Lyα Emission and Radiative Transfer in DLAs

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Are they DLAs?

A model for DLA absorption

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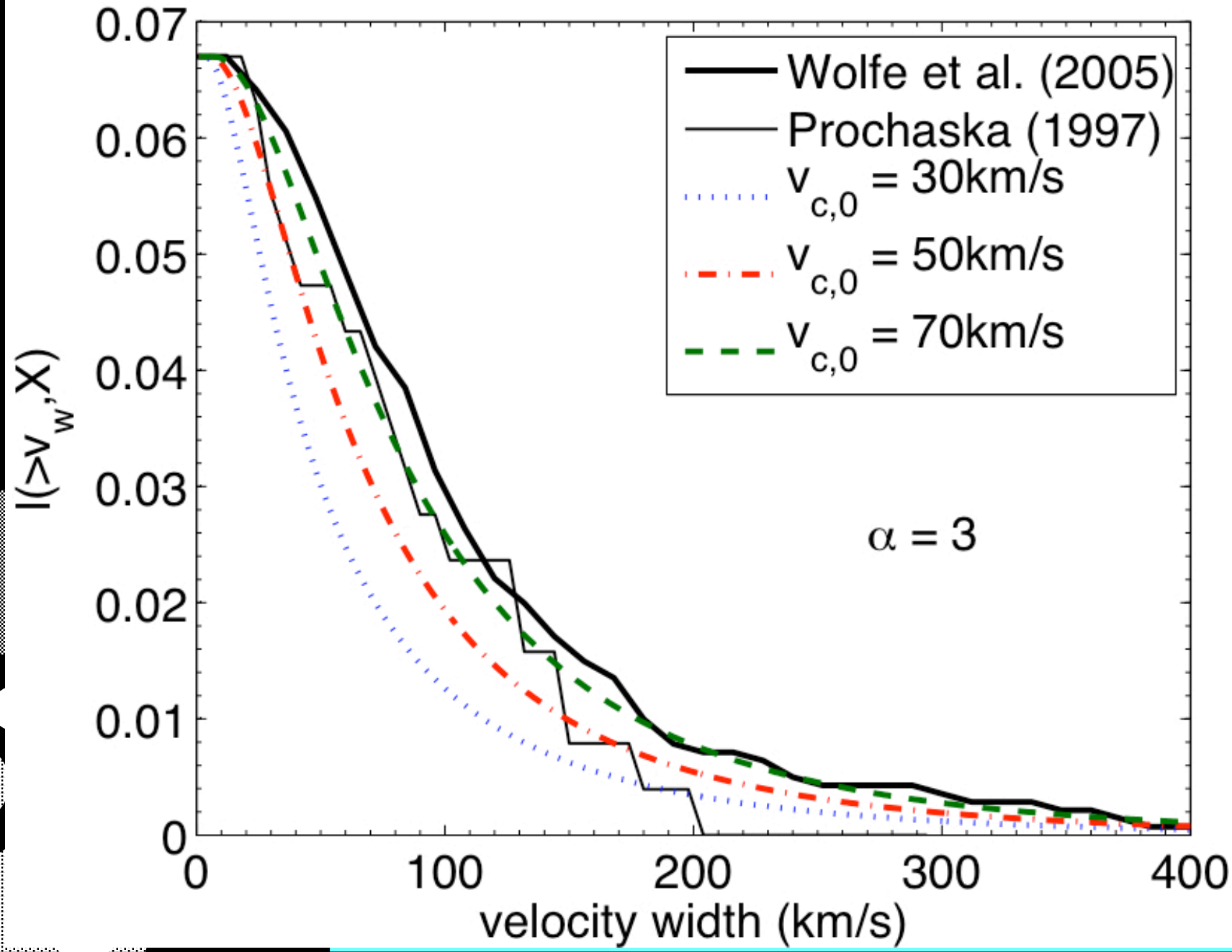
Predict DLA Lyα emission

Velocity Width Distribution

Line Density per unit v_w =

No. Density per unit M × Cross-section (M) × Prob. Dist v_w | M

From simulations:
Median $v_w \approx 0.6\ v_c$


Wolfe et al. (2005)
Prochaska (1997)
$v_{c,0}$ = 30km/s
$v_{c,0}$ = 50km/s
$v_{c,0}$ = 70km/s
$\alpha = 3$
$l(>v_w, X)$
velocity width (km/s)
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
100
200
300
400

