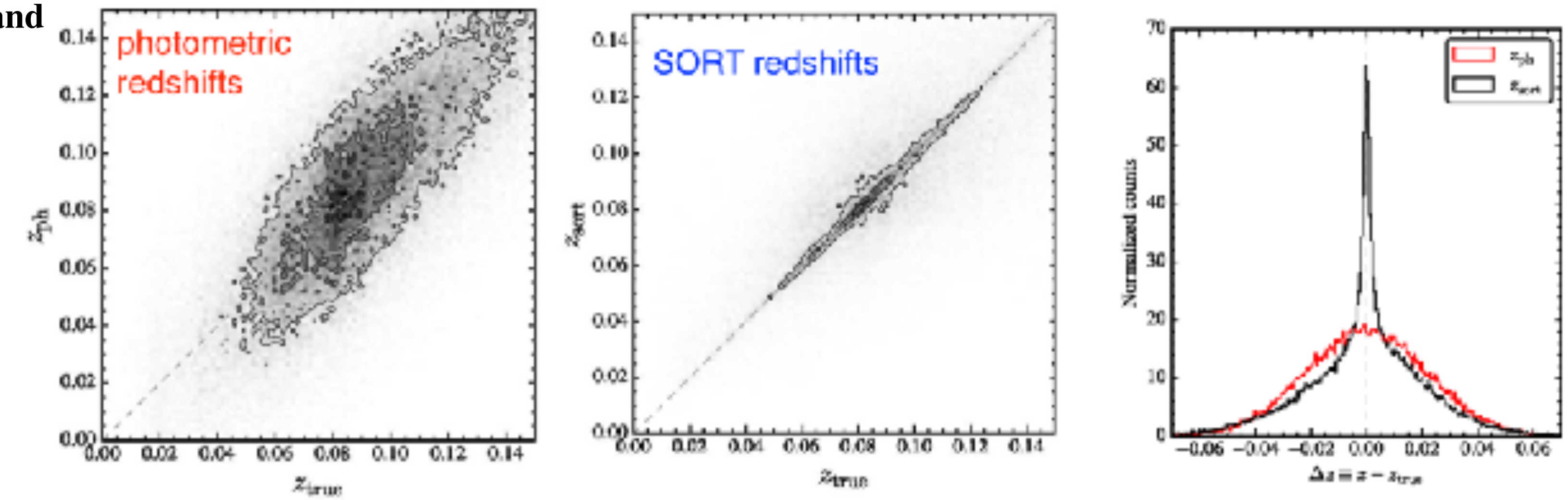


R_s
$R_{\rm vir}$
883195976
snap = 103
$z = 1.99$
$a = 0.33$
$f_b = 0.96$
$V_{\rm max}$
$\Delta\mu = 86p$
$\mathrm{NP_{tot}} = 5283p$
num_p = 3150p
$\log_{10}\mu = 11.84$ [4448p]
$|\vec{v}|$ [km/s]
$|\vec{r}|$ [h^{-1}Mpc]
NP
1 + z
$M_{\rm vir}/M_0$
$R_{\rm vir}/R_0$
R_s [kpc]
λ_B [10^{-2}]
$\mathcal{P}$
TF
$T/|U|$

Deep Learning for Redshifts project: Fernando Caro, James Kakos, and Dominic Pasquale may use DL for a project to improve distance and local environment estimates for galaxies with only photometric redshifts. This is related to the following work:

Stochastic Order Redshift Technique (SORT): a simple, efficient and robust method to improve cosmological redshift measurements

Nicolas Tejos, Aldo Rodríguez-Puebla and Joel R. Primack, submitted to MNRAS



Circumgalactic medium (CGM): VELA **mock quasar absorption spectra** compared with observations - Clayton Strawn. Hassen Yesuf is working with X Prochaska to look at evidence for **outflows** in galaxies at z ~ 0.5 and compare with our ART simulations. Hassen is being hooded by David Koo today at the PhD graduation.