

Puddling and Quenching: How Does HI Content Depend on Galaxy Mass?

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with help from David Stark, Lisa Wei,
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Q: what is the most commonly used predictor of M_{HI}/M_* by theorists?

GALMASS: A SMARTPHONE APPLICATION FOR ESTIMATING GALAXY MASSES

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Galaxy Mass Conversion

Abundance Matching Model:

Conroy & Wechsler (2009) Moster et al. (2010)

Behroozi et al. (2010)

Disk Galaxy Gas Model: Stewart et al. (2009)

Mean value only Allow scatter (<sigma)

Abundance Matching and Gas Model Options

Input Parameters
(Empty field "hints" show value ranges for valid results)

Log Mvir: 11 - 15

Redshift: 0 - 2

Output Field

Log Mstar = 0.0

Log Mgas = 0.0

Log Mbar = 0.0

Gas Frac. = 0.0

Calculate

Switch Input Screens

Mvir to... Mstar to... Mgas to... Clear

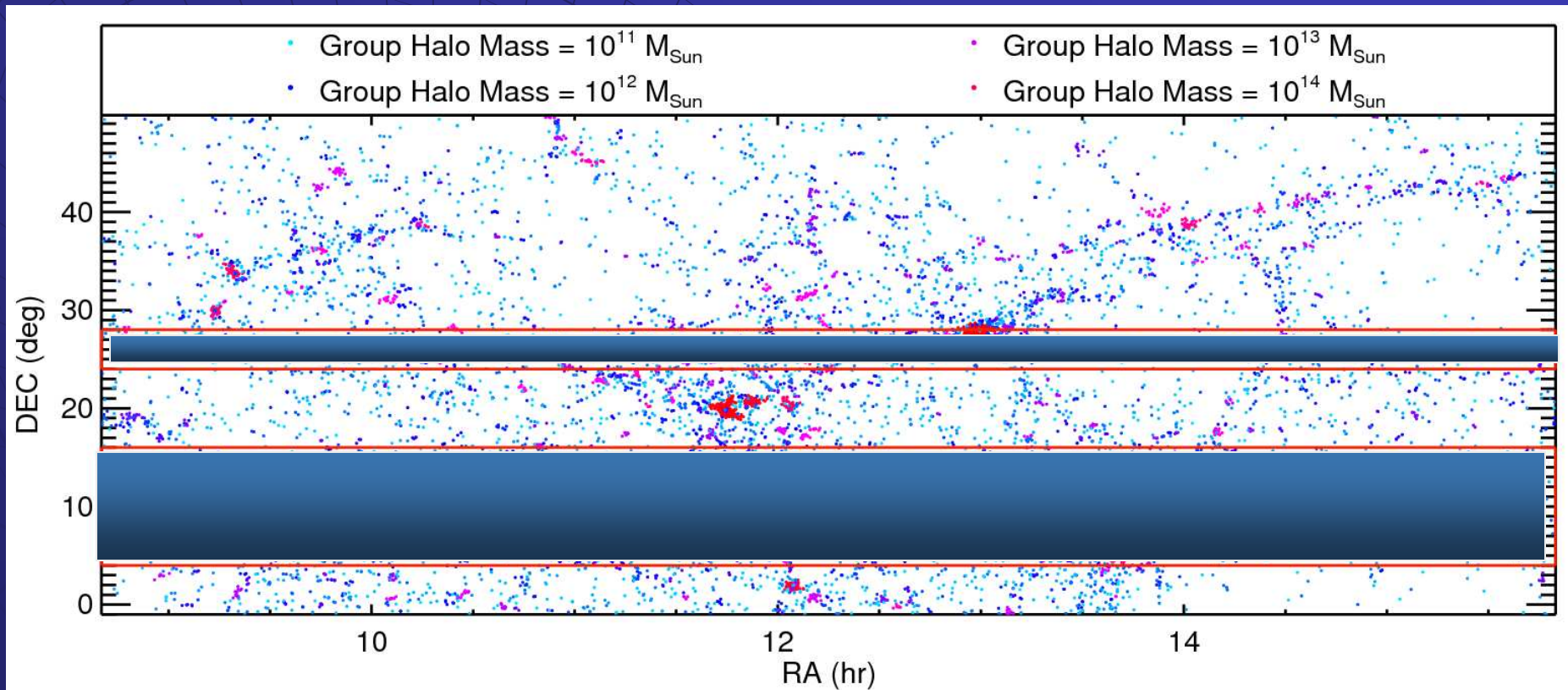
Please report bugs/errors to galmass@kirstewart.com

