Outflowing shells as a model for Lyman alpha profile fitting

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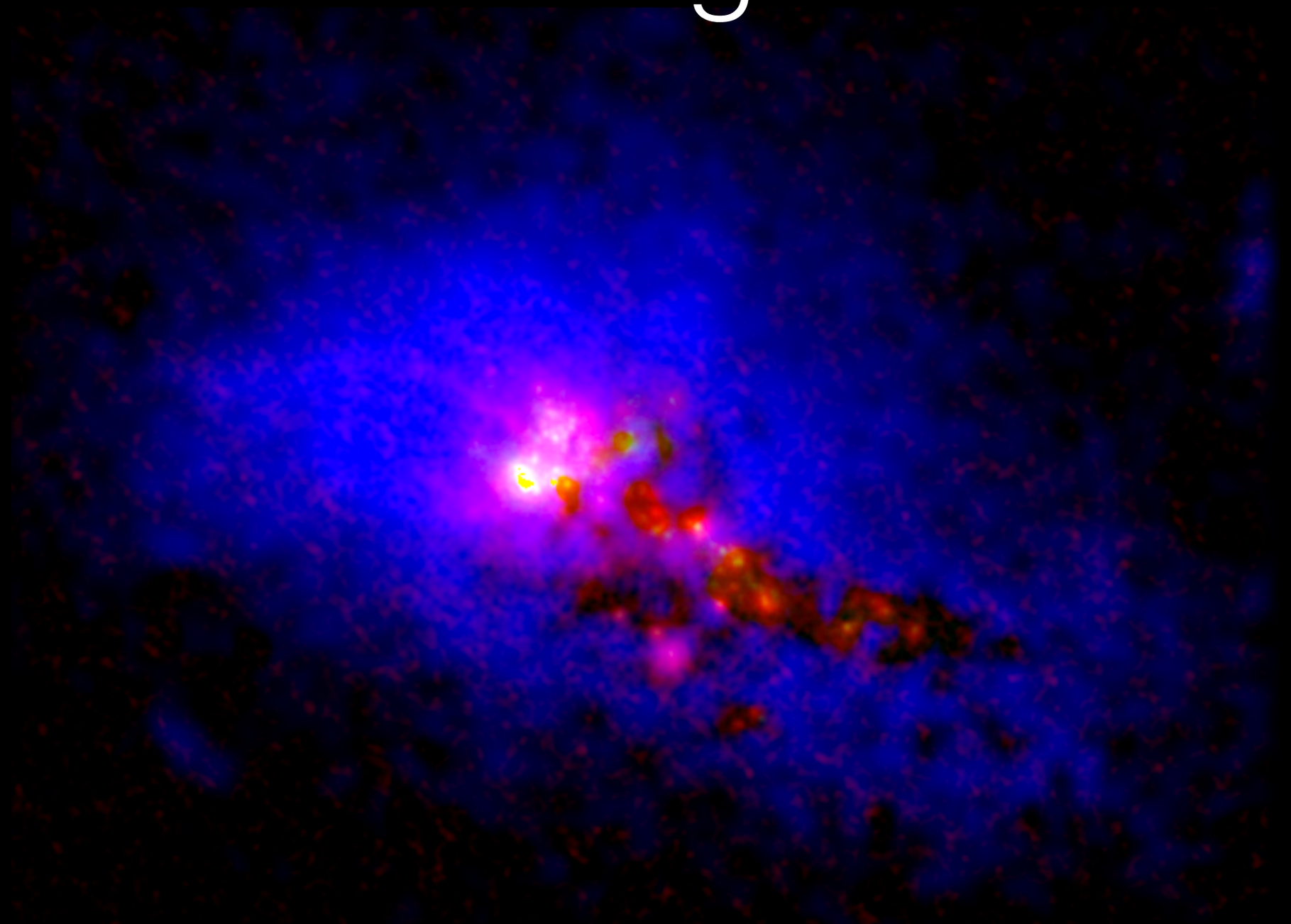
Lya photons sample their host galaxies

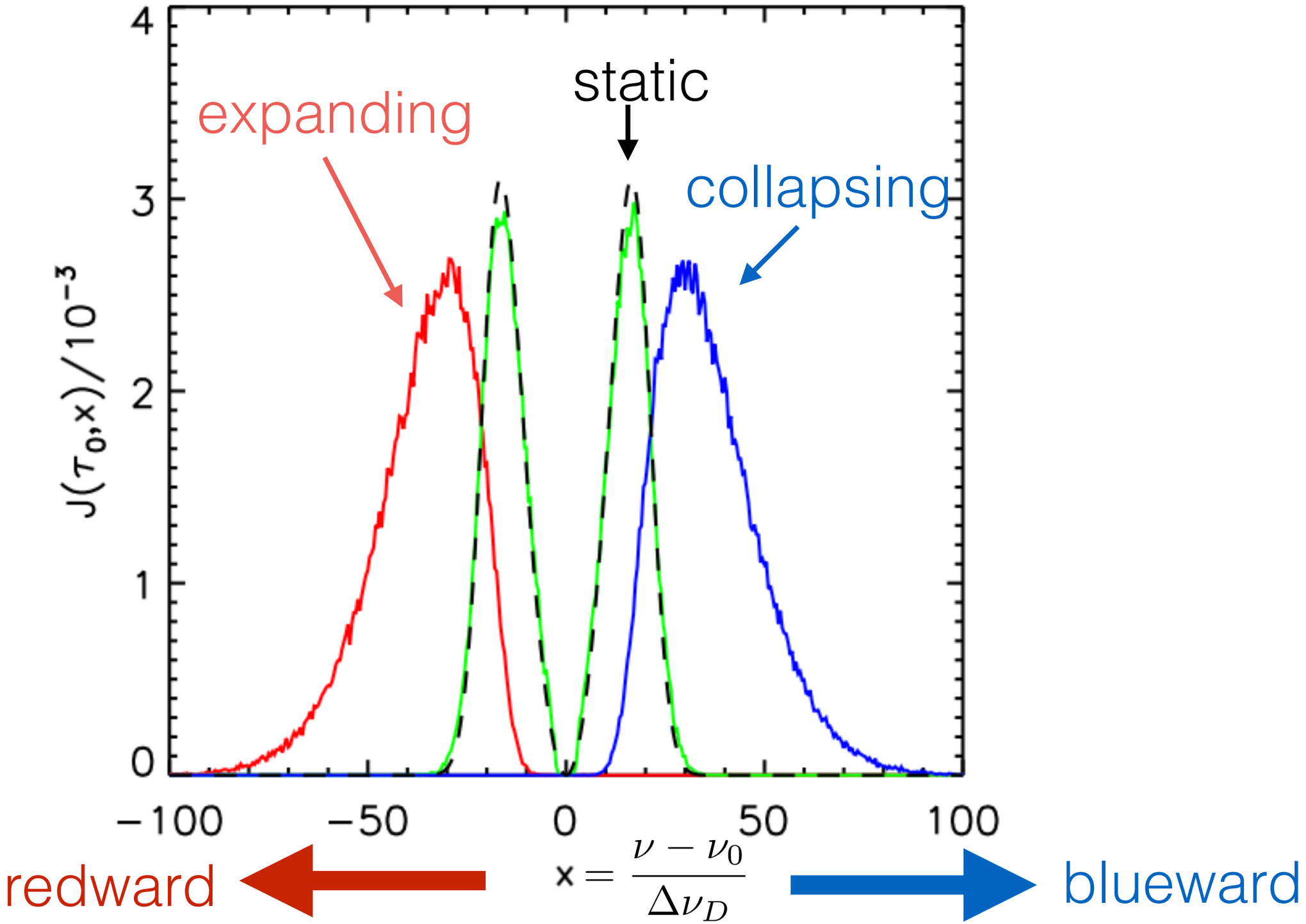


"LARS01" - Östlin et al. (2014)

