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Pontzen+ 08 MNRAS, Accepted arXiv:0804.4474

Pontzen & Pettini 08 In Prep.

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# The Strange Loop of Subgrid Physics

Prescriptions

Parameterisation

Parameters

# The Strange Loop of Subgrid Physics

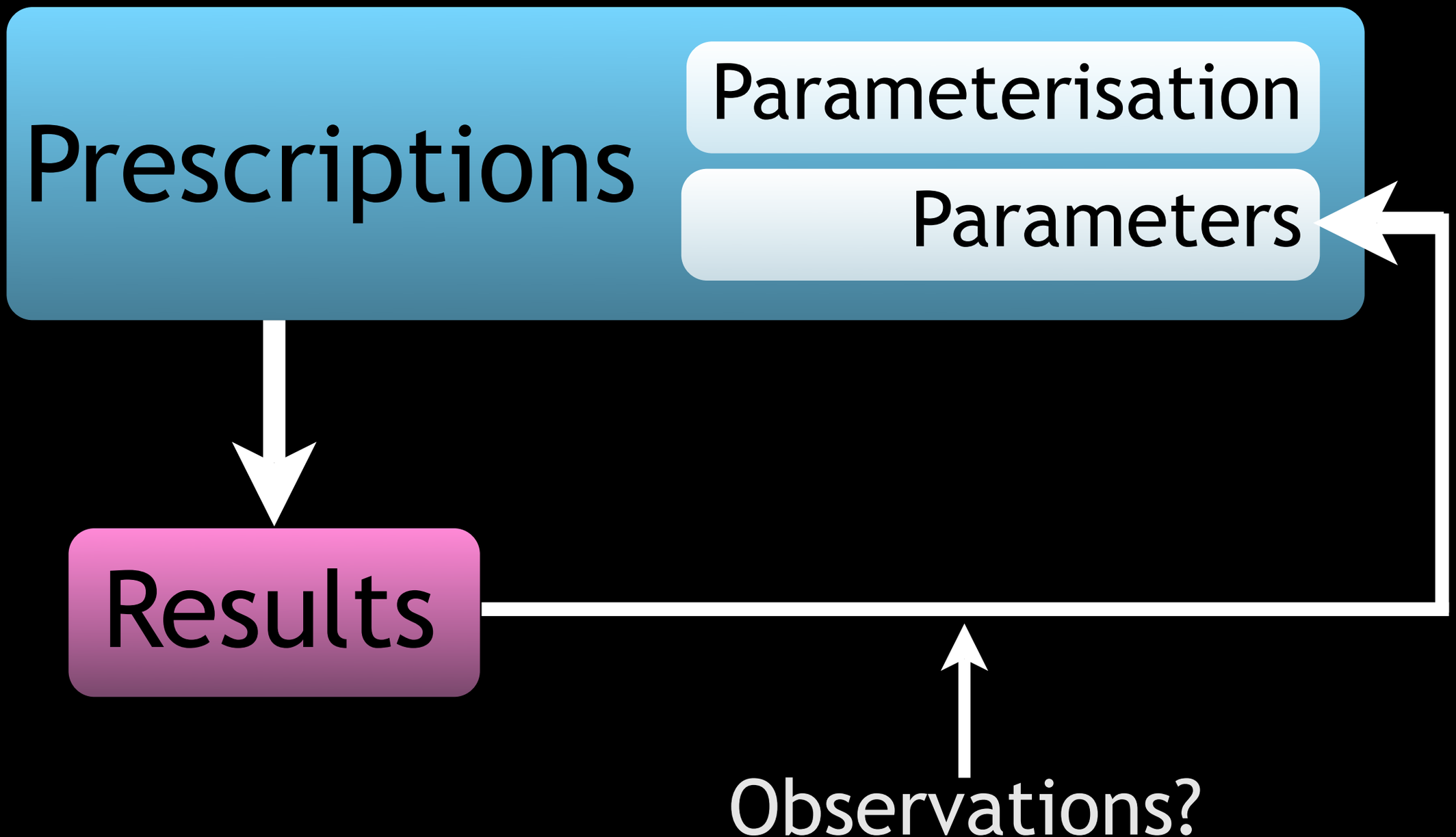
Prescriptions

Parameterisation

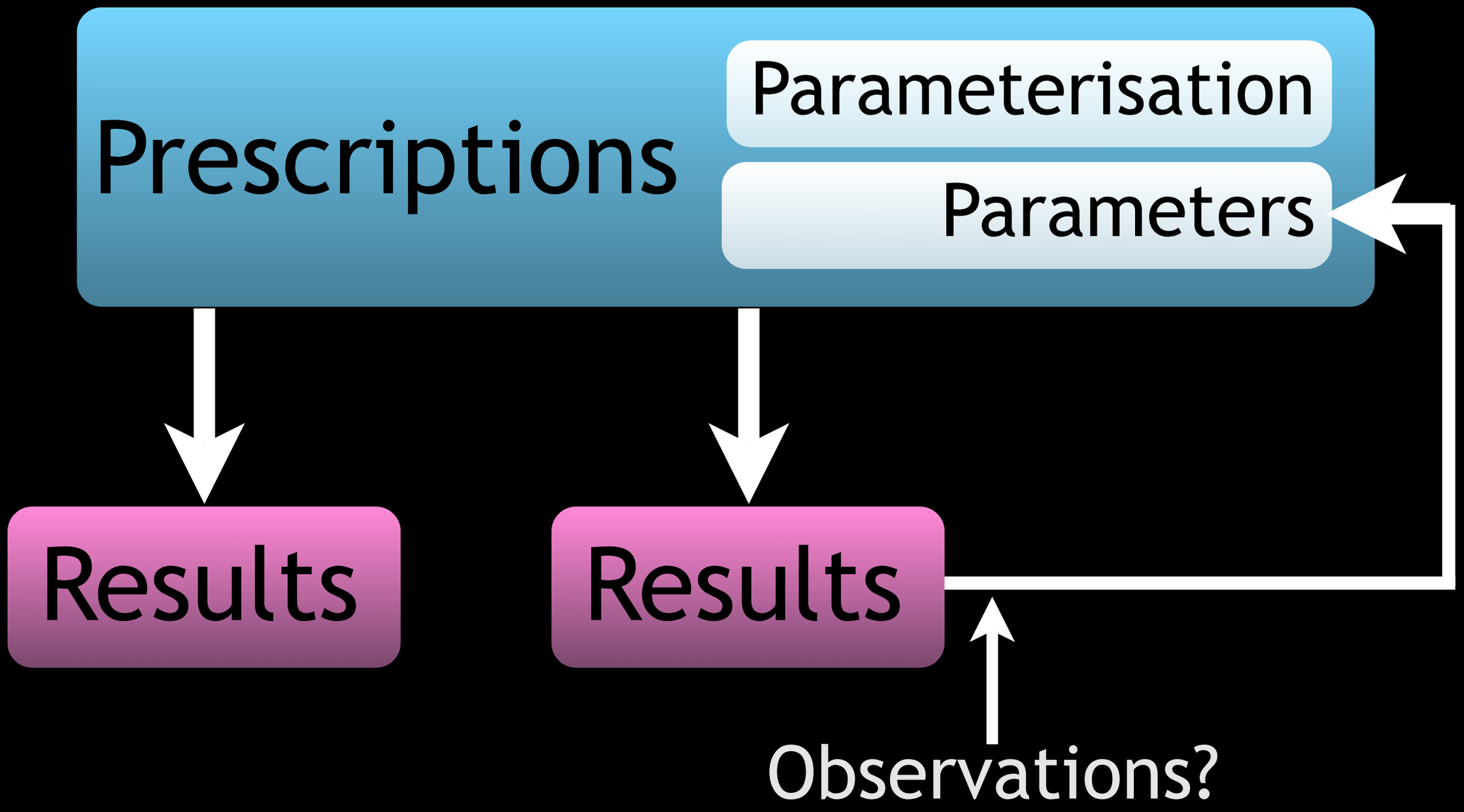
Parameters

Results

# The Strange Loop of Subgrid Physics



# The Strange Loop of Subgrid Physics




*cf yesterday's discussion of "predictions"?*

# Governato et al 2007

## Forming Disk Galaxies in ΛCDM Simulations

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5 February 2008

**ABSTRACT**

We used fully cosmological, high resolution N-body + SPH simulations to follow the formation of disk galaxies with rotational velocities between 135 and 270 km/sec in a ΛCDM universe. The simulations include gas cooling, star formation, the effects of a uniform UV background and a physically motivated description of feedback from supernovae. The host dark matter halos have a spin and last major merger redshift typical of galaxy sized halos as measured in recent large scale N–Body simulations. The simulated galaxies form rotationally supported disks with realistic exponential scale lengths and fall on both the I-band and baryonic Tully Fisher relations. An extended stellar disk forms inside the Milky Way sized halo immediately after the last major merger. The combination of UV background and SN feedback drastically reduces the number of visible satellites orbiting inside a Milky Way sized halo, bringing it in fair agreement with observations. Our

# The Simulations...

IN:

- Cosmological UV (thin + RT post-process)
- Single-parameter supernova feedback (Stinson et al 2006)
- Tuned to produce realistic z=0 SFRs
- High resolution (down to $10^4$ solar masses)

# The Simulations...

IN:
- Cosmological UV (thin + RT post-process)
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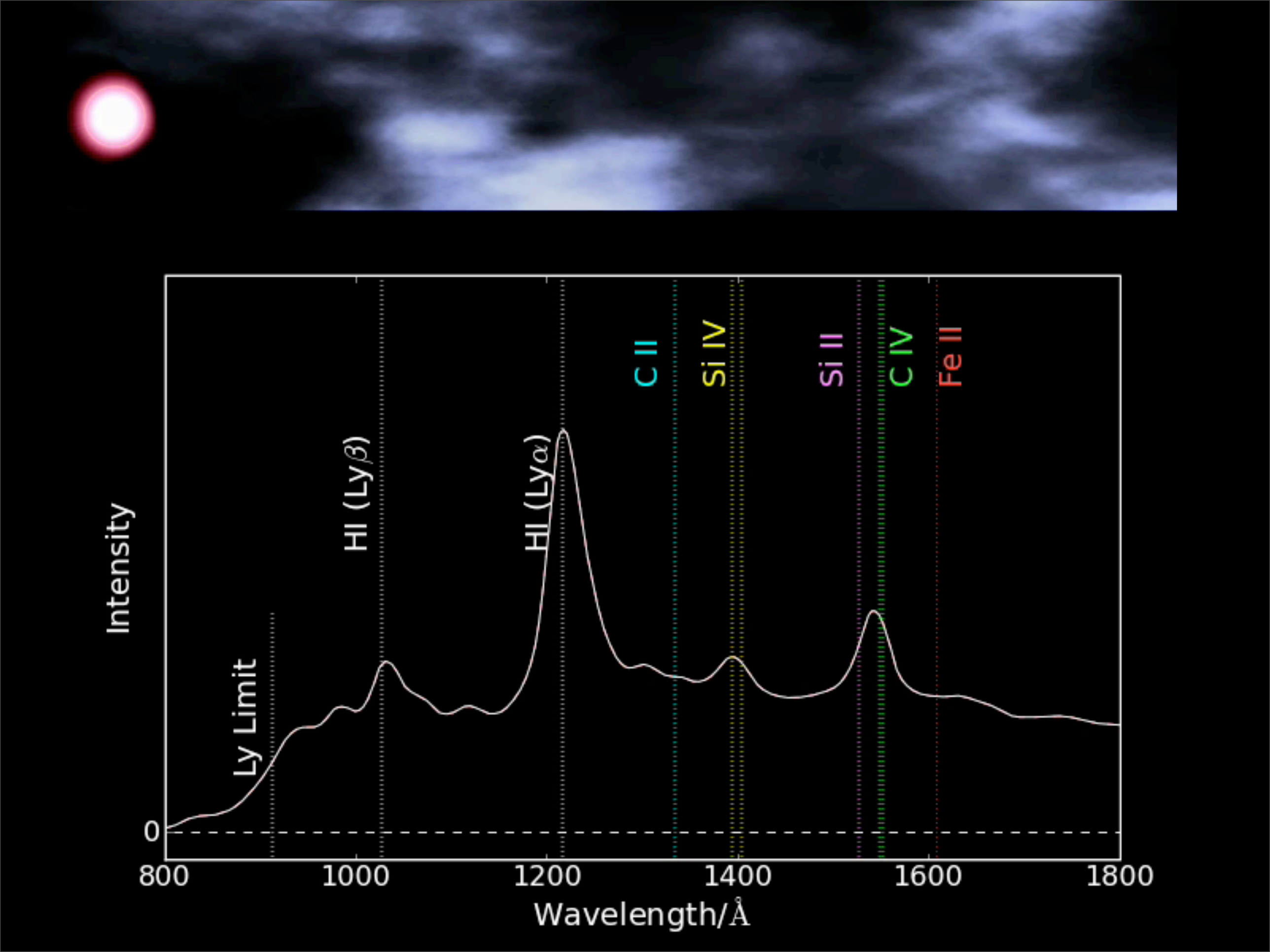