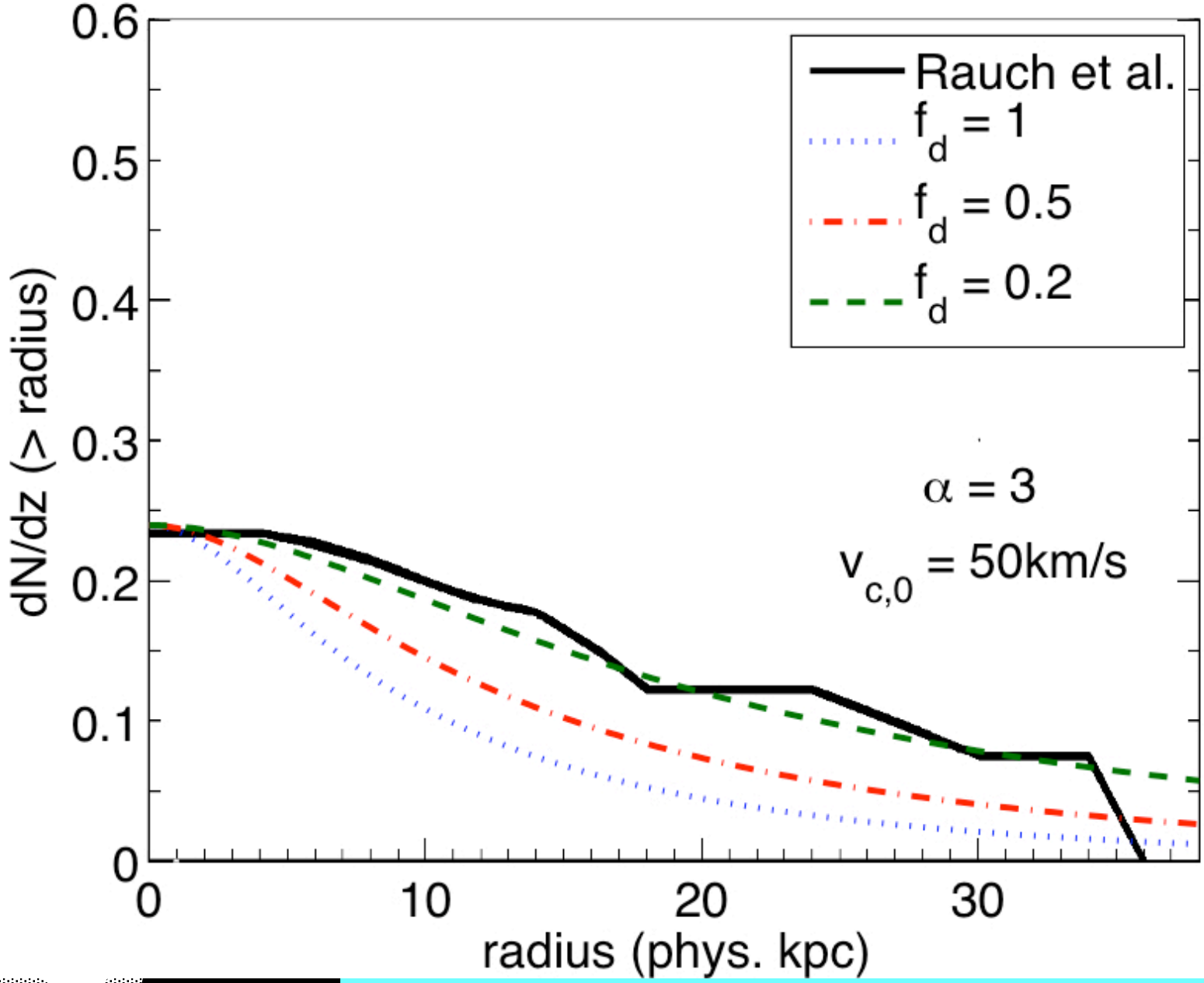
DLAs in emission

- Size distribution
- Luminosity function

