Galactic Halo or Local Group Intergalactic Medium?

A tale of two sightlines

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With

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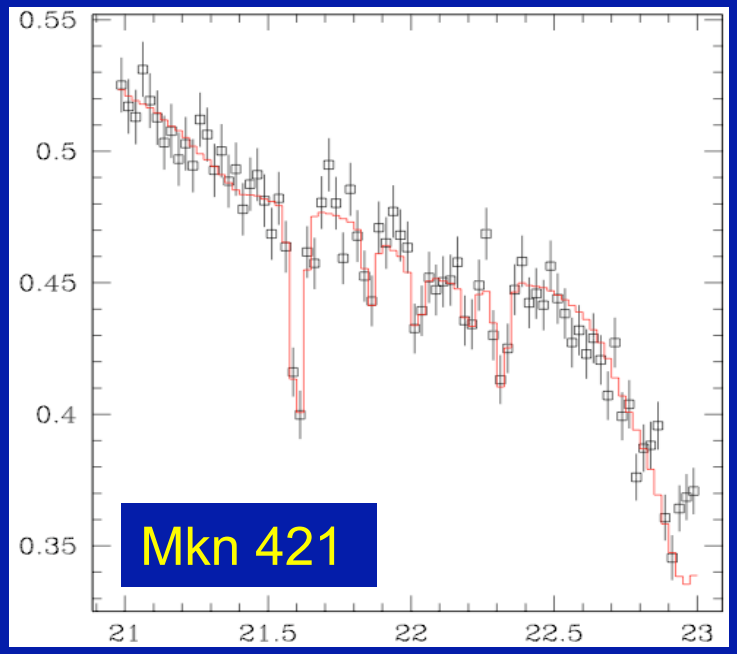
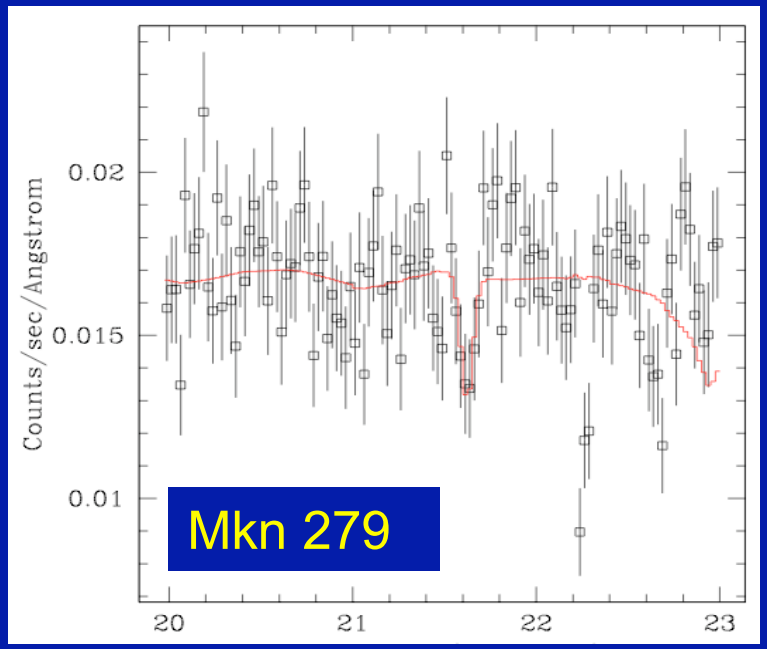
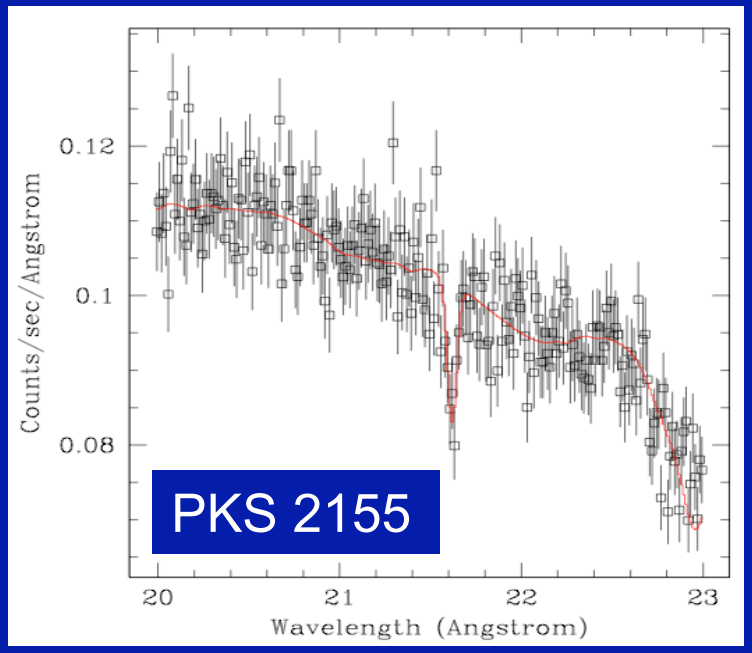
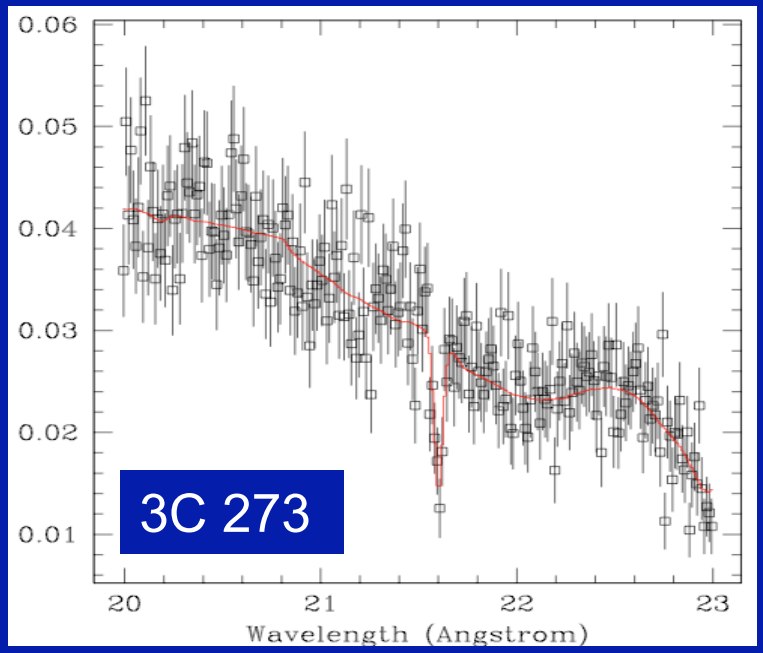
$z = 0$ X-ray Absorption