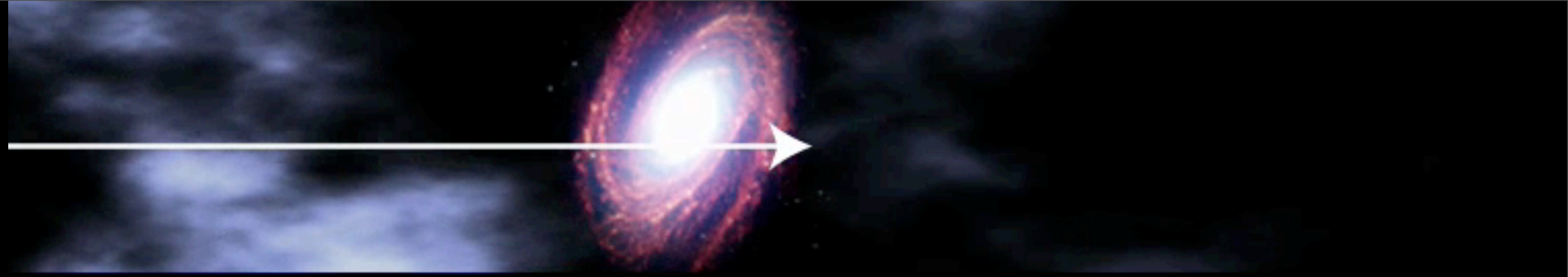
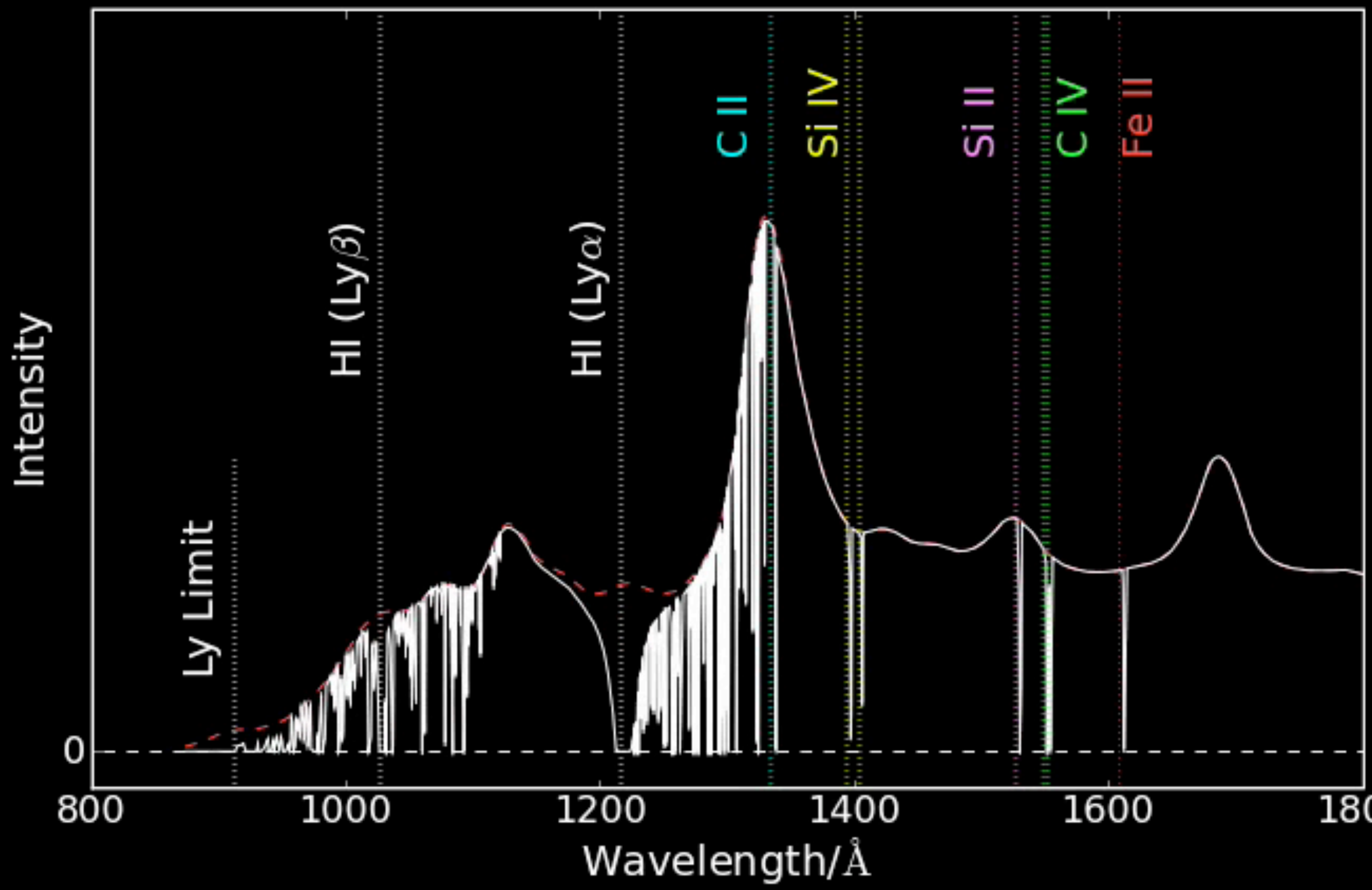
OUT:
- Land on Tully-Fisher relation (lum vs $v_{rot}$)
- Realistic LF (inc. distribution of MW satellites)
- But watch out: exaggerated bulges = declining rotation curves
- Stellar Mass-Metallicity relation sensible for 0<z<3 (Brooks et al 2006)


