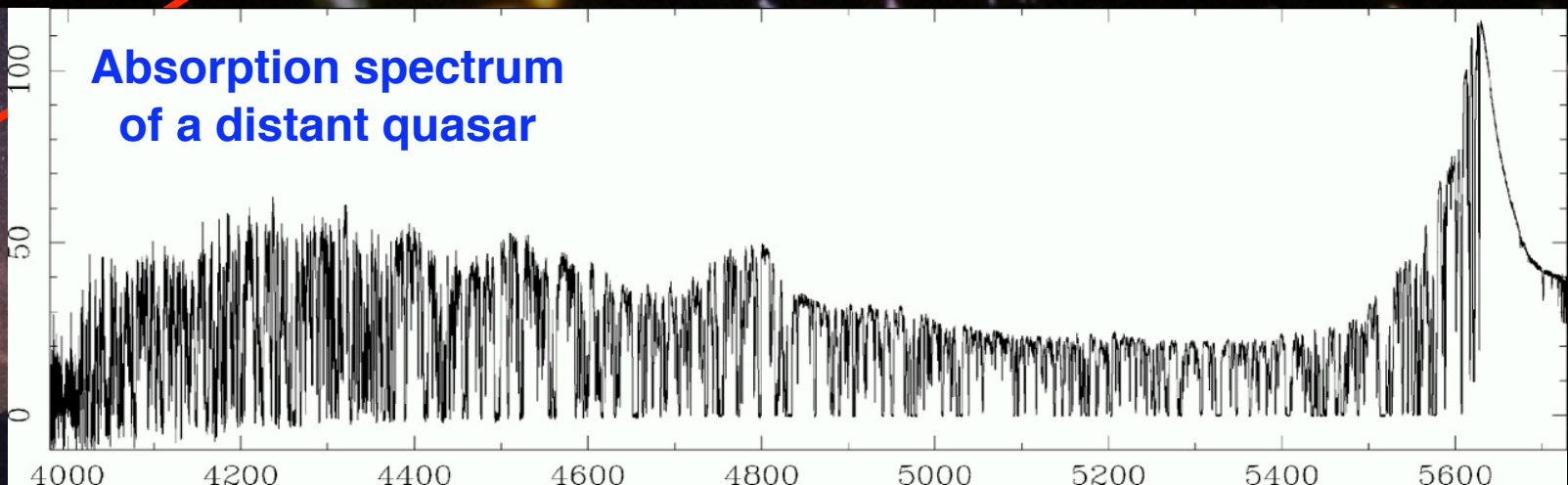
The Baryon Content of Dark Matter Halos:

Hsiao-Wen Chen

(University of Chicago)


Mapping the Dark Universe

Mapping the Dark Universe



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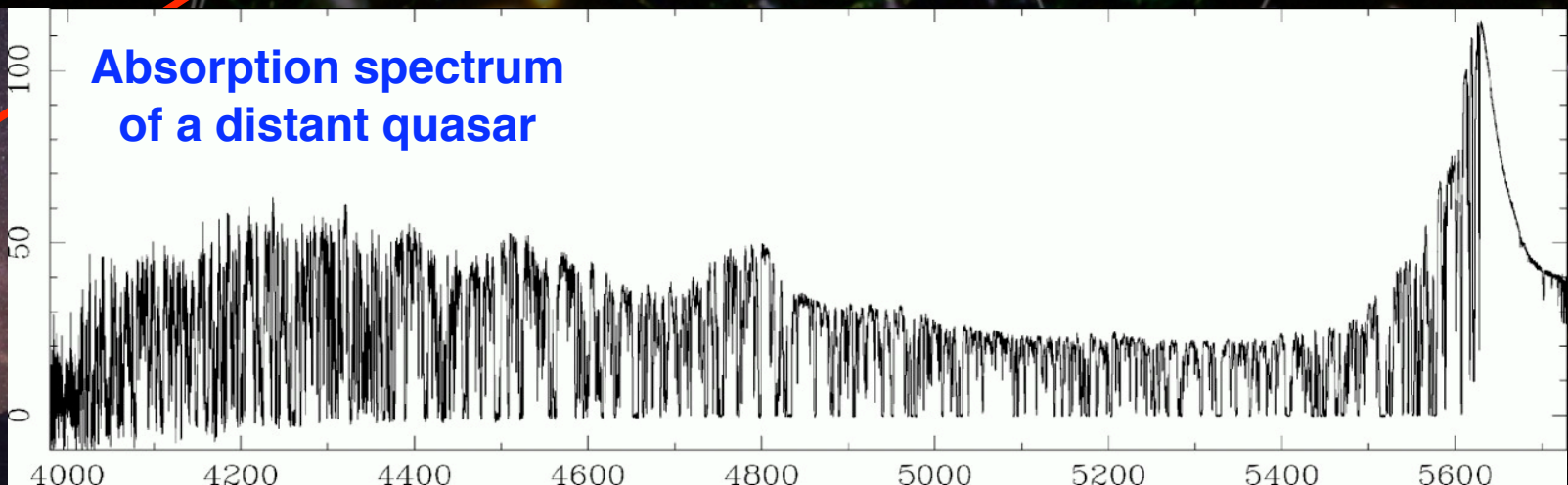
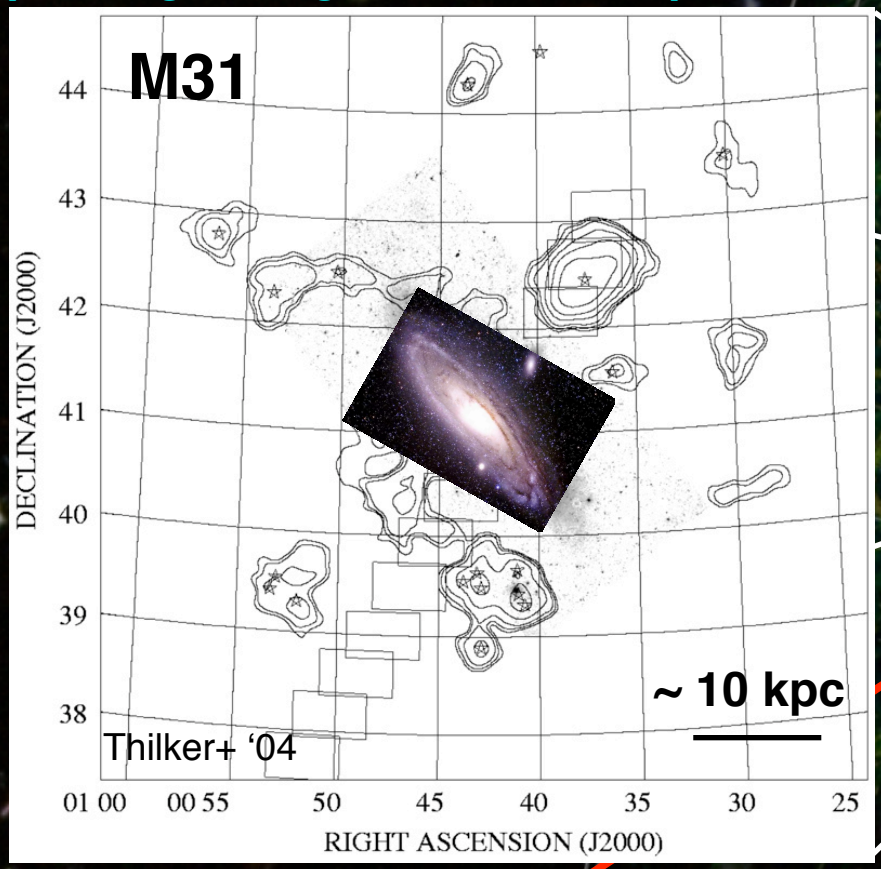
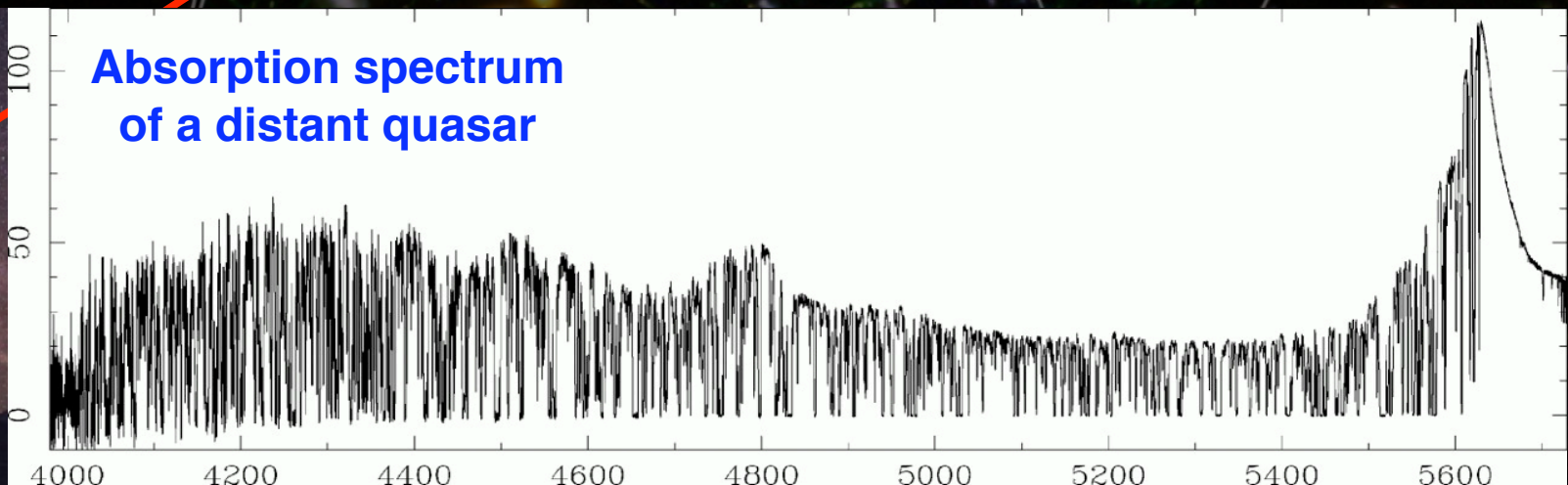


Mapping the Dark Universe

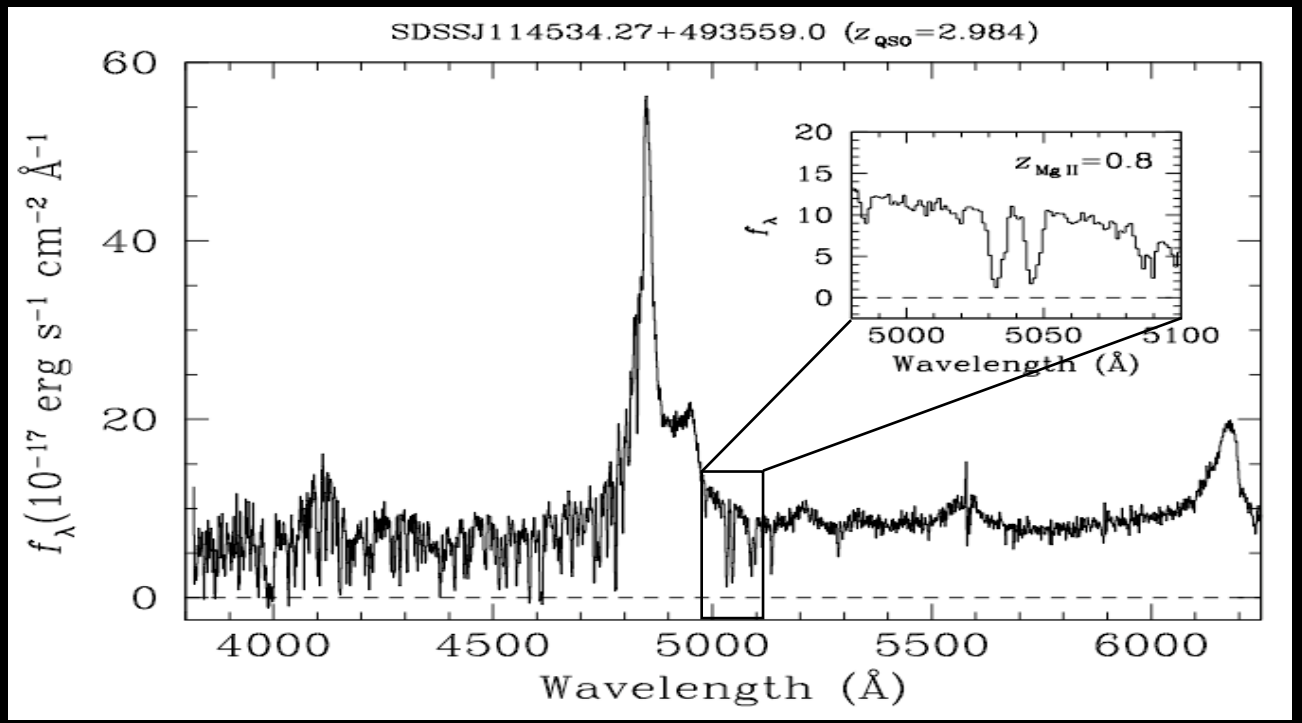
probing halo gas on 10-100 kpc scales





Properties of MgII absorbers

- prominent doublet features at λ=2796, 2803 Å; observable in the optical window at z = 0.3-2.5



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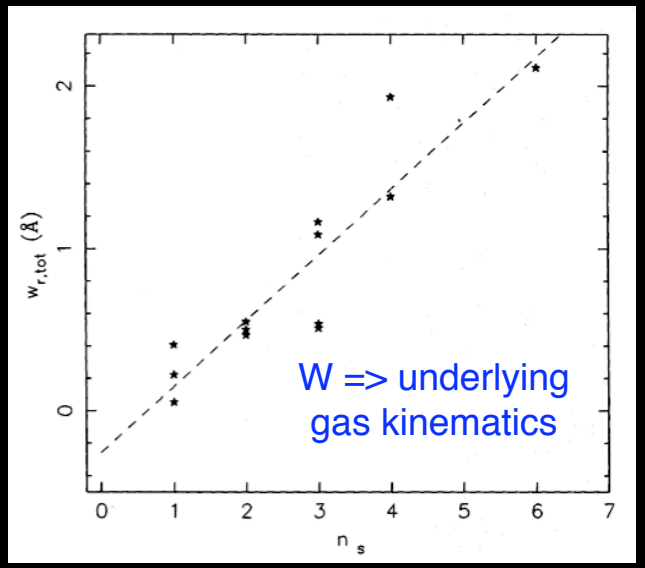