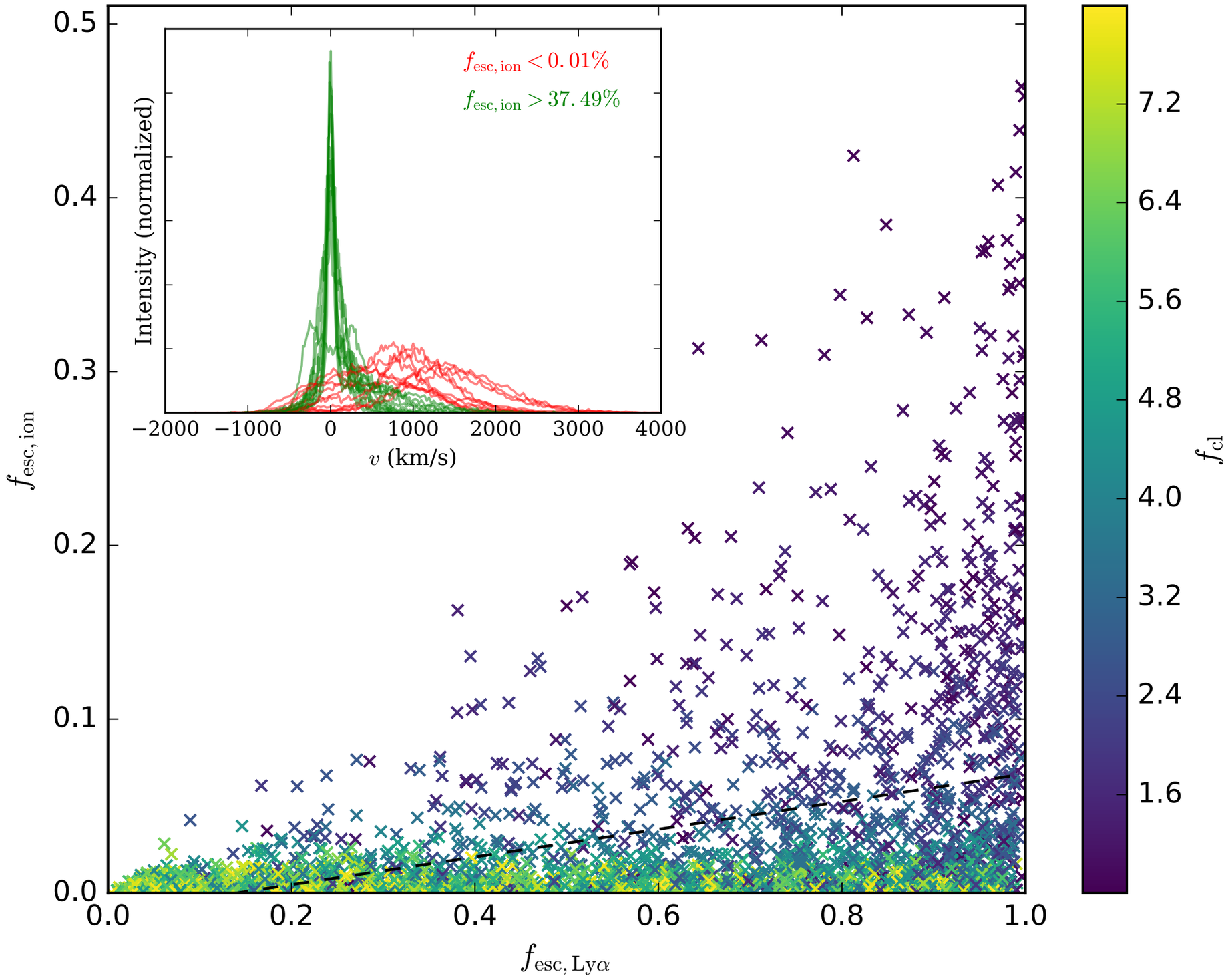
Lya in blue, Ha in red, FUV in green

Lya spectra contain information

Laursen (2010)

