DEEP-Theory Meeting 22 May 2017

GALFIT and clump analysis of VELA simulations and comparison with observations — VivianTang, Yicheng Guo, David Koo, Liz McGrath — new paper by Yicheng Guo on clump properties with disk subtraction

Deep Learning for Galaxies project: Analysis of VELA Gen3 simulations is ongoing by 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. Elliot Eckholm will help visualize the VELA simulations with yt in 3DVizlab. Alex Bogert will be visiting UCSC Tuesday 2:30-5 pm and possibly also Thursday to help us with such yt visualizations.

Deep Learning for Redshifts 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.

Deep Learning visit to Google on Tuesday May 30.

Galaxy size vs. local density project — Christoph Lee, Graham Vanbenthuysen, Viraj Pandya, Doug Hellinger, Aldo Rodriguez-Puebla, David Koo — Huertas-Company+13 found no difference vs. density, and Cebrian & Trujillo 2017 find, if anything, galaxies in low-density regions are larger. Yan, Fan, & White 2013 used SDSS DR7 and measured density using distance to 3rd nearest galaxy, and found that galaxies are smaller at low densities. we are measuring λ vs. density by various methods in Aldo’s mock catalogs from Bolshoi-Planck and MultiDark-Planck.

Halo properties like concentration, accretion history, and spin are mainly determined by environmental density rather than by location within the cosmic web — Tze Goh, Christoph Lee, Peter Behroozi, Doug Hellinger, Miguel Aragon Calvo, Elliot Eckholm

DM halo mass loss and **halo radial profile** papers being drafted — Christoph Lee, Doug Hellinger

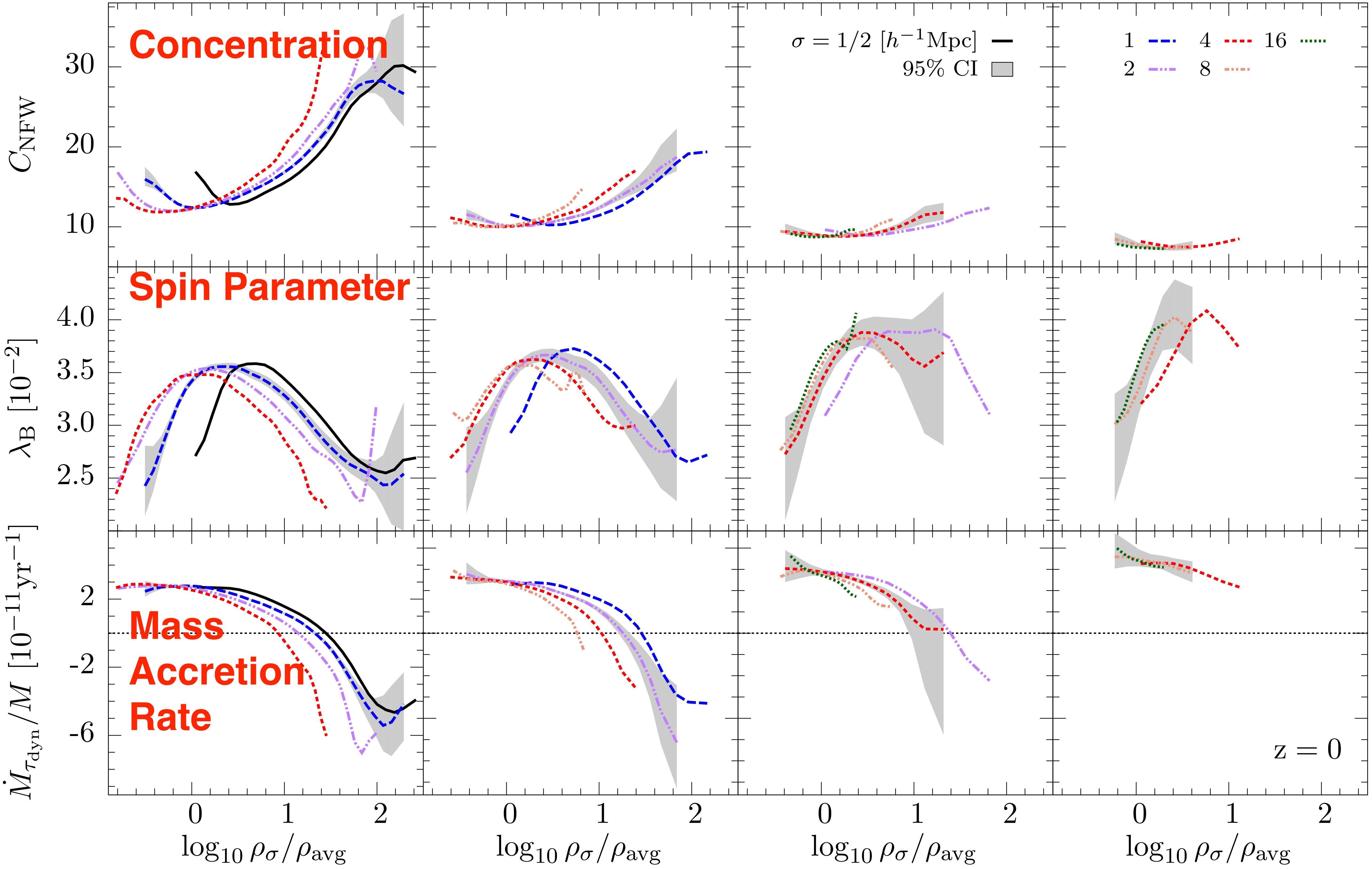
Improved Santa Cruz Semi-Analytic Model of galaxy population evolution, including insights from high-resolution hydro simulations — Viraj Pandya, Christoph Lee, Rachel Somerville, Sandy Faber