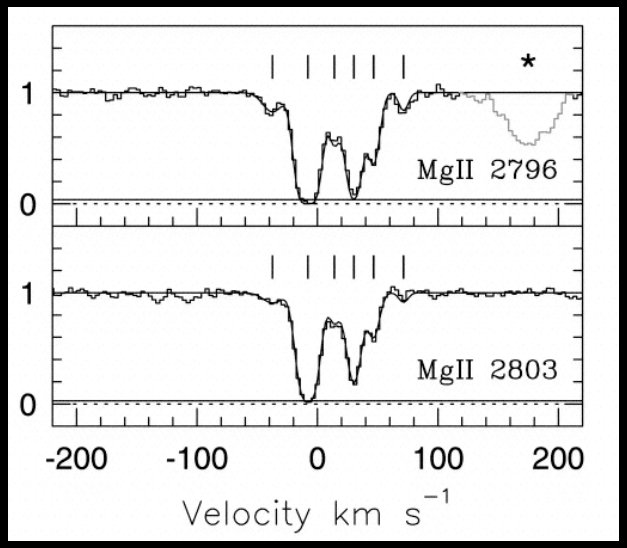

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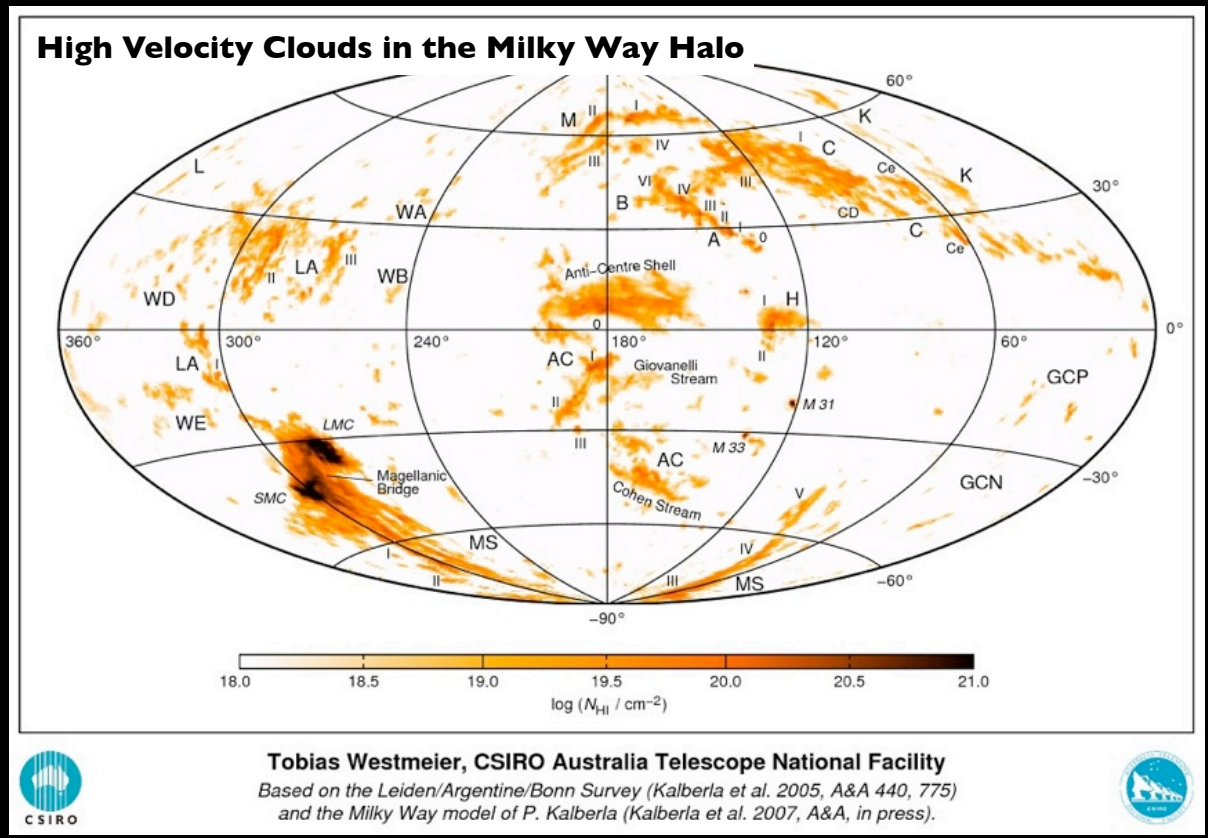
- association with luminous galaxies at $\rho \lesssim 100\ h^{-1}$ kpc

  (Lanzetta & Bowen '90; Steidel +94; Kacprzak +08)

Probing halo gas with MgII absorbers



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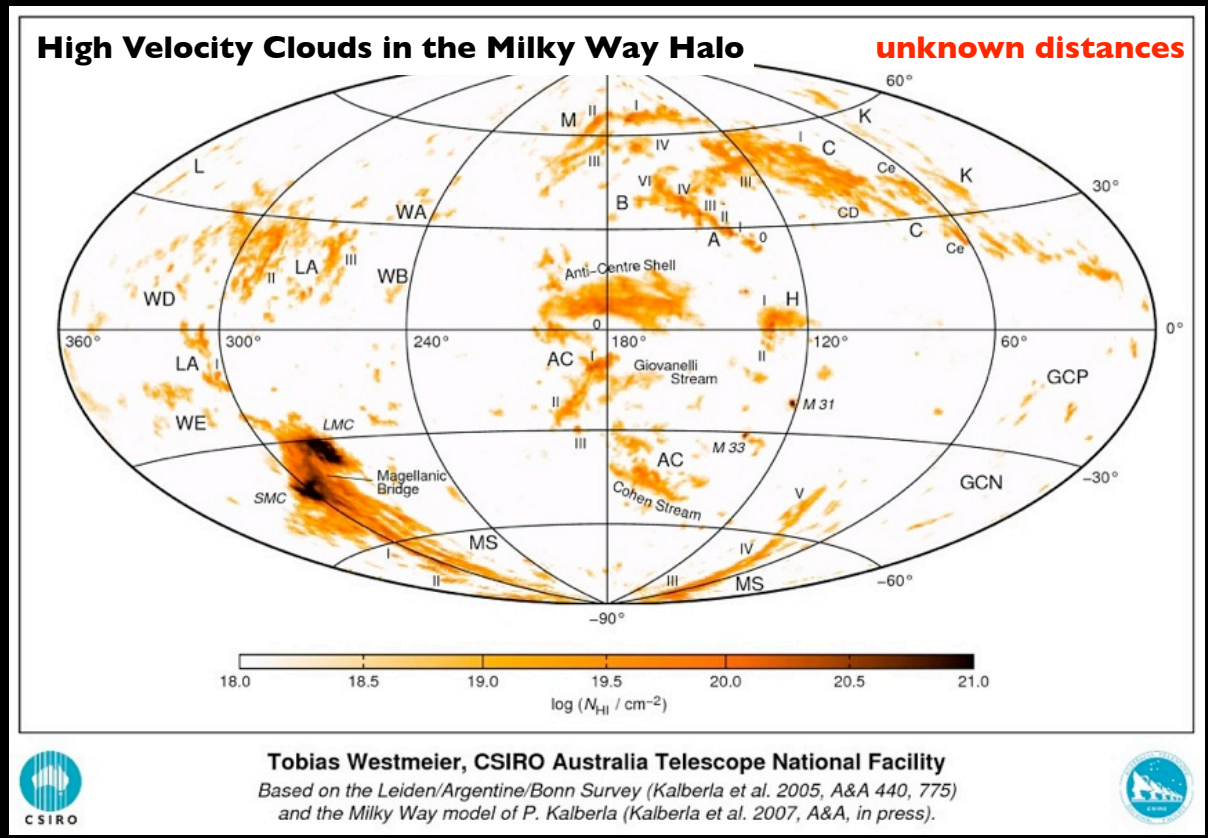

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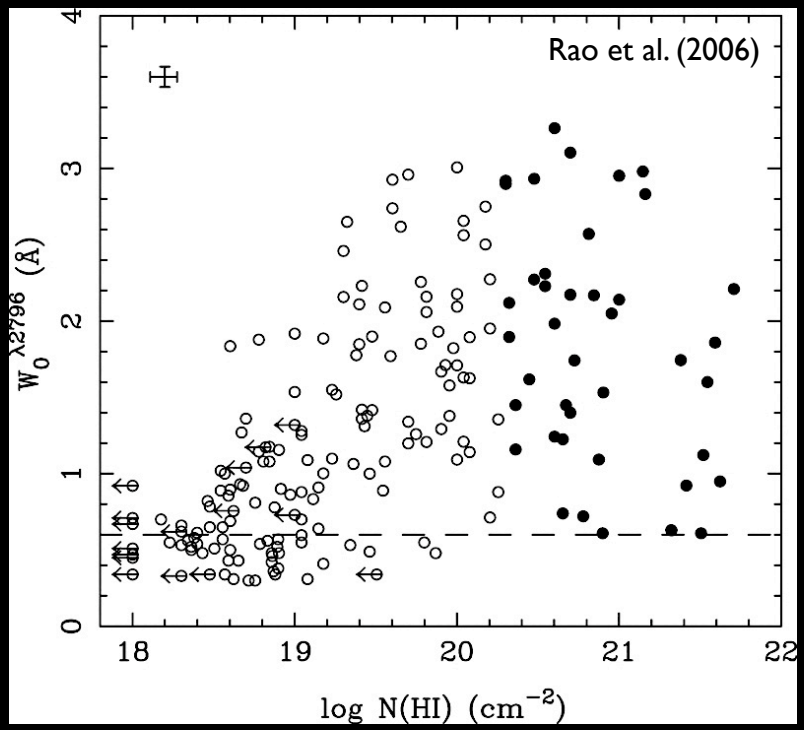