A: stellar mass

$$M_{\text{gas}} = 0.04 M_{\text{star}} \left(\frac{M_{\text{star}}}{4.5 \times 10^{11} M_{\odot}} \right)^{-\mu(z)}$$

explore with volume-limited subsample of ALFALFA+SDSS

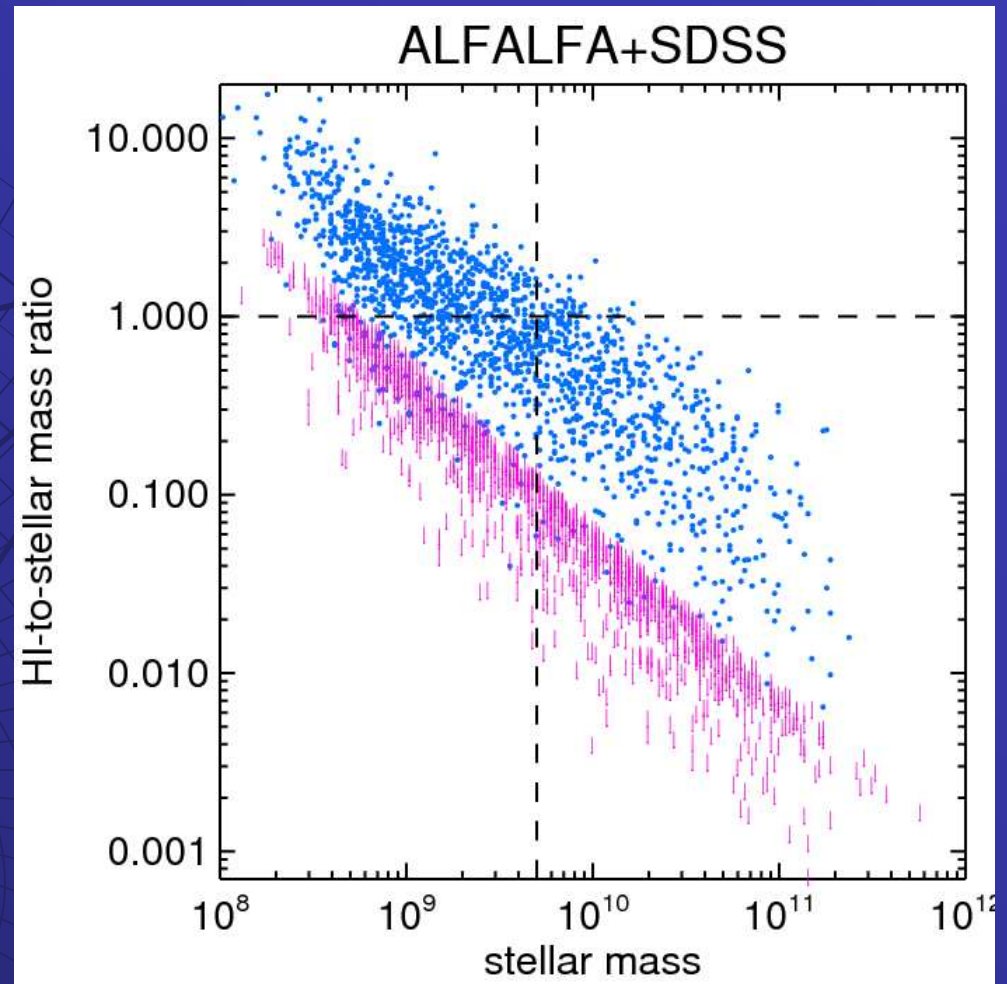
(Haynes et al. 2011 $\alpha 40$ data release)



approx. 3000 galaxies between $cz=2500-7000$ km/s
selection: SDSS $M_r < -17.23$ + HyperLeda (\approx CfA survey)