- In several high S/N Chandra spectra:
  - Mkn 421 (Williams et al. 2005)
  - Mkn 279 (Williams et al, in prep)
  - PKS 2155-304 (Nicastro et al. 2002)
  - 3C 273 (Fang et al. 2003)
  - Other sightlines with lower significance (McKernan et al 2004)
- Always OVII, sometimes other species
- Chandra-LETG resolution 700 km/s, so all lines are unresolved


0.55
0.5
0.45
0.4
0.35
21
21.5
22
22.5
23
Mkn 421


Counts/sec/Angstrom
0.02
0.015
0.01
20
21
22
23
Mkn 279

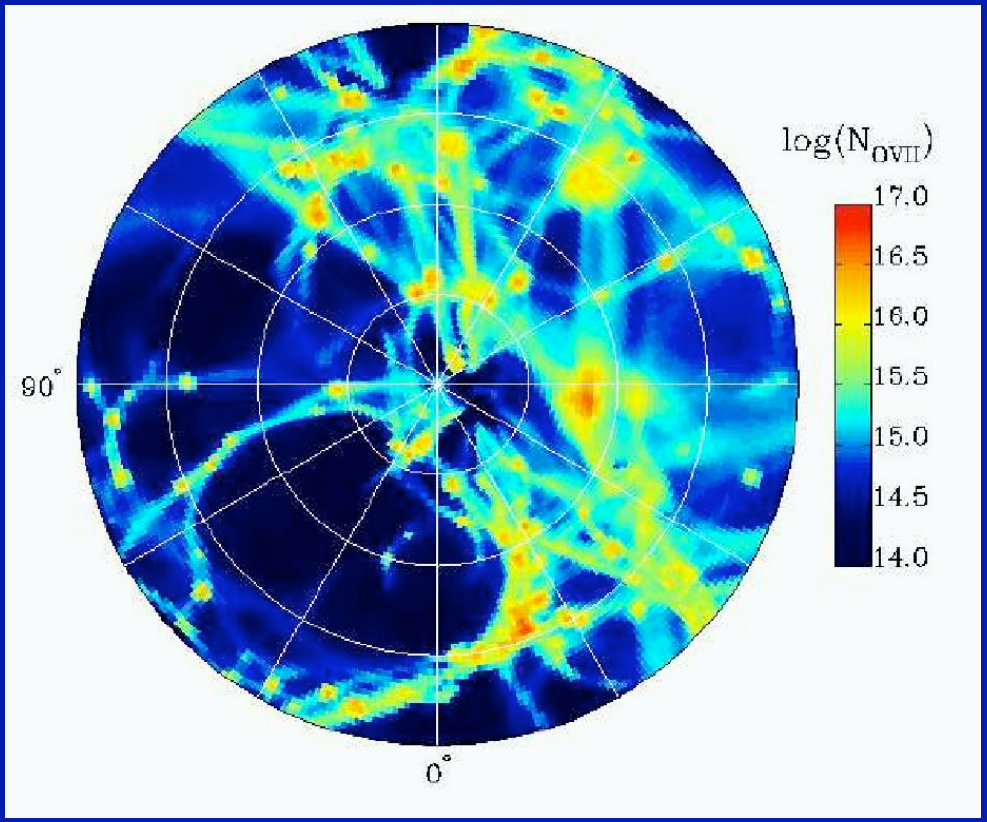

Counts/sec/Angstrom
0.12
0.1
0.08
20
21
22
23
Wavelength (Angstrom)
PKS 2155


0.06
0.05
0.04
0.03
0.02
0.01
20
21
22
23
Wavelength (Angstrom)
3C 273

Origin

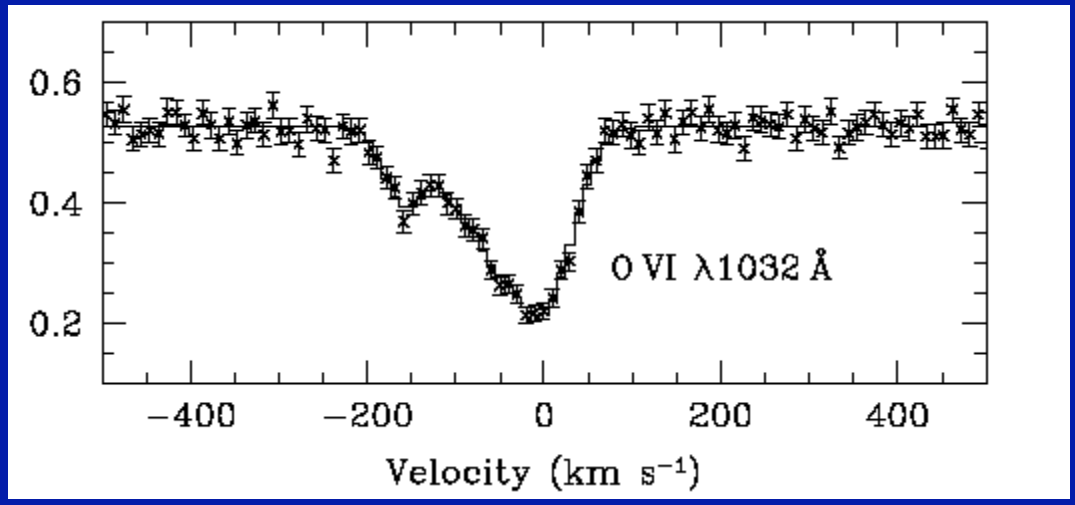
- Hot Galactic Halo/Corona…
  - From galaxy formation / feedback processes
  - Some OVII seen within 50 kpc (Wang et al. 2005)
- … or Local Warm-Hot IGM?
  - Predicted by simulations (Kravtsov et al. 2002)
  - Upper limit on OVII emission implies very low density (Rasmussen et al. 2003)