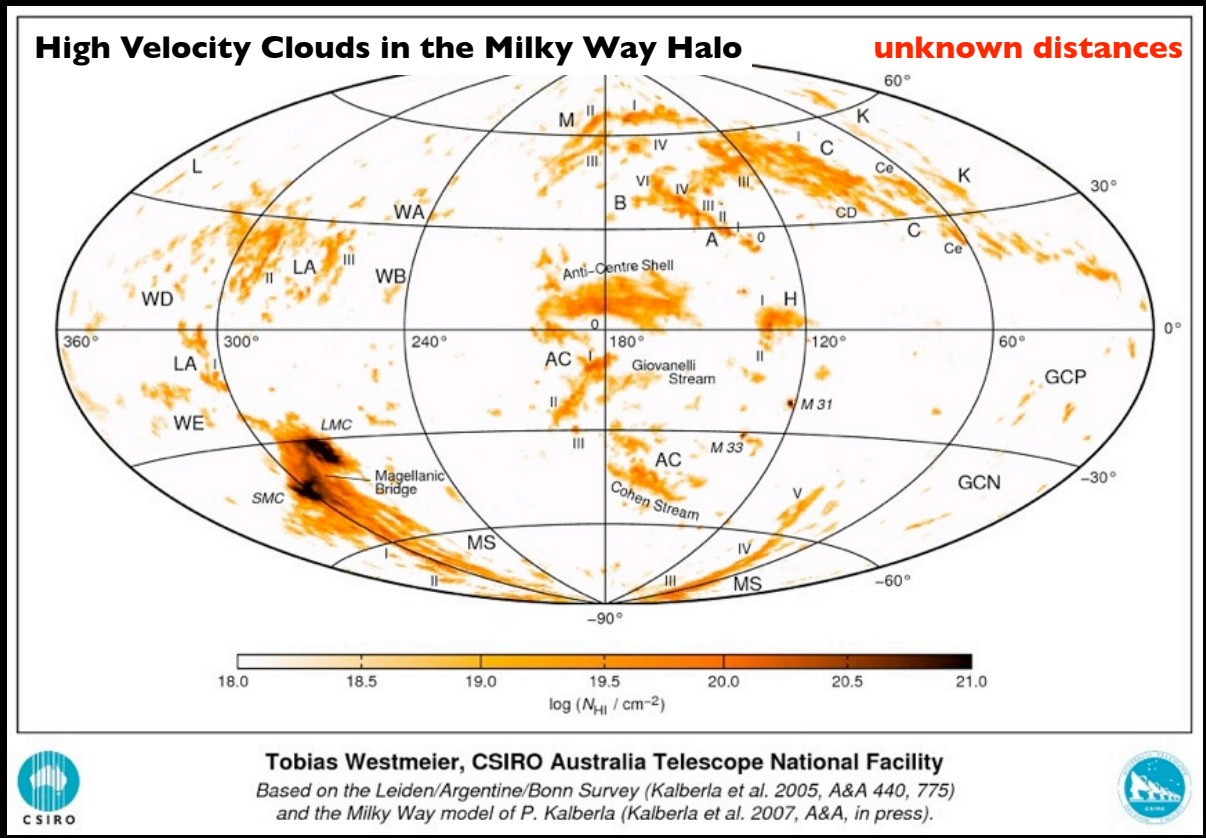

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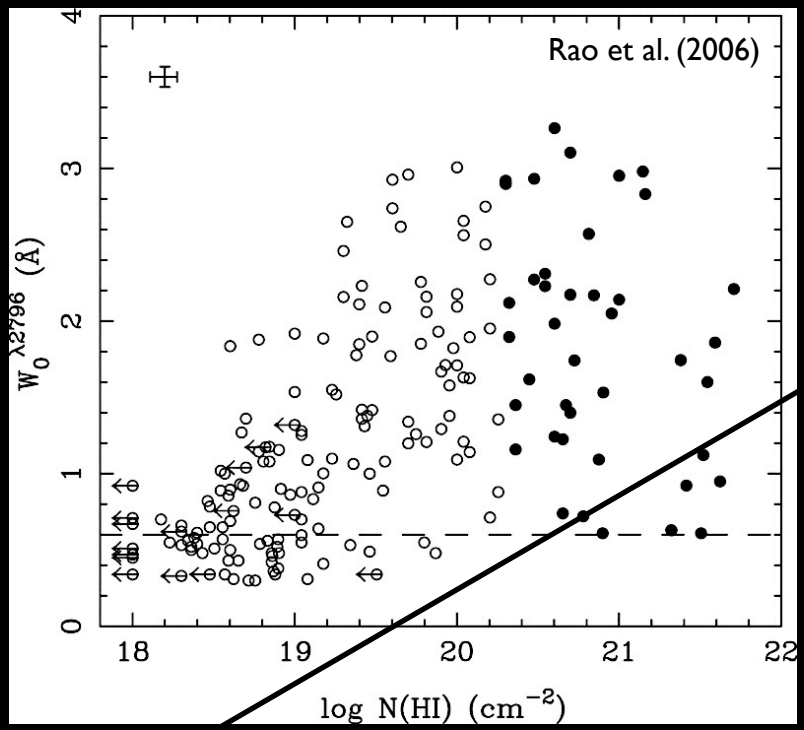
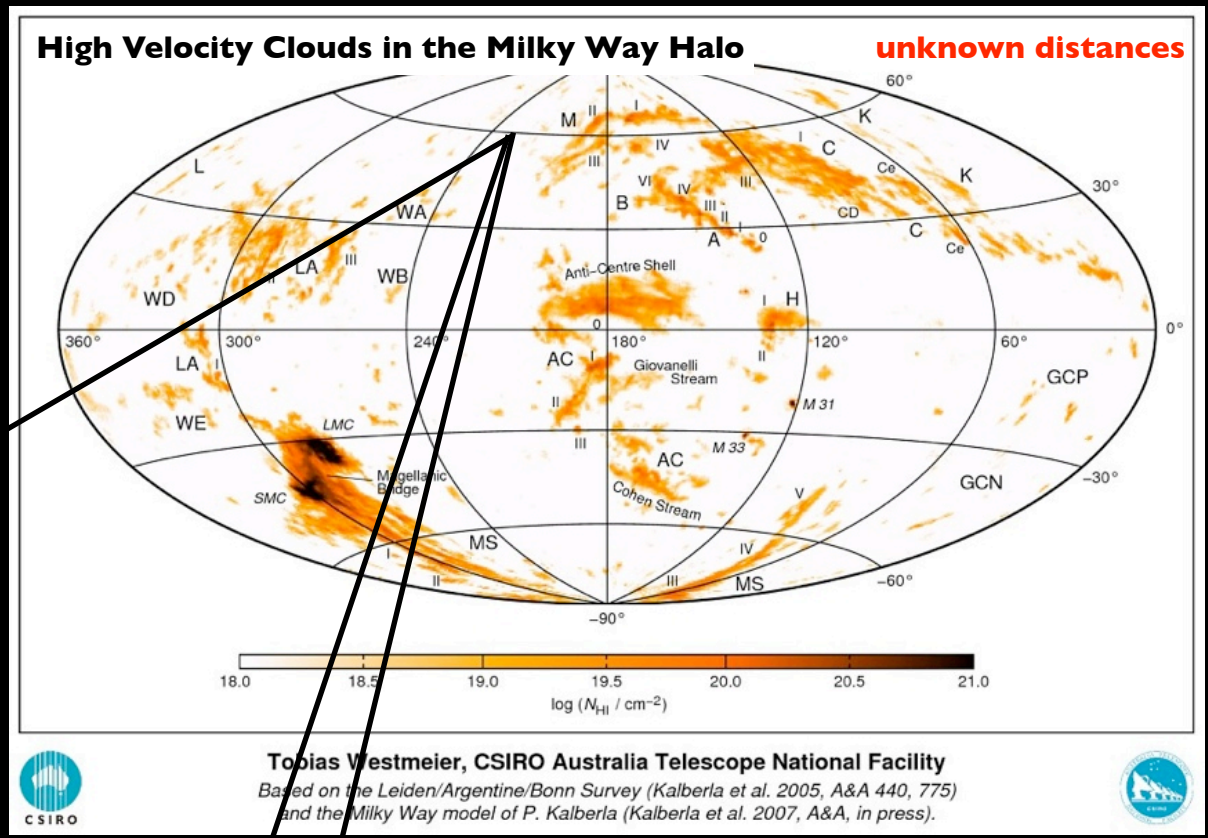
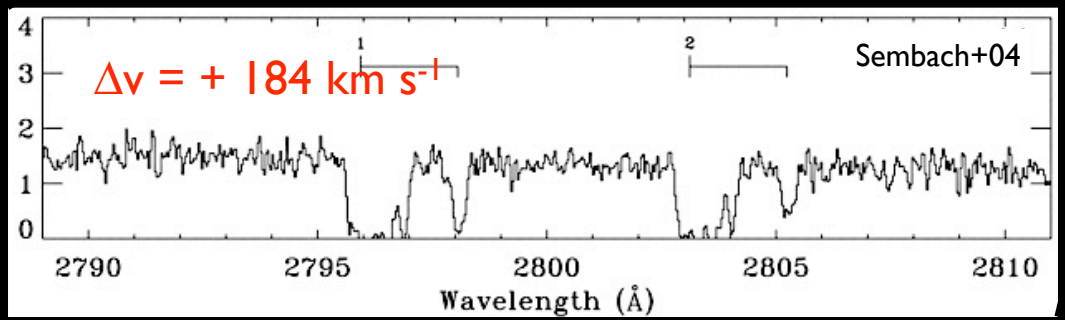




High velocity MgII cloud along PG1116+215



sensitive to low column density clouds

Empirical Constraints from a Random Sample of Foreground Galaxies

Chen & Tinker (2008)

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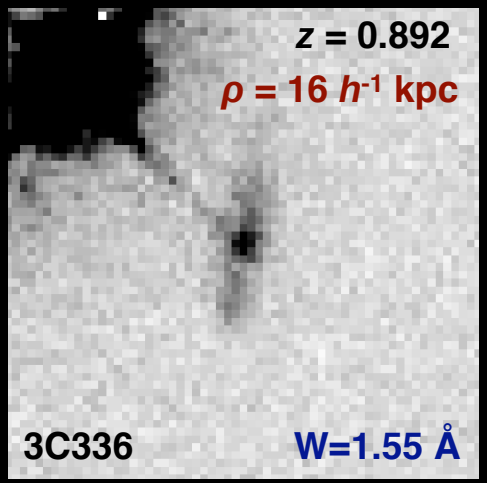

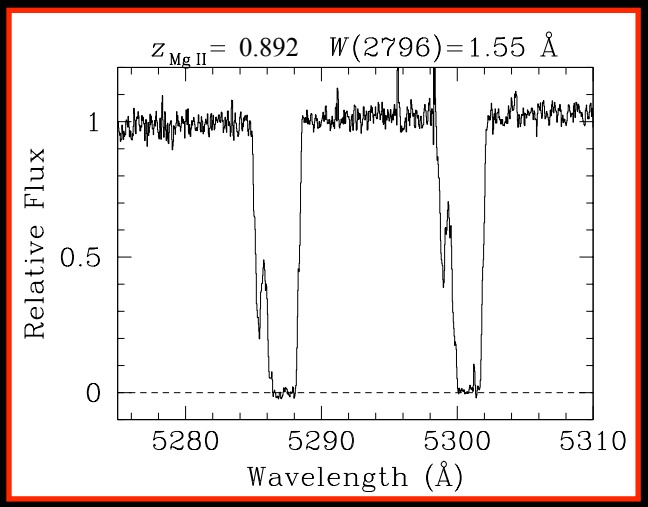

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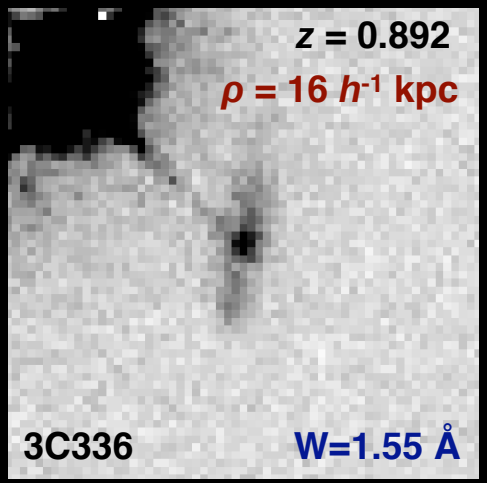