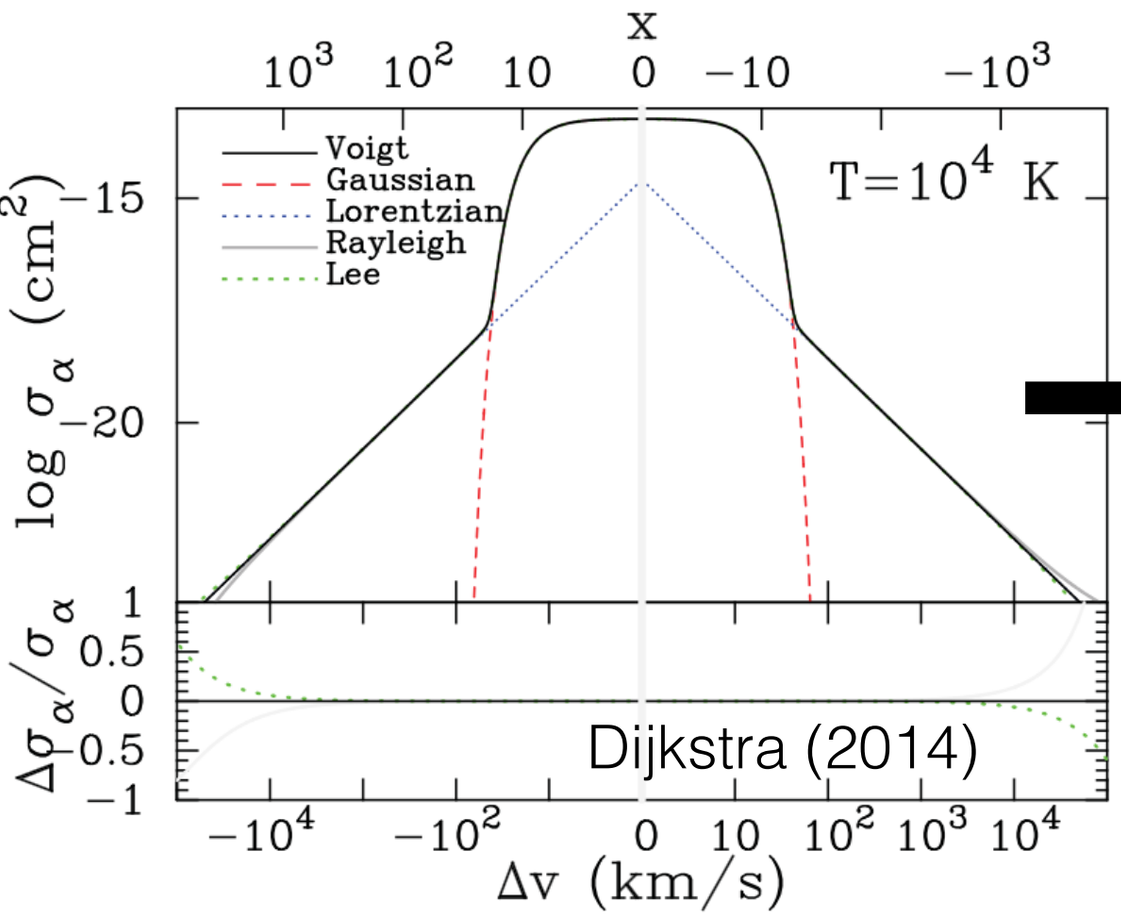


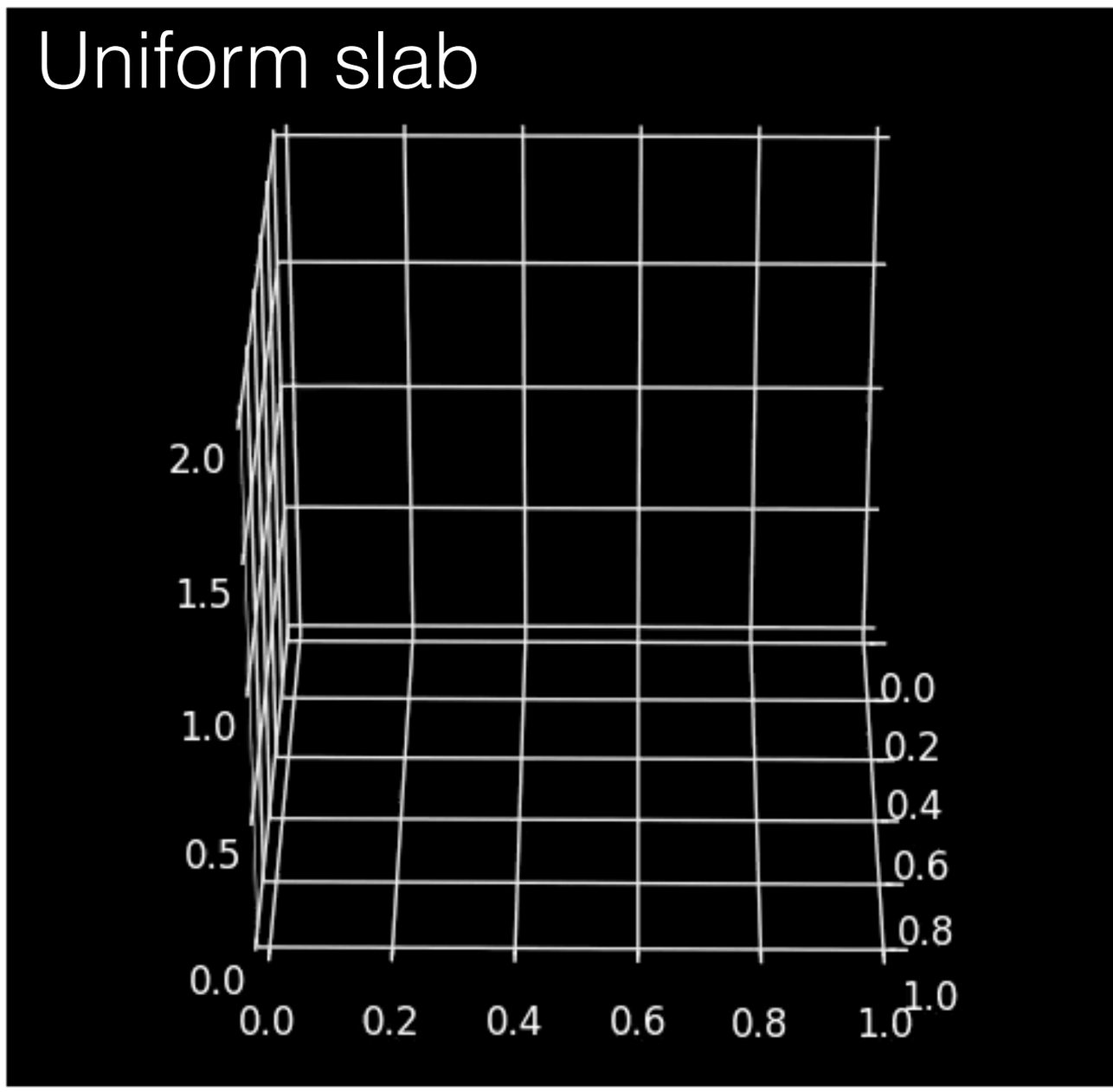
Lya spectra contain valuable information

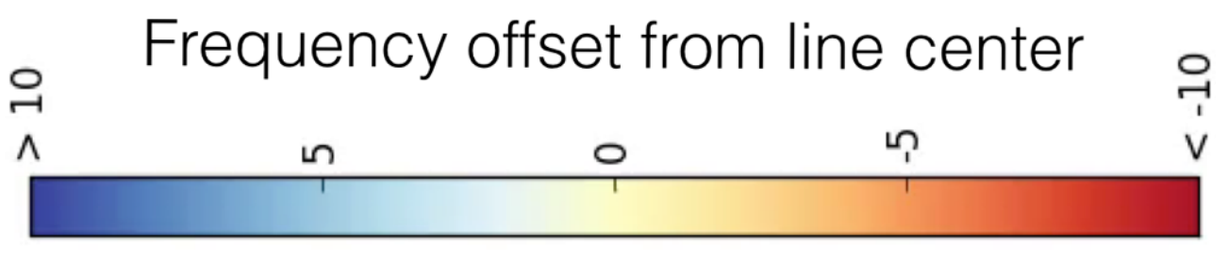


The need for a sub-grid model

Lya scattering
cross section



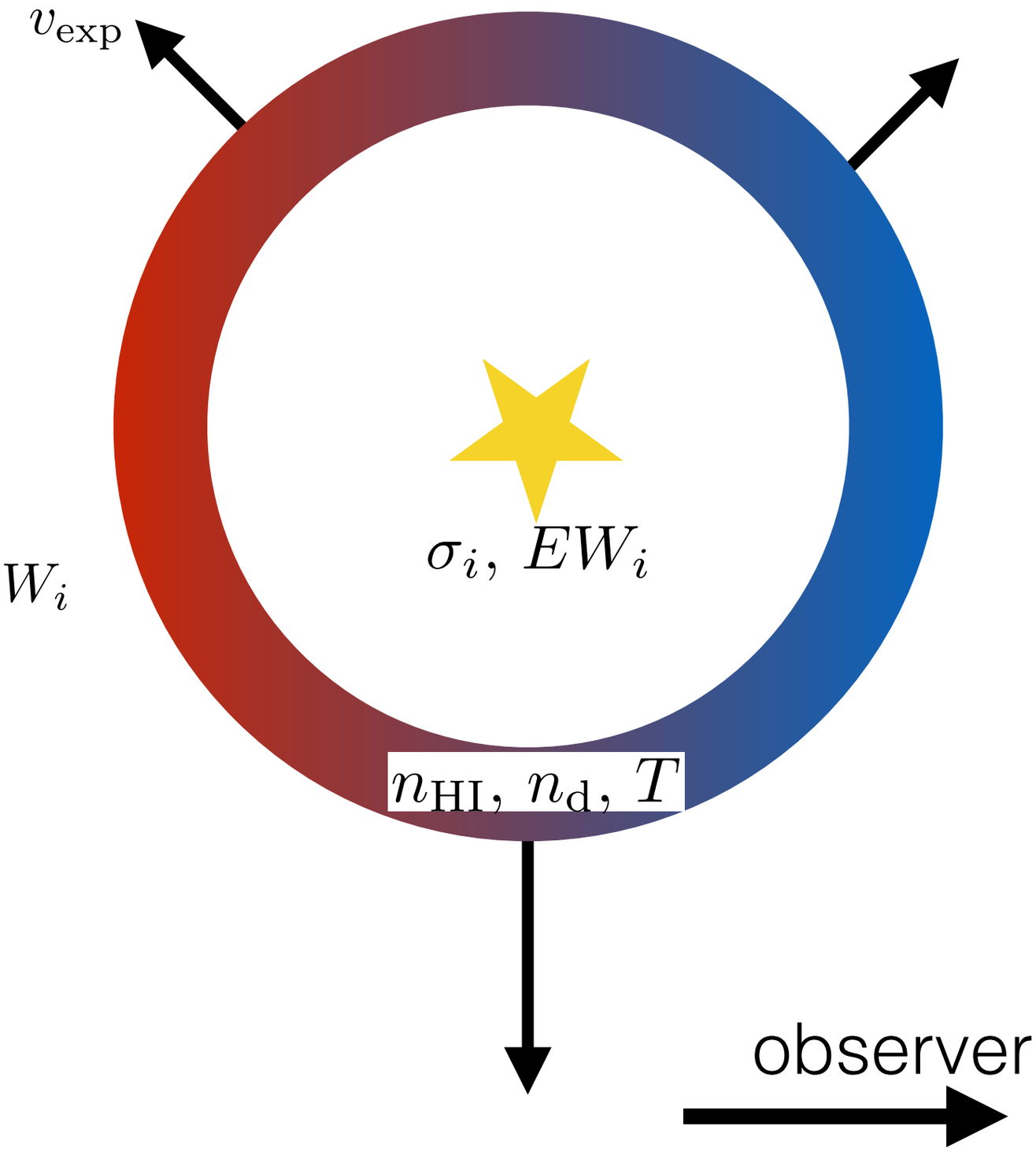




The “shell-model”

