Constraints on Assembly Bias from Galaxy Clustering

Andrew R. Zentner[1], Andrew P. Hearin[2], Frank C. van den Bosch[3],
Antonio Villareal[1], Johannes Lange[3], P. Rogers Nelson[4], Probably some others of unspecifi

[1] *Department of Physics and Astronomy & Pittsburgh Particle Physics, Astrophysics, and Cosmology Center (PITT PACC),*
University of Pittsburgh, Pittsburgh, PA 15260
[2] *Yale Center for Astronomy & Astrophysics, Yale University, New Haven, CT*
[3] *Department of Astronomy, Yale University, P.O. Box 208101, New Haven, CT*
[4] *Paisley Park, Chanhassen, MN*

Today

ABSTRACT

We fit SDSS DR7 data with models that include assembly bias.

1 INTRODUCTION

2 METHODS

3 RESULTS

We have performed parameter inference analyses in order to infer the underlying HOD of galaxies from the projected galaxy two-point function $w_{\mathrm{p}}(r_{\mathrm{p}})$ as described in the preceding section. In this section, we describe the primary results of these analyses. Our marginalized one-dimensional parameter constraints are given in Table **??**.

3.1 Standard Analysis

Prior to discussing our results using models that include assembly bias, we present results of standard HOD analyses that include no model for assembly bias.

3.2 Analysis with Decorated HOD

Sample M_r	Authors	$\log(M_{\min})$	$\sigma_{\log M}$	$\log(M_1)$	α	$A_{\rm cen}$	$A_{\rm sat}$	$\chi^2/{\rm DoF}$
-21	Zehavi+11	12.78 ± 0.10	0.68 ± 0.15	13.80 ± 0.03	1.15 ± 0.06	$--$	$--$	3.1
-21	Zentner+16	$12.92^{+0.07}_{-0.11}$	$0.74^{+0.09}_{-0.16}$	$13.93^{+0.04}_{-0.05}$	$1.23^{+0.10}_{-0.12}$	$--$	$--$	1.59
-21	Zentner+16	$12.83^{+0.11}_{-0.09}$	$0.60^{+0.15}_{-0.17}$	$13.93^{+0.05}_{-0.08}$	$1.16^{+0.12}_{-0.14}$	$0.29^{+0.44}_{-0.35}$	$0.08^{+0.49}_{-0.36}$	1.34
-20.5	Zehavi+11	12.14 ± 0.03	0.17 ± 0.15	13.44 ± 0.03	1.15 ± 0.03	$--$	$--$	2.7
-20.5	Zentner+16	$12.25^{+0.07}_{-0.03}$	$0.23^{+0.17}_{-0.15}$	$13.59^{+0.02}_{-0.02}$	$1.20^{+0.04}_{-0.04}$	$--$	$--$	1.90
-20.5	Zentner+16	$12.30^{+0.11}_{-0.07}$	$0.42^{+0.20}_{-0.26}$	$13.59^{+0.04}_{-0.04}$	$1.15^{+0.05}_{-0.06}$	$> 0.0(90\%)$	$0.23^{+0.39}_{-0.31}$	1.71
-20	Zehavi+11	11.83 ± 0.03	0.25 ± 0.11	13.08 ± 0.03	1.00 ± 0.05	$--$	$--$	2.1
-20	Zentner+16	$11.95^{+0.11}_{-0.6}$	$0.37^{+0.23}_{-0.21}$	$13.28^{+0.03}_{-0.04}$	$1.16^{+0.04}_{-0.04}$	$--$	$--$	2.19
-20	Zentner+16	$12.23^{+0.33}_{-0.21}$	$0.84^{+0.37}_{-0.31}$	$13.20^{+0.06}_{-0.08}$	$1.05^{+0.06}_{-0.08}$	$> 0.28(99\%)$	$0.01^{+0.32}_{-0.26}$	1.16
-19.5	Zehavi+11	11.57 ± 0.04	0.17 ± 0.13	12.87 ± 0.03	0.99 ± 0.04	$--$	$--$	1.00
-19.5	Zentner+16	$11.76^{+0.33}_{-0.11}$	$0.51^{+0.51}_{-0.29}$	$13.05^{+0.04}_{-0.08}$	$1.12^{+0.04}_{-0.07}$	$--$	$--$	1.24
-19.5	Zentner+16	$11.70^{+0.23}_{-0.08}$	$0.42^{+0.42}_{-0.26}$	$13.04^{+0.08}_{-0.13}$	$1.07^{+0.07}_{-0.10}$	$> -0.05(84\%)$	$> -0.14(84\%)$	0.83
-19	Zehavi+11	11.45 ± 0.04	0.19 ± 0.13	12.64 ± 0.04	1.02 ± 0.02	$--$	$--$	1.8
-19	Zentner+16	$11.72^{+0.33}_{-0.19}$	$0.69^{+0.52}_{-0.46}$	$12.78^{+0.04}_{-0.04}$	$1.03^{+0.04}_{-0.04}$	$--$	$--$	2.77
-19	Zentner+16	$11.62^{+0.33}_{-0.13}$	$0.53^{+0.57}_{-0.35}$	$12.83^{+0.06}_{-0.07}$	$1.02^{+0.04}_{-0.04}$	$0.35^{+0.45}_{-0.66}$	$> 0.02(84\%)$	2.01