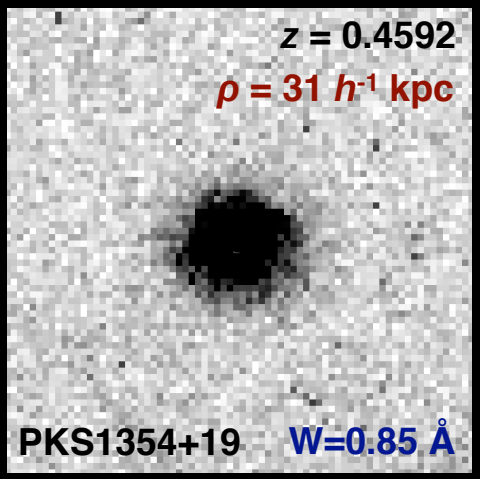

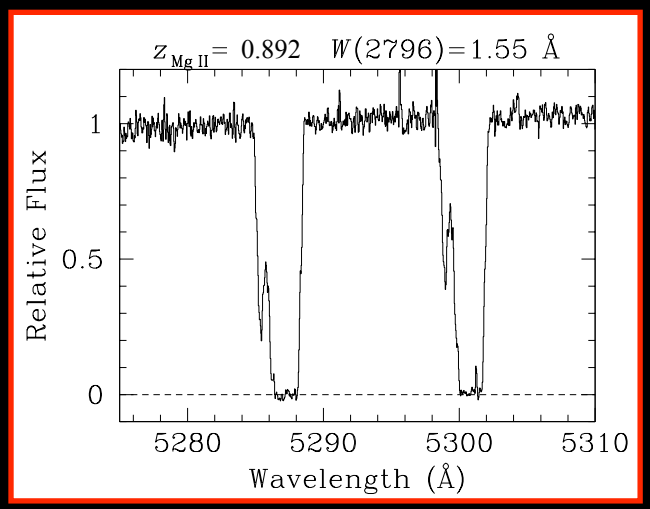

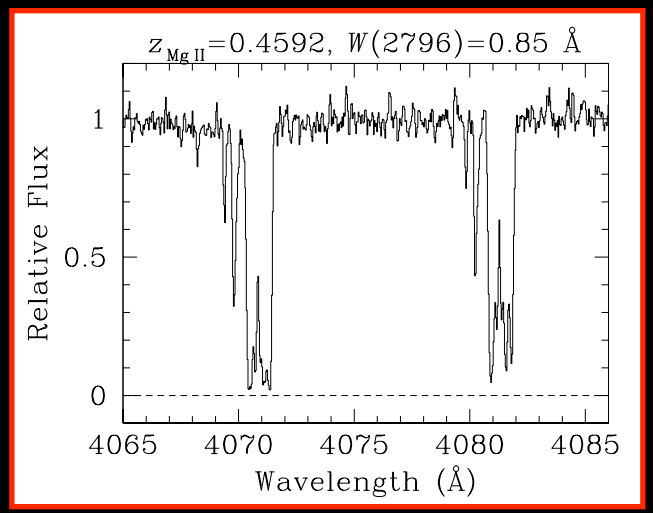

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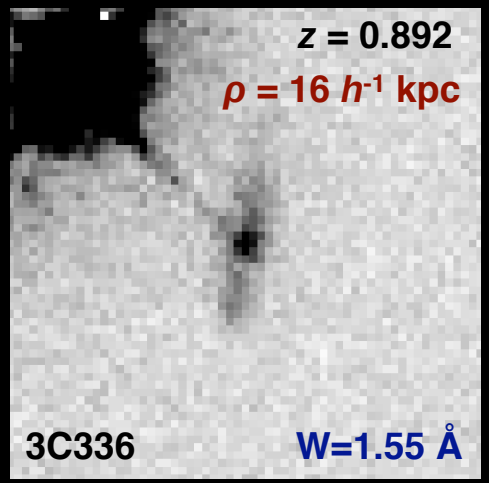
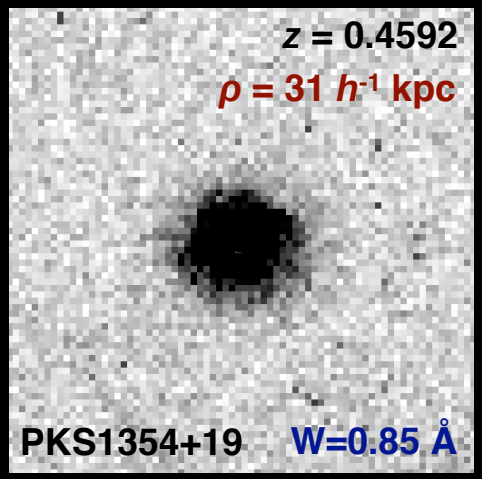
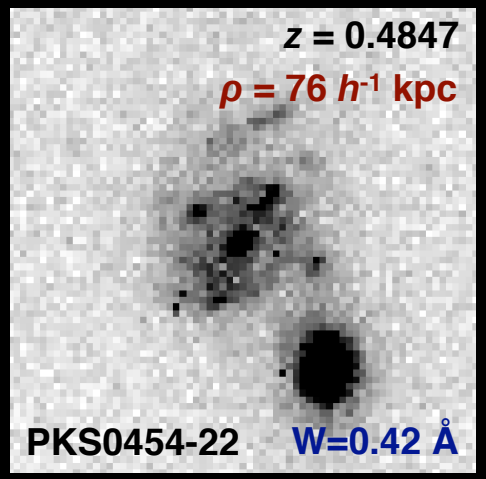
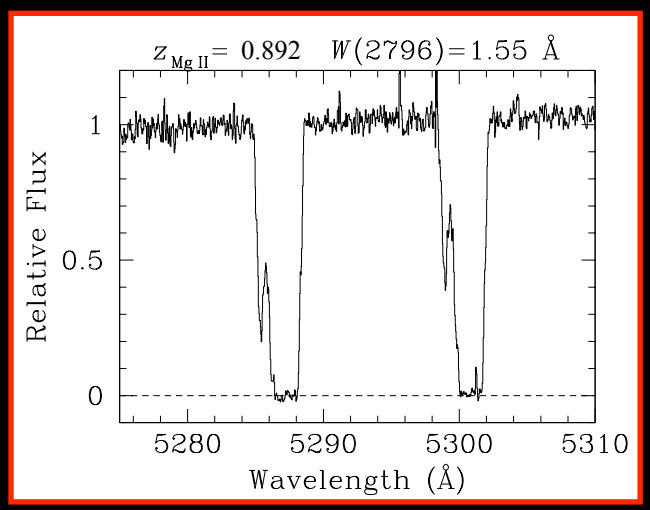
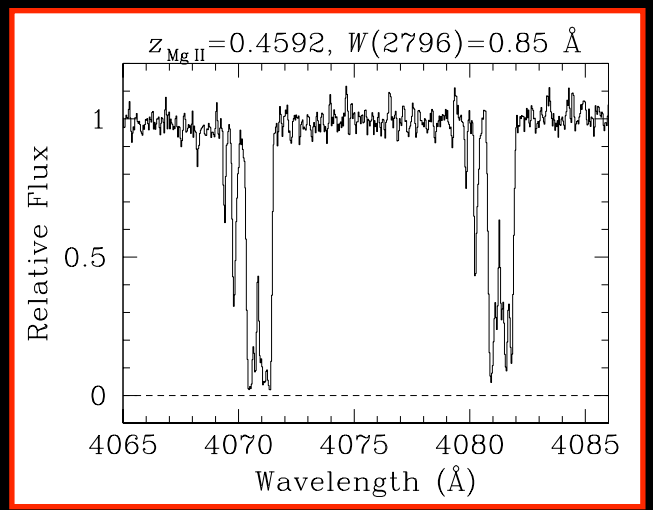
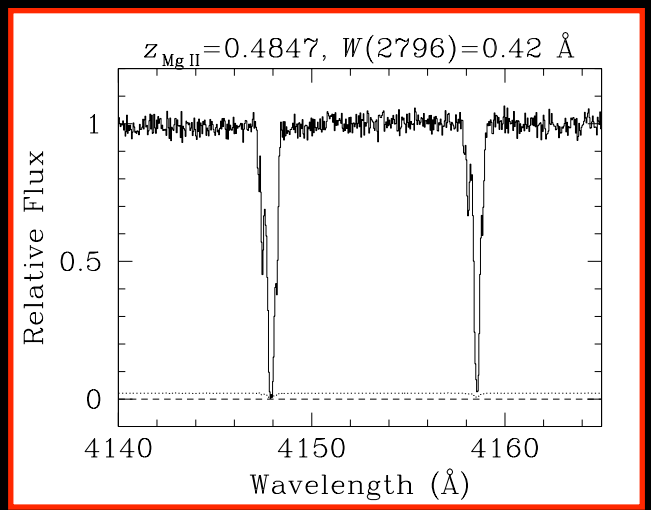




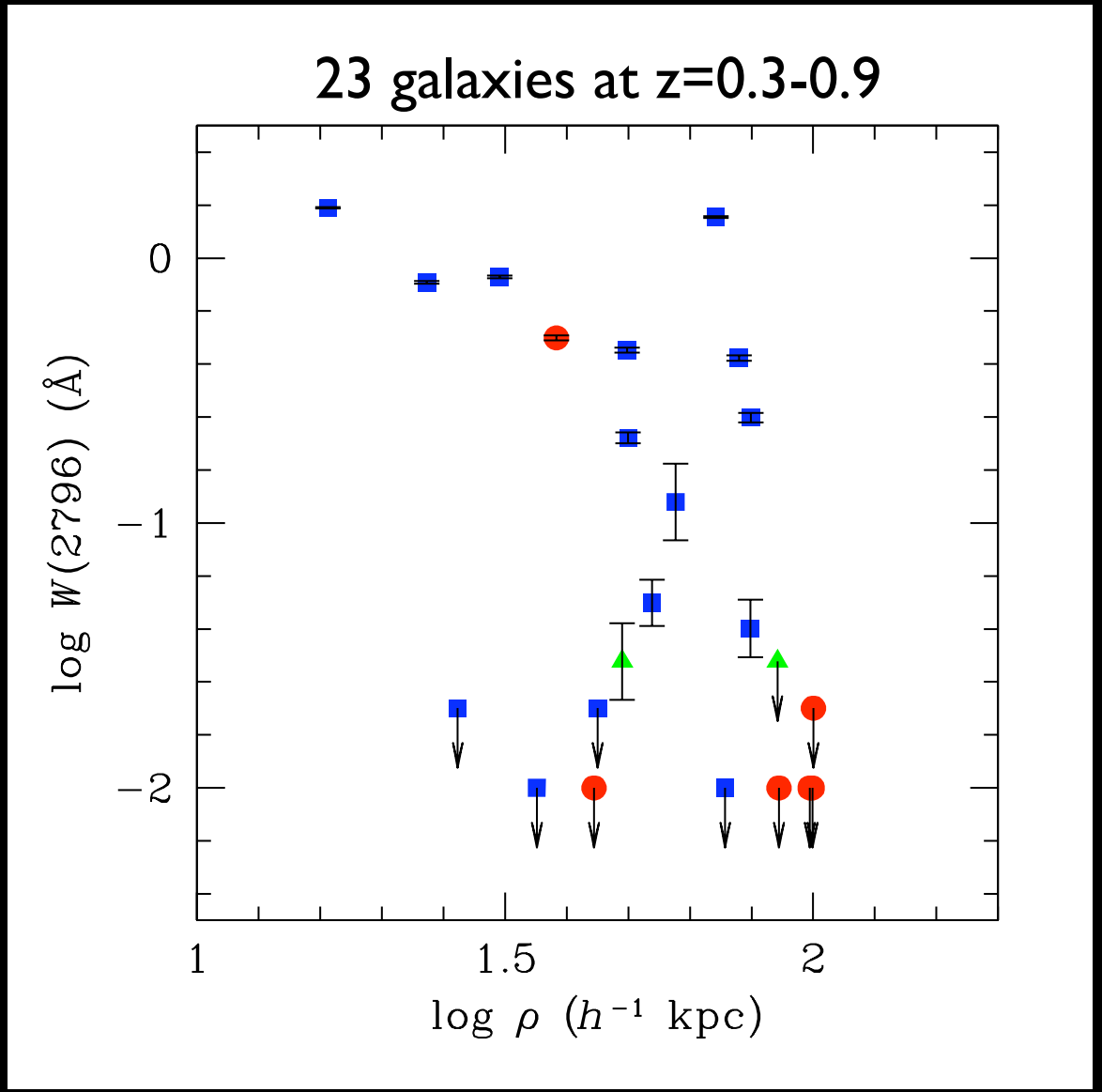








Extent of Gaseous Halos and Covering Fraction



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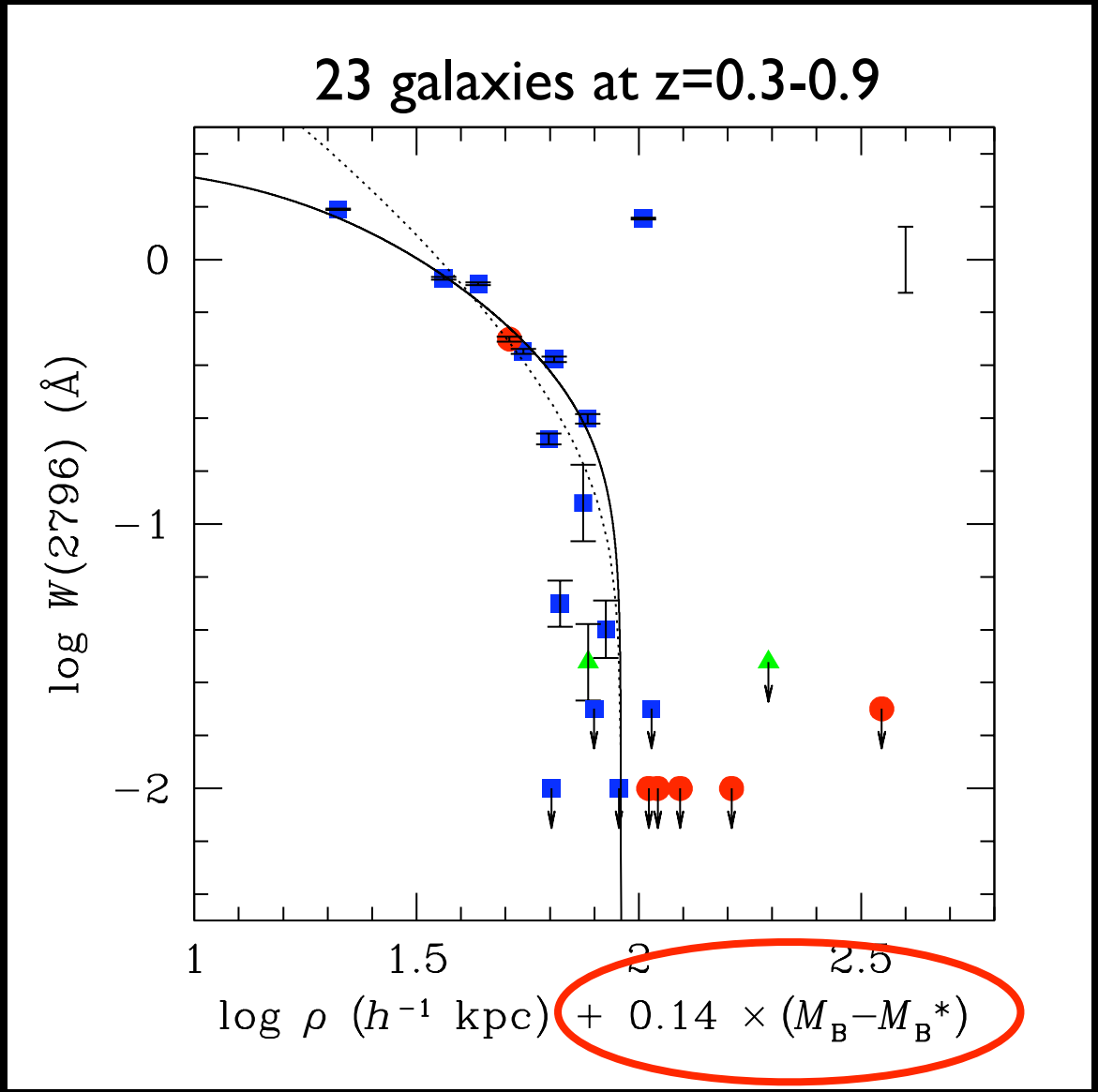