Properties of Dark Matter Haloes: Local Environment Density

Christoph T. Lee, Joel R. Primack, Peter Behroozi, Aldo Rodríguez-Puebla, Doug Hellinger, Avishai Dekel **MNRAS 2017**

Low Mass **Intermediate Mass** **High Mass**

$\log_{10} M_{\rm vir}/(h^{-1}M_{\odot})$ = 11.200±0.375 11.95±0.375 12.70±0.375 13.45±0.375



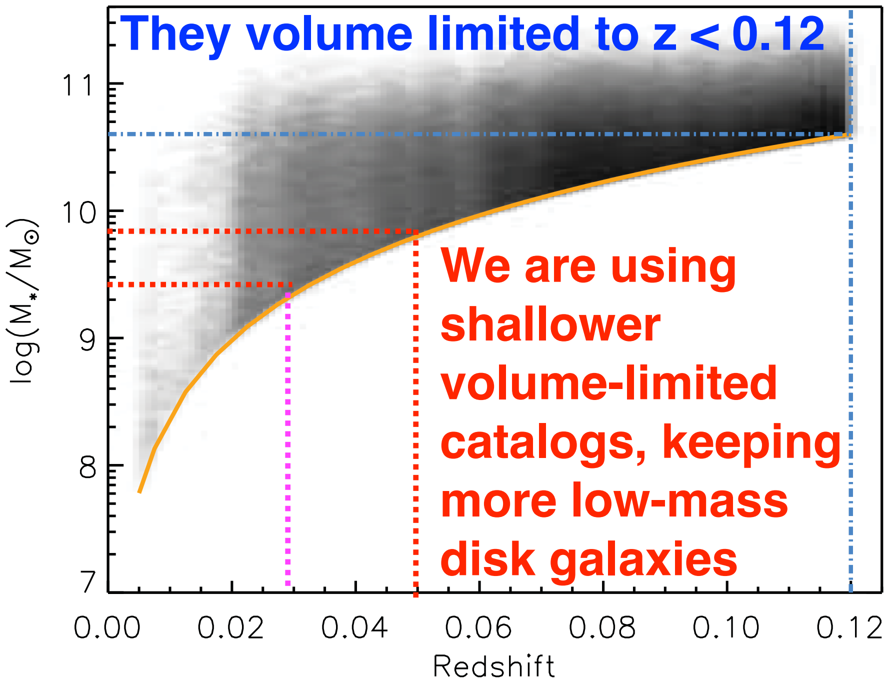
Is Galaxy Radius $R^*_{3D} \propto \lambda R_{halo}$? Measure R^*_{3D} vs. Local Density

Huertas-Company+13 found no difference vs. density, and Cebrian & Trujillo MNRAS 2017 find that galaxies in low-density regions are slightly larger.