Table 1. Results of standard HOD fits to SDSS DR7 $w_{\rm p}(r_{\rm p})$. If the constraints on $A_{\rm cen}$ and $A_{\rm sat}$ are unspecified, then the model used to interpret the data does not include assembly bias.
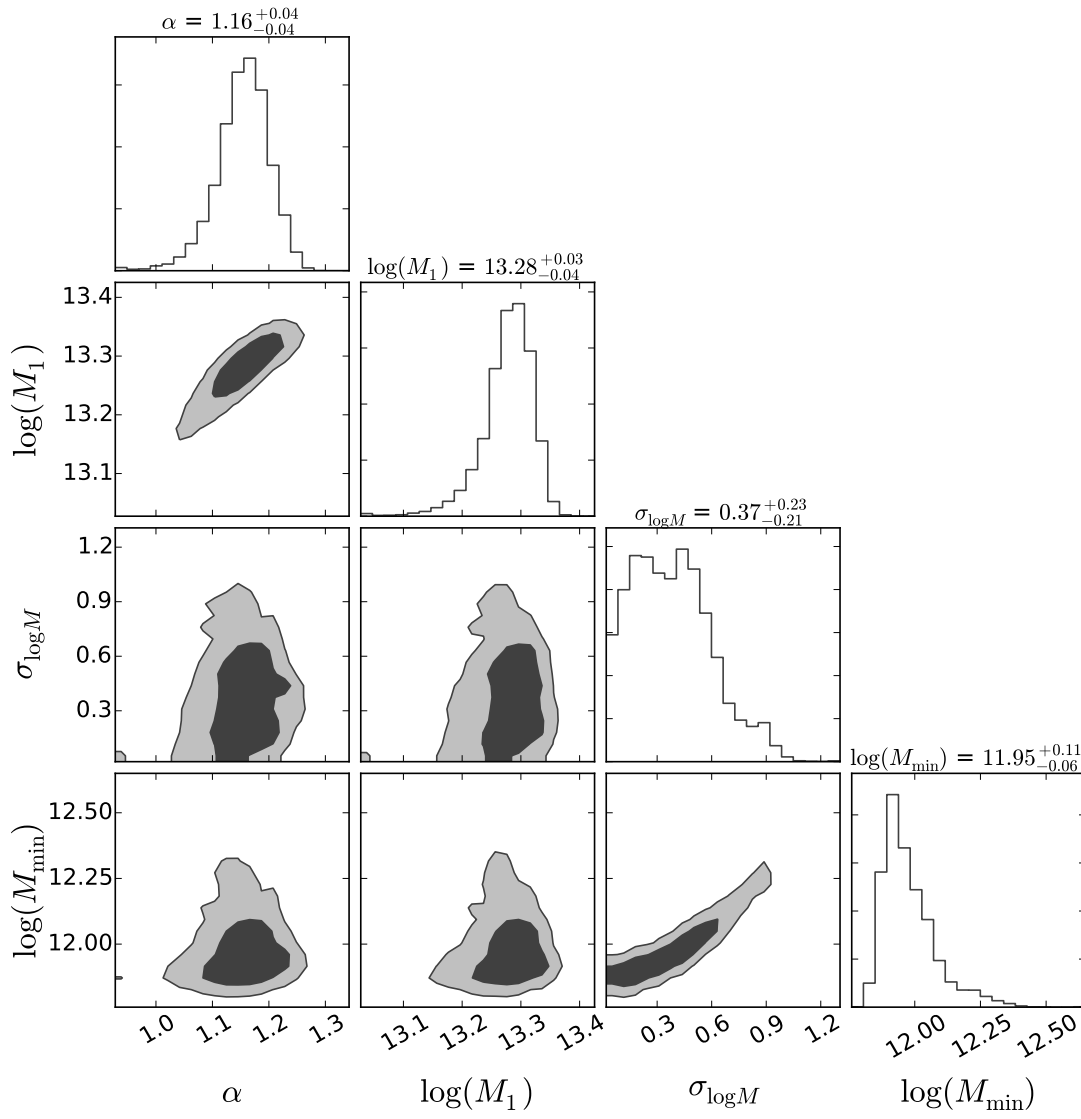
Figure 1. Two-dimensional marginalized constraints on HOD parameters inferred from standard HOD fits to $w_{\mathrm{p}}(r_{\mathrm{p}})$ data for the $M_r < -20$ sample. The HOD parameter $\log(M_0)$ is extremely poorly constrained by the $w_{\mathrm{p}}(r_{\mathrm{p}})$ data and has been omitted from this panel.