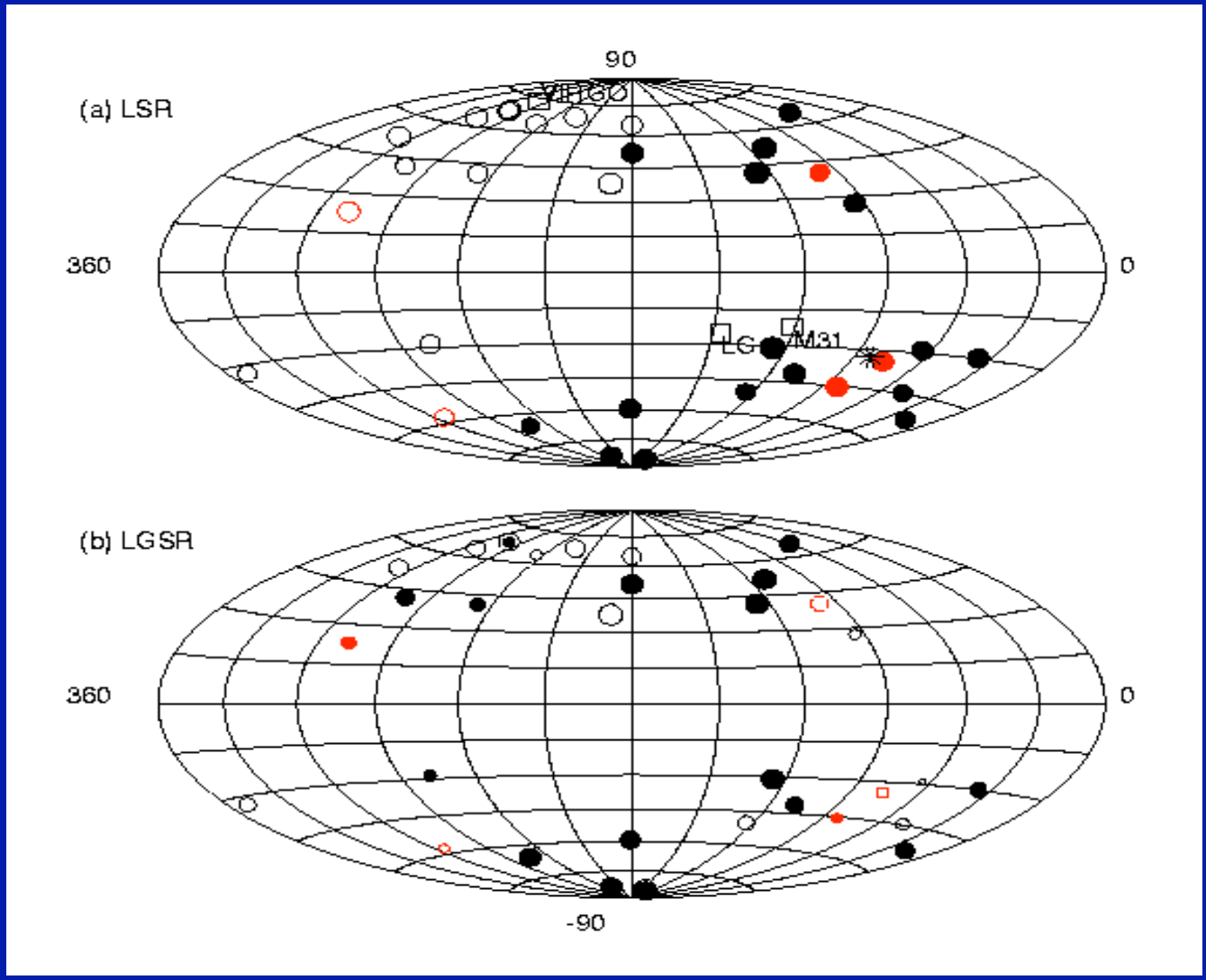
Constrained Simulations of the Local Supercluster Region



Kravtsov, Klypin & Hoffman 2002

What is relation between OVI and OVII absorbers?





Nicastro et al 2003

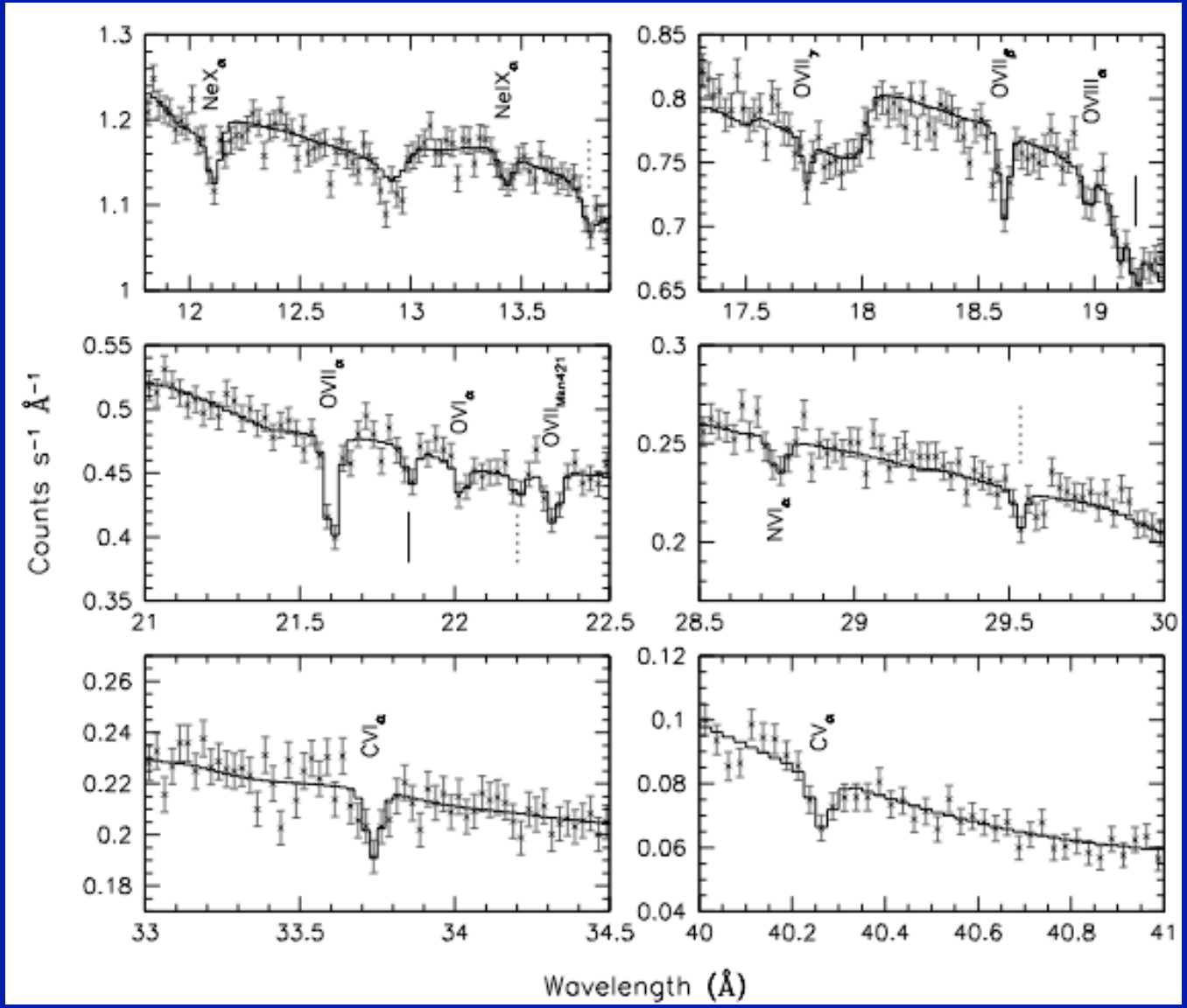
Why is this important?