The effect of the environment on the stellar mass–size relationship for present-day galaxies

Marıa Cebrian and Ignacio Trujillo MNRAS 2014

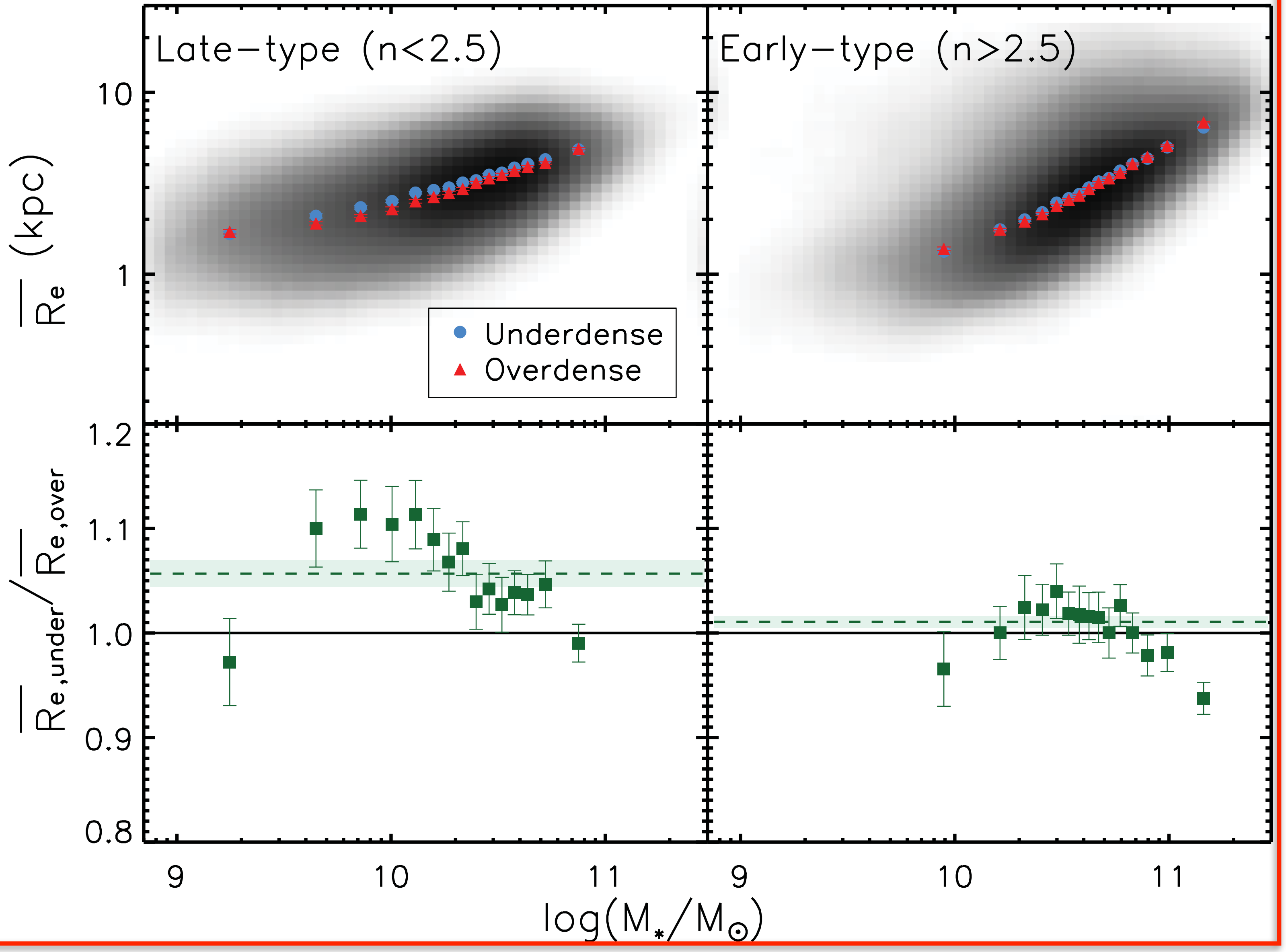
For every galaxy in our sample, we explore the surrounding density within 2 Mpc using two distinct estimators of the environment. We find that galaxies are slightly larger in the field than in high-density regions. This effect is more pronounced for late-type morphologies (~7.5 per cent larger) and especially at low masses ($M_* < 2 \times 10^{10}\,M_\odot$), although it is also measurable in early-type galaxies (~3.5 per cent larger).



