The Circumgalactic Medium of Dwarf Galaxies in Simulations

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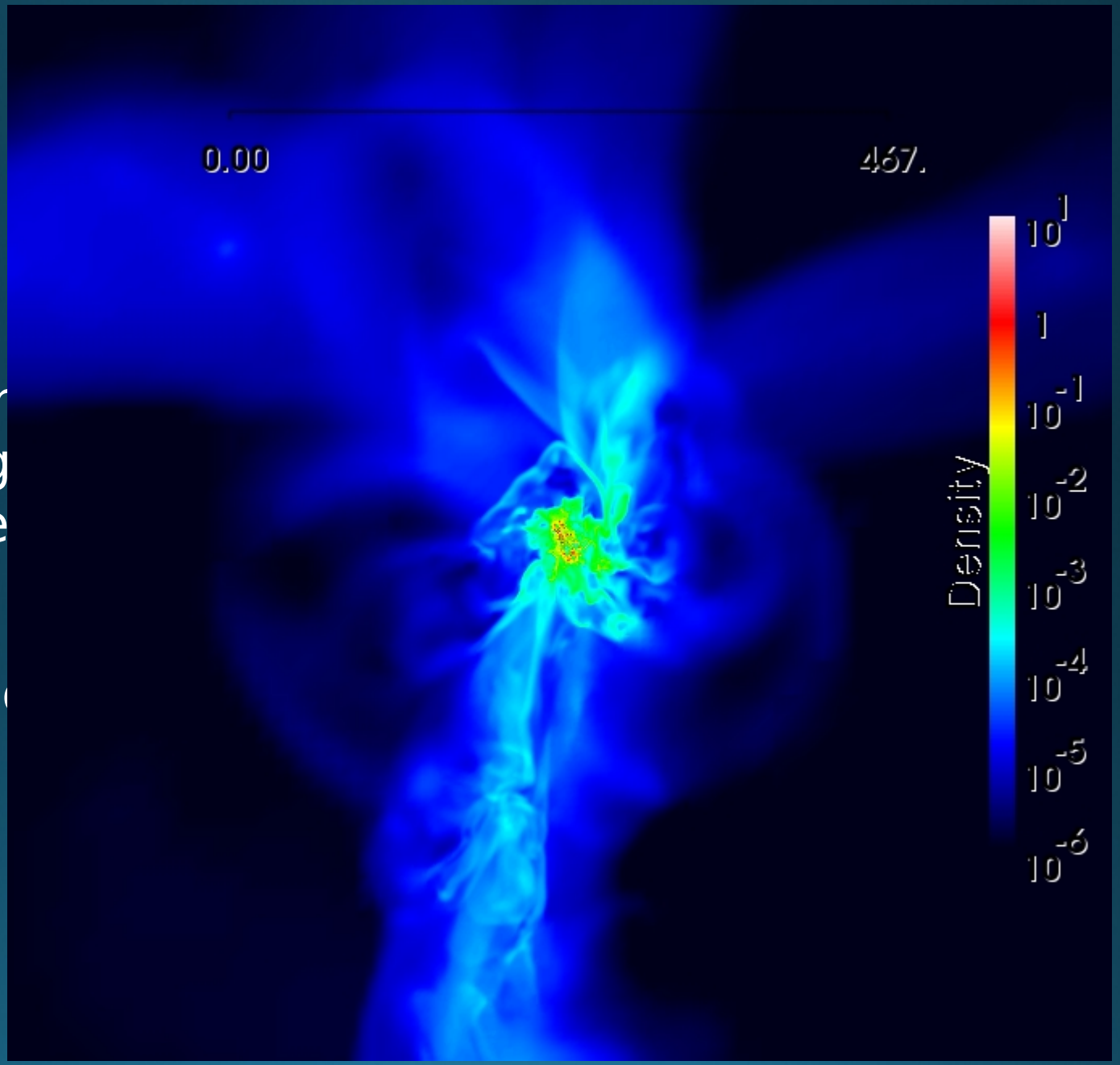
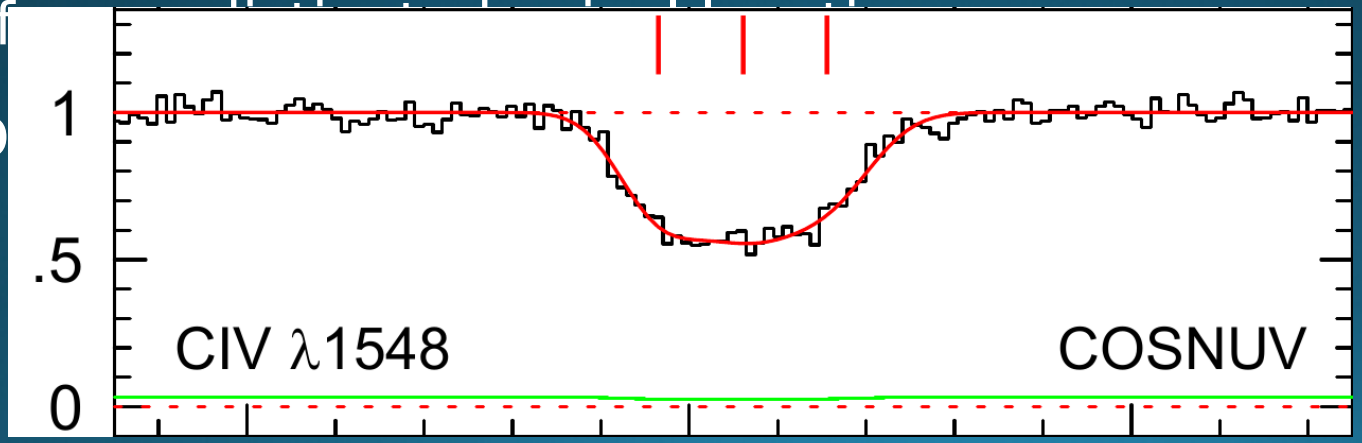
What is the CGM?

- Diffuse gas reservoir surroundir a galaxy, extending out to a few hundre kpc
- Typically observe through absorption in quasar spectra