- Mass.

  - if from large scale structure, the implied baryonic mass can be huge.

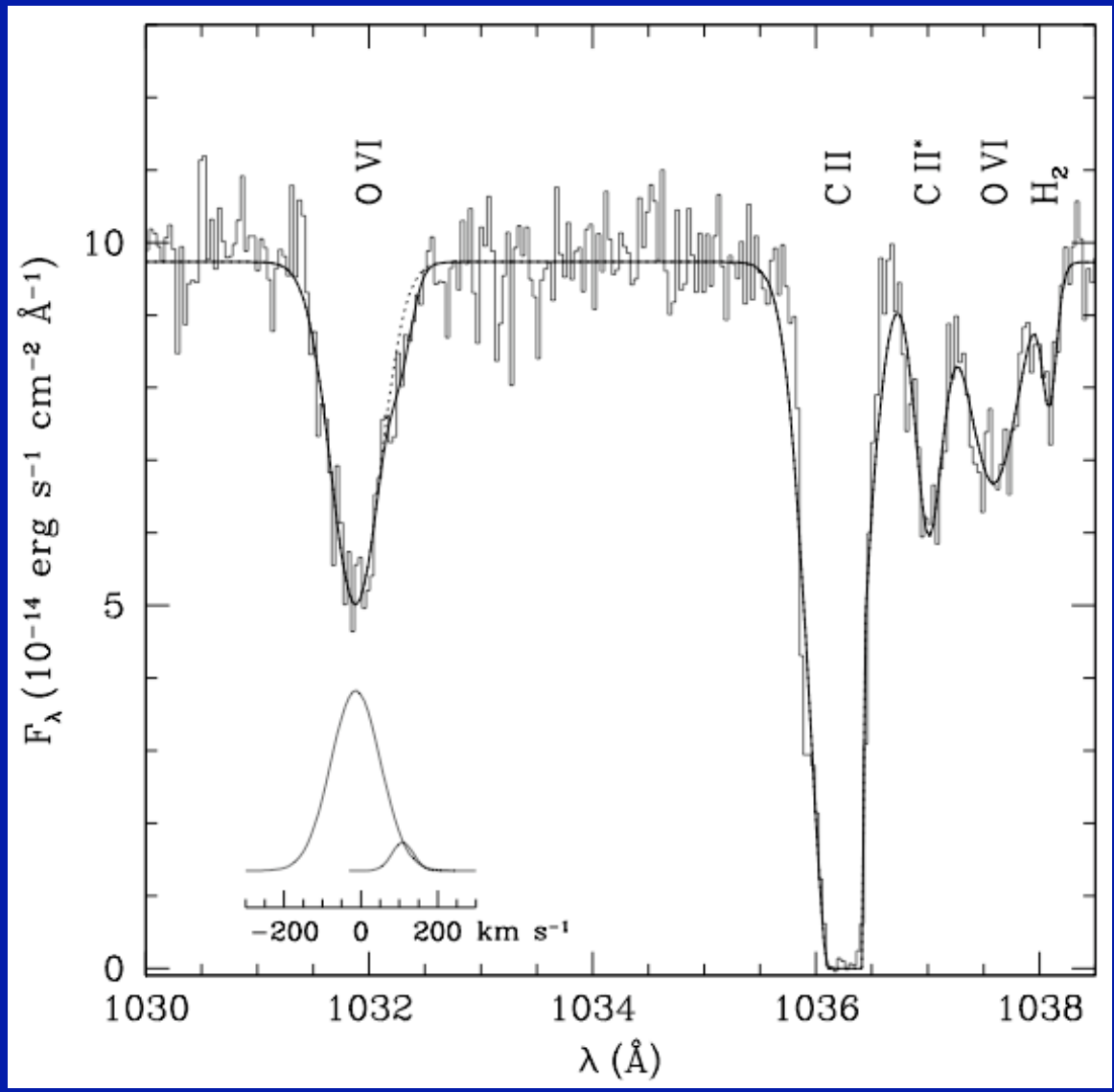
  - may account for all the missing Local Group baryons.
- Tests of models of galaxy formation and LSS

Mkn 421: Chandra HRC+ACIS/LETG, 200 ks



Williams et al. (2005; astro-ph/0504558)