Intensity
0
Ly Limit
HI (Ly$\beta$)
HI (Ly$\alpha$)
C II
Si IV
Si II
C IV
Fe II
800
1000
1200
1400
1600
1800
Wavelength/Å




C II
Si IV
Si II
C IV
Fe II
HI (Lyβ)
HI (Lyα)
Ly Limit
Intensity
0
800
1000
1200
1400
1600
1800
Wavelength/Å

z = 3
"MW"

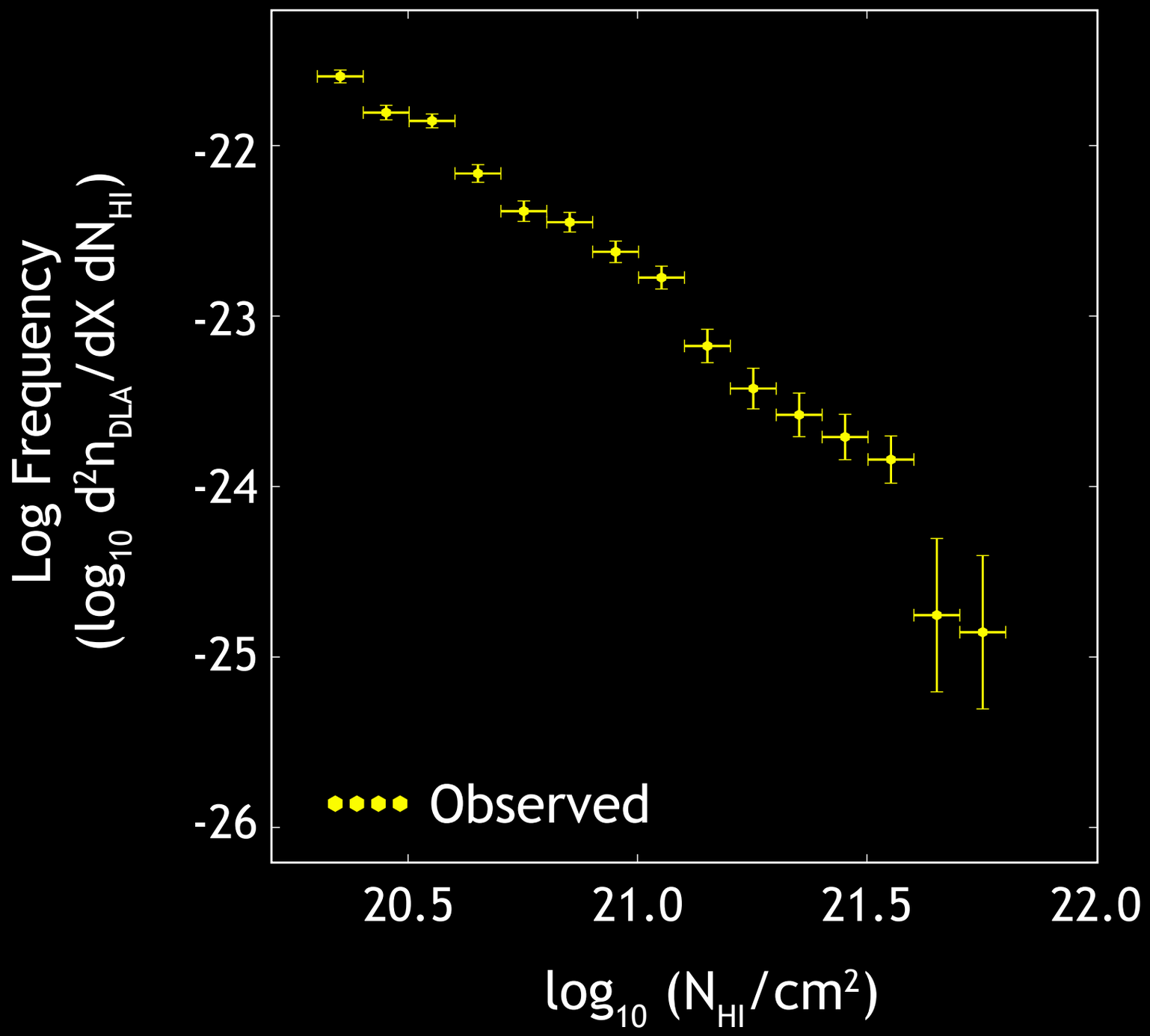
200 kpc

23
22
21
20
19
18
17
16
15
14
13

$\log_{10} N_{HI}$

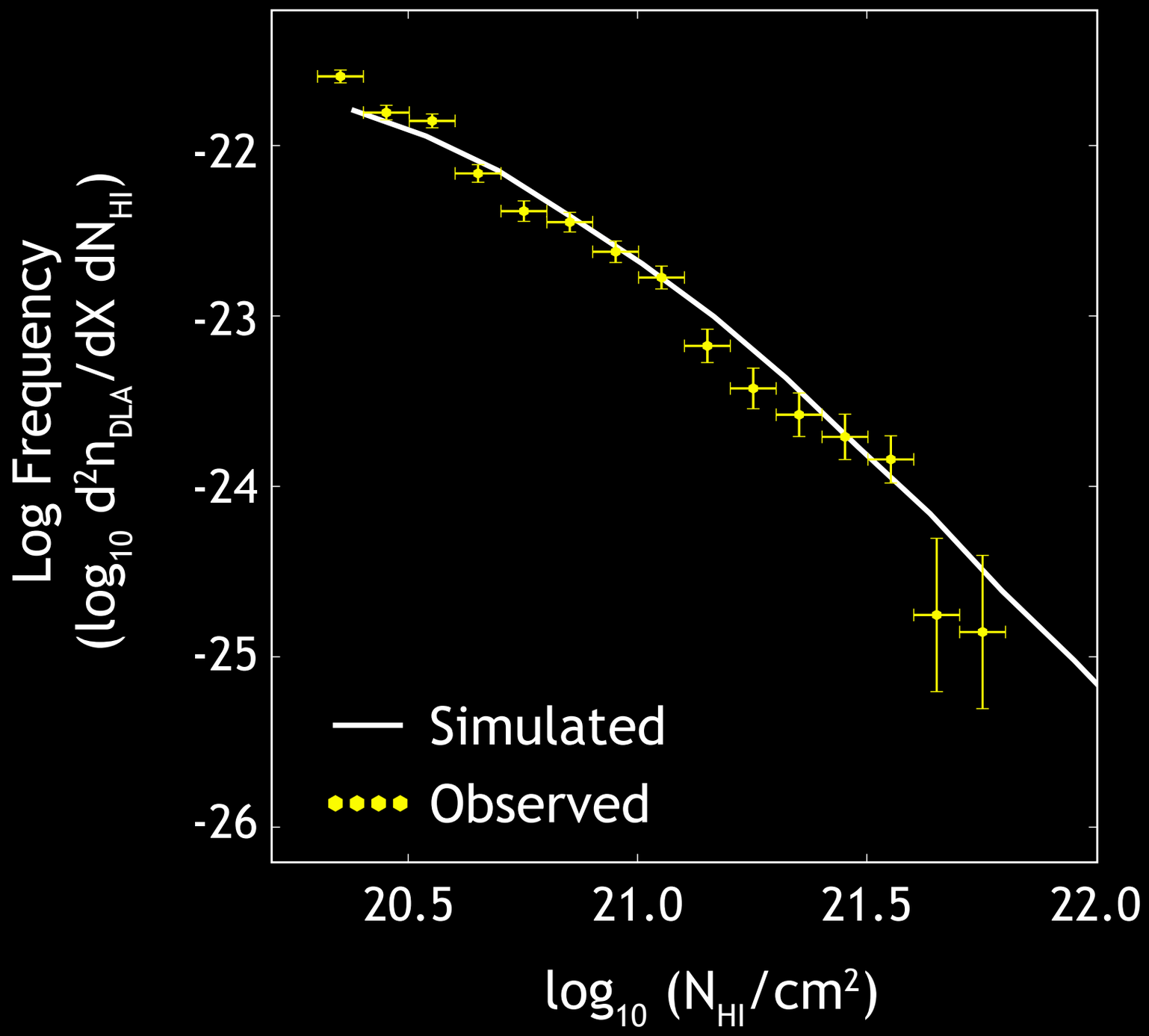
Rendering by SimAn: real-time OpenGL / python simulation analysis environment
www.ast.cam.ac.uk/~app26/siman