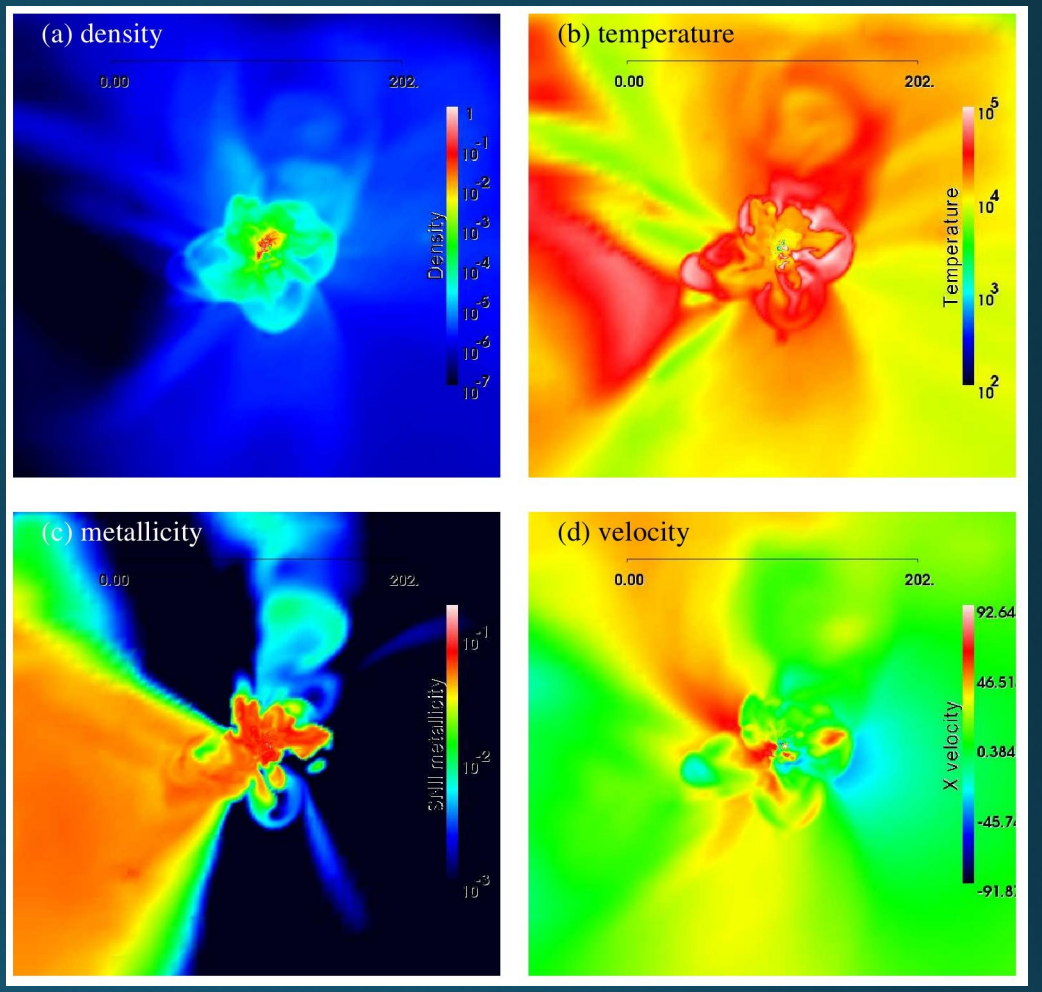


Difficulties

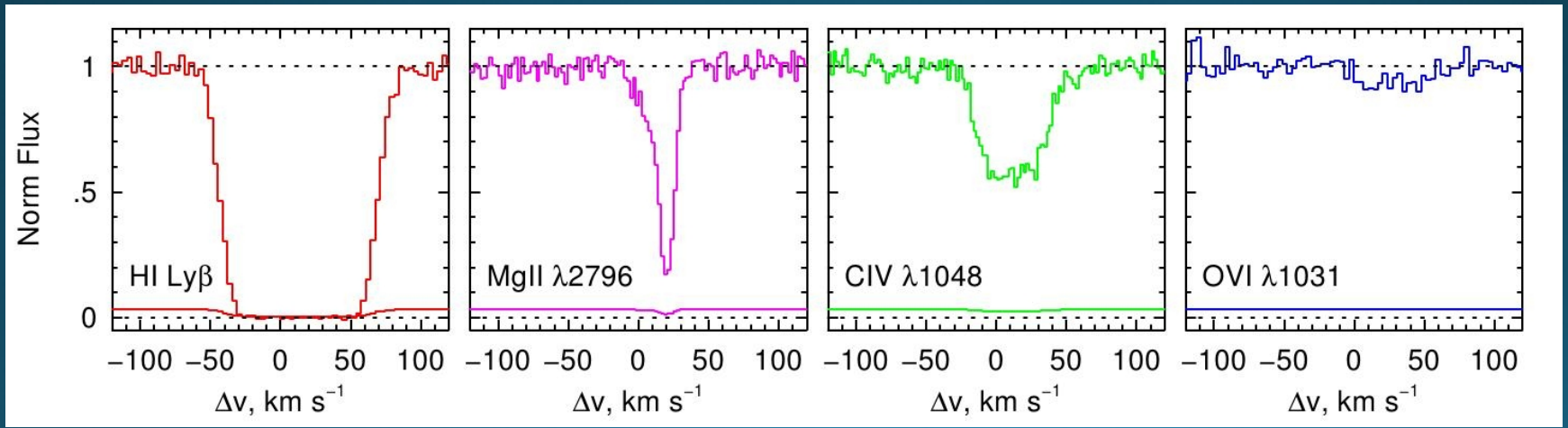
- Hard to interpret observations
- Density and thermal properties determined from Voigt profile fitting
- Depends on numerous assumptions
  - Absorbers are cloud-like (constant density, temperature)
  - An absorber at a distinct line-of-sight velocity arises f
- Ho