Mkn 421: FUSE LiF1A, 85 ksec

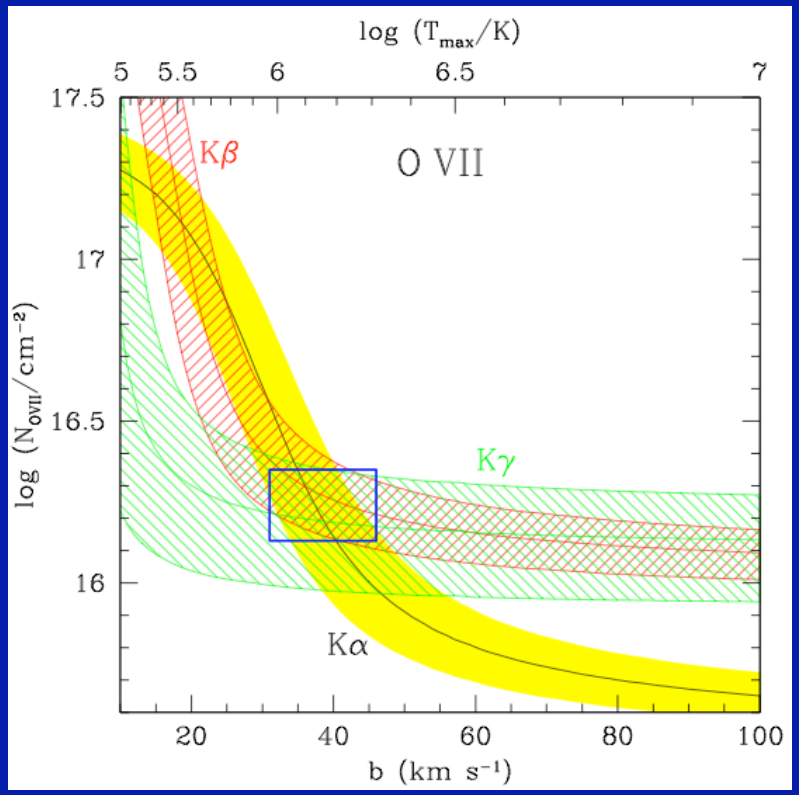


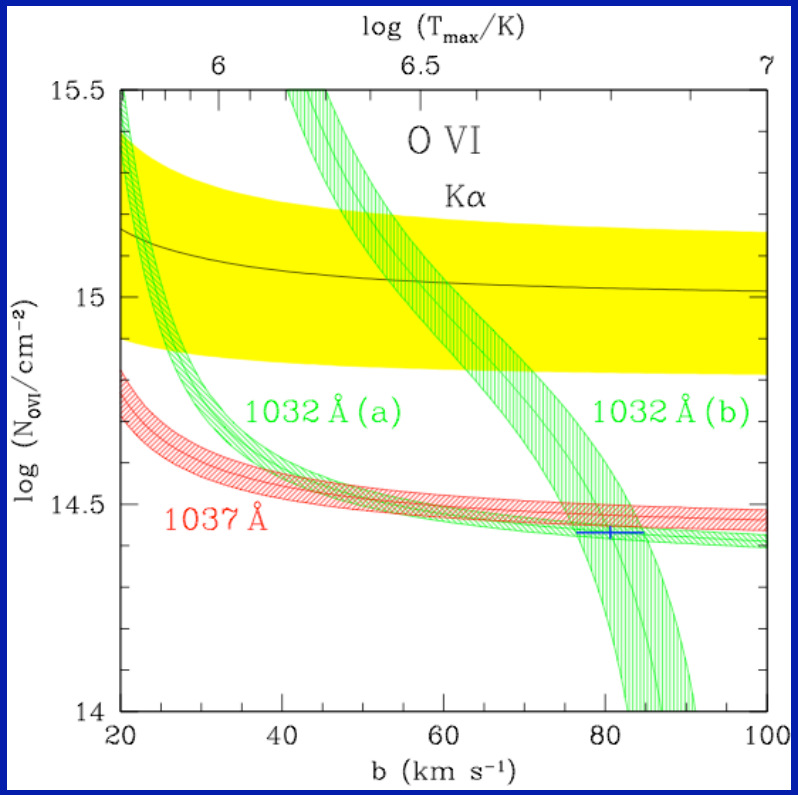
Williams et al. (2005; astro-ph/0504558)

What can we derive?

- Same ion, multiple transitions
  - Doppler parameter, consistency check
- Same element, different ions
  - N_i/N_j constrains T, U *(n)*
- Transitions from different elements
  - Constrain T, U, A_X/A_Y (assuming one or more)