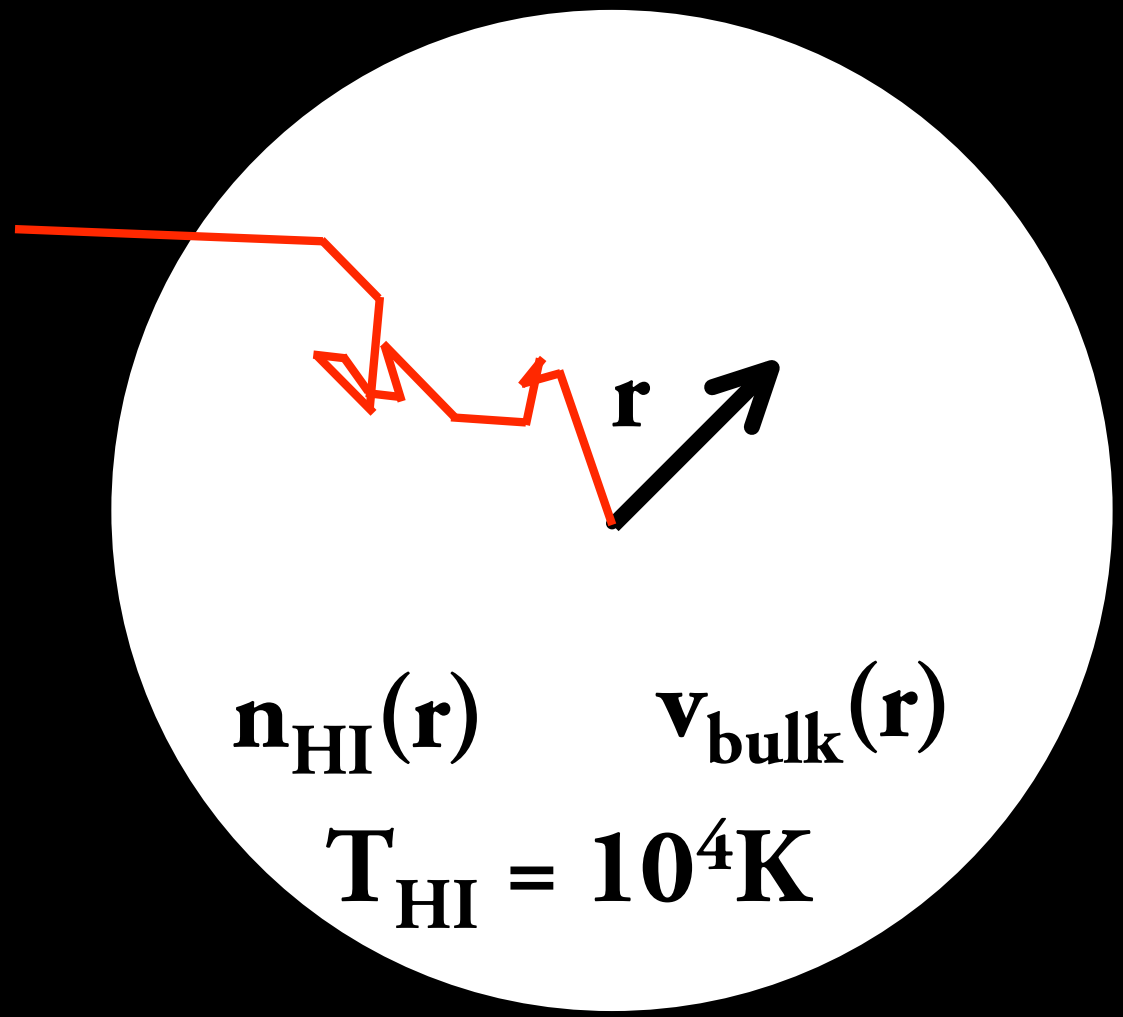
DLAs in emission

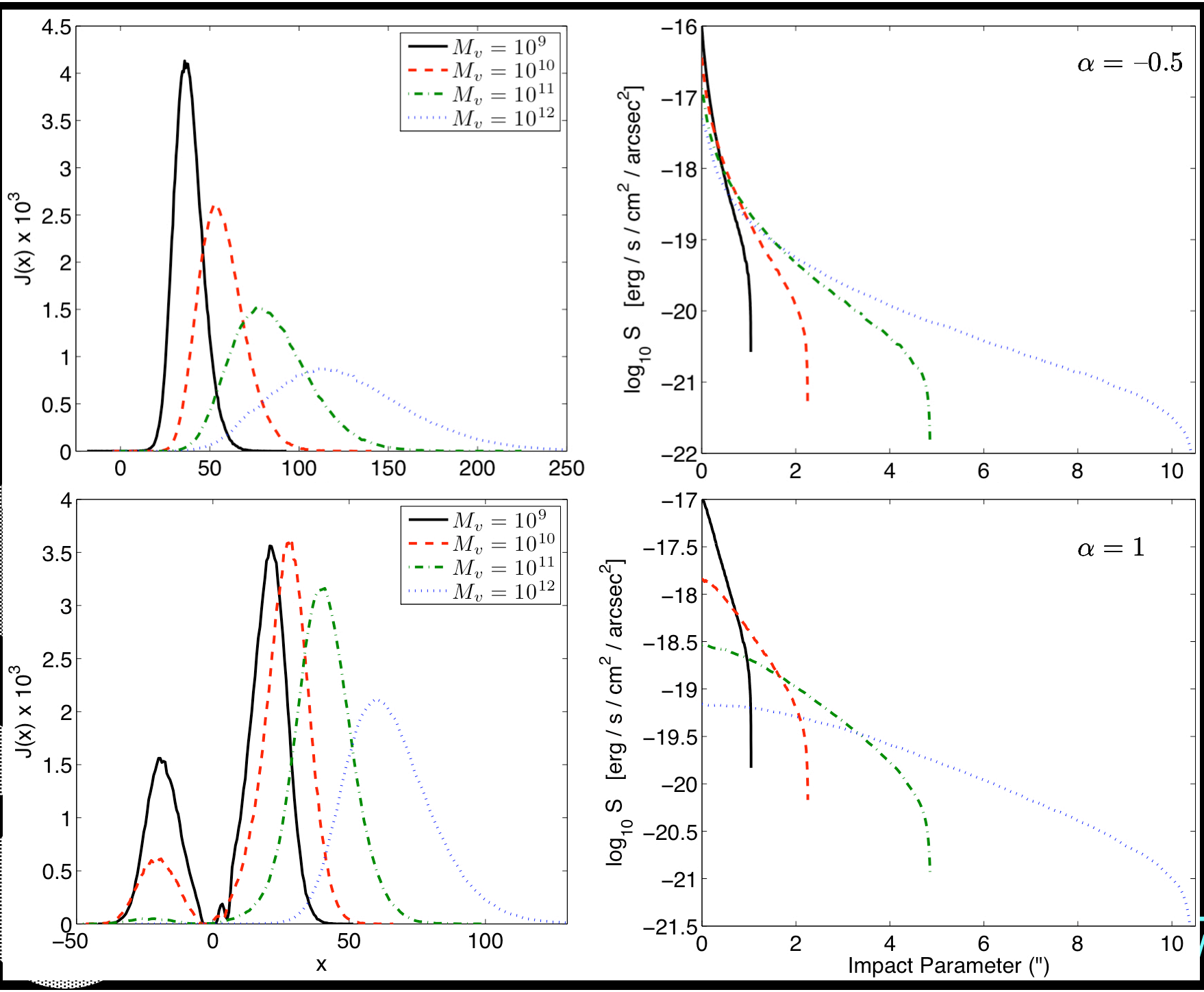