# Column Density Distribution




Observational data =
SDSS DR5
(Prochaska et al)

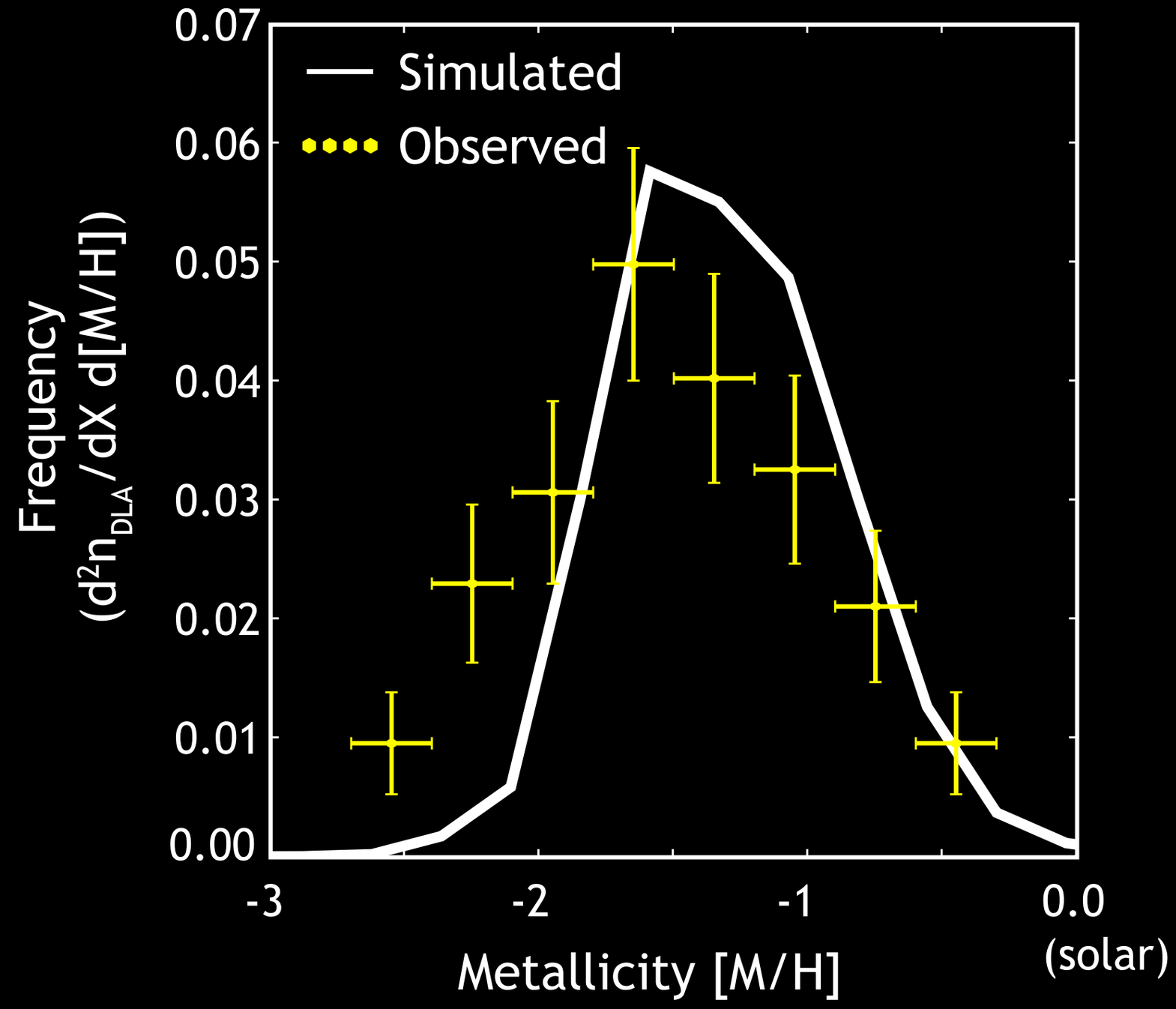
# Column Density Distribution




Success, with no free parameters!