Mkn 421: Constraining b

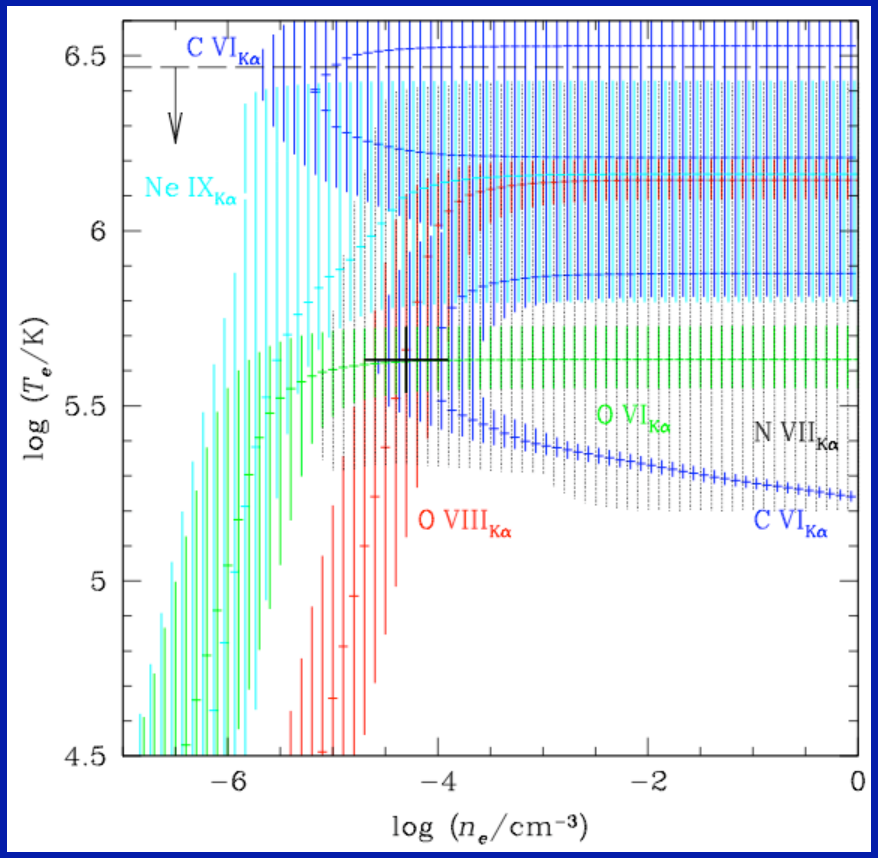




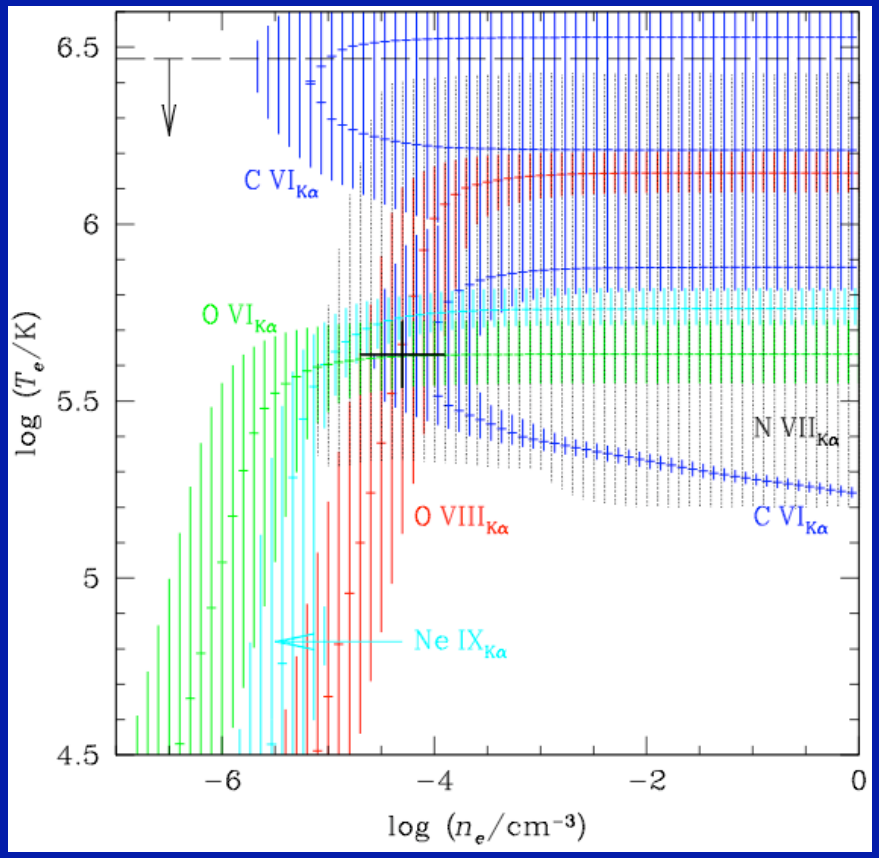
Williams et al. (2005; astro-ph/0504558)

Temperature-density constraints

[Ne/O] = 0

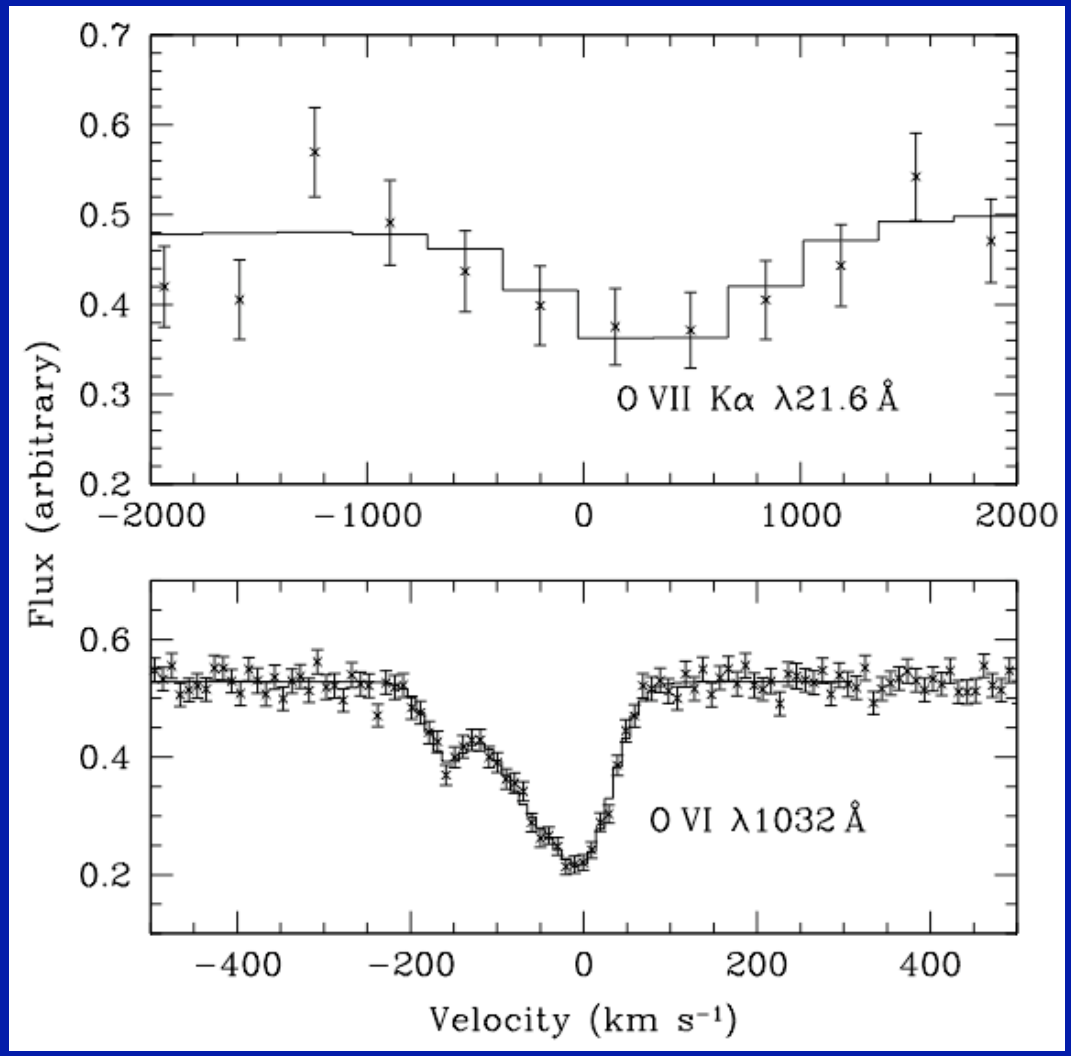


[Ne/O] = 1



Williams et al. (2005; astro-ph/0504558)