They volume limited to $z < 0.12$

We are using shallower volume-limited catalogs, keeping more low-mass disk galaxies

Figure 4. The redshift–mass plane of the stellar mass-complete galaxies in the NYU-VAGC. The solid orange line shows the mass-completeness line of the sample. The vertical and horizontal blue lines indicate the redshift and the mass limit used to explore the density of various environments. In order to lighten the plot, the density of objects is represented as a shaded surface instead of using individual points.



We are measuring R^*_{3D} vs. density in SDSS, and spin λ by the exact same methods in mock catalogs from Bolshoi-Planck and MultiDark-Planck.

After my talk at the Galaxy-Halo conference at the KITP at UCSB last week, Simon White said that our work with Tze Goh showing that halo properties are controlled by density rather than cosmic web location is compatible with the findings of Fan, Yan, and White 2013 (http://adsabs.harvard.edu/abs/2013MNRAS.430.3432Y). Reading that paper, I see that they also found that on their "adaptive smoothing scale" of ~2 Mpc, measured by the distance to the 3rd nearest galaxy in a volume-limited SDSS+ NYU-VAGC sample with r-magnitude brighter than -20 (corresponding to z<0.062), galaxies in low density environments are smaller:

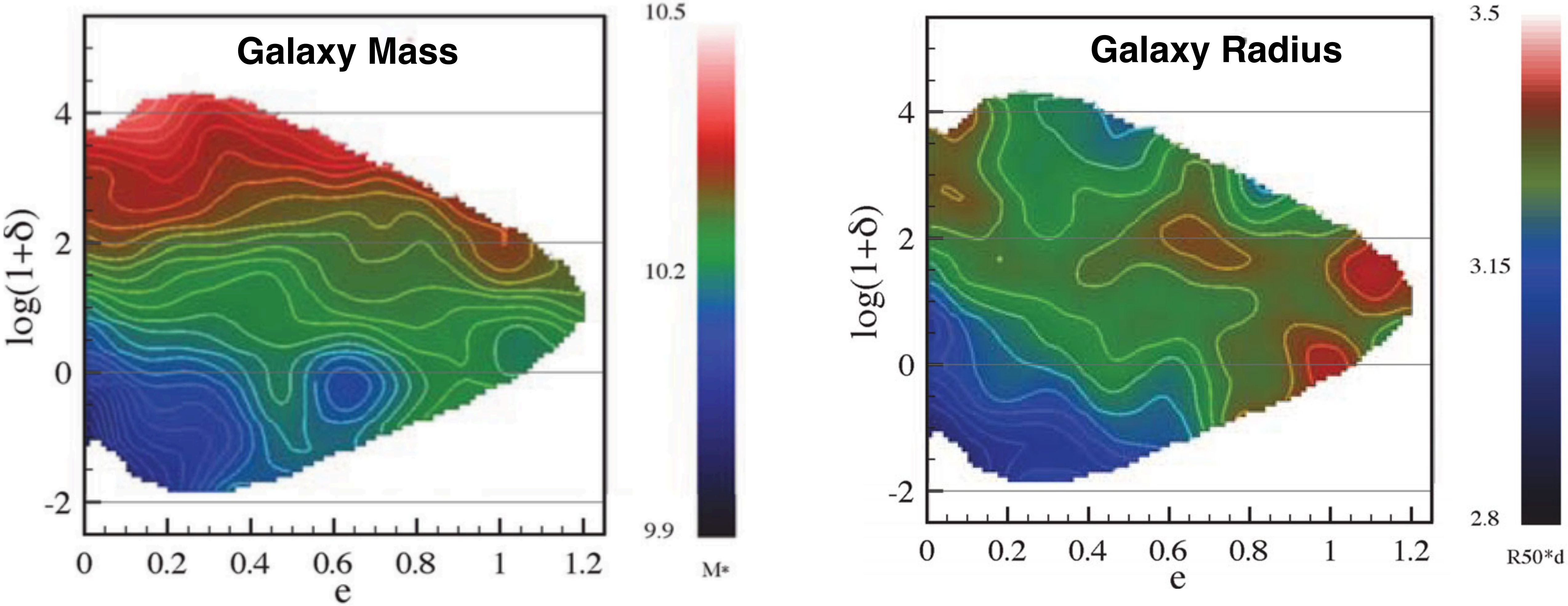
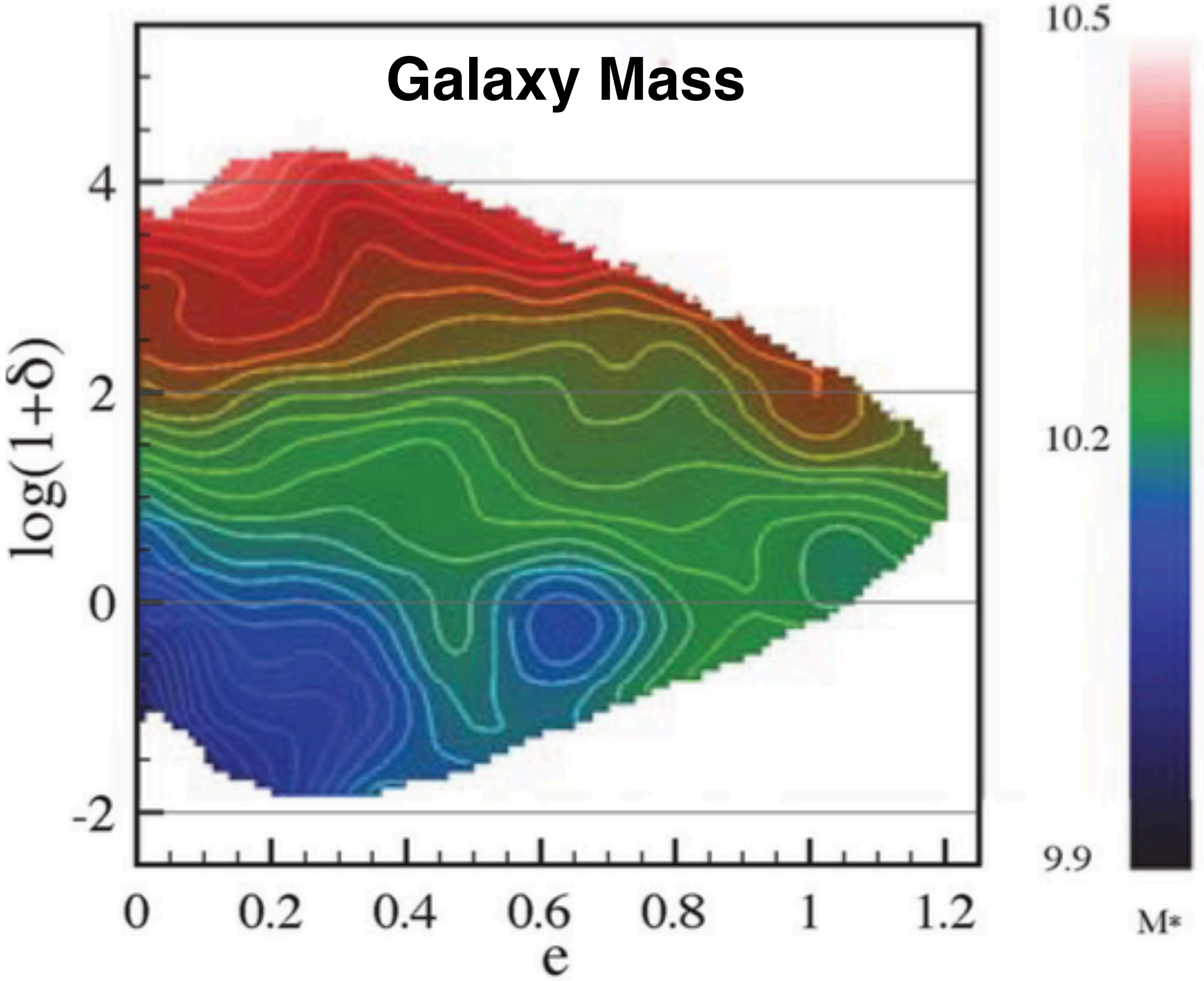
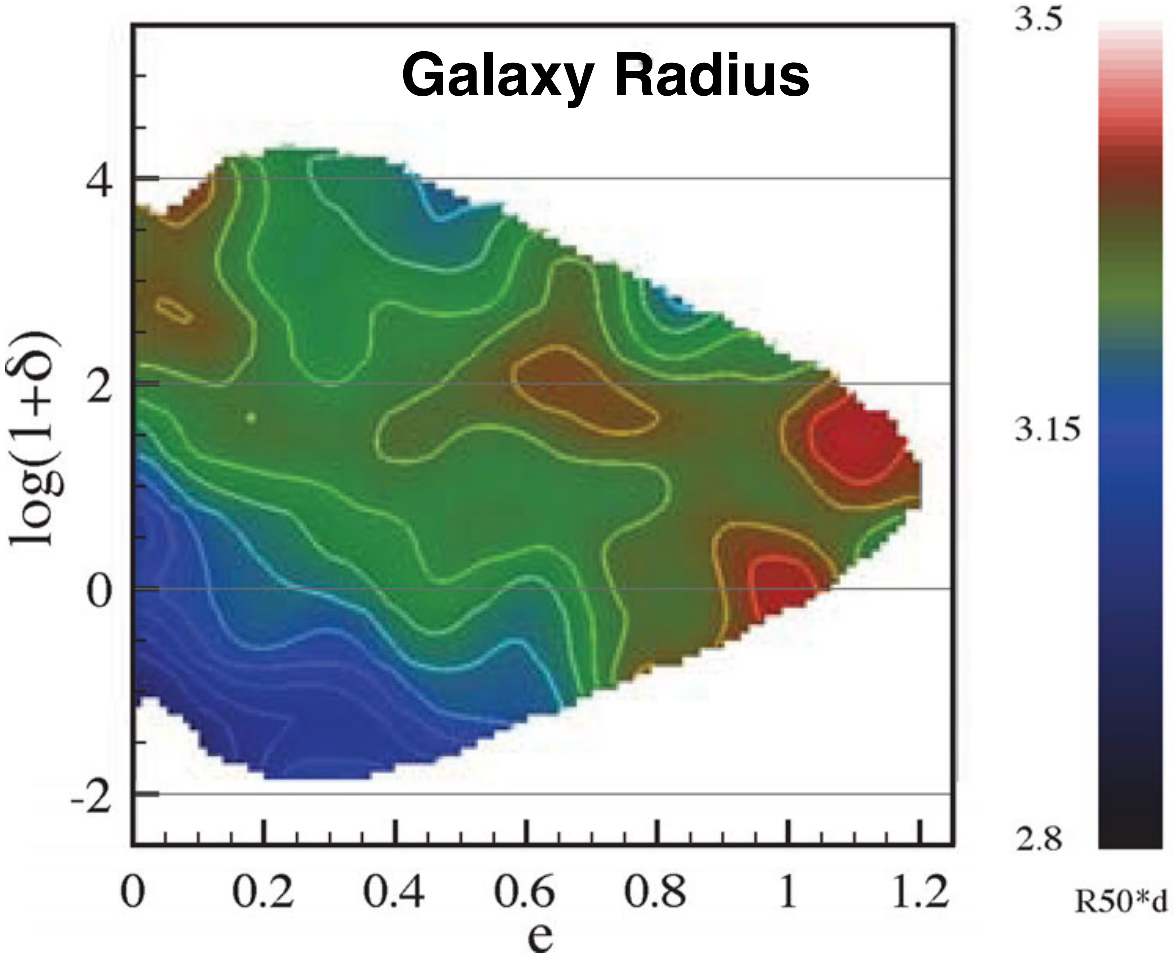