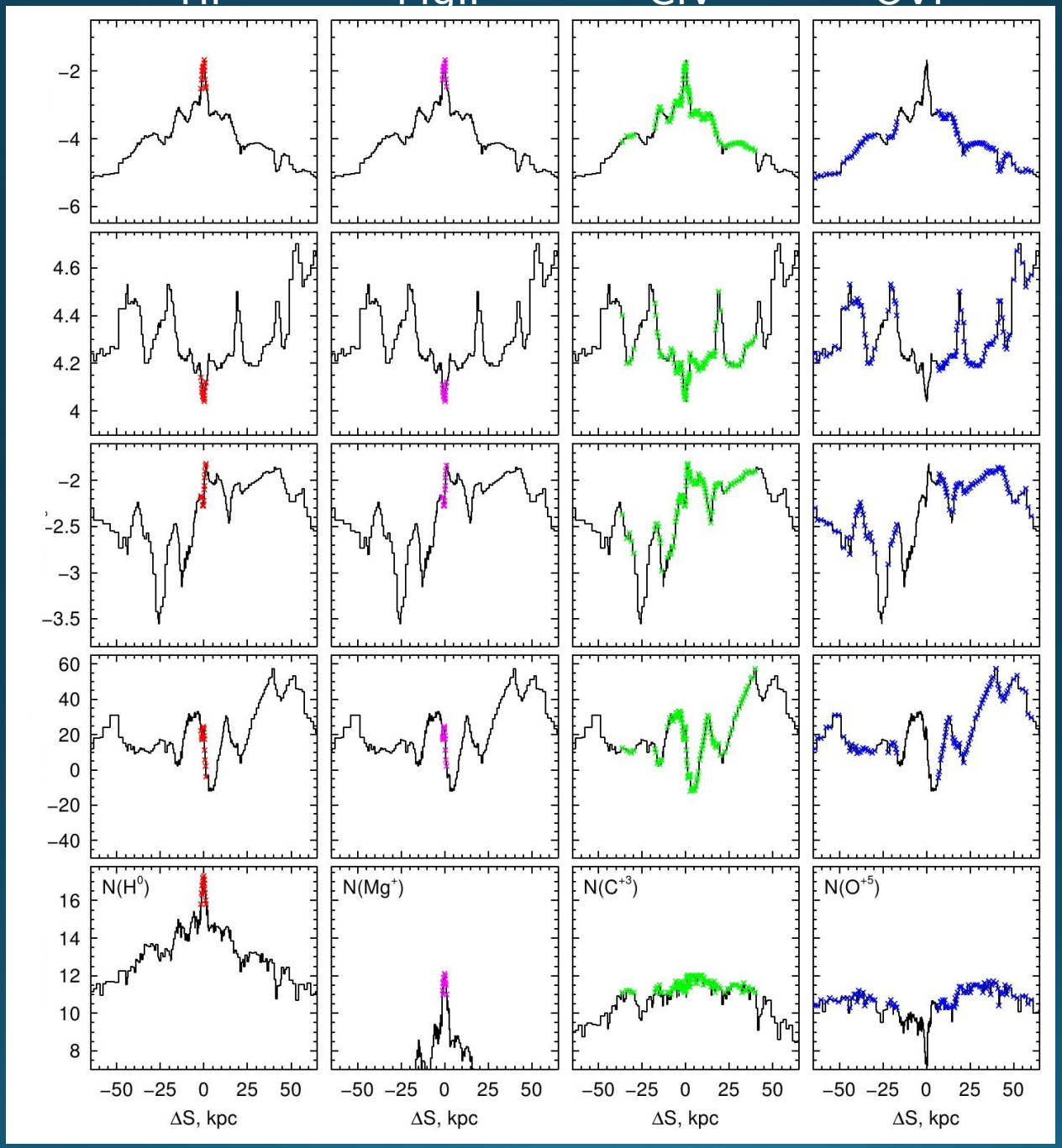


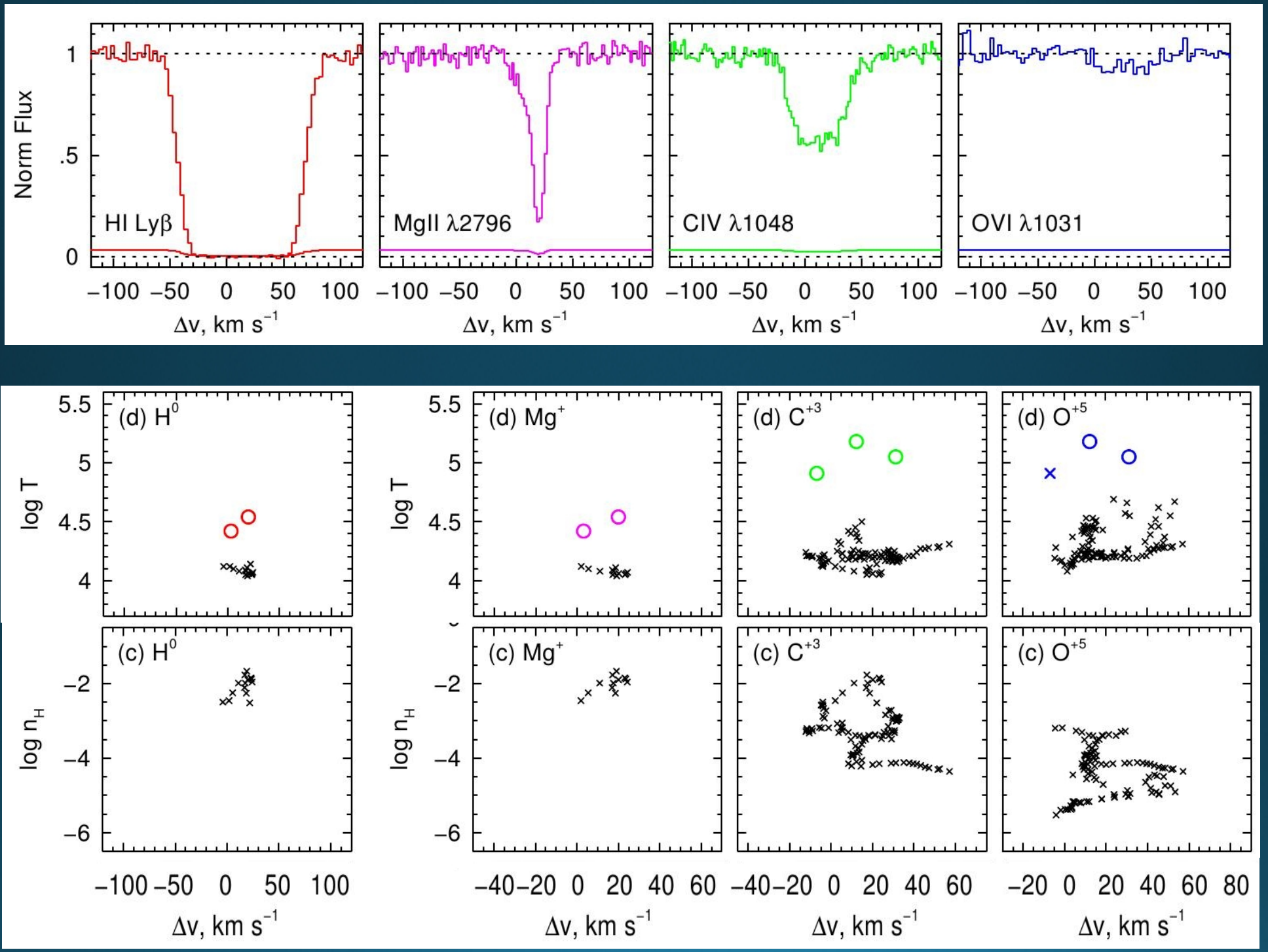
- Use cosmological zoom-in simulations using ART by Trujillo-Gomez et al. (2013)
- Isolated dwarf galaxies
  - Mvir = 3x1010 M⊙ at z=0
- Run lines of sight through the gaseous halo
- Generate spectra based on:
  - Physical properties
  - Kinematics
  - Instrumental effects
- Fit Voigt profiles to spectra
- Compare the derived physical values of gas from fits to actual properties in the simulation