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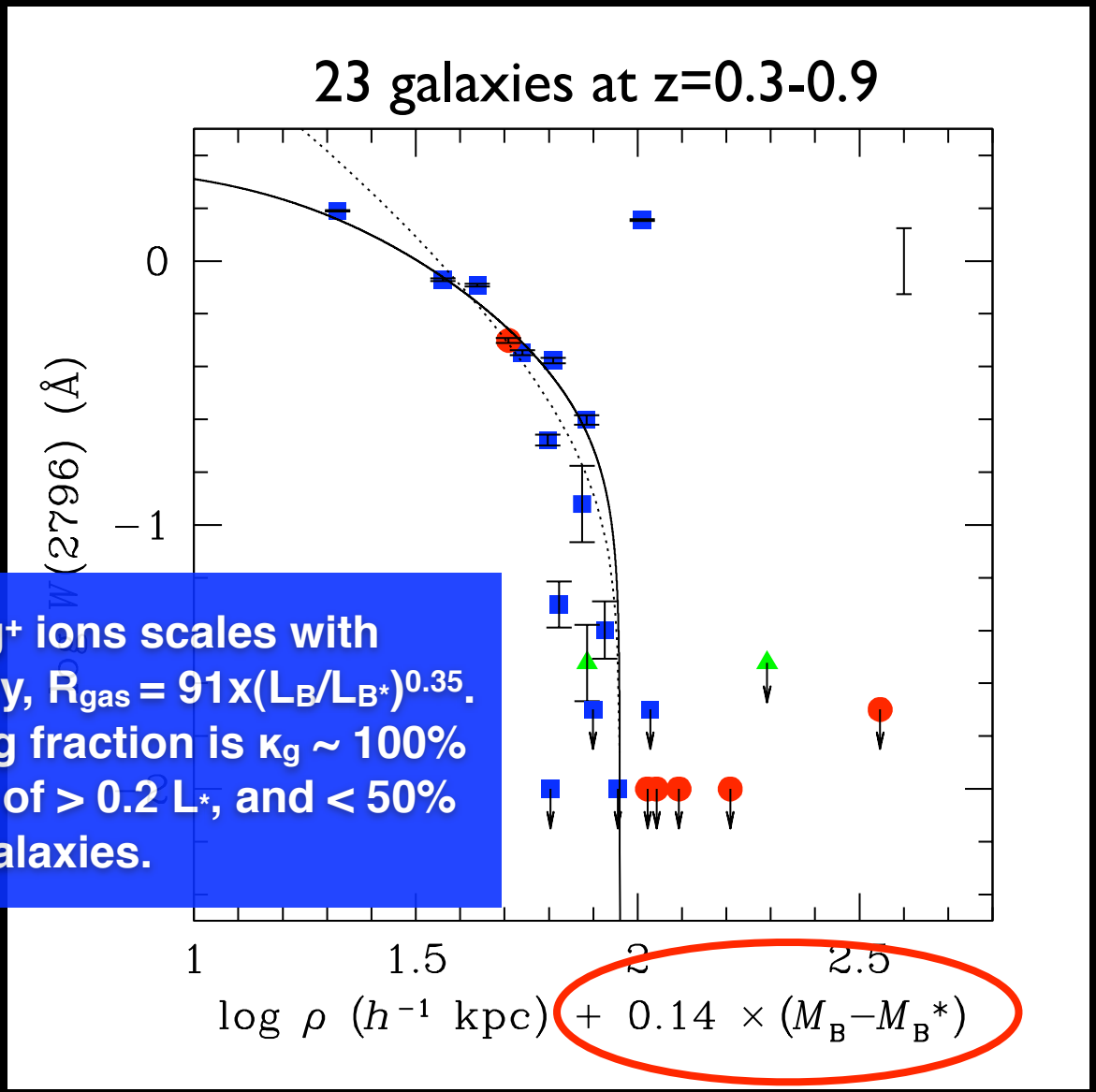
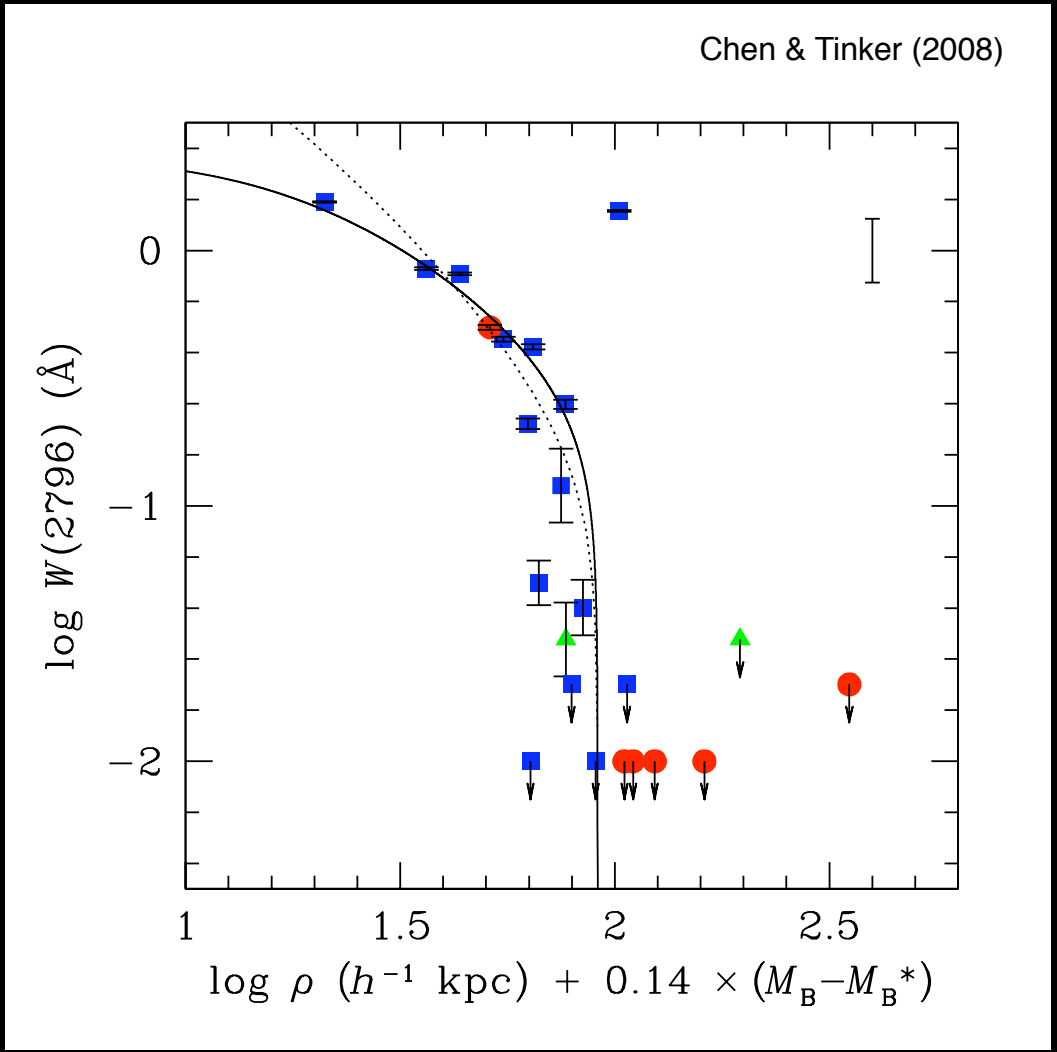


- The extent of Mg^+ ions scales with galaxy luminosity, $R_{gas} = 91x(L_B/L_{B^*})^{0.35}$.
- The gas covering fraction is $\kappa_g \sim 100\%$ around galaxies of > 0.2 L_*, and < 50% around fainter galaxies.

Chen & Tinker (2008)

The Origin of Halo Clouds:

fuel for star formation or wind remnant?



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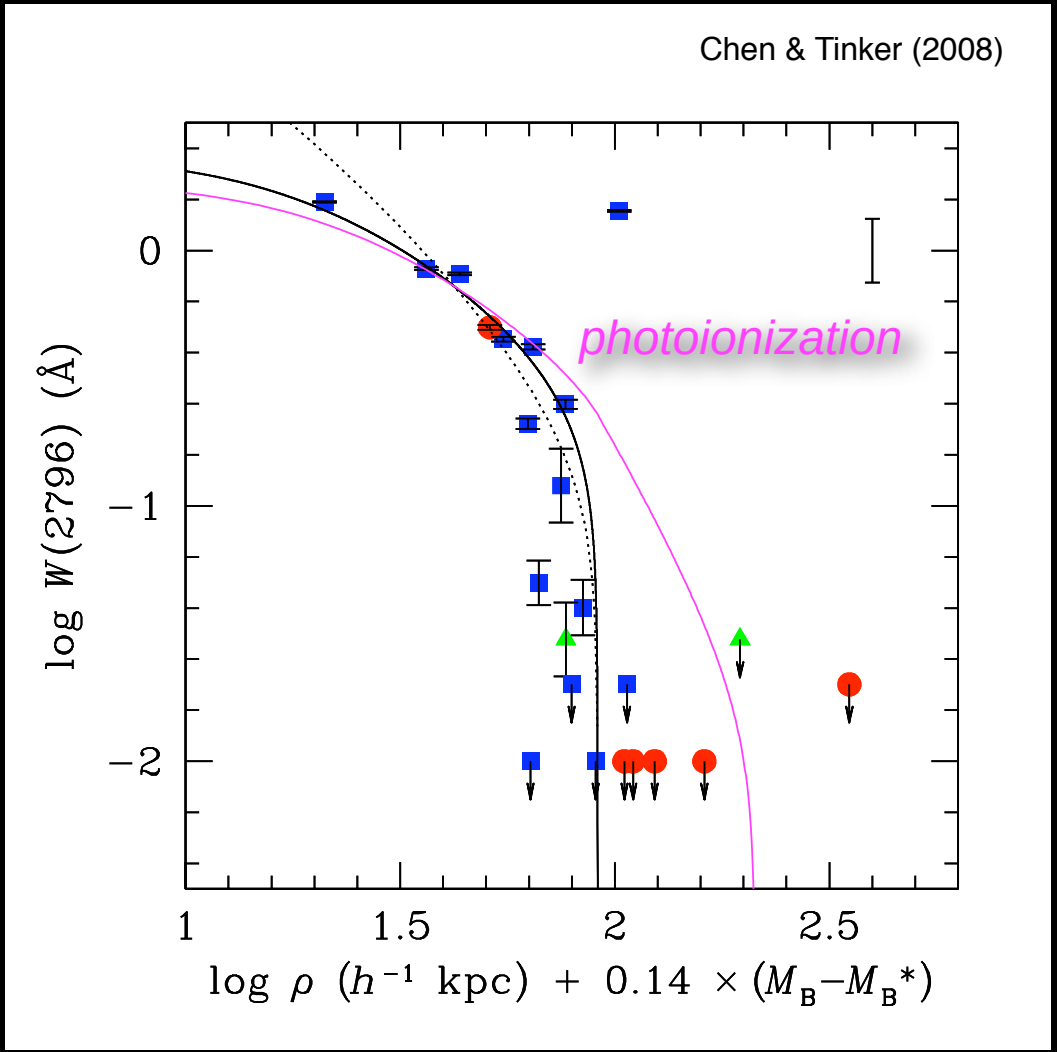

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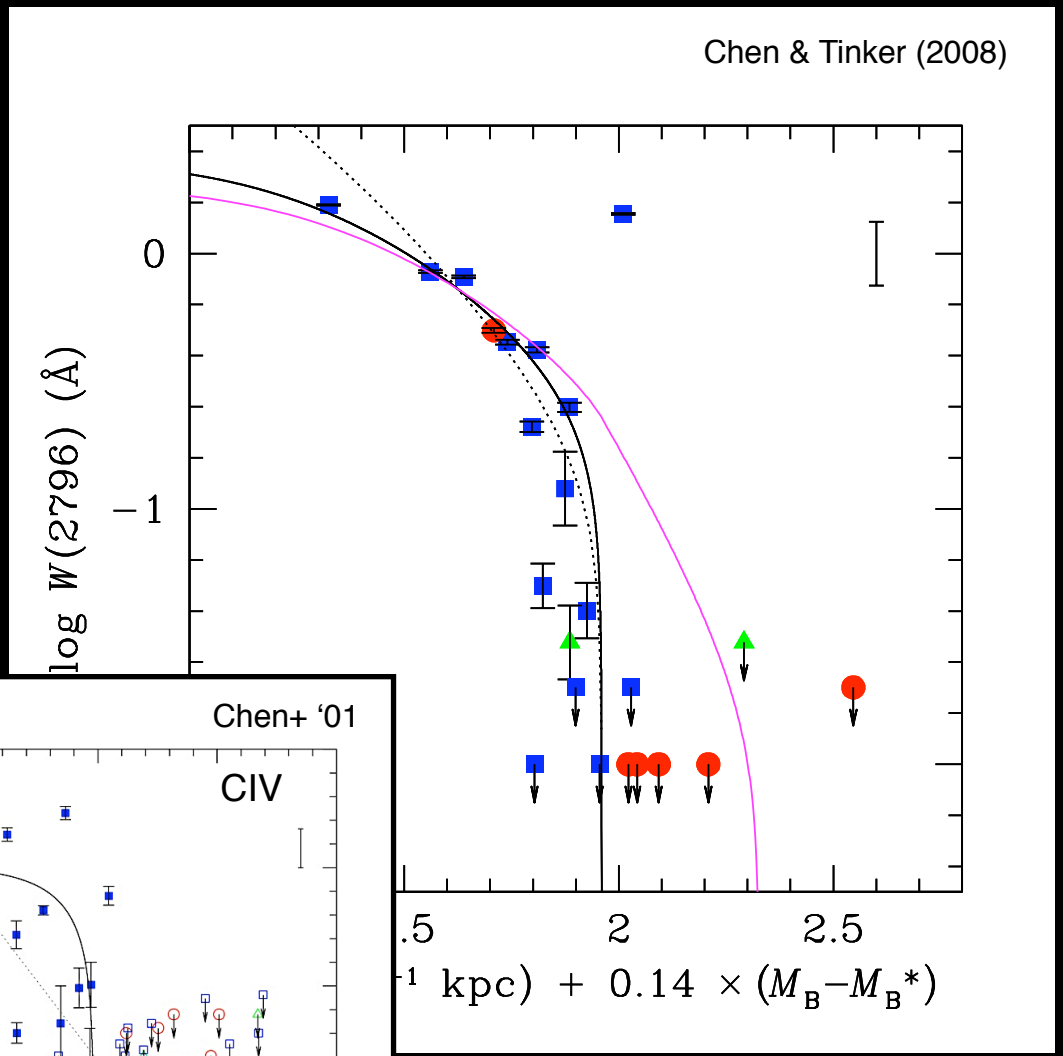