Ahn et al. (2004)
Verhamme et al. (2008)
…

- Set of 6 parameters:
  - Emission parameters σ_i, EW_i
  - Outflow velocity $v_{\rm exp}$
  - Shell-content $n_{\rm HI}$, $n_{\rm d}$, T

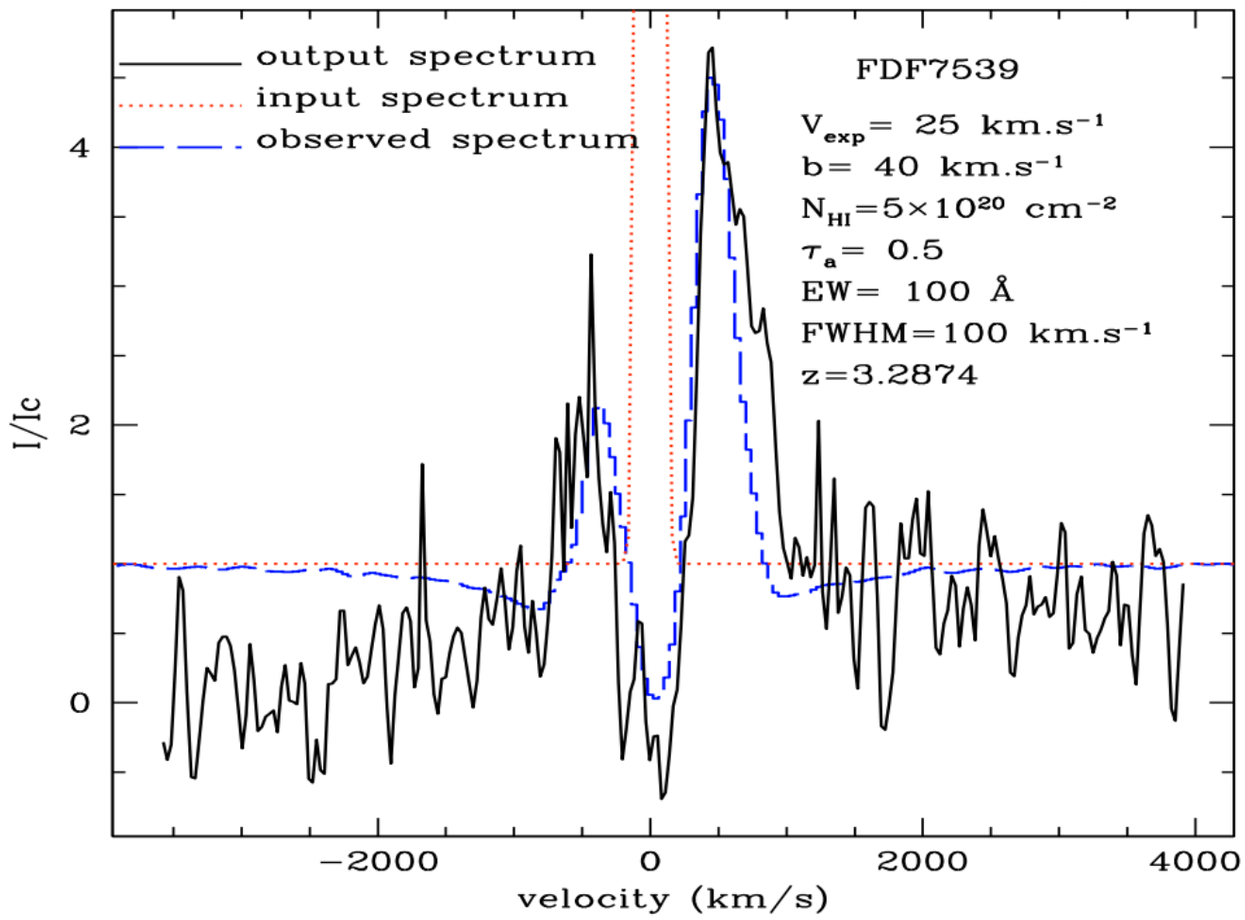


“Shell-model” fitting

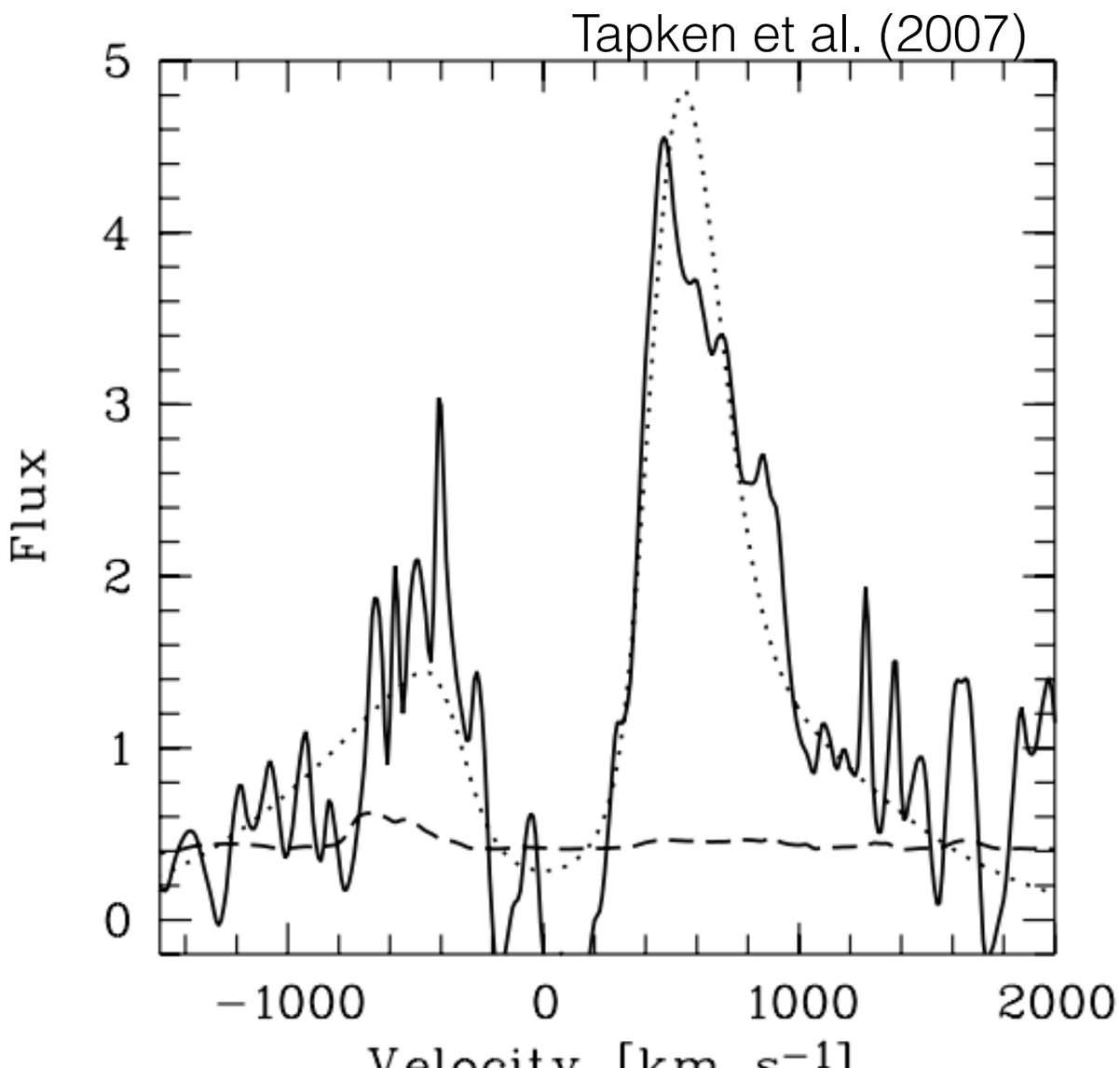
1. Degeneracy of shell-model parameters?