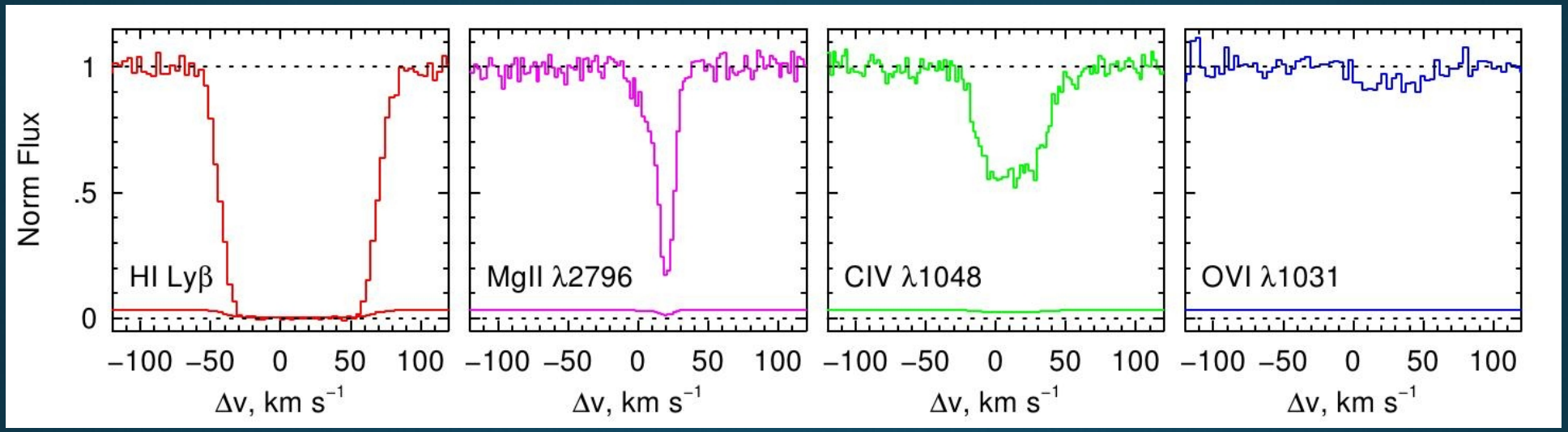


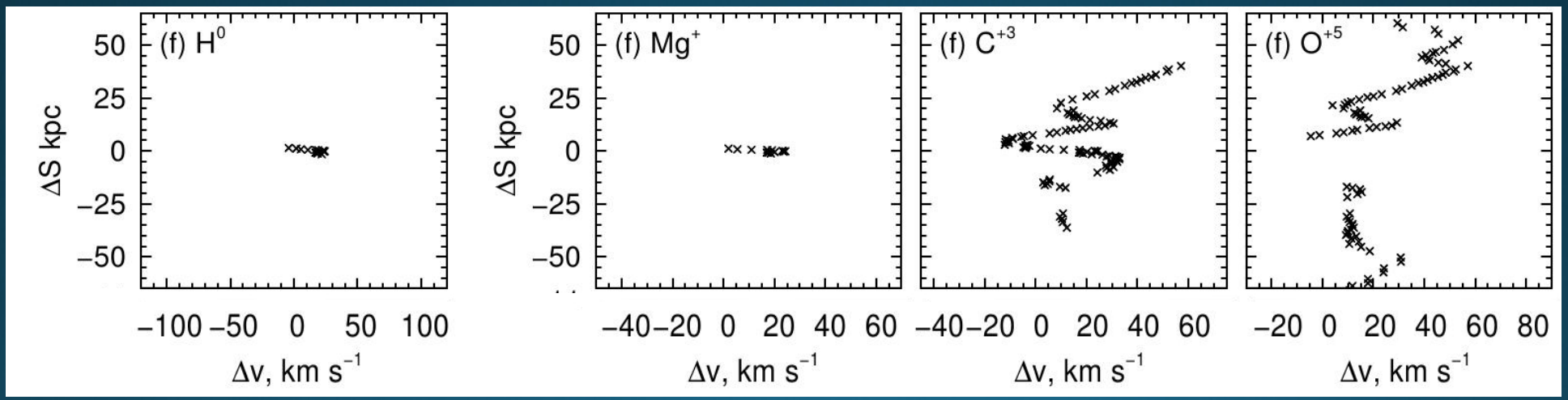
Churchill+ 2014, to be submitted

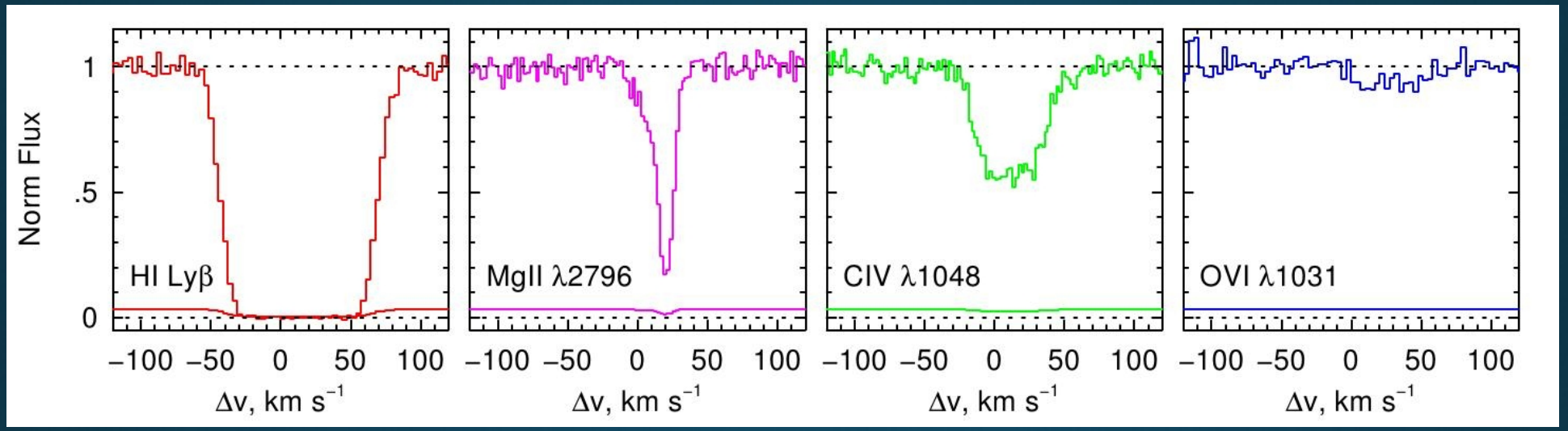


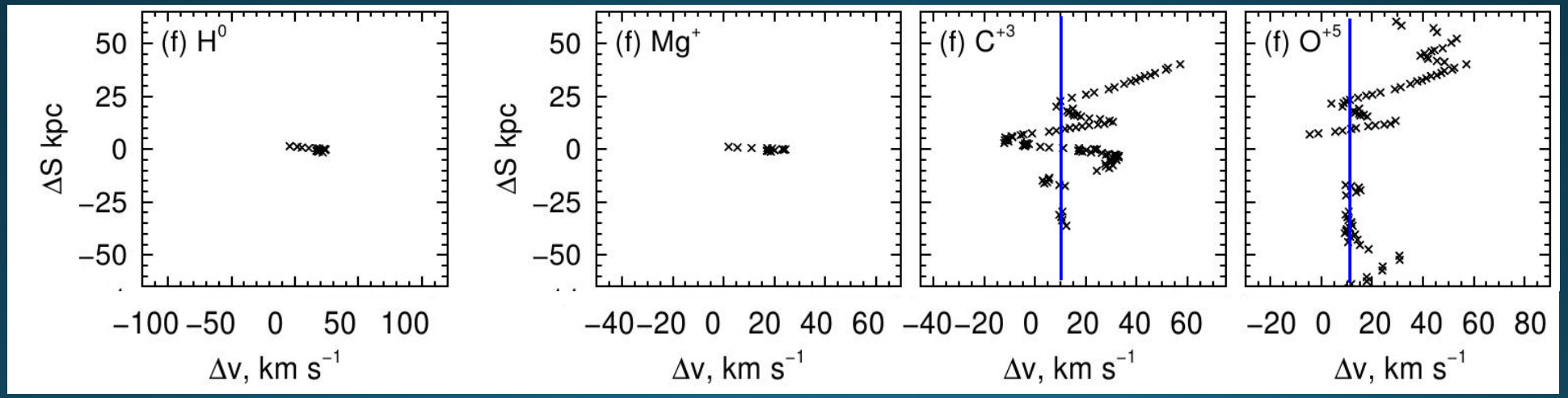

HI
MgII
CIV
OVI
log nH
log T
log Z/ZΘ
Δv
log N(X)
N(H^0)
N(Mg^+)
N(C^+3)
N(O^+5)
ΔS, kpc
Distance along LOS