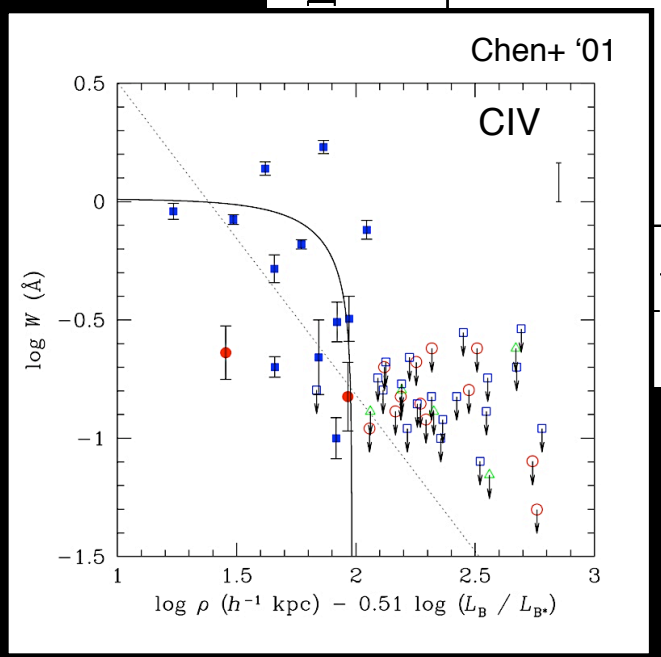

comparable extent between C^{3+} and Mg^{+}

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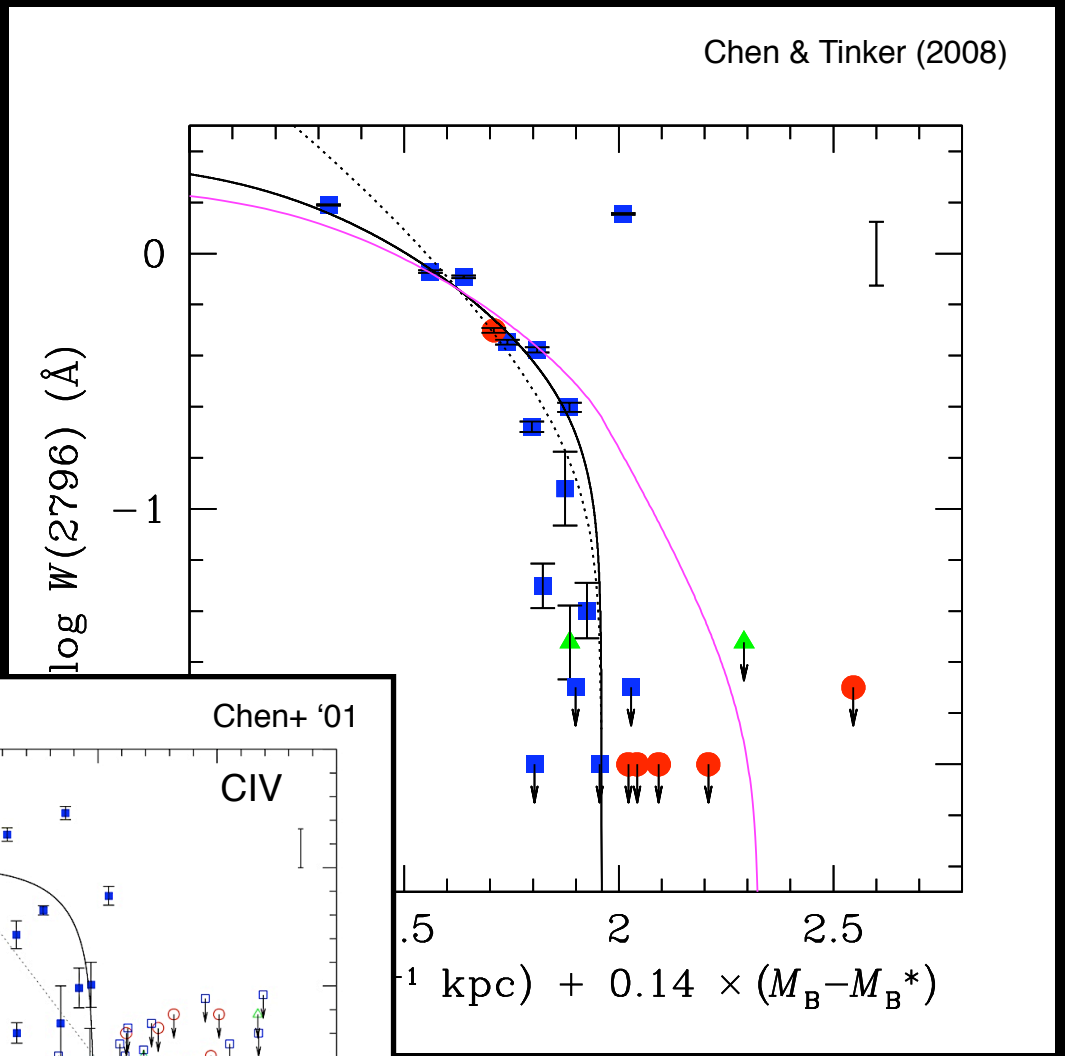

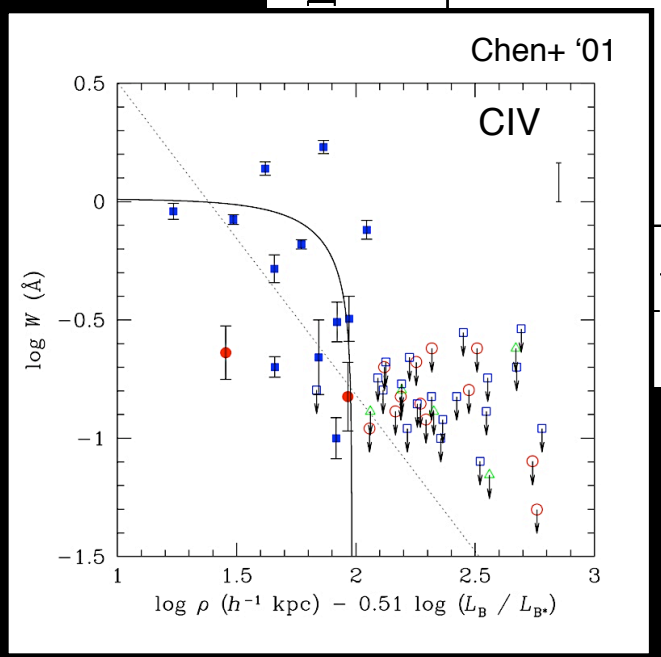

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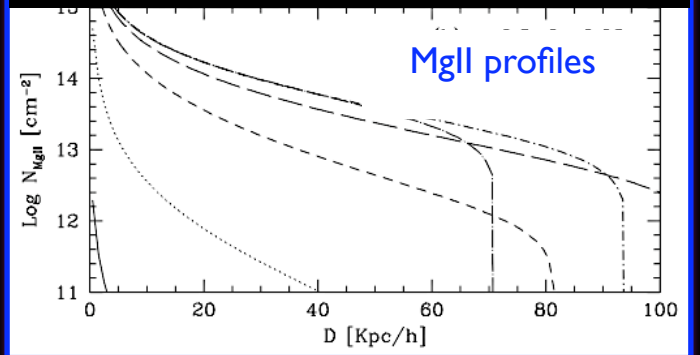
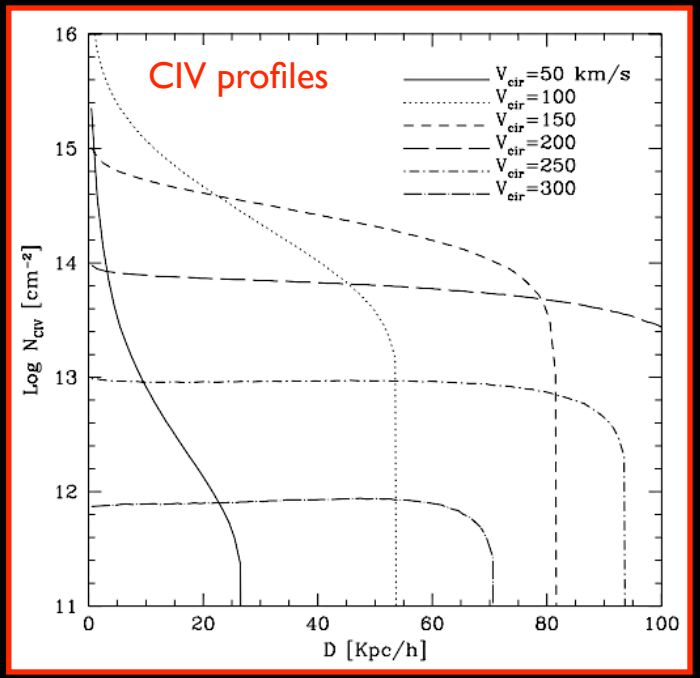
two-phase medium: pressure confined cold clouds in hot halos

Mo & Miralda-Escudé '96; Maller & Bullock '04





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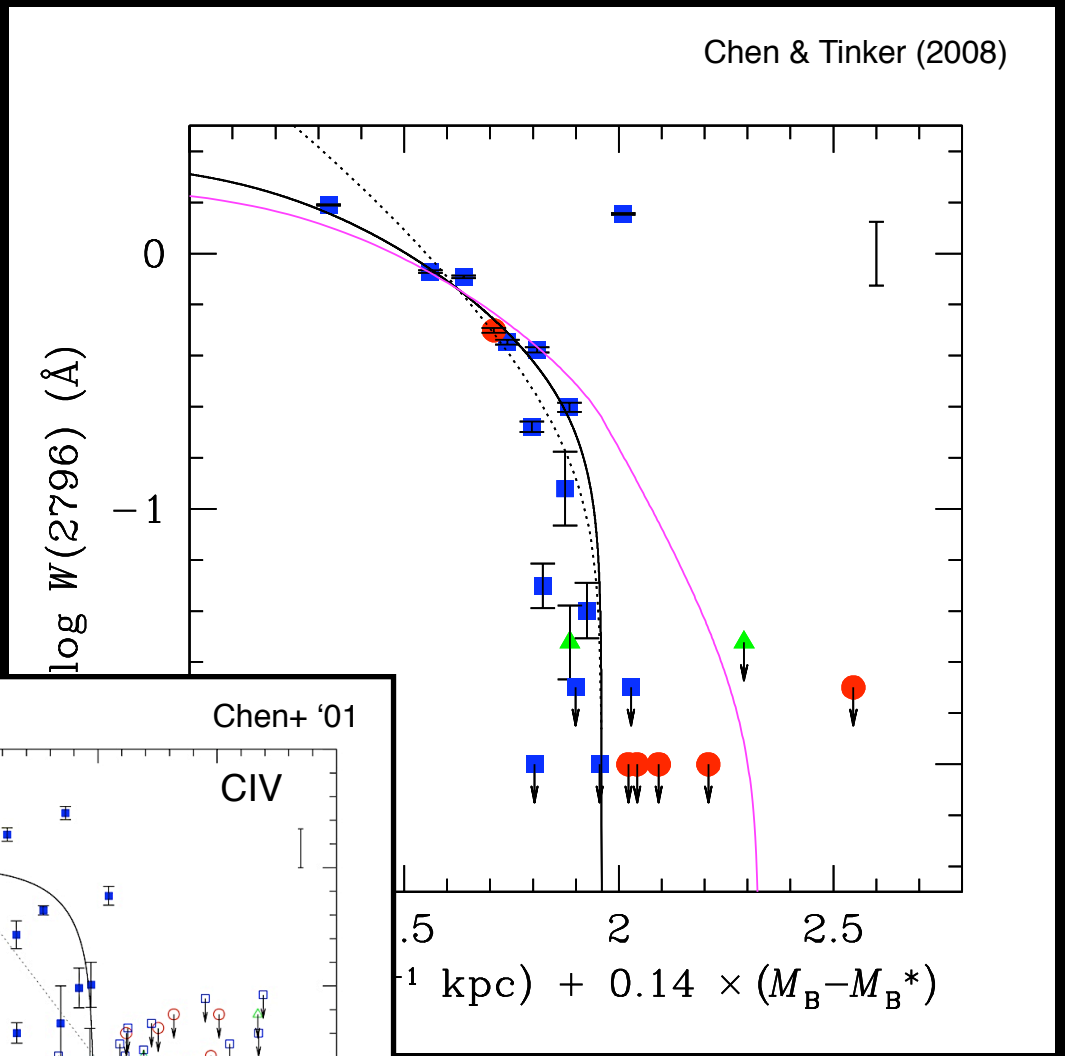