2. How much Physics is in the shell model?

Verhamme et al. (2008)



Tapken et al. (2007)



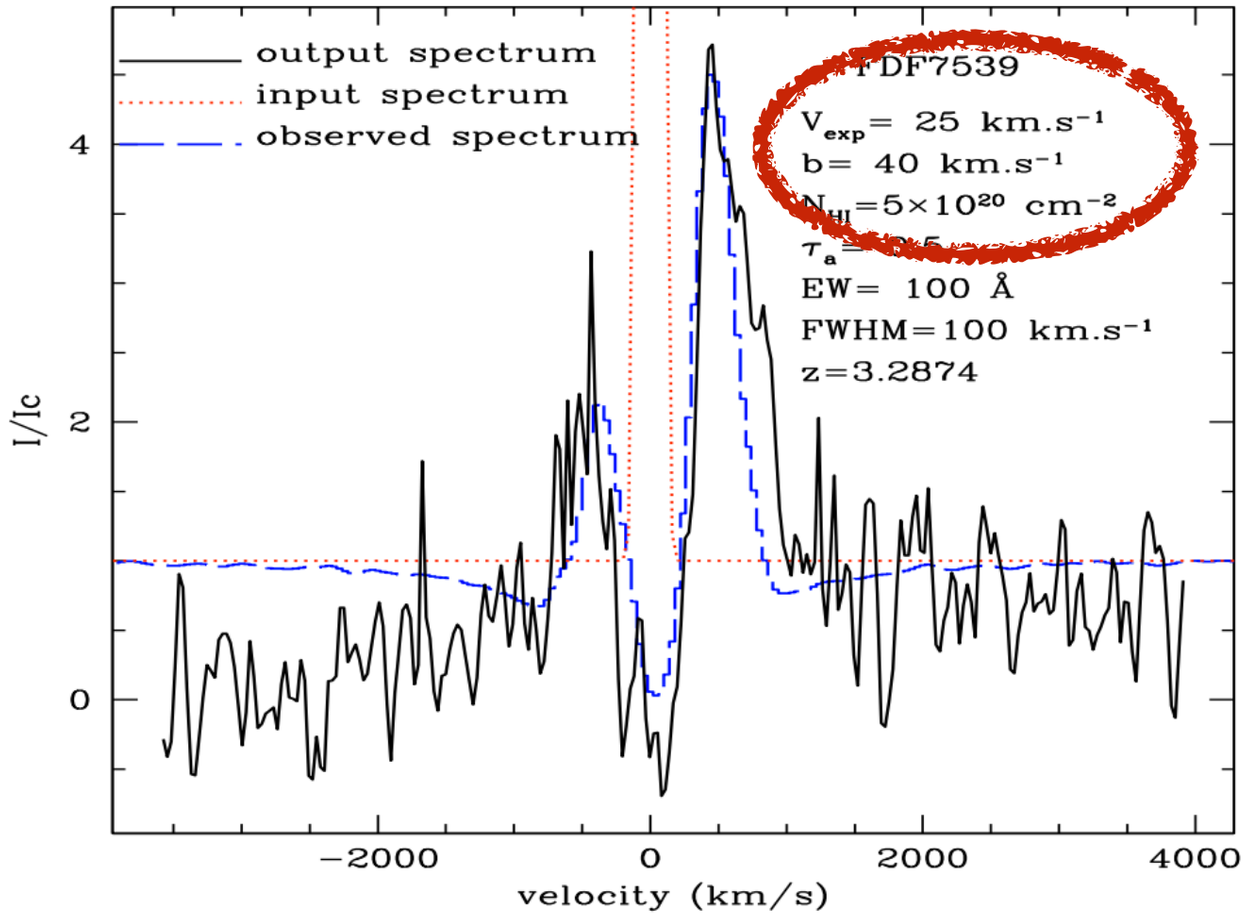
“Shell-model” fitting

1. Degeneracy of shell-model parameters?

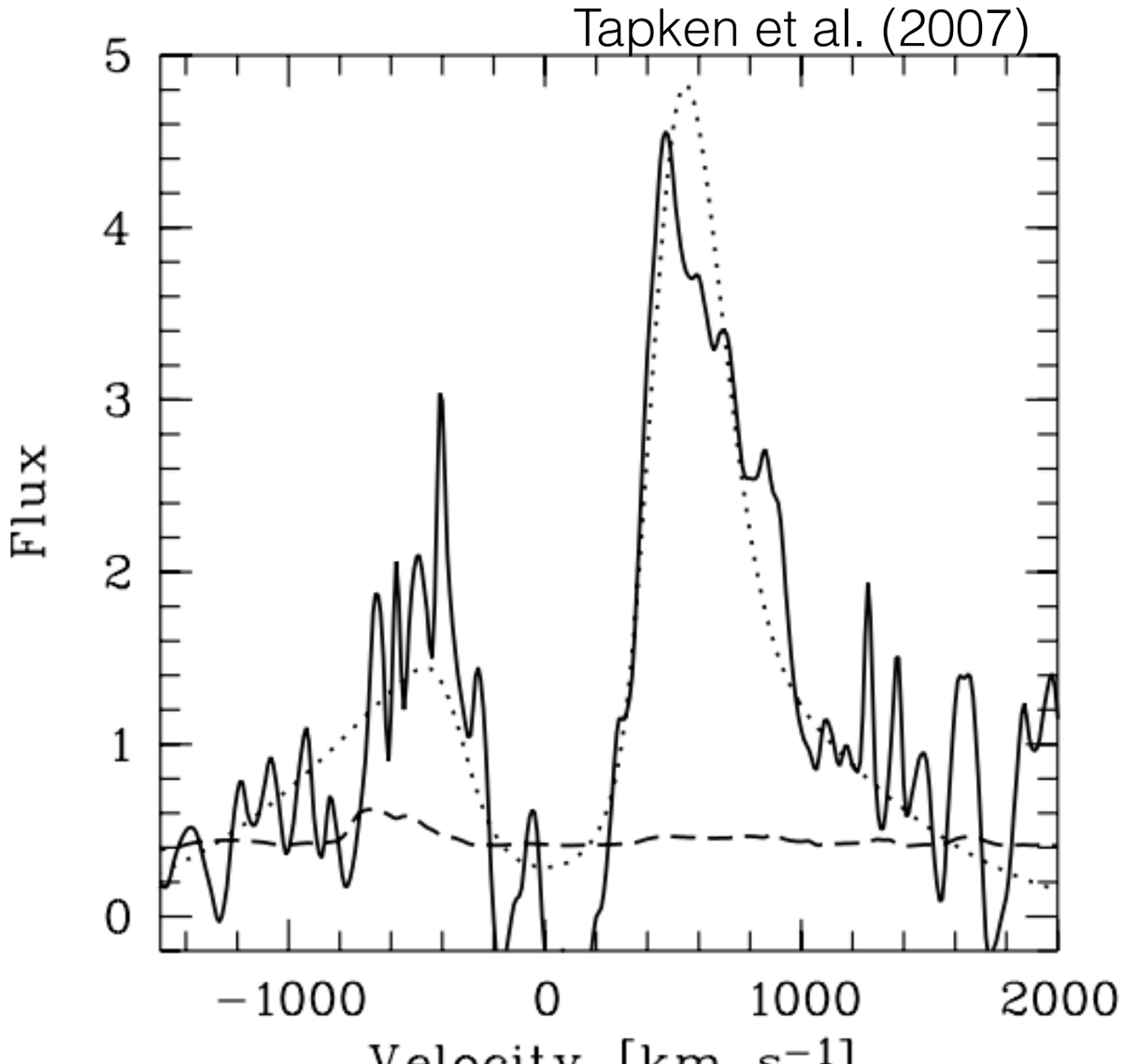
2. How much Physics is in the shell model?