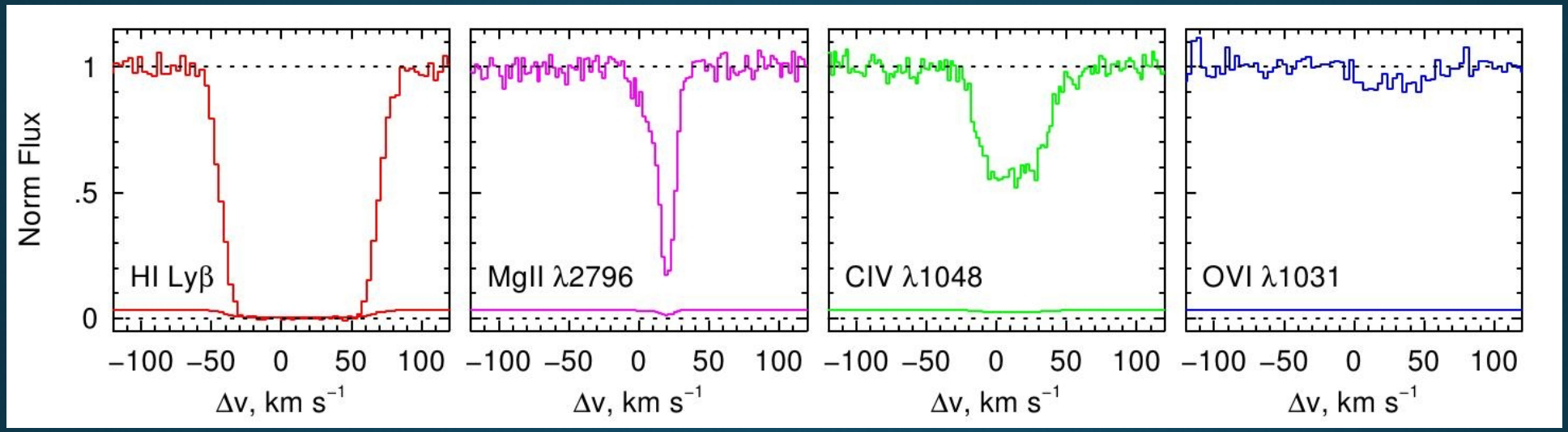

Norm Flux
HI Lyβ
MgII λ2796
CIV λ1048
OVI λ1031
Δv, km s^{-1}
log T
log n_H
(d) H^0
(c) H^0
(d) Mg^+
(c) Mg^+
(d) C^{+3}
(c) C^{+3}
(d) O^{+5}
(c) O^{+5}

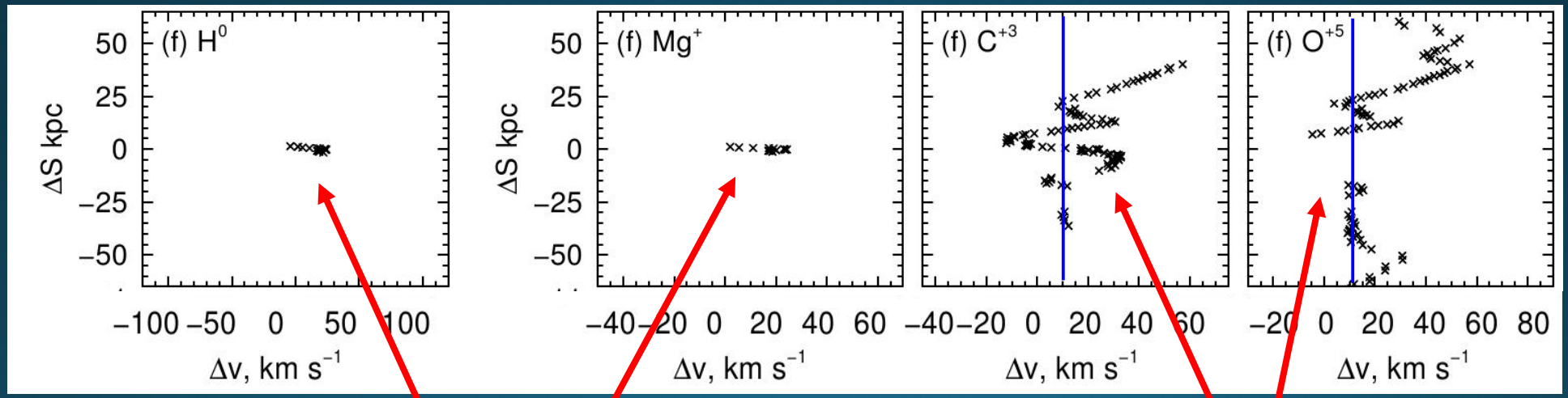

Norm Flux
1
.5
0
HI Lyβ
MgII λ2796
CIV λ1048
OVI λ1031
−100 −50 0 50 100
Δv, km s^{-1}


(f) H^{0}
(f) Mg^{+}
(f) C^{+3}
(f) O^{+5}
ΔS kpc
50
25
0
−25
−50
−100 −50 0 50 100
−40 −20 0 20 40 60
−20 0 20 40 60 80
Δv, km s^{-1}


Norm Flux
1
.5
0
HI Lyβ
MgII λ2796
CIV λ1048
OVI λ1031
−100 −50 0 50 100
Δv, km s^{-1}