Mkn 279



Williams et al., 2005, in preparation

Low-velocity OVI

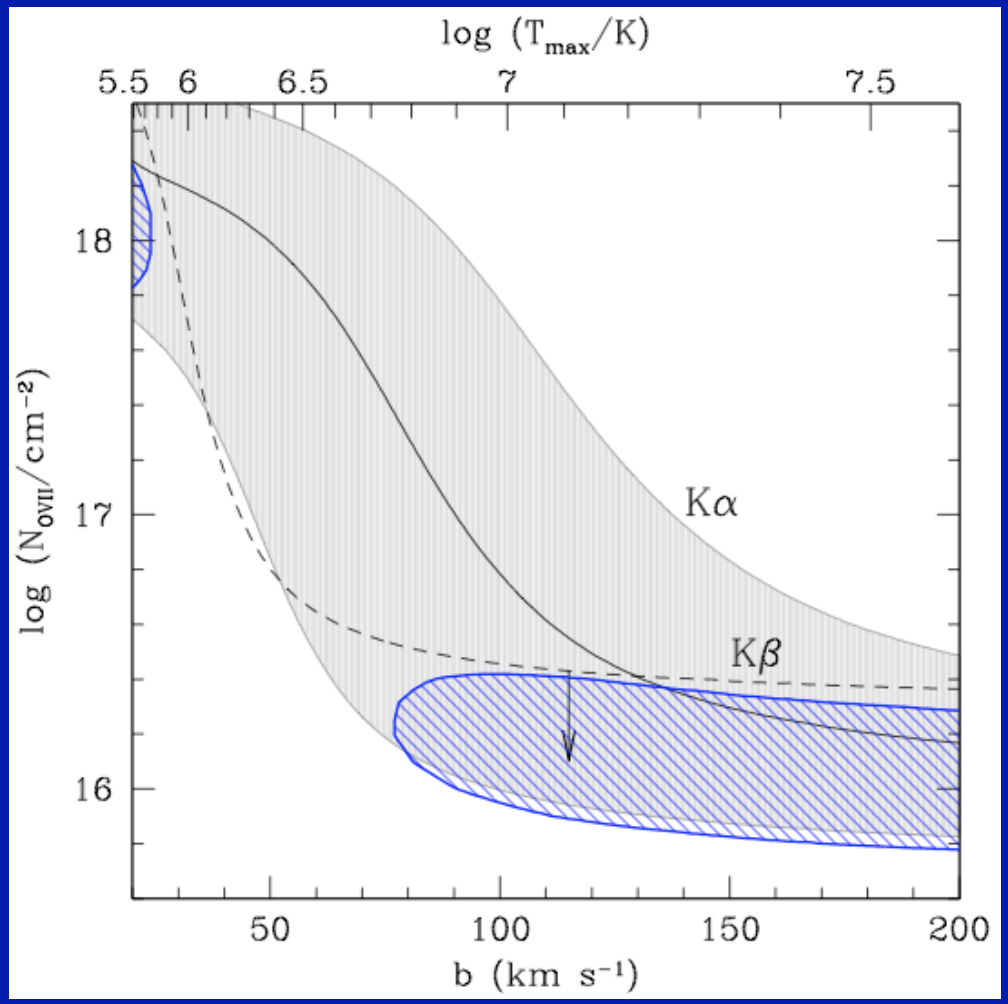
Two components

b=40 + b=60 km/s

High-velocity OVI

b=30 km/s

Mkn 279: Constraining b



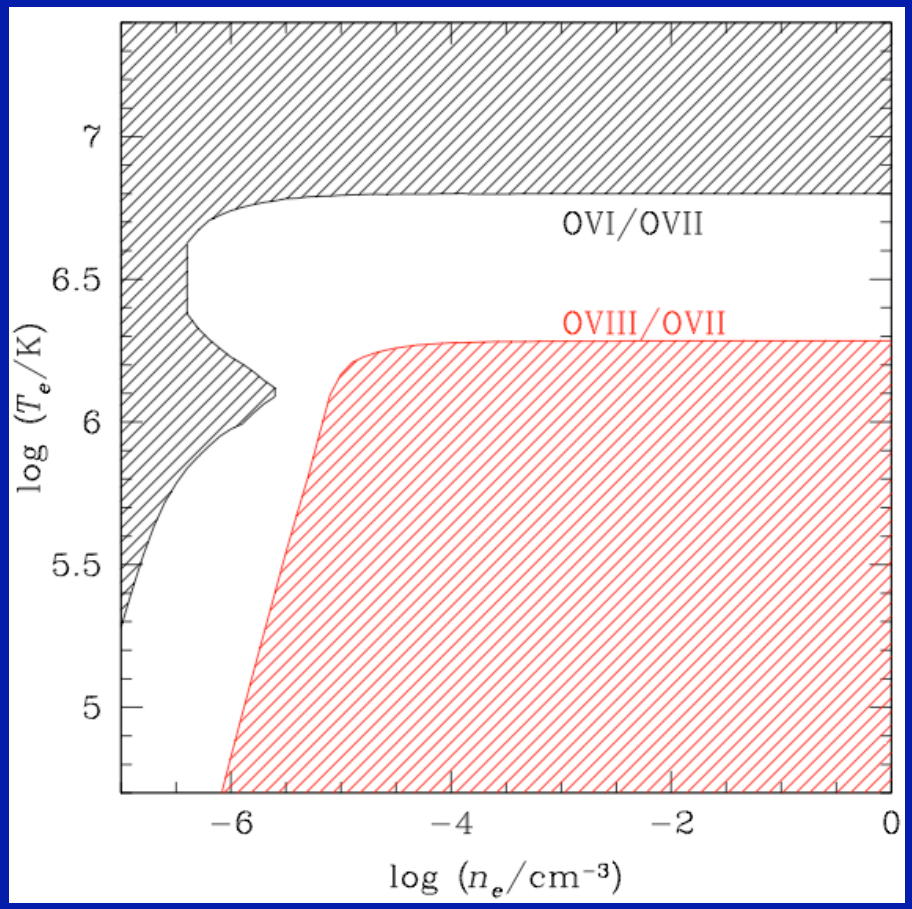
b > 77 km/s

(95% conf.)