ID	v_{dis}(core) [km s^{-1}]	v_{dis}(shell) [km s^{-1}]	N_{HI} [cm^{-2}]	$v_{outflow}$ [km s^{-1}]
4691	600	60	4×10^{17}	12
5215	500	125	2×10^{16}	125
7539	1140	190	2.5×10^{16}	190

Verhamme et al. (2008)

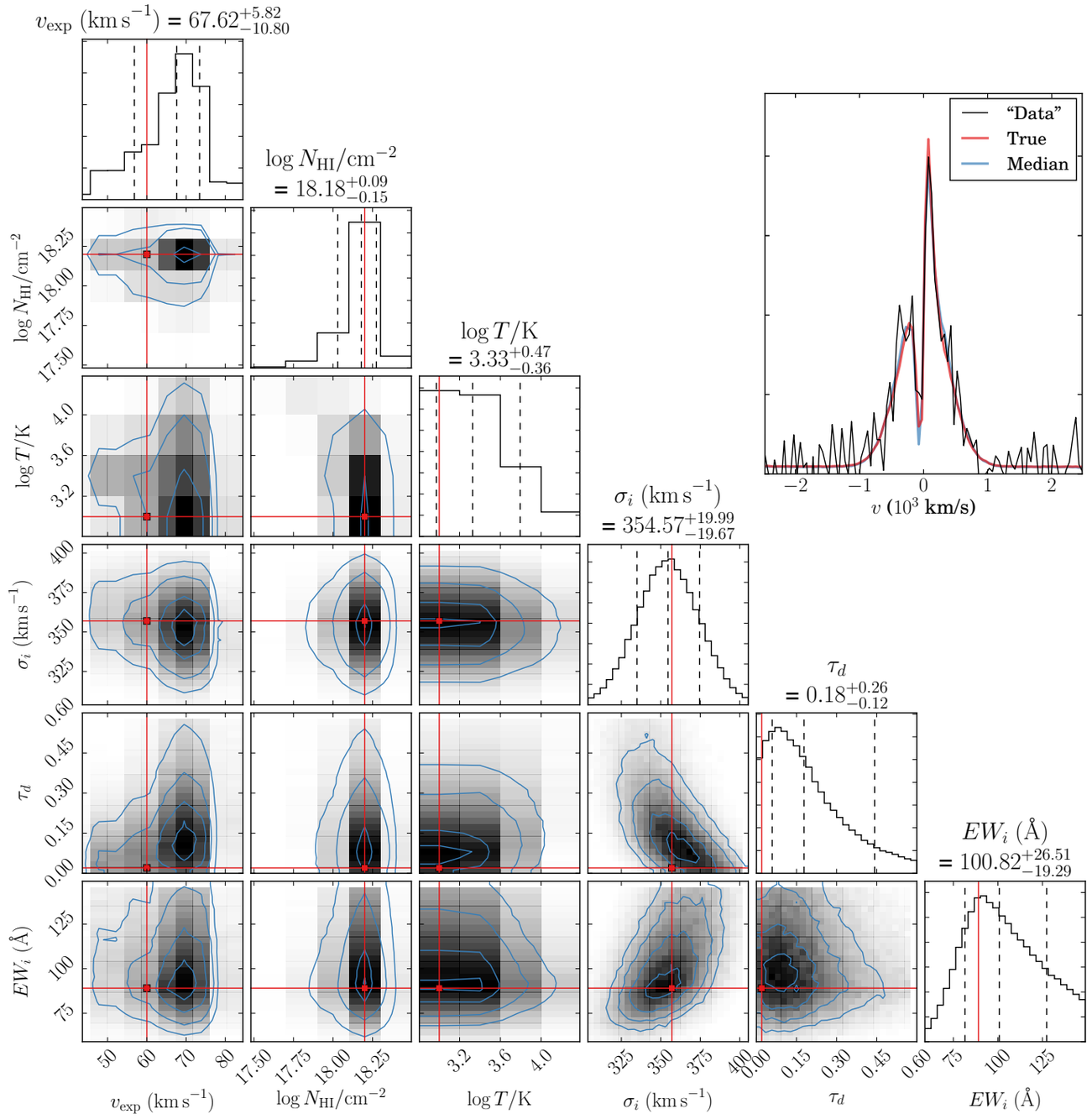


Tapken et al. (2007)



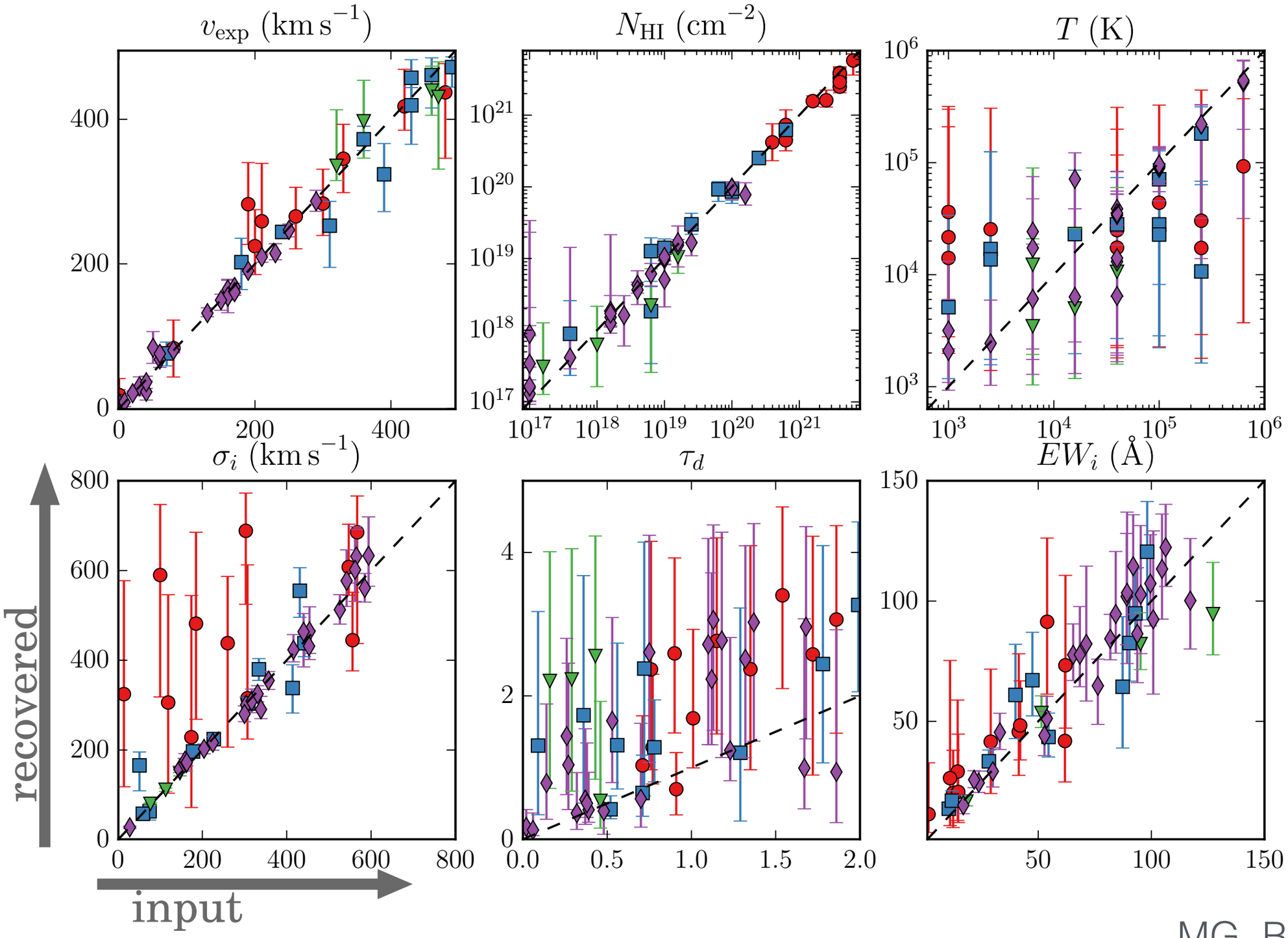
A systematic approach

- 3 out of 6 parameters as through weighting of photons
- 10,800 discrete models with 170,000 photon packages each
- Interactive online tool to access the spectra at **http://bit.ly/man-alpha**
- Possible to do a full likelihood analysis