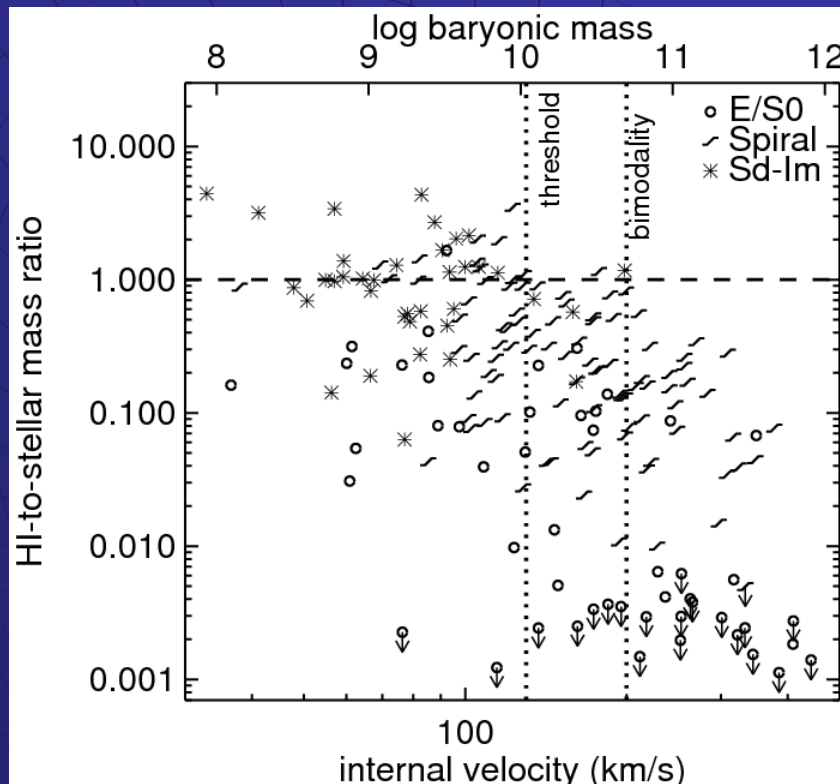
looks like a correlation...

- ◆ custom reprocessed ugrizJHK photometry
- ◆ stellar masses from SED fitting
- ◆ upper limits using r-band TFR + photometric inclination (preliminary)

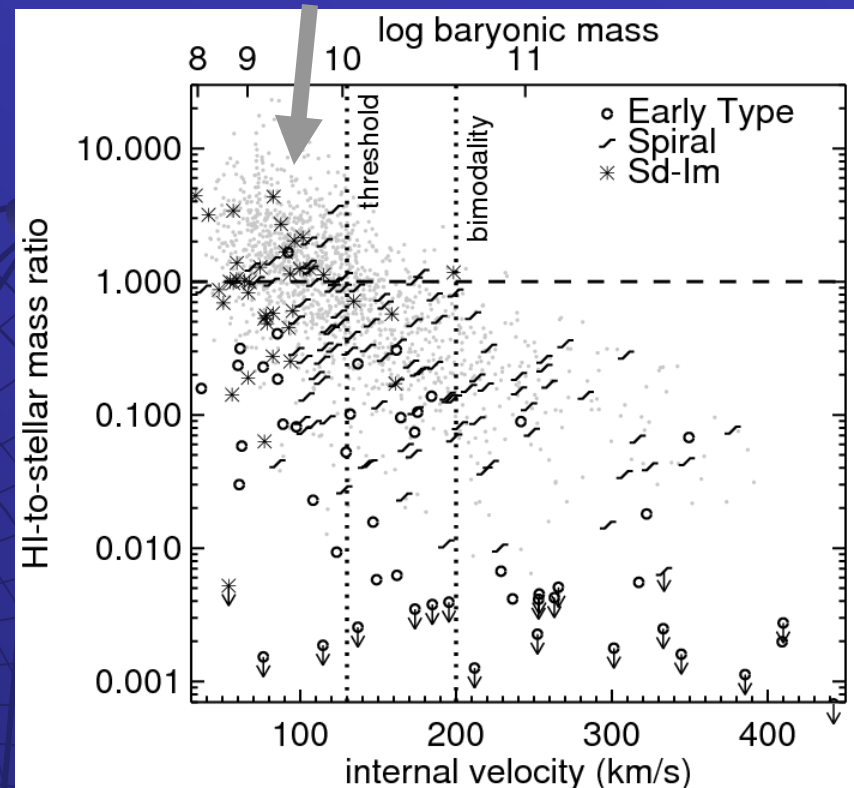


...but covariant and full of upper limits

try V , a more fundamental mass metric...