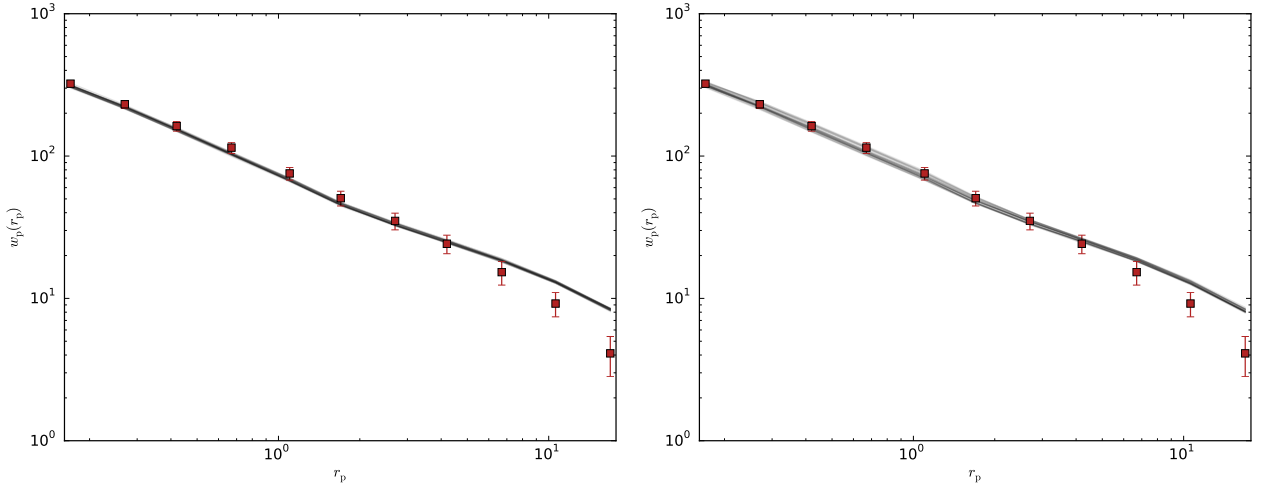
Figure 2. Left: The $M_r < -19$ threshold sample projected correlation function with diagonal elements of covariance (points with errorbars). The grey lines are 25 randomly-selected HOD models that yield $\Delta\chi^2 < 1$ compared to the best-fitting model. **Right:** Same as the left panel for decorated HOD models that contain parameters to describe the strength of assembly bias.
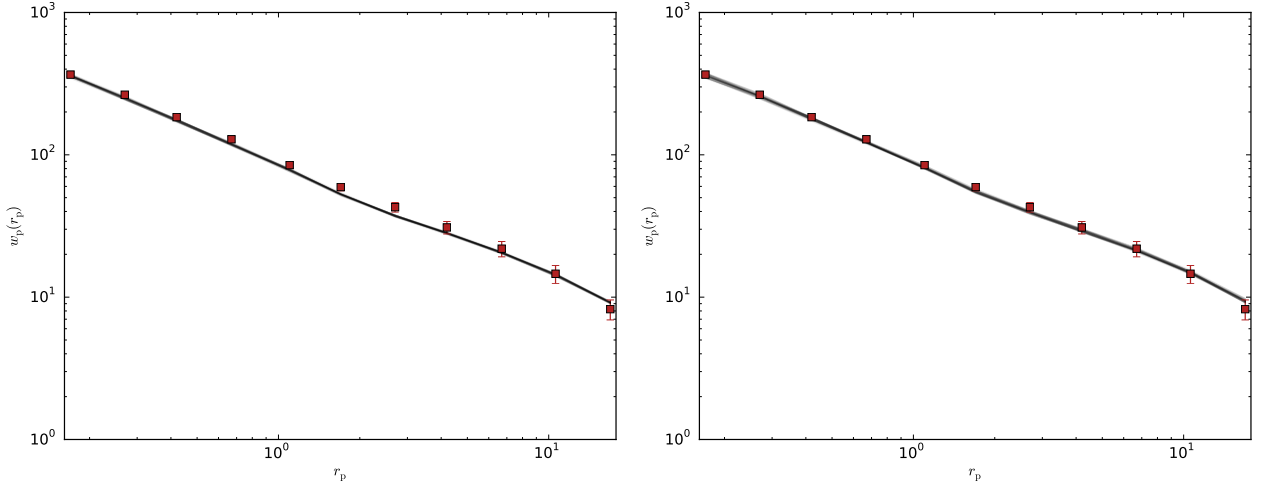