MG, Bull, Dijkstra (2015)

Can we trust the fitting results?



absorption

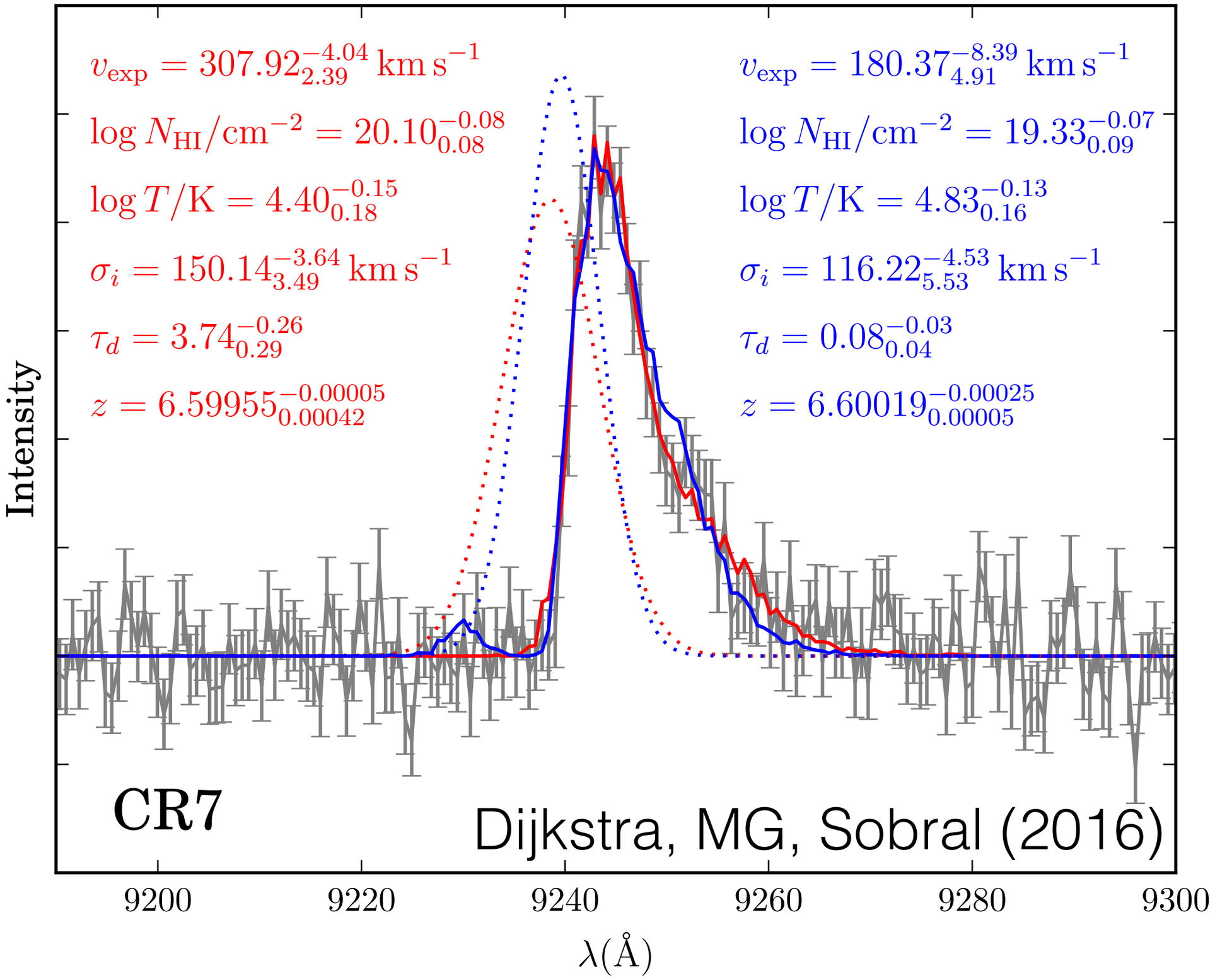
P-Cygni

single peak

double peak

MG, Bull, Dijkstra (2015)

Fitting “CR7”



(as seen in Mark’s talk)

Towards a realistic ISM

A THEORY OF THE INTERSTELLAR MEDIUM: THREE COMPONENTS REGULATED BY SUPERNOVA EXPLOSIONS IN AN INHOMOGENEOUS SUBSTRATE

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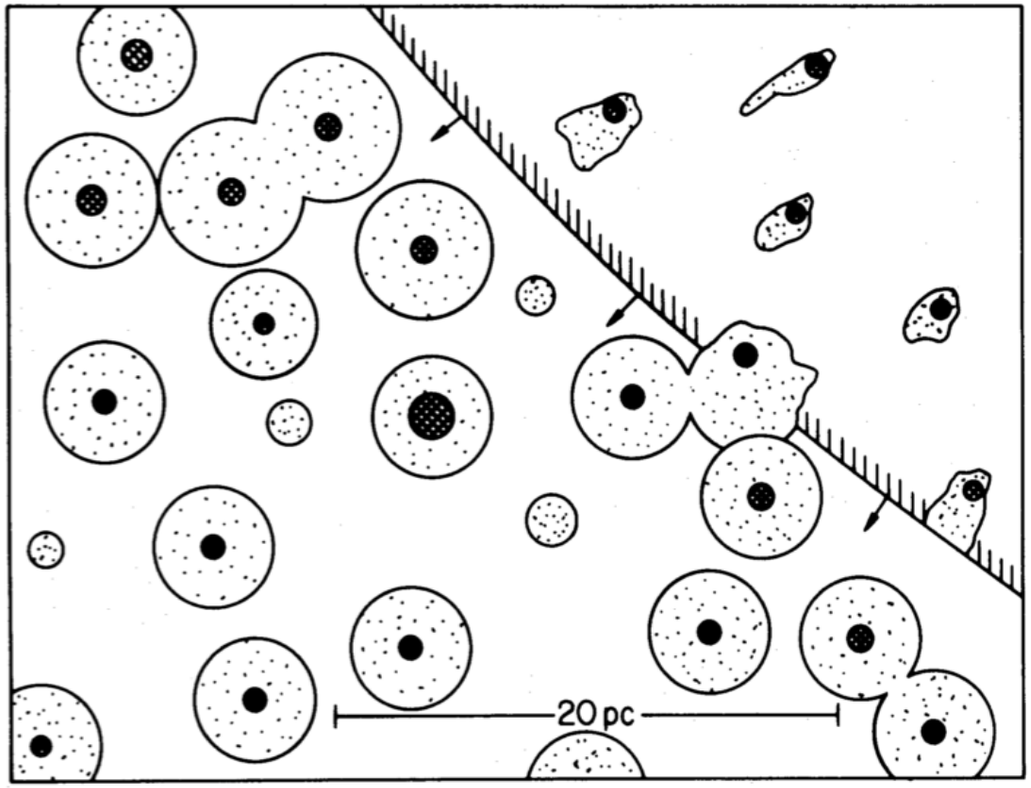
Received 1977 February 3; accepted 1977 May 2