Figure7. Left panel: contours of stellar mass in the *e*–log(1+δ) plane for SDSS M_r20 galaxies. **Right panel**: contours of galaxy size defined as R50 d in unit of kpc for the SDSS M_r 20 sample. The boundary for both panels is the 0.2σ uncertainty contour, where σ is the standard deviation of galaxy size for the whole sample. The optimal adaptive smoothing is applied.

My comment (revised): The right panel of Fig. 7 shows that at low densities the size is ~ 3.10 kpc (deep blue) while at higher densities the sizes range from 3.15 to 3.5, so the size ratio is about 3.3/3.0 i.e. 10%, with some dependance also on the ellipticity parameter e. However, the left panel shows that galaxies are lower mass in lower density regions (as we would also expect). The mass ratio from intermediate density to lowest density is about $10^{10.25}/10^{10}$ i.e. ~75%. Since halo radius is proportional to the cube root of halo mass, the mass difference corresponds to a halo radius difference of ~25%. So most of the differences in galaxy radii could be due to lower masses rather than smaller spin parameters in low-density regions. **We need to quantify this: how much smaller are radii as a function of density at fixed stellar mass.**





Fan, Yan, & White 2013, left column of p. 3439:

We also analyse the environmental dependence of galaxy size defined as $R50d$ in units of h^{-1} kpc, where d denotes the distance to a galaxy. The results are shown in the lower panel of Fig. 7, again using our optimal adaptive smoothing. It is seen that in high-density regions, galaxy size has no detectable correlation with either environmental density or ellipticity. In low-density regions, on the other hand, there is a notable correlation between galaxy size and e_0 in addition to the correlation with δ_0. We will show in Section 4.3 that in low-density regions, survey boundary effects can bias the δ_0 and e_0 measurements to lower values. This can induce an artificial correlation with e_0 , which is considerable for small-volume samples such as M_r 18. For M_r 20, however, the survey volume is large and the boundary effects are insignificant. **Thus the correlations seen in the lower left region of the right panel Fig. 7 may indicate that both the density and the ellipticity of the environment can affect the galaxy size. Galaxies are systematically smaller in lower (δ , e) regions.** Due to the still limited statistics of SDSS, the environmental e_0 dependence of galaxy size needs to be investigated further with future large surveys that can provide much improved statistics.

And near the bottom of the first column on p. 3442:

Our analysis shows that galaxy size is independent of environment in high-density regions. In low-density regions, some correlation with e_0 in addition to the dependence on δ_0 is detected. Galaxies in lower (δ_0, e_0) regions tend to be smaller. Such correlations need to be further explored with future observations.

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MNRAS **430,** 3432–3444 (2013)