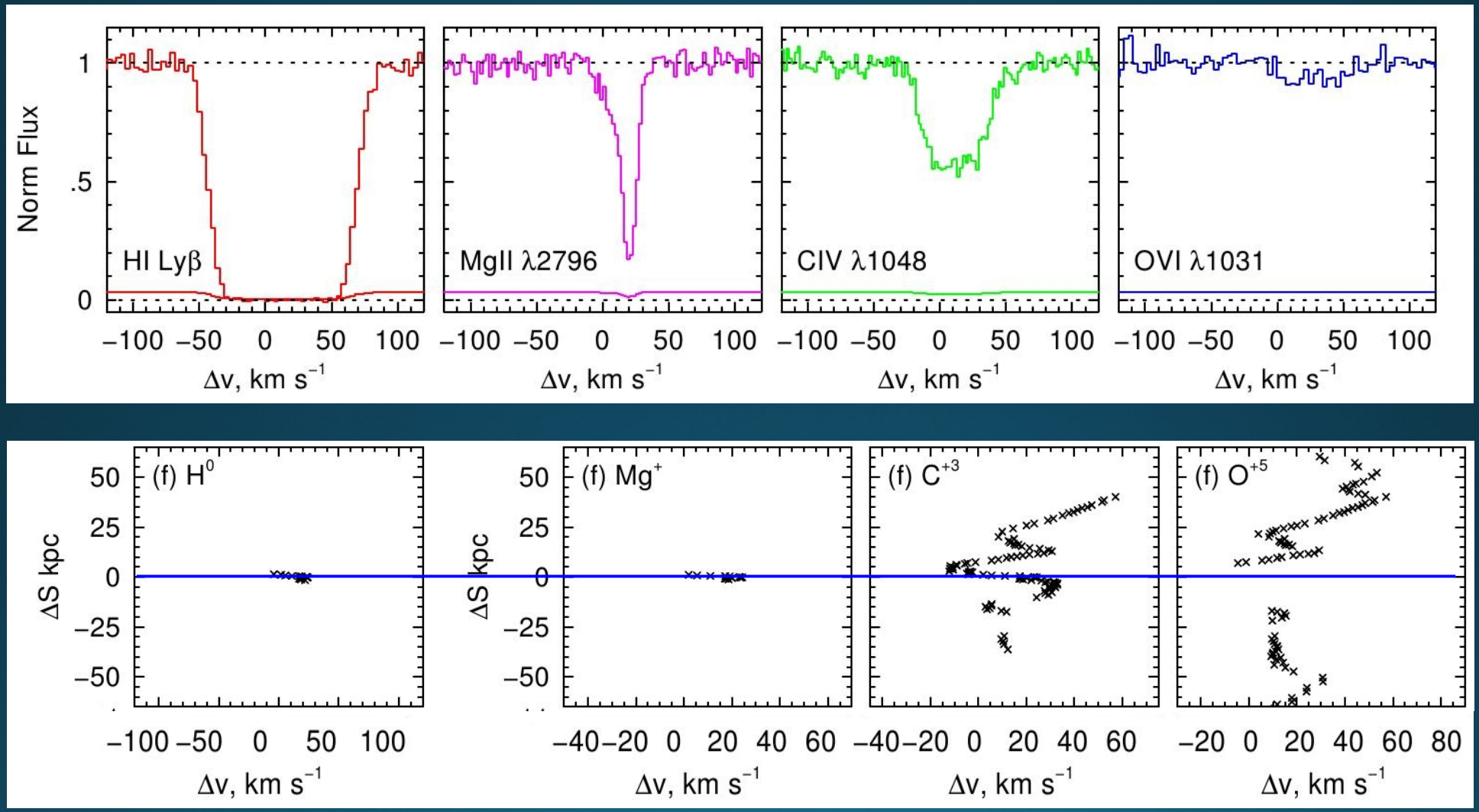

ΔS kpc
50
25
0
−25
−50
(f) H^{0}
(f) Mg^{+}
(f) C^{+3}
(f) O^{+5}
−100 −50 0 50 100
−40 −20 0 20 40 60
−20 0 20 40 60 80
Δv, km s^{-1}





Cloud-like

Not cloud-like



Gas with HI absorption does not give rise to OVI

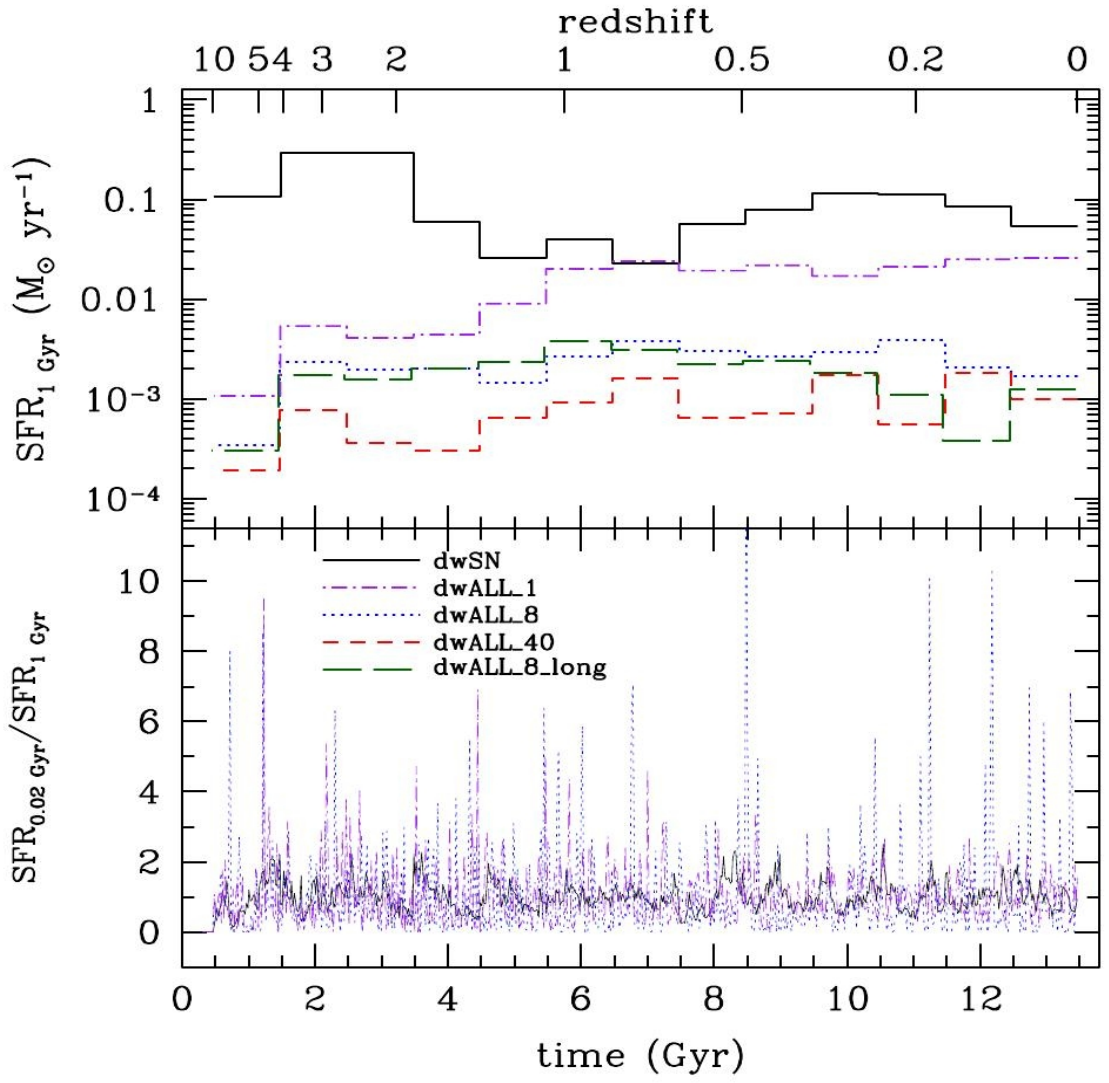
Role of Stellar Feedback in CGM Structure

Low redshift (z<0.1)

Three Feedback Prescriptions:

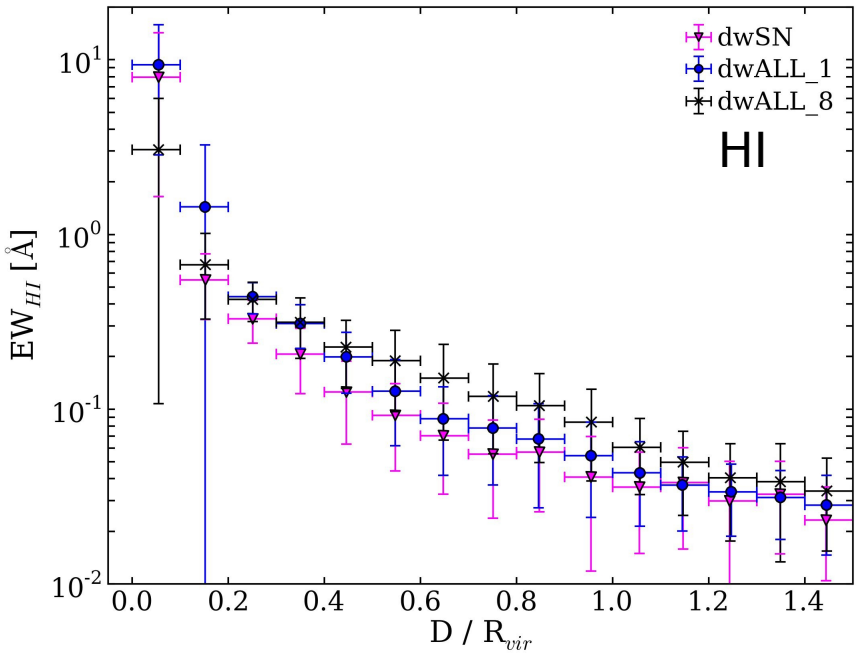
- dwSN = Supernova Only
- dwALL_1 = Weak Radiation Feedback
- dwALL_8 = Strong Radiation Feedback