A CLOSE UP VIEW

1. Degeneracy of shell-model parameters?
2. How much Physics is in the shell model?

Multiphase models

hot inter-clump medium (ICM)

$$n_{\rm HI} \lesssim 10^{-6}{\rm cm}^{-3}$$

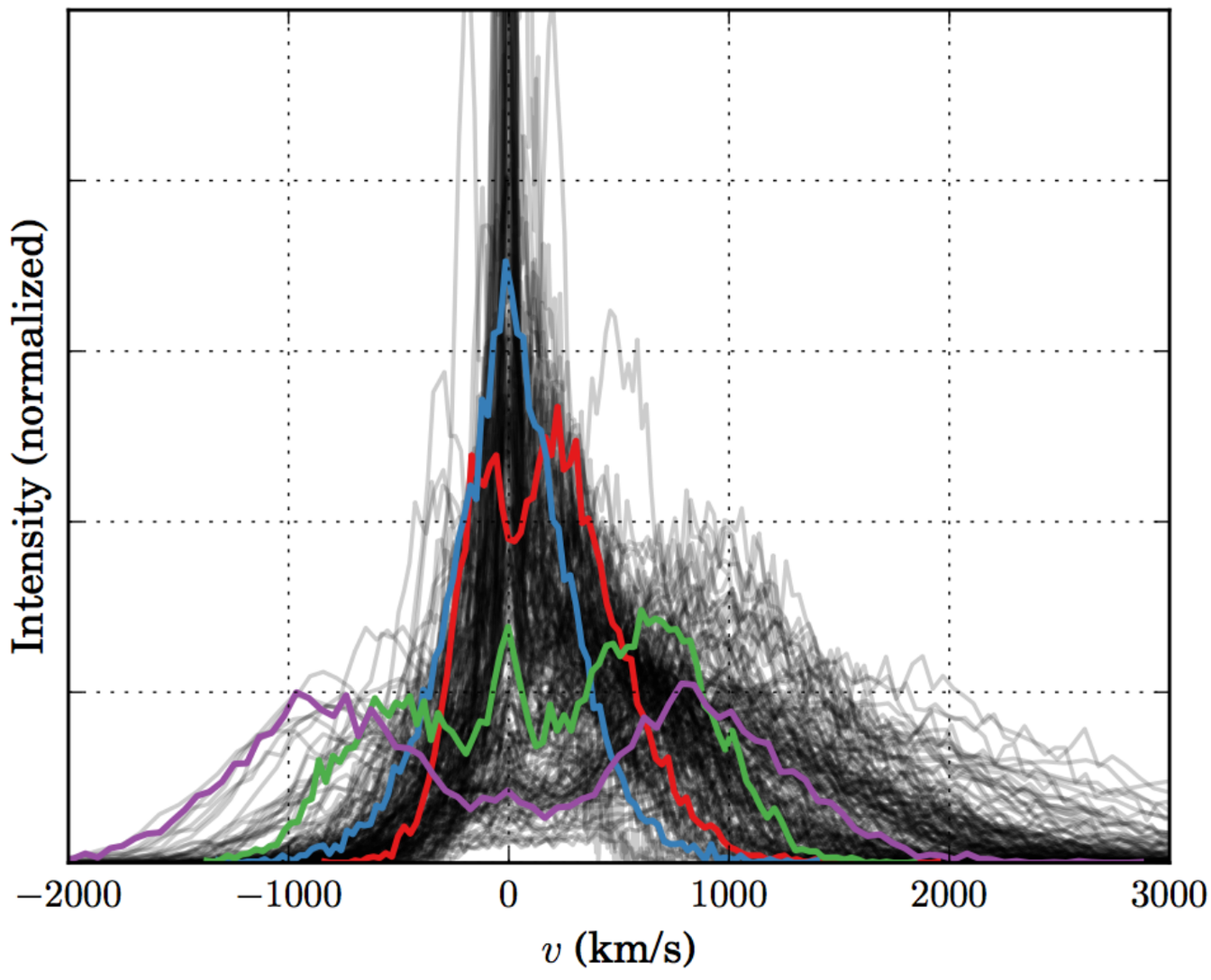
$$T \sim 10^6{\rm K}$$

cold, dense clumps

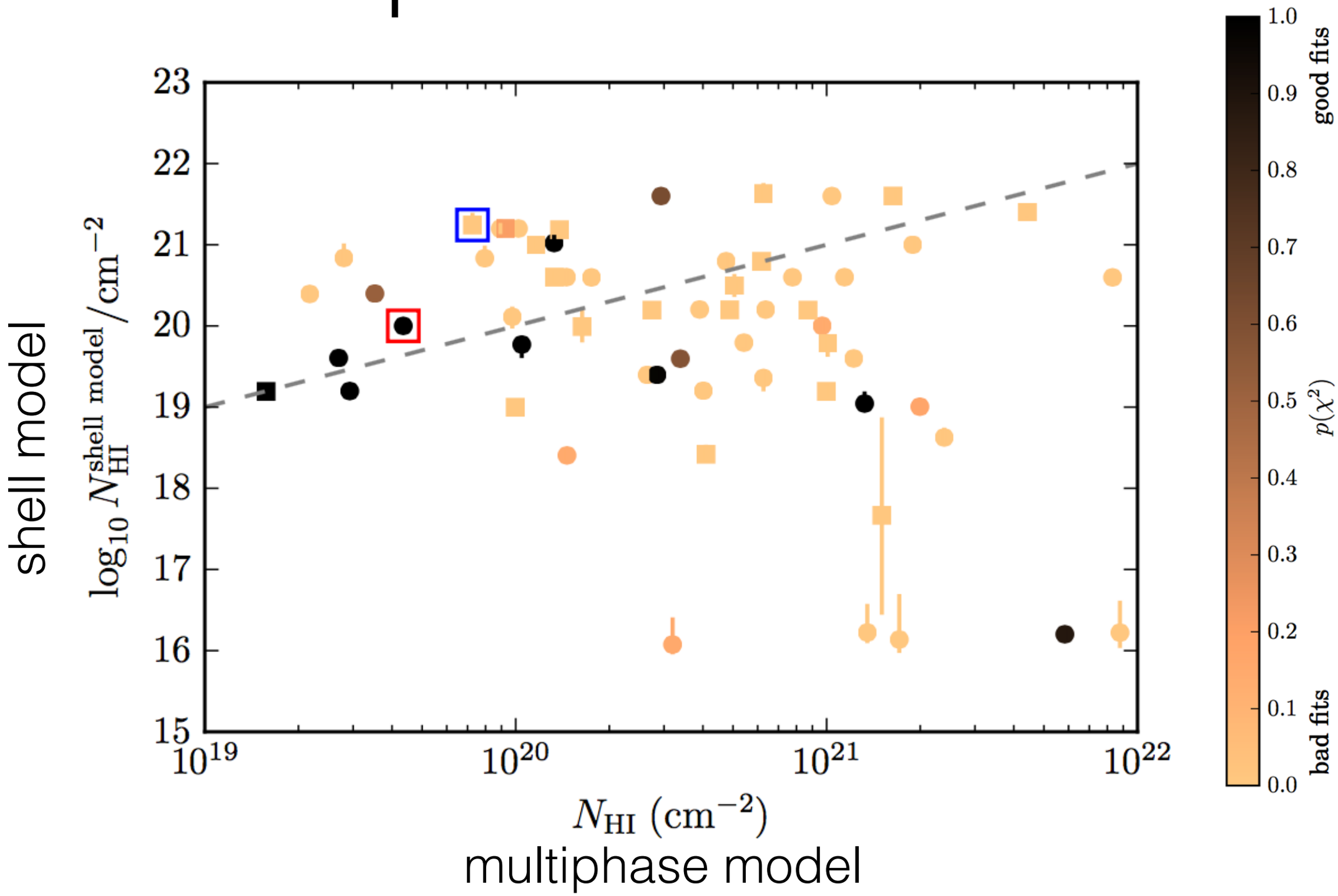
$$n_{\rm HI} \sim 1\,{\rm cm}^{-3}$$

$$T \sim 10^4\,{\rm K}$$

$$v \sim 100\,{\rm km\,s}^{-1}$$



Shell model versus multiphase models



Conclusions

- “Shell-model” remarkably successful in reproducing observed spectra
- Our fitting procedure allows to quantify uncertainties & degeneracies
- Tension between multiphase & shell models
- “Decrypting” the shell-model parameters still an outstanding issue