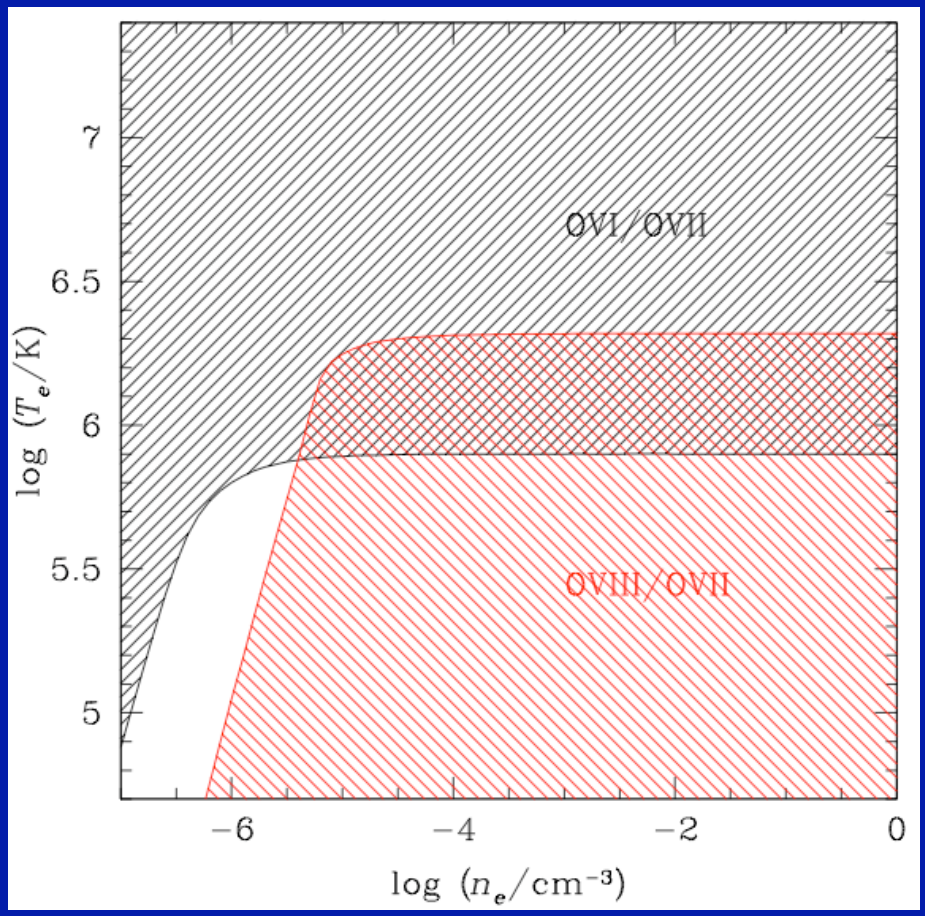
Williams et al., 2005, in preparation

Temperature—density constraints

b=100 km/s



b=200 km/s



Williams et al., 2005, in preparation

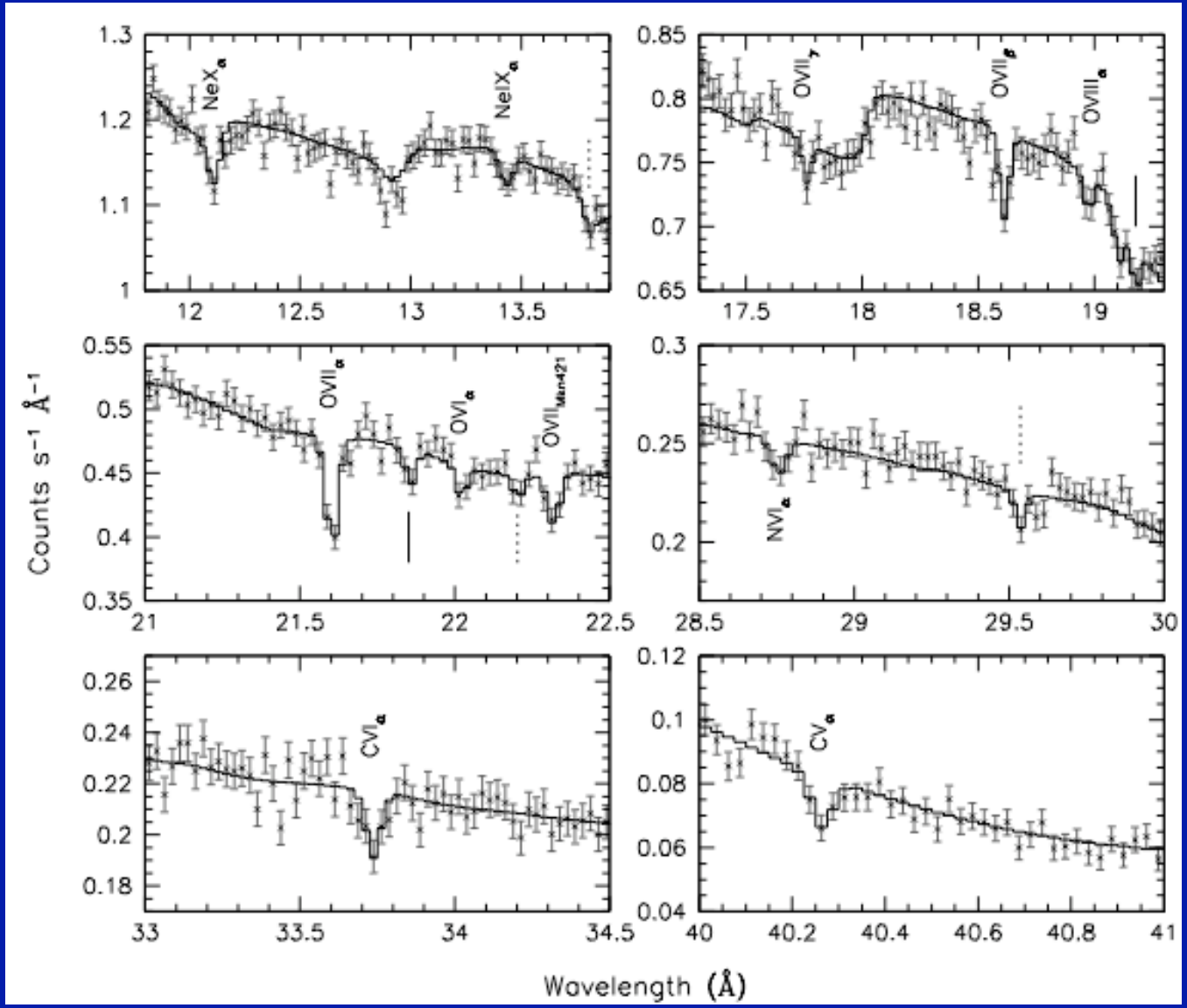
X-ray Absorber Properties

(all 2σ limits)	**Mkn 421**	**Mkn 279**
Log(N_{OVII})	16.23 ± 0.21	16.03 ± 0.25
b	24-55 km/s	>77 km/s
Log(*T*)	6.1-6.2 (coll) 5.5-5.7 (photo)	< 6.3 > 5.7
Log(n_e)	> -4.7 < -3.9 (maybe)	> -5.5

Summary

- OVII toward both sightlines is not associated with any single OVI component
- Extragalactic origin cannot be ruled out
- Difference in *b* values means variety of phenomena?
- Better data crucial!

Mkn 421: Chandra HRC+ACIS/LETG, 200 ks



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