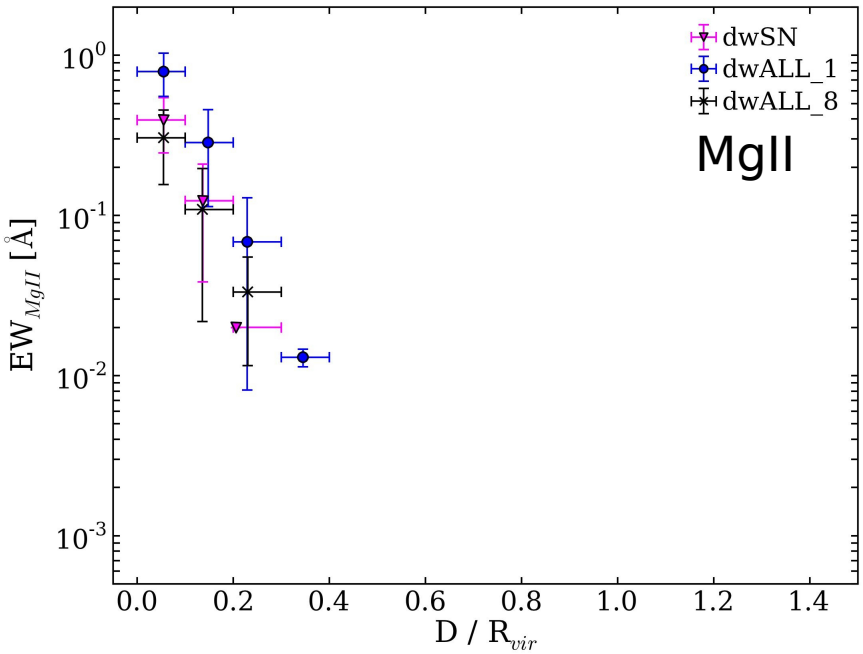
Model	ϵ_{ff}	feedback	τ_{tot}	P_{PH}/k_B (10^6 K cm^{-3})
dwSN	0.02	SNII+SW	-	0
dwRP_1_long	0.05	SNII+SW+RP	1	0
dwRP_10_long	0.05	SNII+SW+RP	10	0
dwRP_50_long	0.05	SNII+SW+RP	50	0
dwALL_1	0.05	SNII+SW+RP+PH	1	1
dwALL_8	0.02	SNII+SW+RP+PH	1	8
dwALL_40	0.02	SNII+SW+RP+PH	1	40
dwALL_8_long	0.02	SNII+SW+RP+PH	1	8

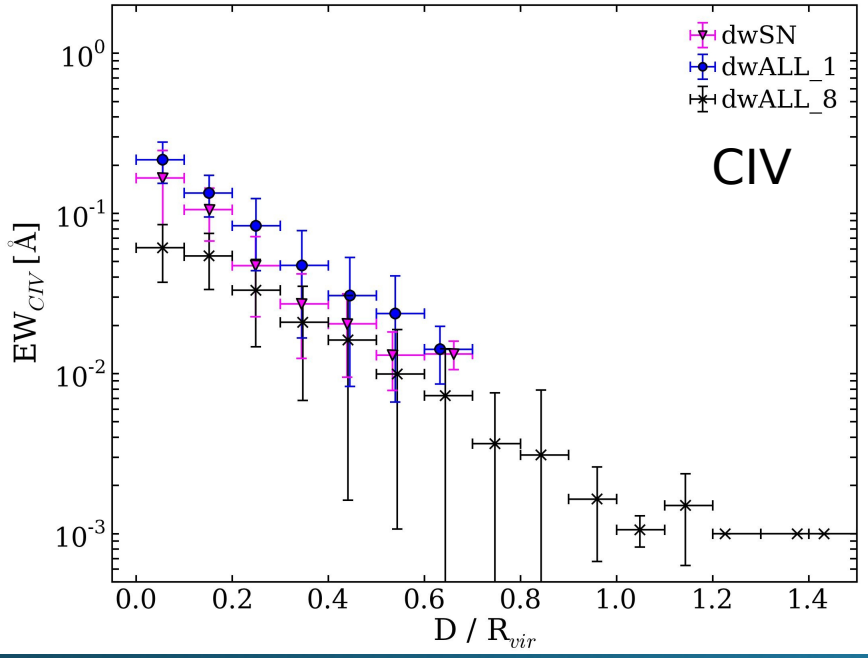


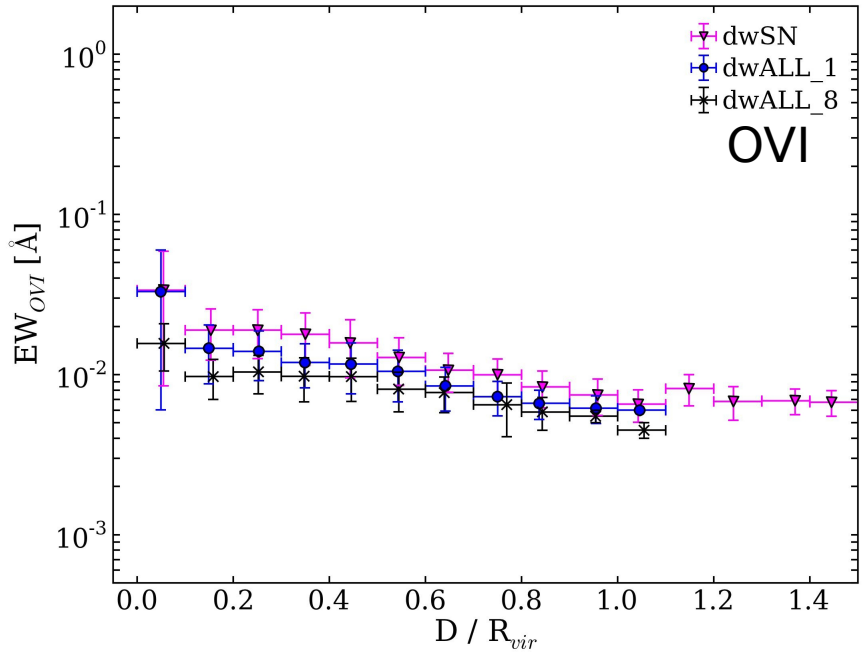
Trujillo-Gomez+ (2013)