Observational data = SDSS DR5 (Prochaska et al)

# Metallicity Distribution



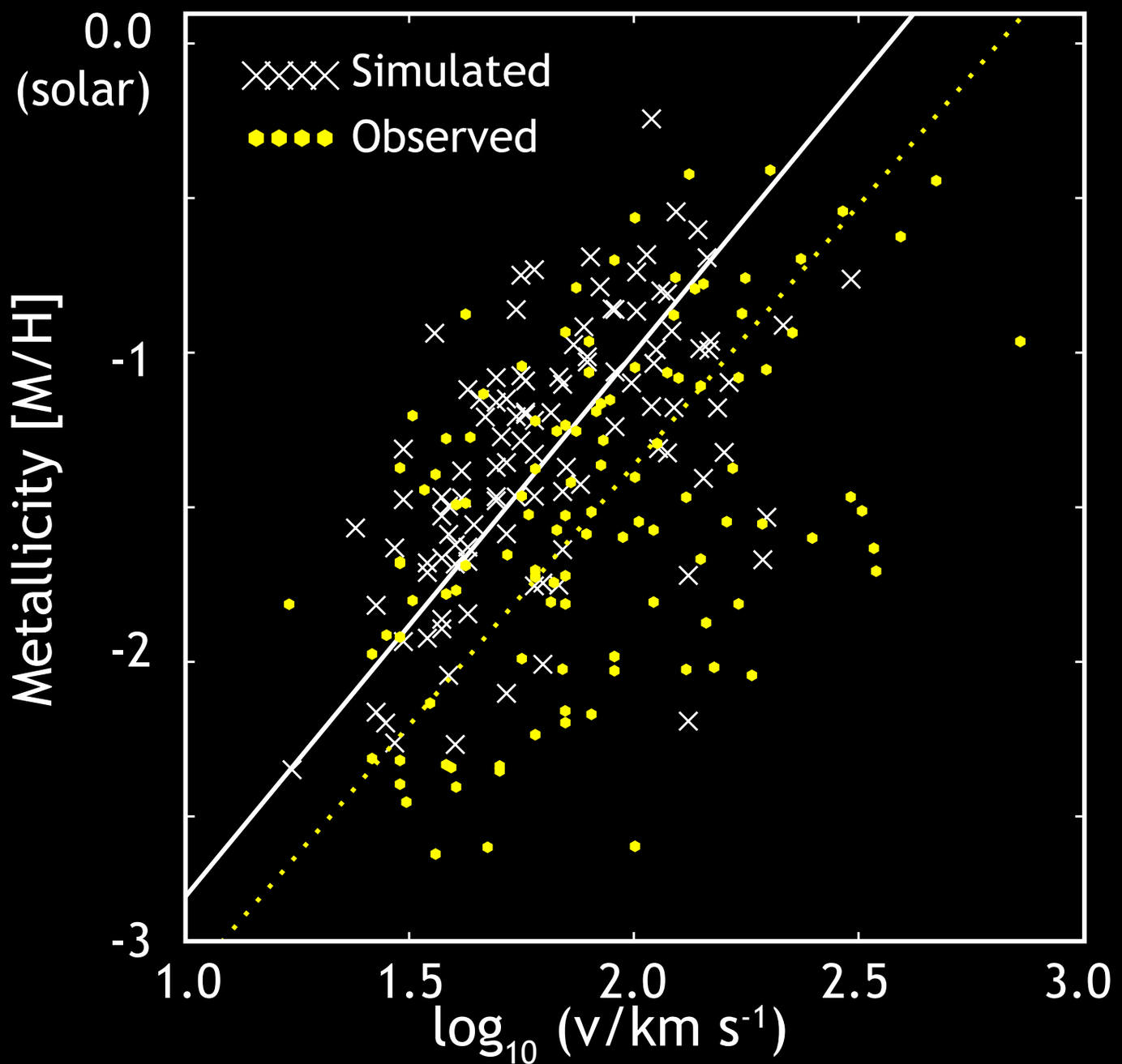

Previous simulations struggle here (out by factors of 5 to 10)

This is a strong joint constraint on DLAs & SF

Observational data = HIRES/UVES compilation (Prochaska, pri. comm.)

# Velocity/Metallicity Correlation

after Ledoux et al 2006




Discrepancy due to velocity width underestimation

Trend in excellent agreement

Observational data = HIRES/UVES compilation (Prochaska, pri. comm.)

# Why the success?

- Cross-section from intermediate mass halos (~$10^{10}$ solar mass)
- Adopted feedback is extremely efficient at suppressing SF in these halos (→ low metallicity)
- Tested weaker feedback: gives much higher metallicities, mass-metallicity relation is lost
- Feedback has little effect on kinematics (shame)

# Conclusions

- First study of DLAs in simulation with realistic z=0 galaxies. No free parameters.
- DLAs associated with $10^9 < M/M_\odot < 10^{11}$ halos. Not all disky (cf SAMs Johansson & Efstathiou etc).
- Successes:
  - cosmological column density distribution
  - metallicity distribution + low SFRs
  - metallicity vs velocity width
- Next step: time evolution & detailed SAMs comparison...

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