The dependence of galaxy properties on the large-scale tidal environment

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ABSTRACT

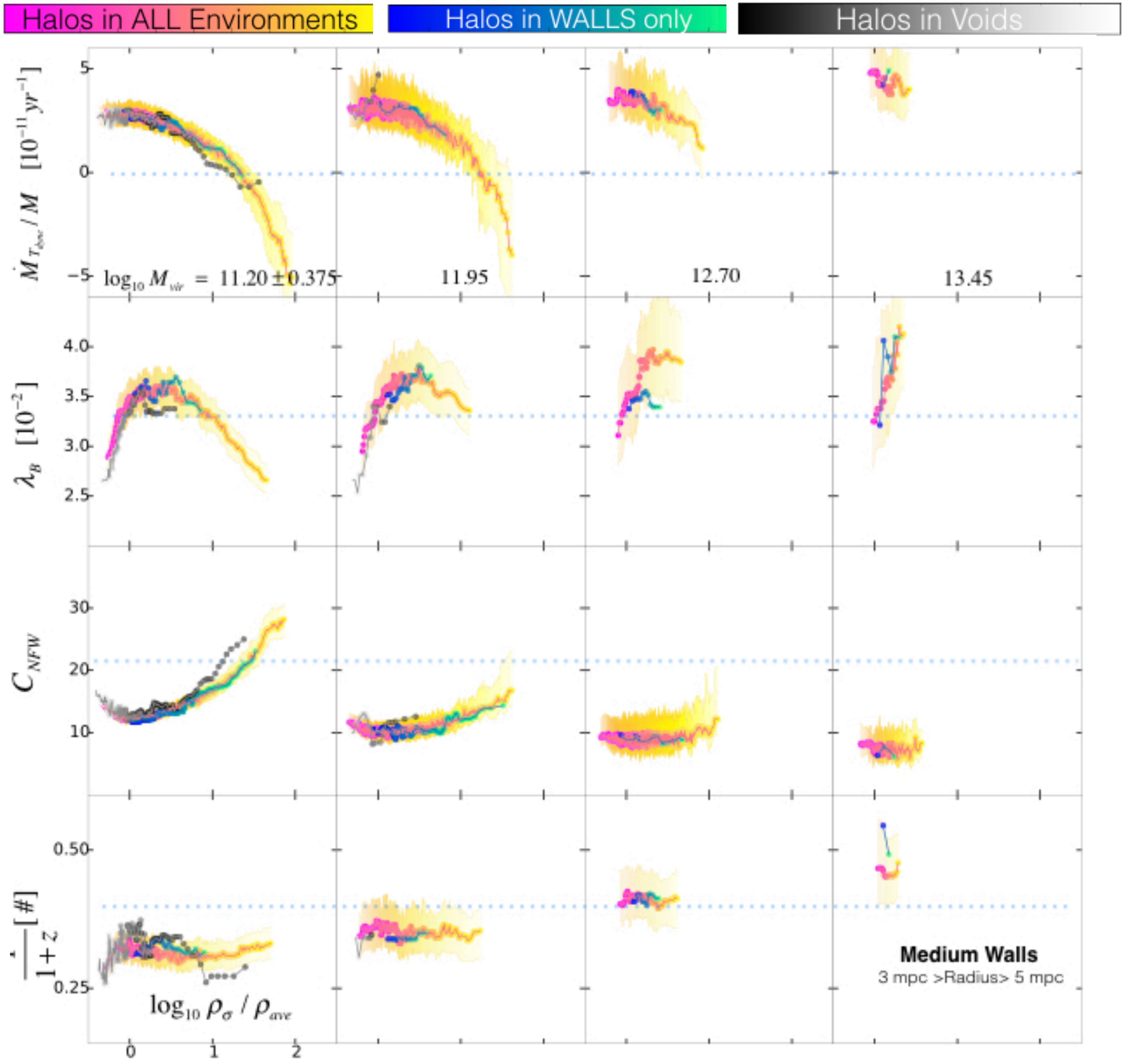
Using volume-limited samples drawn from the Sloan Digital Sky Survey Data Release 7 (SDSS DR7), we measure the tidal environment of galaxies, which we characterize by the smoothed spatial number density $1 + \delta$ of galaxies and the ellipticity e of the potential field derived from it. We investigate whether galaxy colour, D_n4000, concentration and size correlate with e, in addition to depending on $1 + \delta$. We find that there exists a transition smoothing scale at which correlations/anti-correlations with e reverse. This transition scale is well represented by the distance to the third nearest neighbour of a galaxy in a volume-limited sample with $M_r < -20$, which has a distribution peaked at $\sim 2\,h^{-1}$ Mpc. We further demonstrate that this scale corresponds to that where the correlation between the colour of galaxies and environmental density $1 + \delta$ is the strongest. For this optimal smoothing R_0 no additional correlations with e are observed. The apparent dependence on tidal ellipticity e at other smoothing scales $R_{\rm s}$ can be viewed as a geometric effect, arising from the cross-correlation between $(1 + \delta_{\rm o})$ and $e(R_{\rm s})$. We perform the same analysis on numerical simulations with semi-analytical modelling (SAM) of galaxy formation. The e dependence of the galaxy properties shows similar behaviour to that in the SDSS, although the colour–density correlation is significantly stronger in the SAM. The ‘optimal adaptive smoothing scale’ in the SAM is also closely related to the distance to the third nearest neighbour of a galaxy, and its characteristic value is consistent with, albeit slightly smaller than for SDSS.

5 CONCLUSION AND DISCUSSION

In summary, our analysis of SDSS data shows that in addition to environmental density, there is no significant further dependence of galaxy properties on the tidal environment of large-scale structure. Geometrically, ellipticity and density on one smoothing scale cor- relate strongly with ellipticity/density on other smoothing scales. If the smoothing scale is not chosen properly, apparent dependence of galaxy properties on both environment ellipticity and environment density arises which is merely due to geometry. We find that for the optimal adaptive smoothing scale, the dependence on density is maximized and the dependence on ellipticity and prolateness is null.

Halo Properties Independent of Web Location at the Same Density

Tze Ping Goh, Christoph T. Lee, Joel R. Primack, Miguel Aragon Calvo, Peter Behroozi, Aldo Rodríguez-Puebla, Doug Hellinger, Avishai Dekel, Kathryn Johnston (in preparation)



At the same environmental density, halo properties are independent of cosmic web location. It doesn't matter whether a halo is in a cosmic void, wall, or filament, what matters is the halos's environmental density. The properties studied are mass accretion rate, spin, halo concentration, scale factor of the last major merger, and prolateness. We had expected that a web's cosmic web location would matter for at least some of these halo properties. That it does not is a significant discovery.

GAMA data show that the galaxy luminosity function is also independent of web environment at fixed density (Eardley et al. MNRAS 2015). This contrasts with the finding that the halo mass function is dependent on web location at the same density using the v-web (Metuki, Liebeskind, Hoffman 2016).