- Size distribution

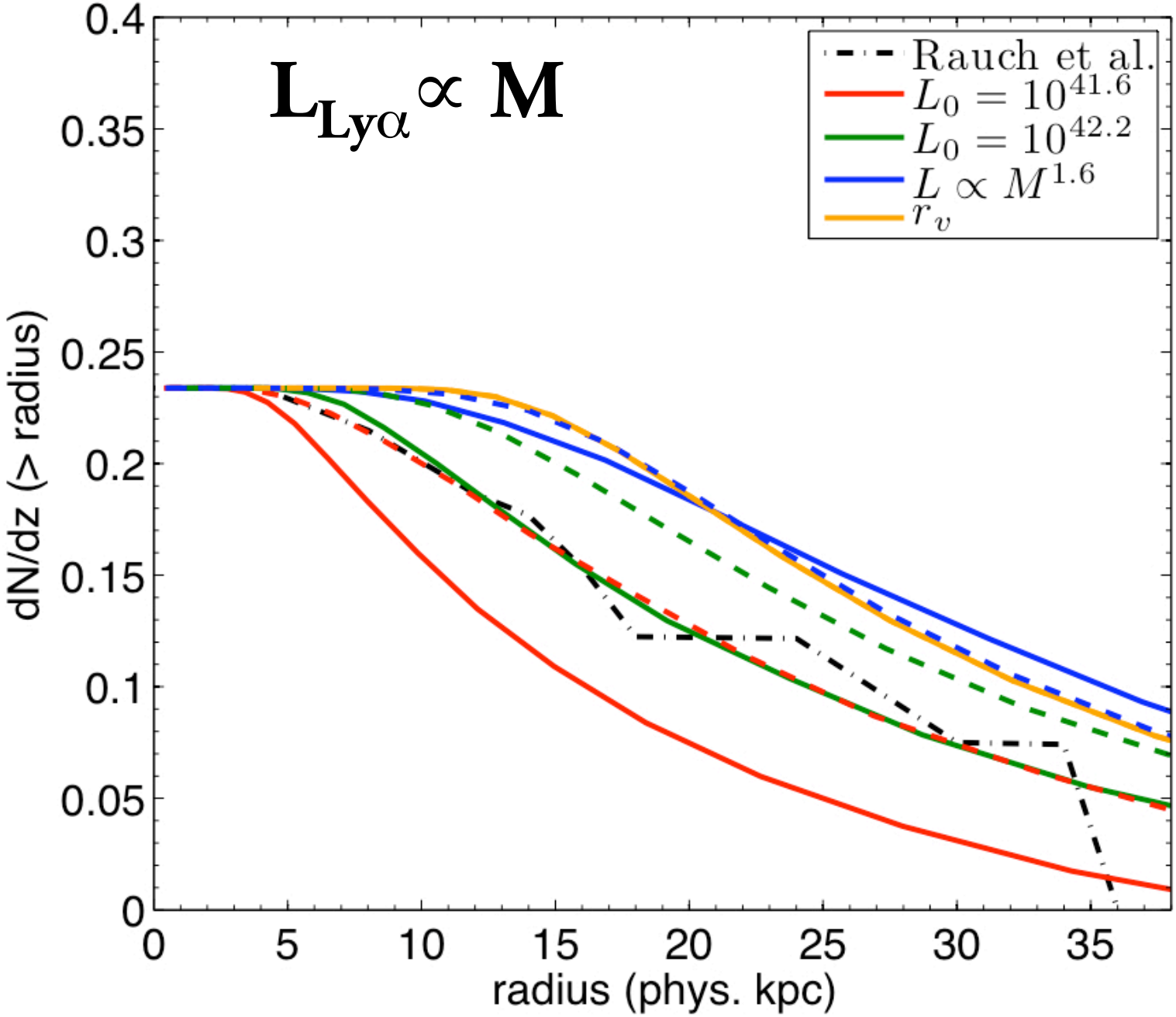
$$\sigma_{abs} = \pi R^2_{em}$$