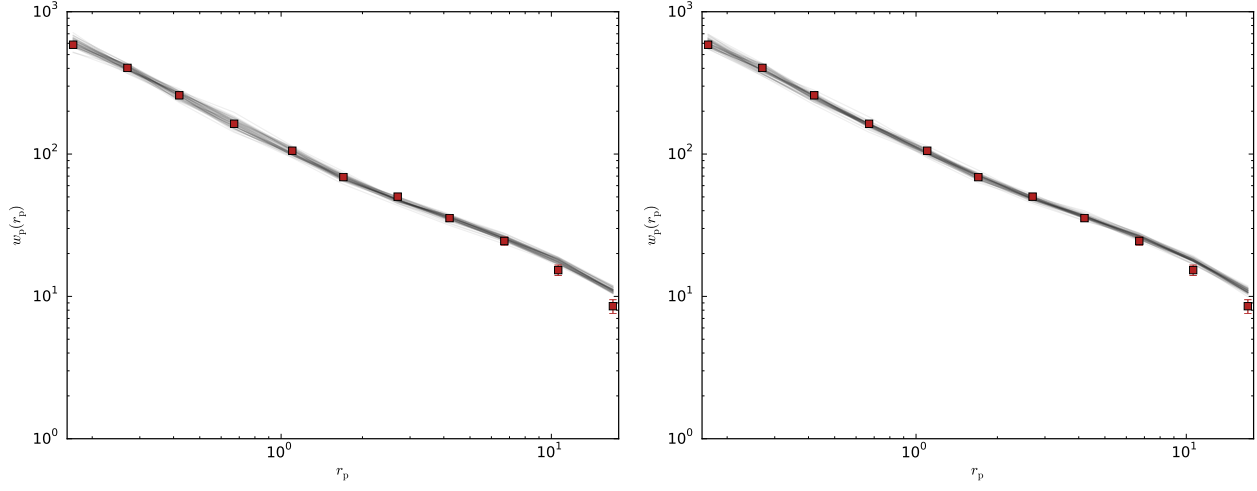**Figure 3.** The same as Figure **??**, but for the $M_r < -20$ threshold sample.