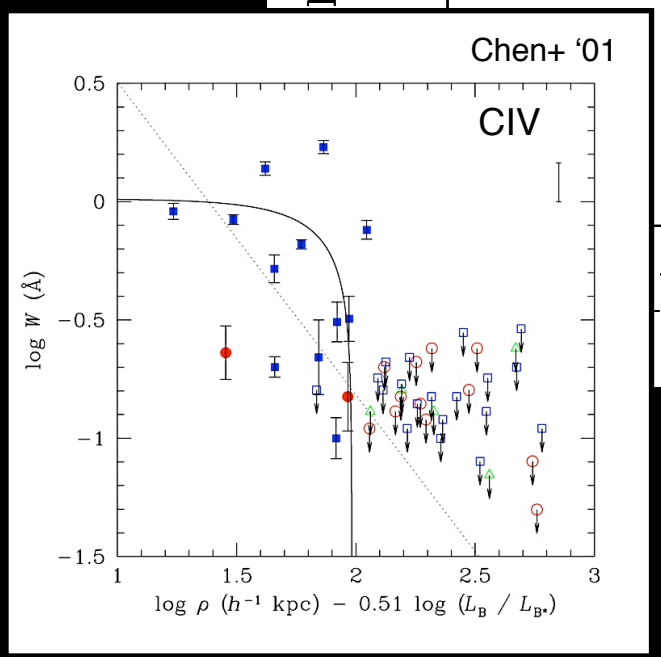

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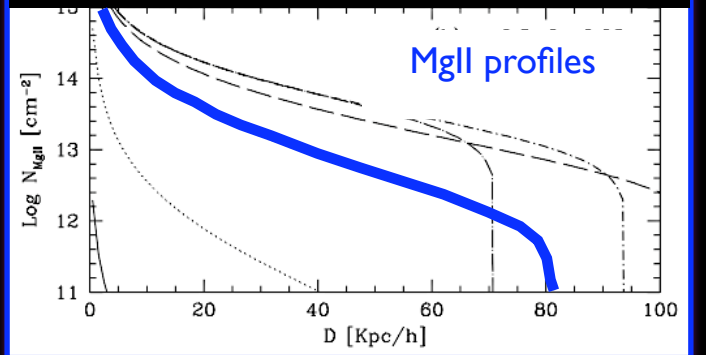
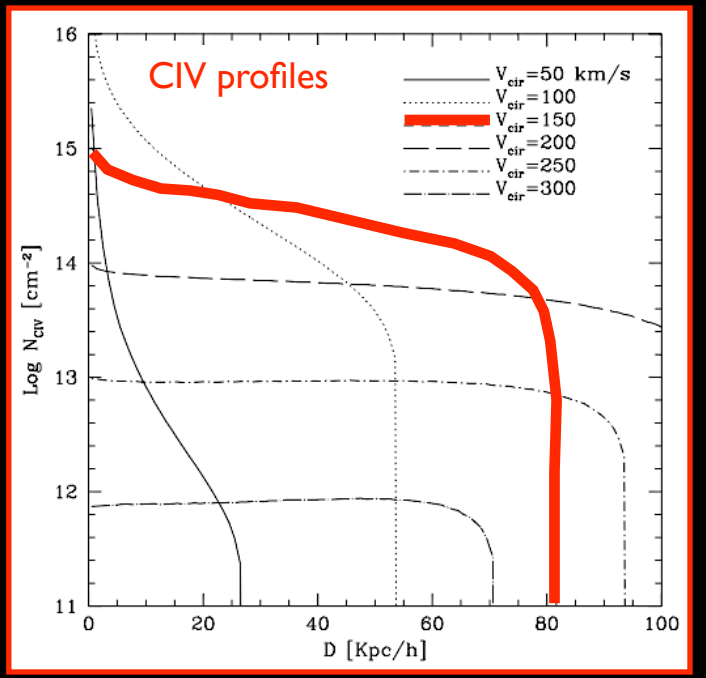
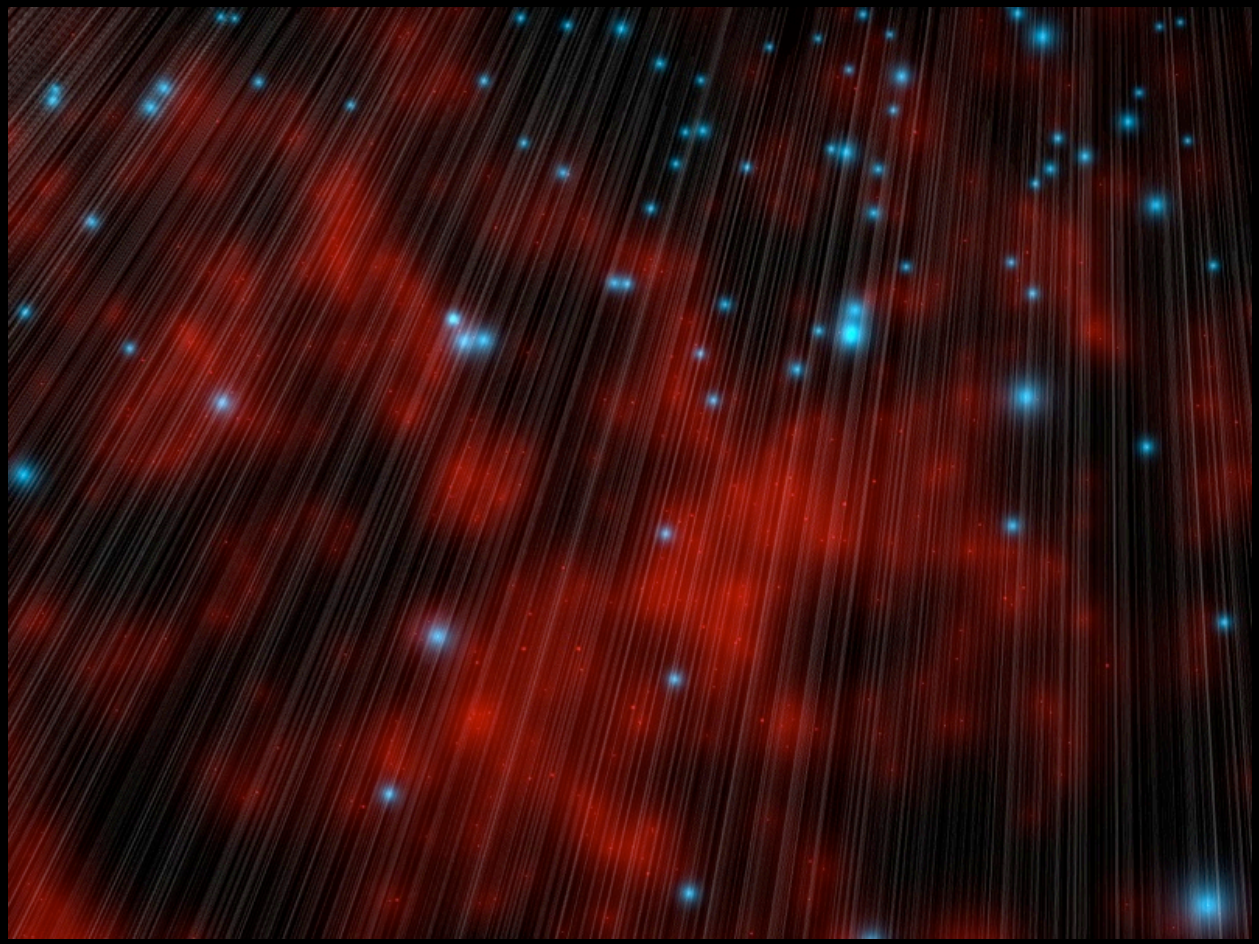




Constraining halo gas content over a broad mass range

luminous red galaxies vs. MgII Absorbers at z = 0.4-0.7



Visualization of SDSS DR5

Courtesy of Mark SubbaRao

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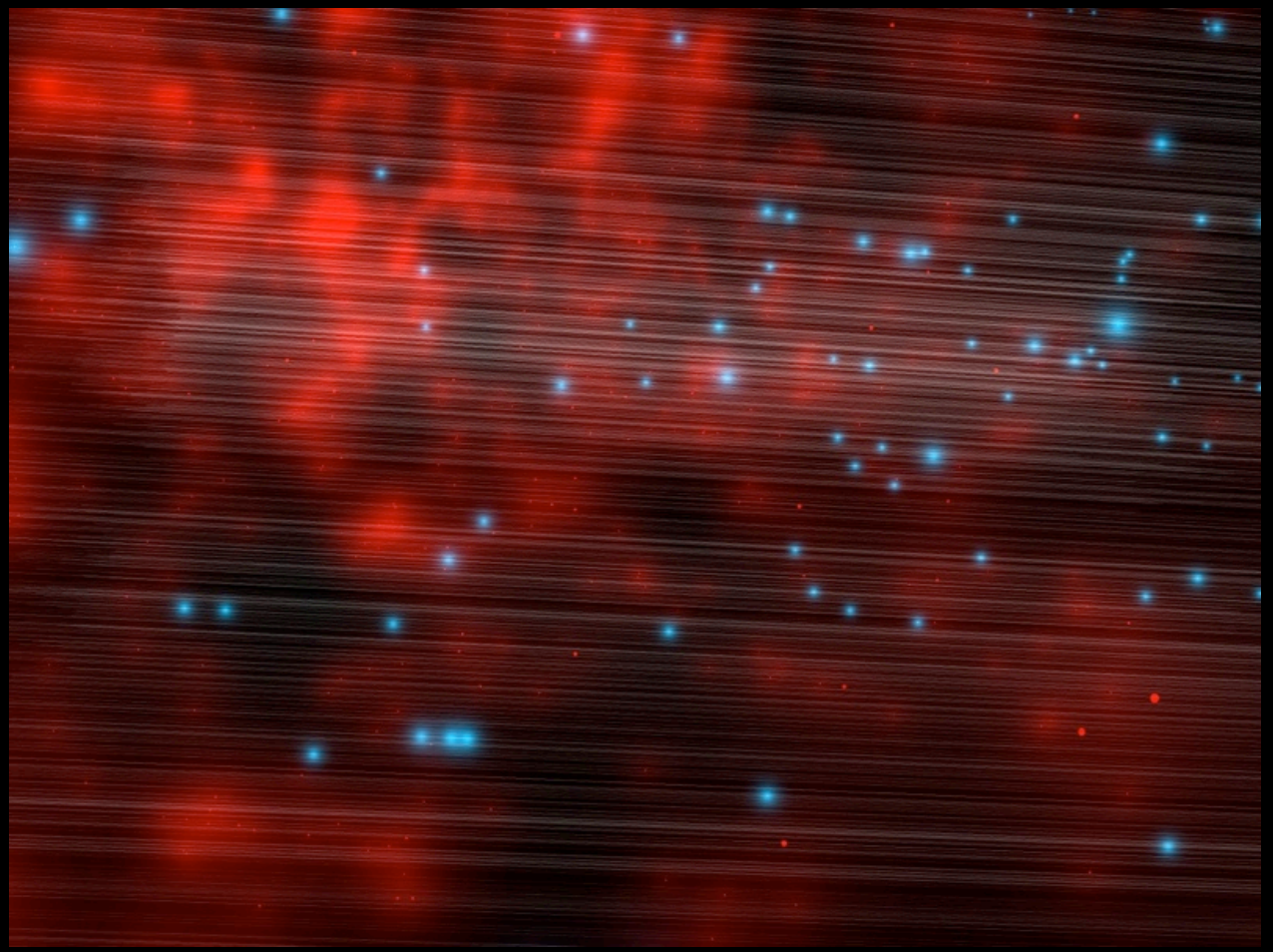

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Halo Occupation of Dark Baryons

An empirical mapping between DM halos and baryons through a statistical approach.

Tinker & Chen (2008)

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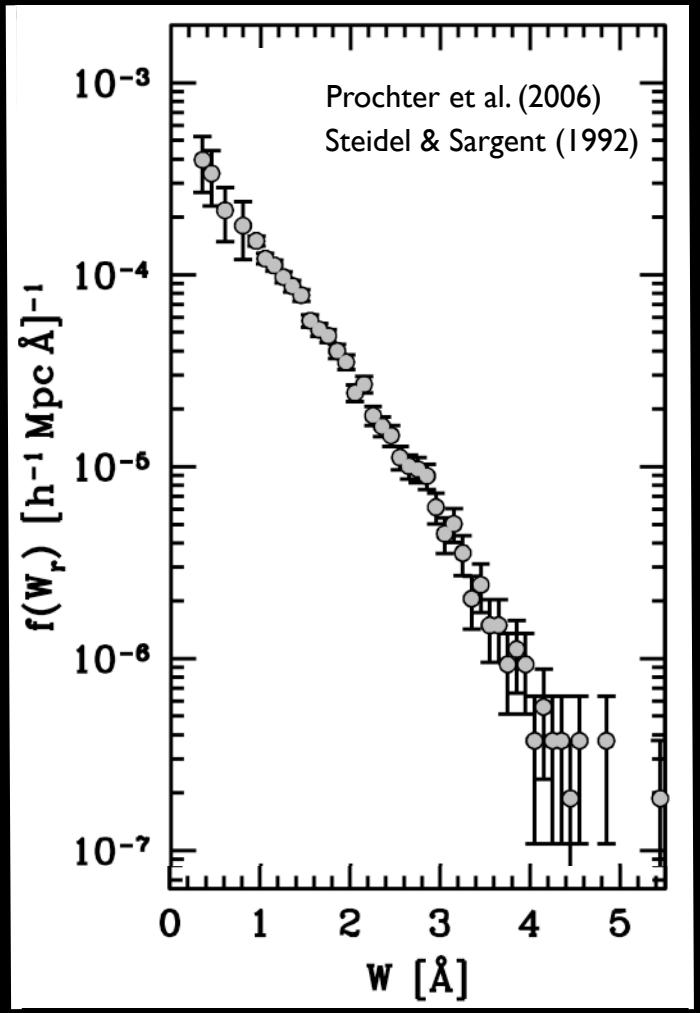

DATA

frequency distribution function + 2-pt clustering amplitude

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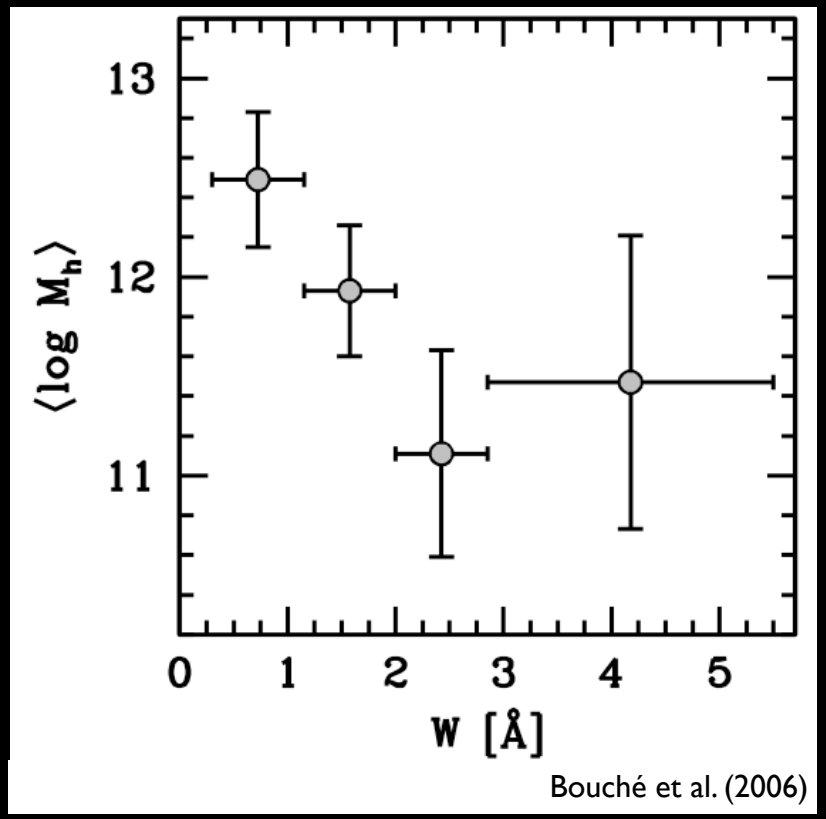

Bouché et al. (2006)

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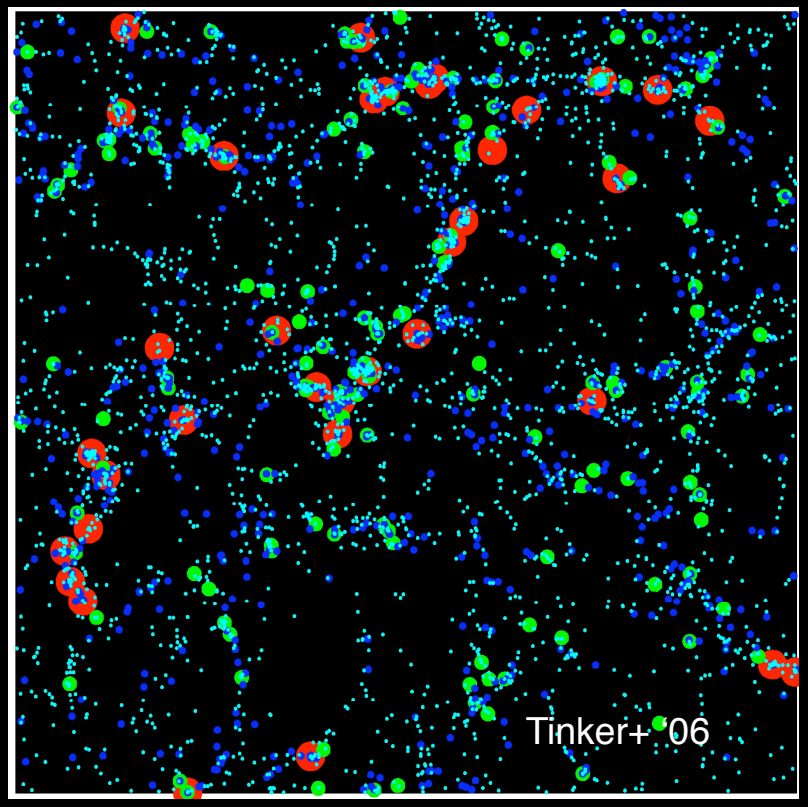