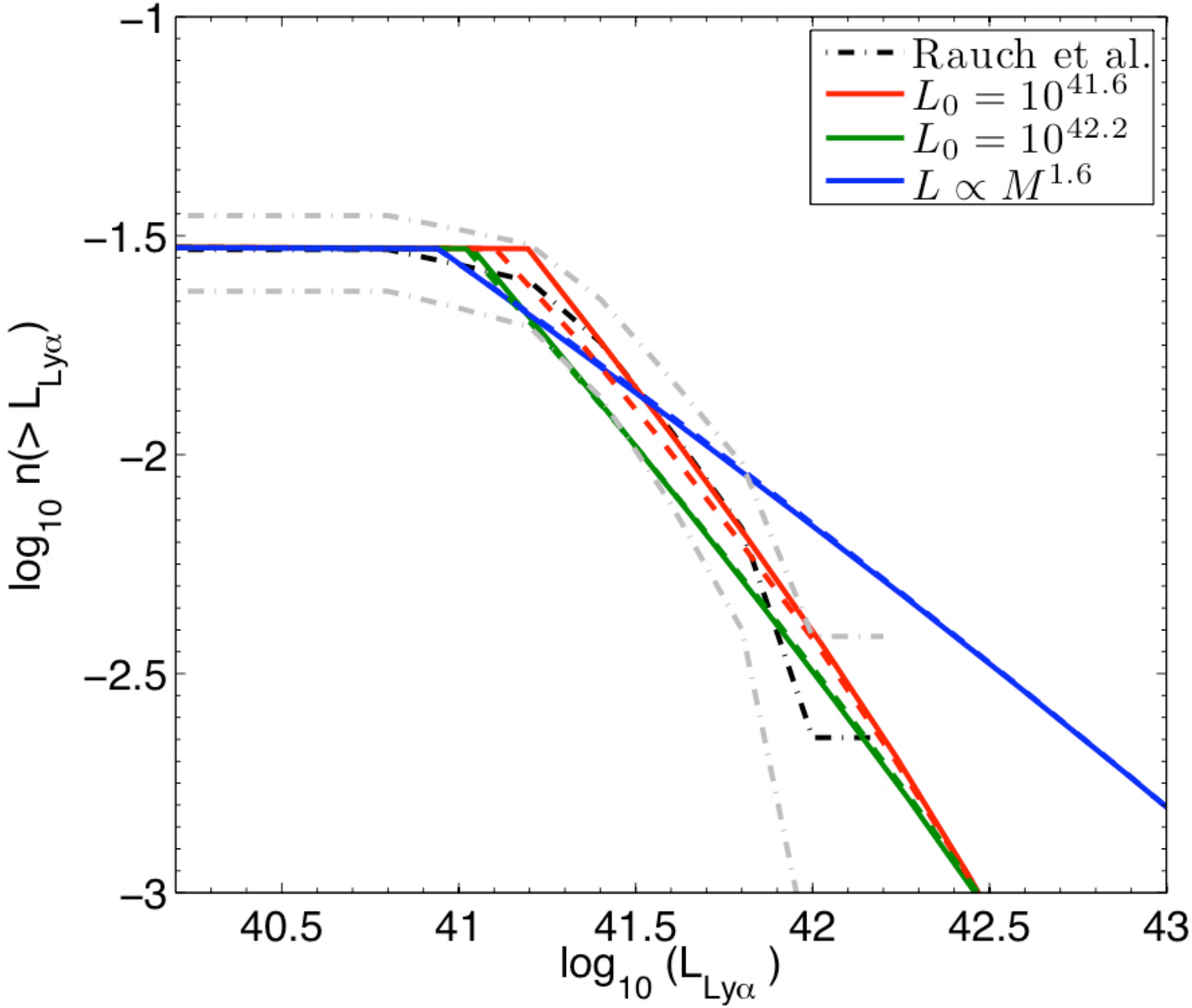

Rauch et al.
$f_d = 1$
$f_d = 0.5$
$f_d = 0.2$
$\alpha = 3$
$v_{c,0} = 50$km/s
dN/dz (> radius)
radius (phys. kpc)
0
0.1
0.2
0.3
0.4
0.5
0.6
0
10
20
30