Equivalent Width vs Impact Parameter



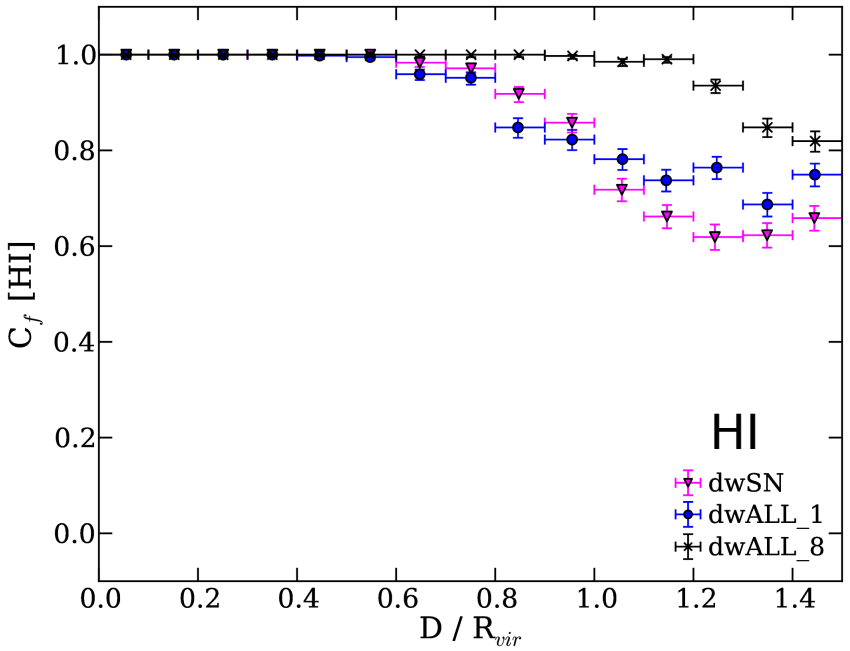


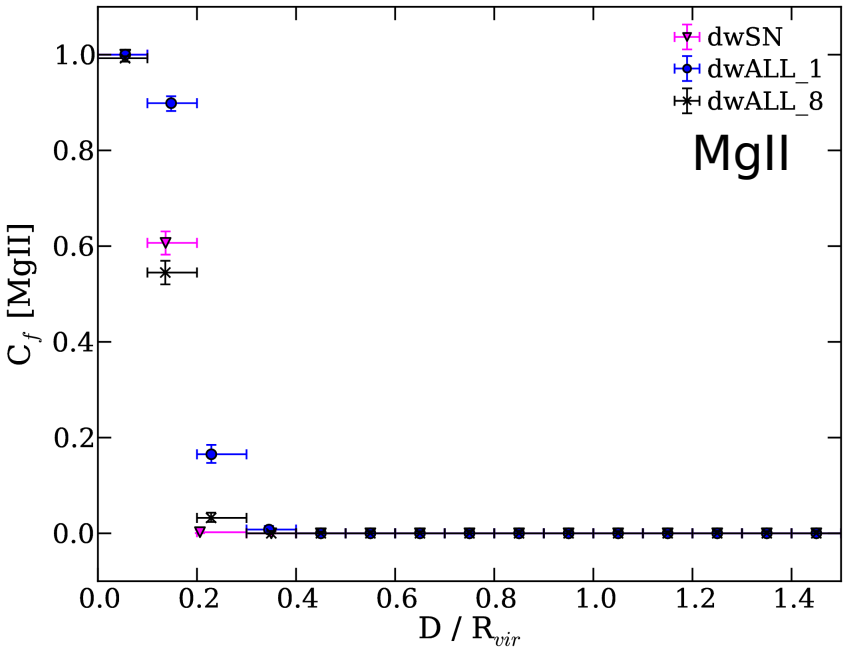


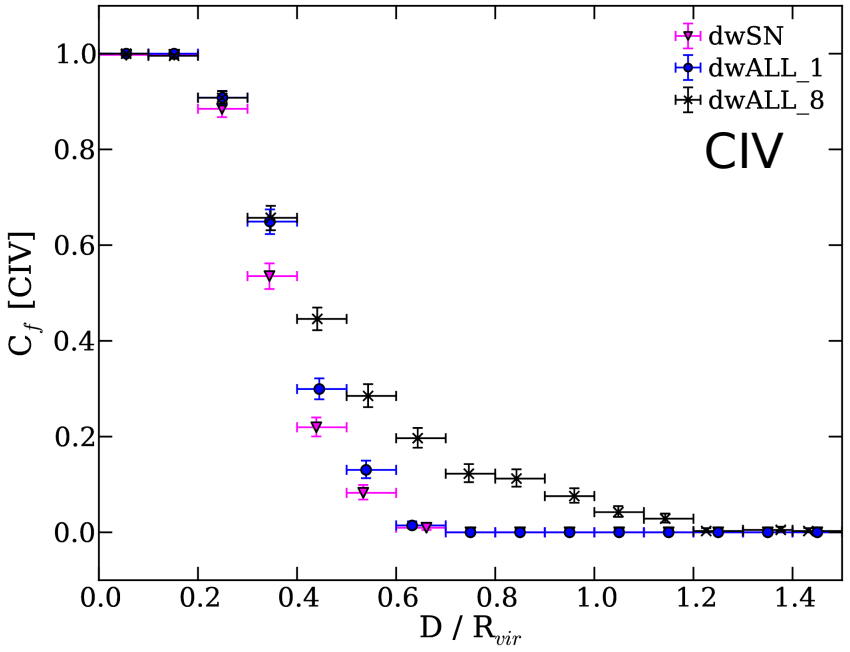


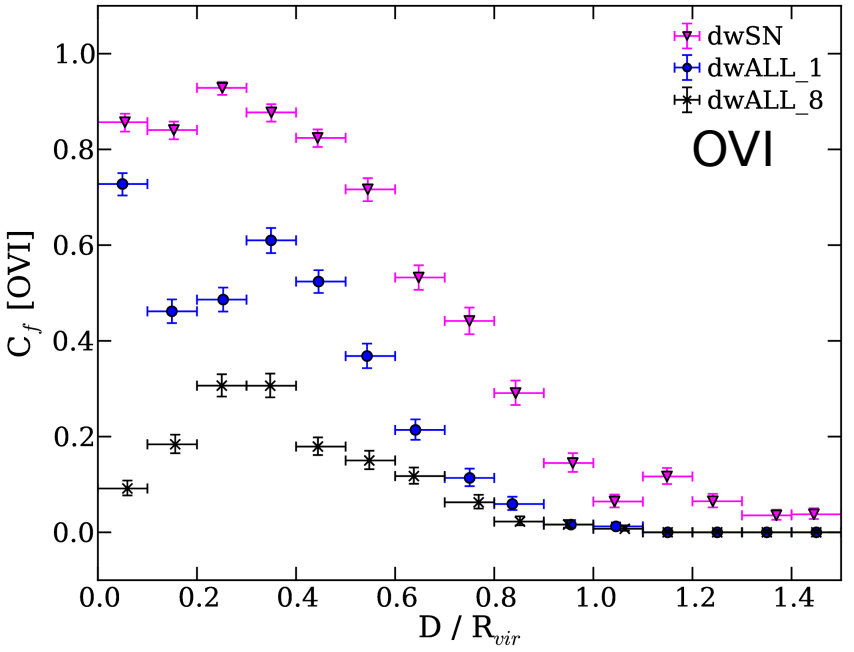
Vander Vliet+ (in prep)

Covering Fraction









Vander Vliet+ (in prep)

Summary

- Low ionization ions tend to arise in cloud-like structures
  - Voigt profile fitting appropriate
- High ionization ions tend to arise in diffuse structures
  - Apply Voigt profile fit with caution
- HI and OVI do not arise in the same gas
- Global properties of the CGM around dwarfs are relatively insensitive to stellar feedback detail
  - Exception: OVI
- Papers:
  - Churchill et al. 2014 to be submitted
  - Vander Vliet et al. 2014 in prep
  - Trujillo-Gomez et al. 2013 (arXiv: 1311.2910)