Figure 4. The same as Figure **??**, but for the $M_r < -21$ threshold sample.
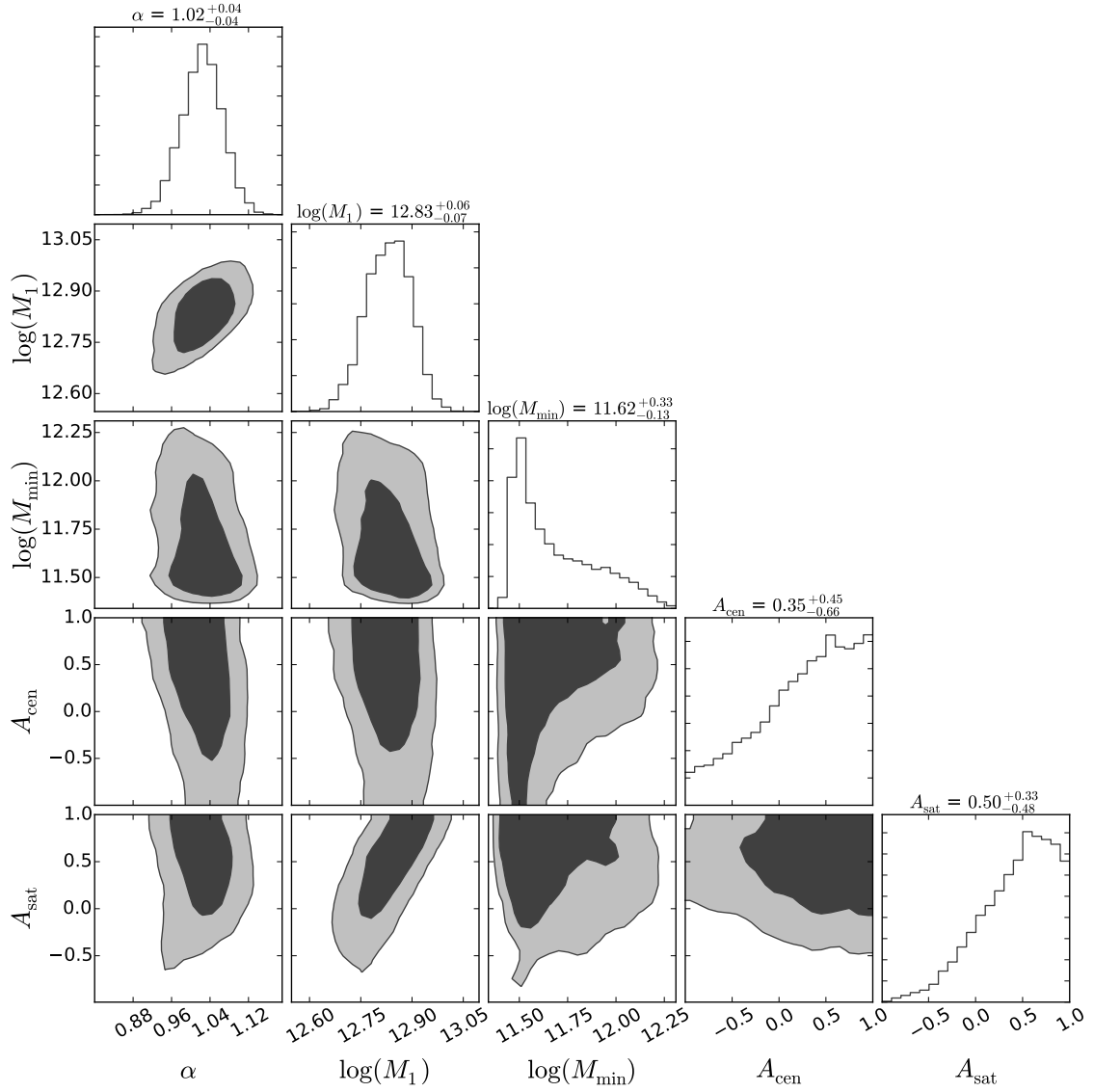
Figure 5. Two-dimensional marginalized constraints on decorated HOD parameters inferred from fits to $w_{\rm p}(r_{\rm p})$ data for the $M_r < -19$ sample. The decorated HOD