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- density profile : $(r^2+a^2)^{-1}$
- gaseous extent : $R_g = 1/3\ R_{200}$
- mass dependence : $M_h^{1/3}$

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frequency distribution function + 2-pt clustering amplitude

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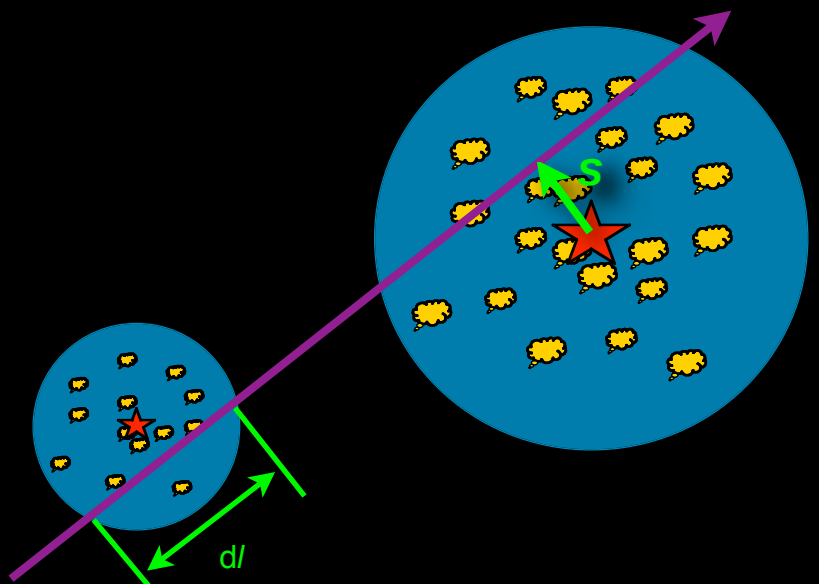
known dark matter halos + *gaseous halo profile*

$$W(s|M) = \frac{W_0\,\sigma_{cl}\,f_g}{M_{cl}} \times \int_0^{\sqrt{R_g^2-s^2}} \rho(\sqrt{s^2+l^2})dl$$



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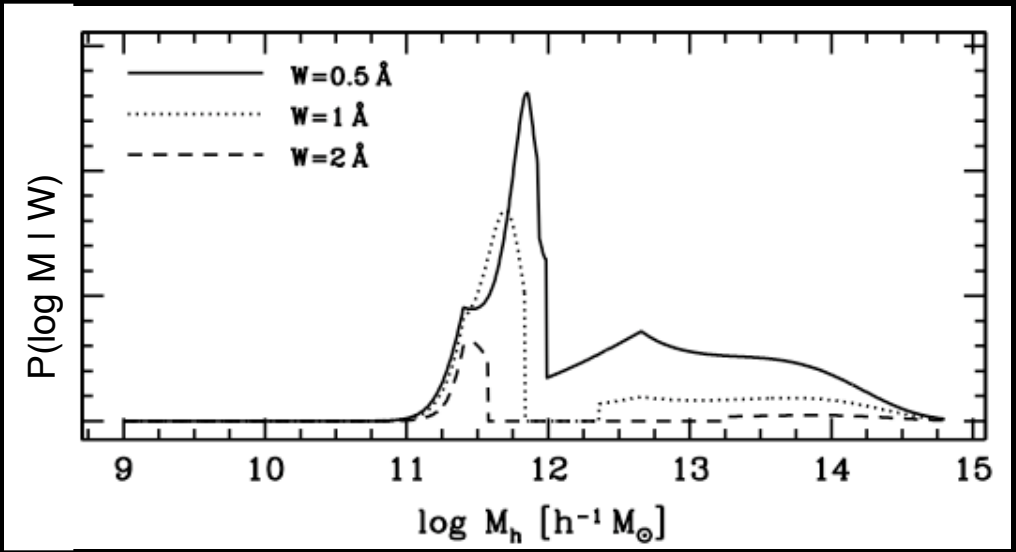

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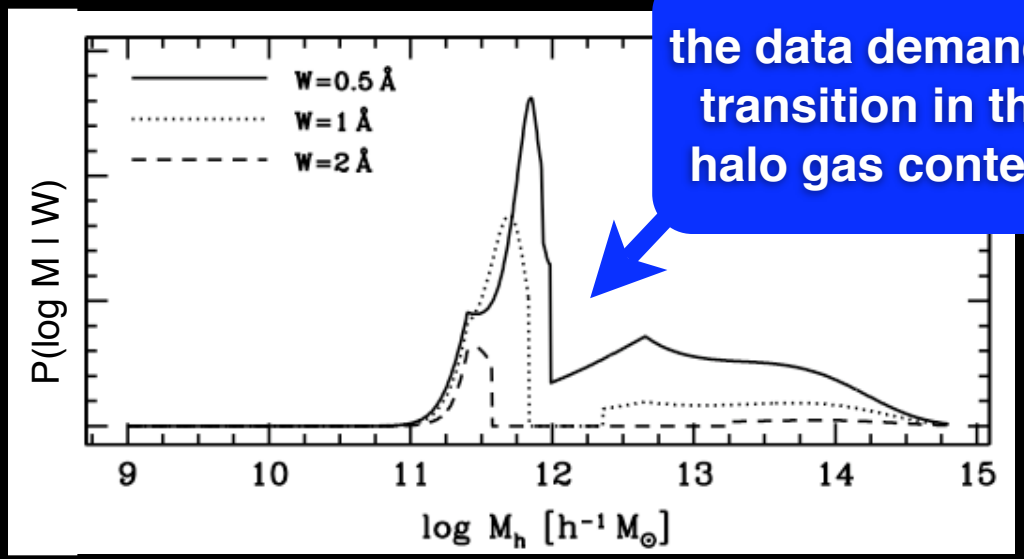
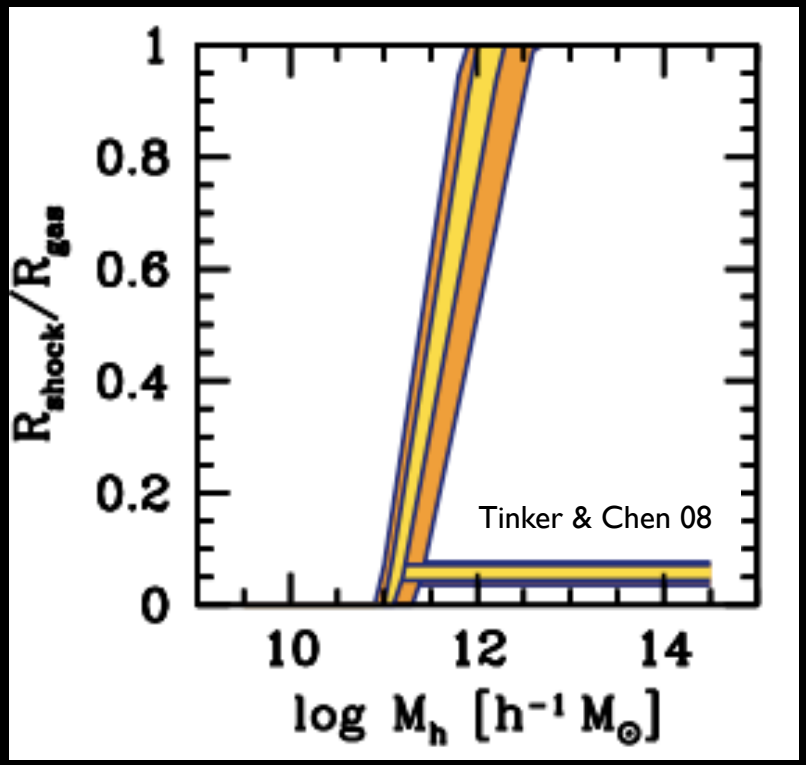


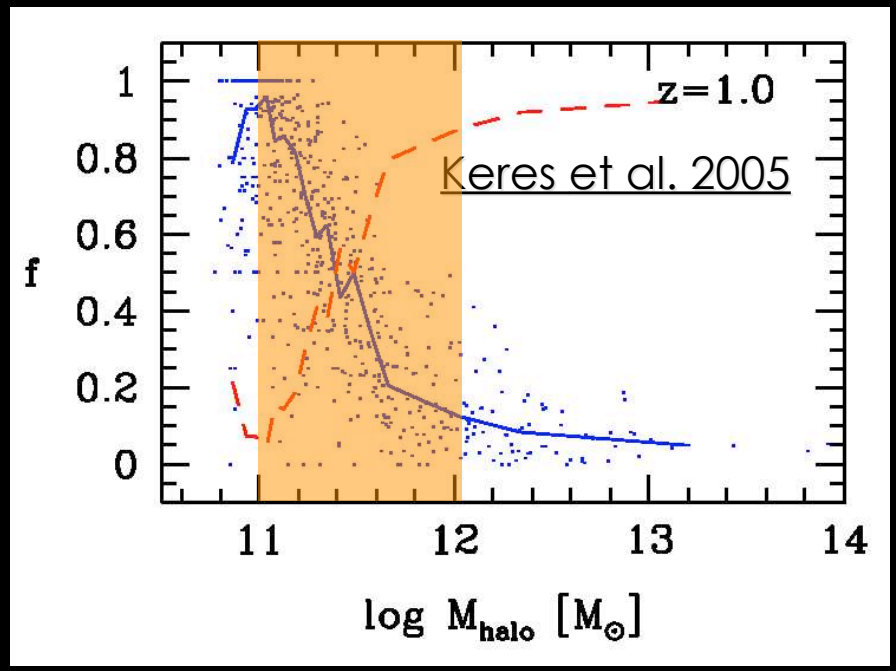
the data demand a transition in the halo gas content

Tinker & Chen (2008)

Comparisons with Theoretical Expectations

The growth of hot halos vs. halo mass





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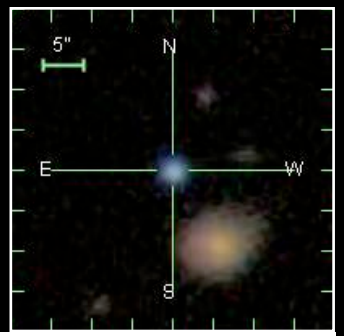
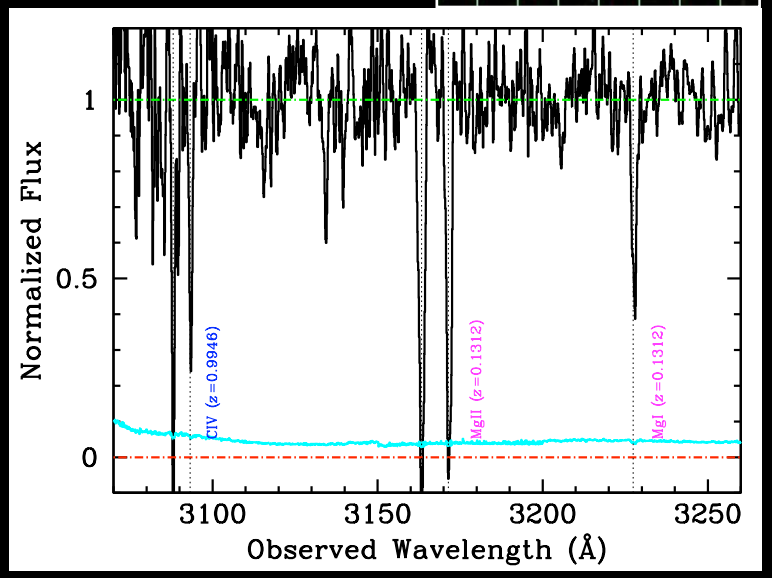
individual probes

A MagE survey of MgII in SDSS galaxies

J.-R. Gauthier, J. Helsby, J. Tinker, S. Shectman, I. Thompson





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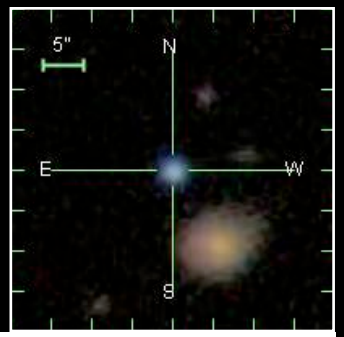

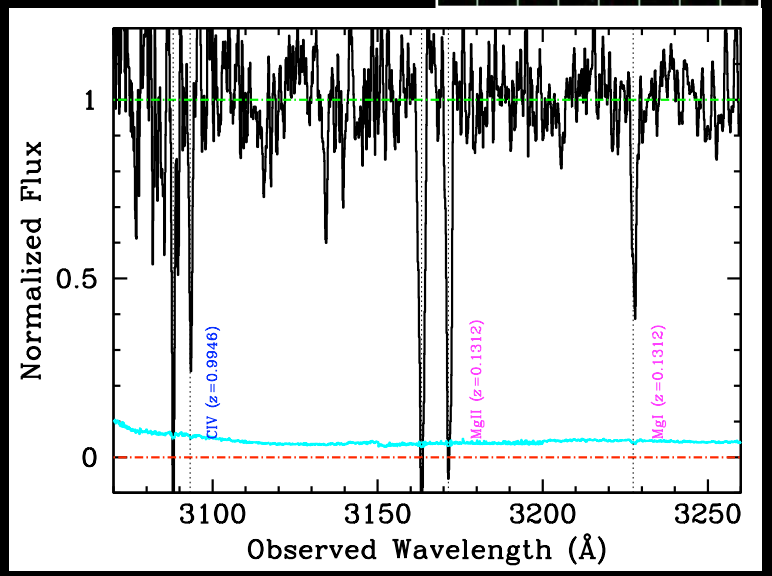

2D map of individual halos