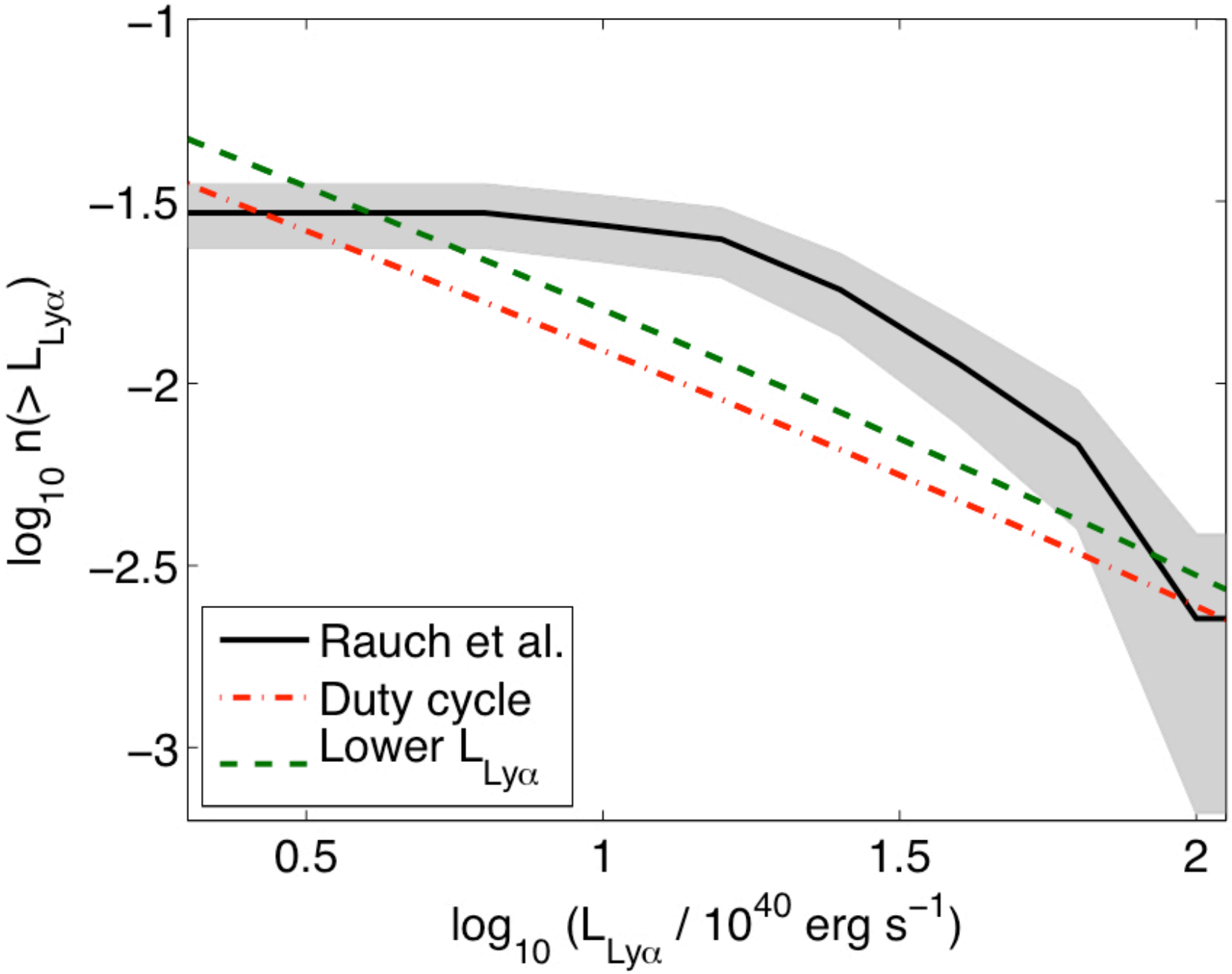
Lyα Radiative Transfer




$M_v = 10^9$
$M_v = 10^{10}$
$M_v = 10^{11}$
$M_v = 10^{12}$
J(x) x 10^3
x
$\alpha = -0.5$
$\alpha = 1$
$\log_{10}$ S [erg / s / cm^2 / arcsec^2]
Impact Parameter (")


$L_{Ly\alpha} \propto M$
Rauch et al.
$L_0 = 10^{41.6}$
$L_0 = 10^{42.2}$
$L \propto M^{1.6}$
r_v
dN/dz (> radius)
radius (phys. kpc)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0
5
10
15
20
25
30
35


Rauch et al.
$L_0 = 10^{41.6}$
$L_0 = 10^{42.2}$
$L \propto M^{1.6}$
$\log_{10} n(> L_{Ly\alpha})$
$\log_{10} (L_{Ly\alpha})$
−1
−1.5
−2
−2.5
−3
40.5
41
41.5
42
42.5
43


−1
−1.5
−2
−2.5
−3
0.5
1
1.5
2
$\log_{10} n(> L_{Ly\alpha})$
$\log_{10} (L_{Ly\alpha} / 10^{40}$ erg s$^{-1})$
Rauch et al.
Duty cycle
Lower $L_{Ly\alpha}$

Conclusions

- Cross-section suppressed below $v_c \sim 50\text{-}70$ km/s
- Lyα radiative transfer can explain the observed sizes
- Central star-formation powered emission