models include a two-parameter model for assembly bias. The HOD parameter $\log(M_0)$ is extremely poorly constrained by the data and has been suppressed for clarity. Likewise, as in Fig. **??**, $\sigma_{\log M}$ and $\log(M_{\rm min})$ share a narrow degeneracy, so we have suppressed $\sigma_{\log M}$ in order to make constraints on other parameters more easily visible.
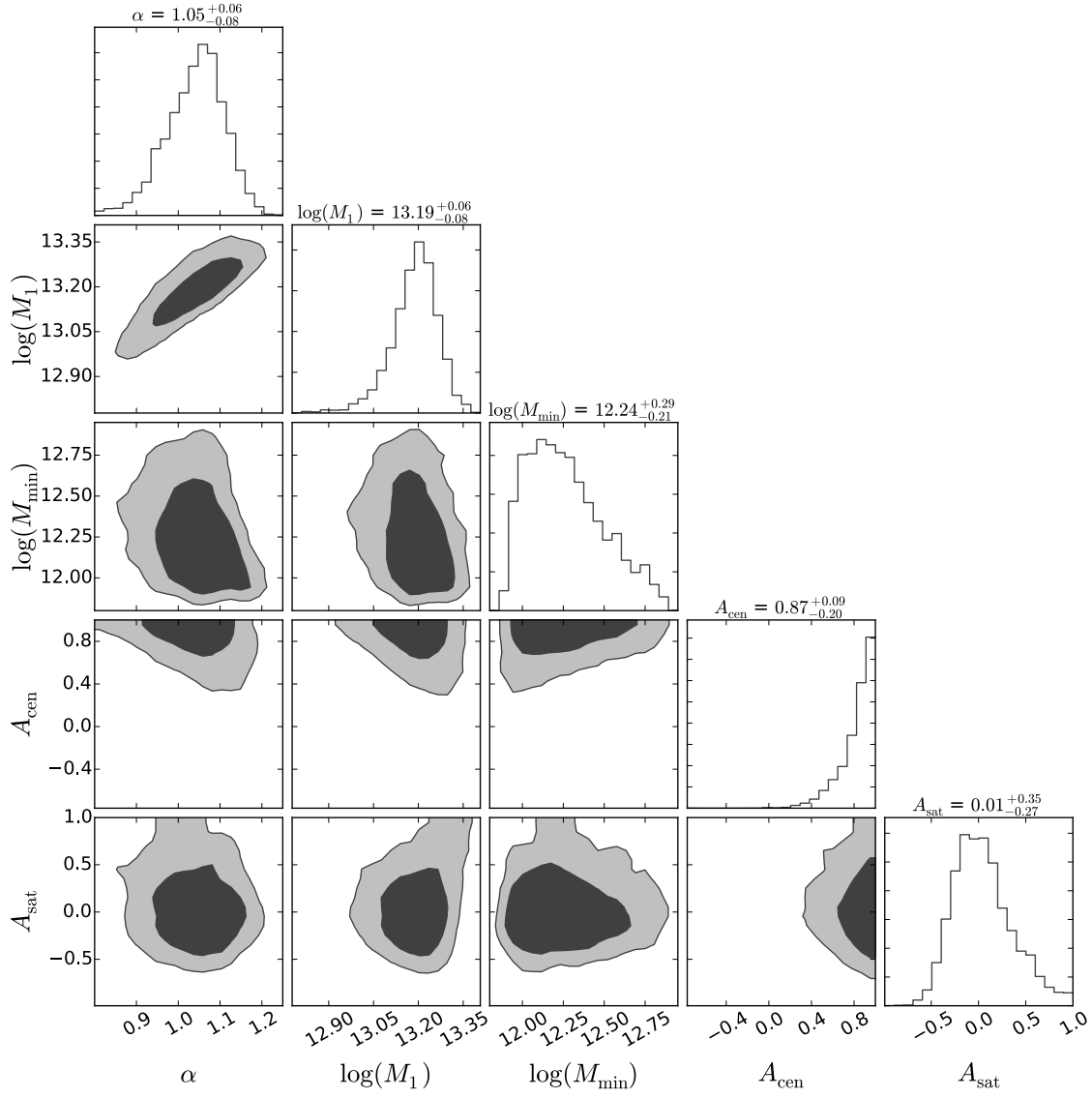
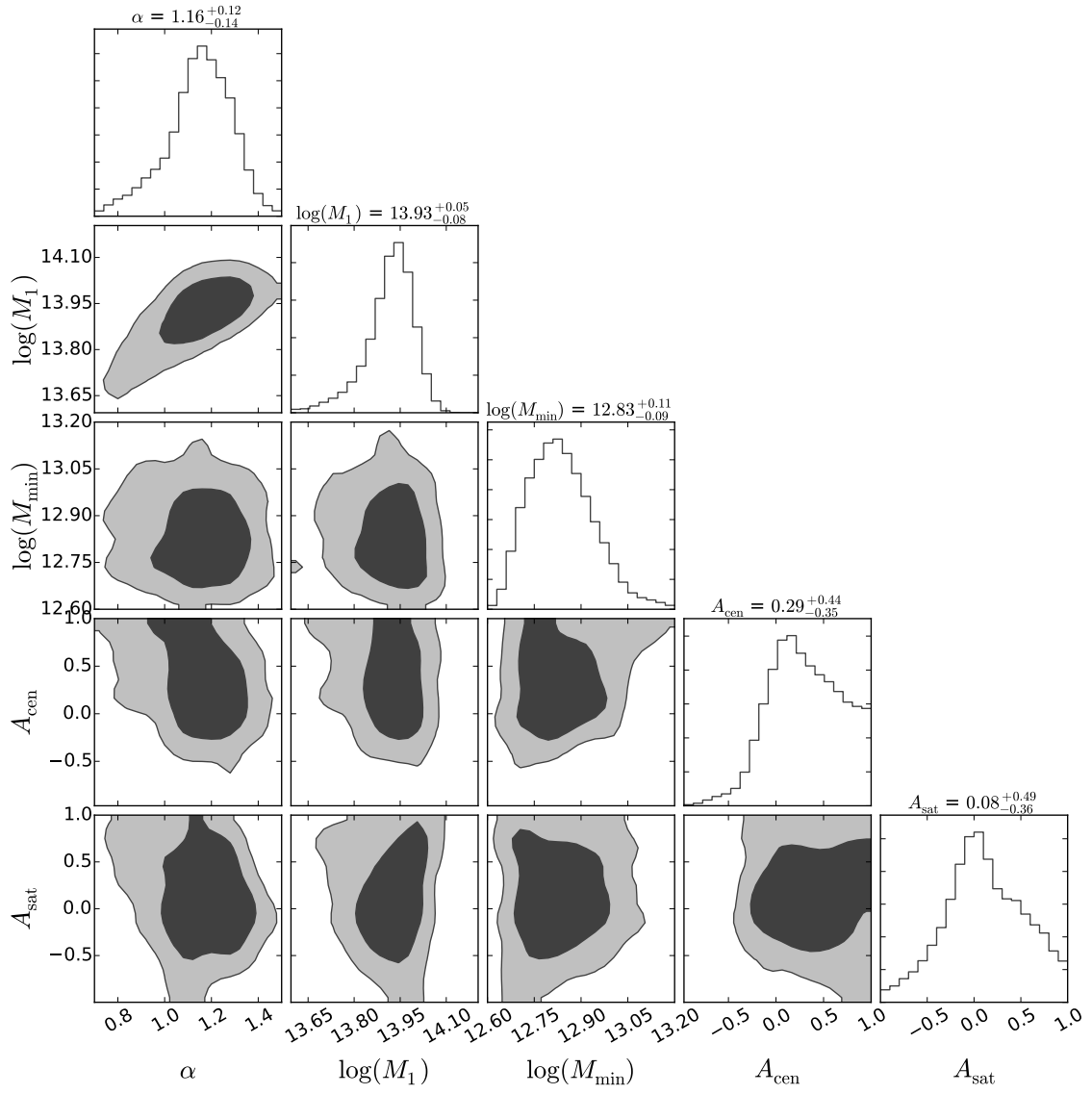**Figure 6.** The same as Figure **??**, but for the $M_r < -20$ sample.

Figure 7. The same as Figure **??**, but for the $M_r < -21$ sample.