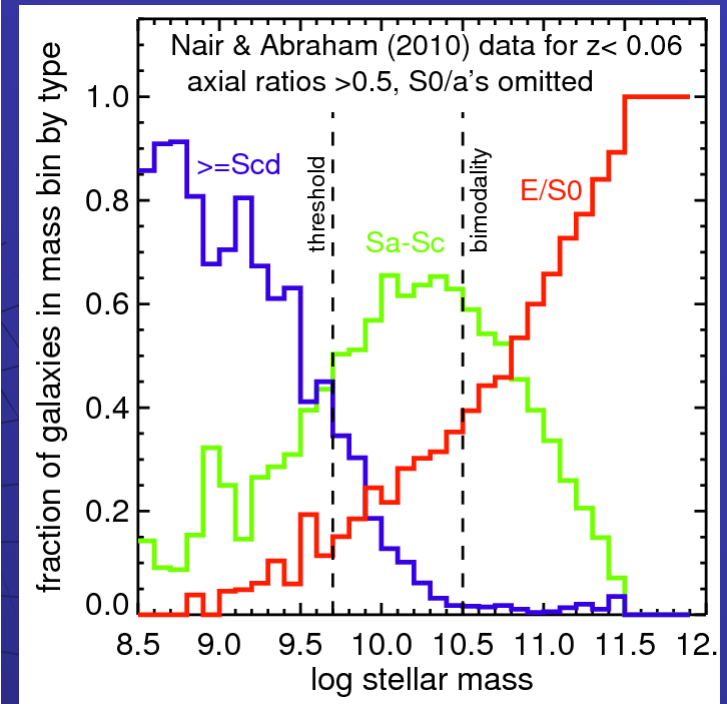
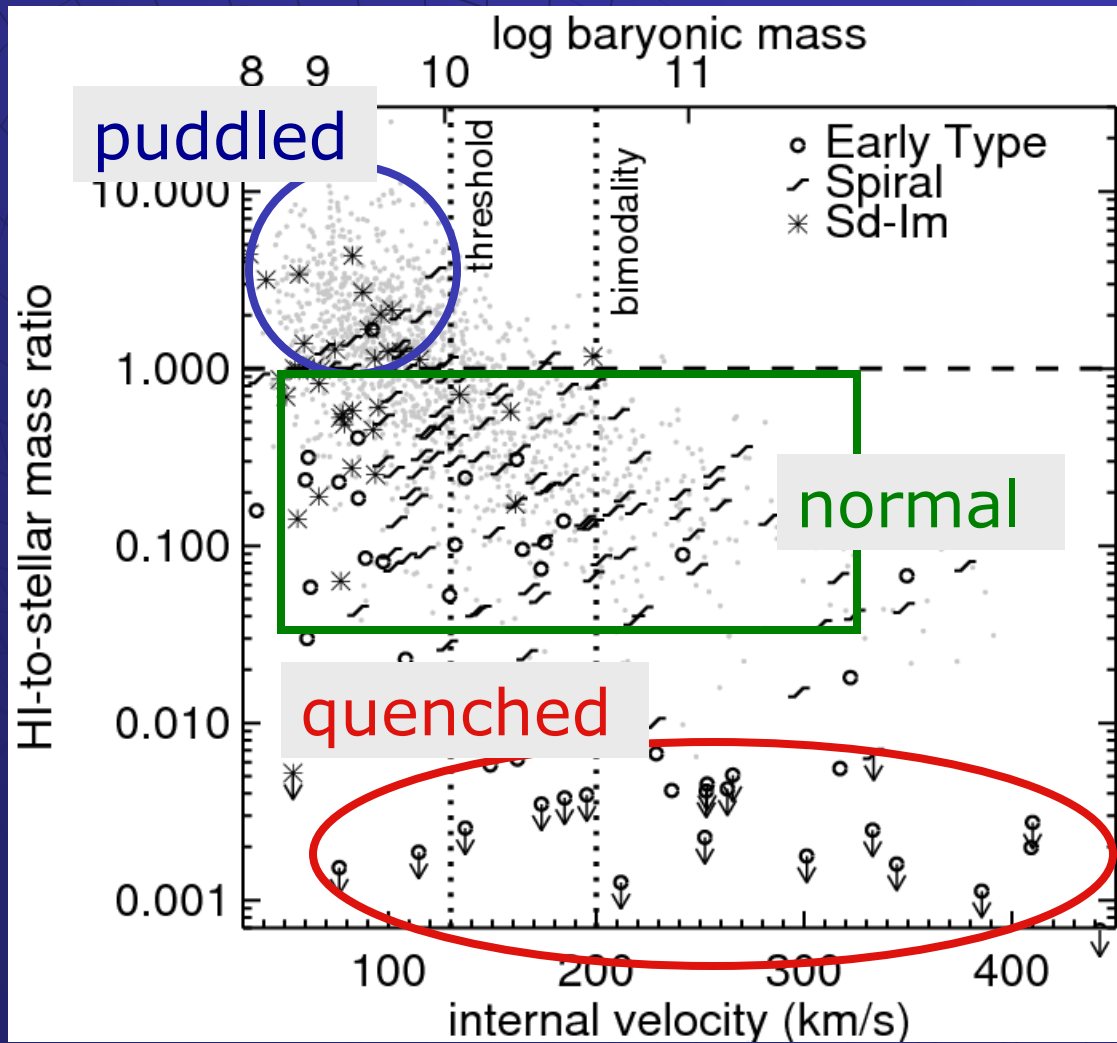
ALFALFA overlaid



strong upper limits in HI inventory for broadly representative Nearby Field Galaxy Survey

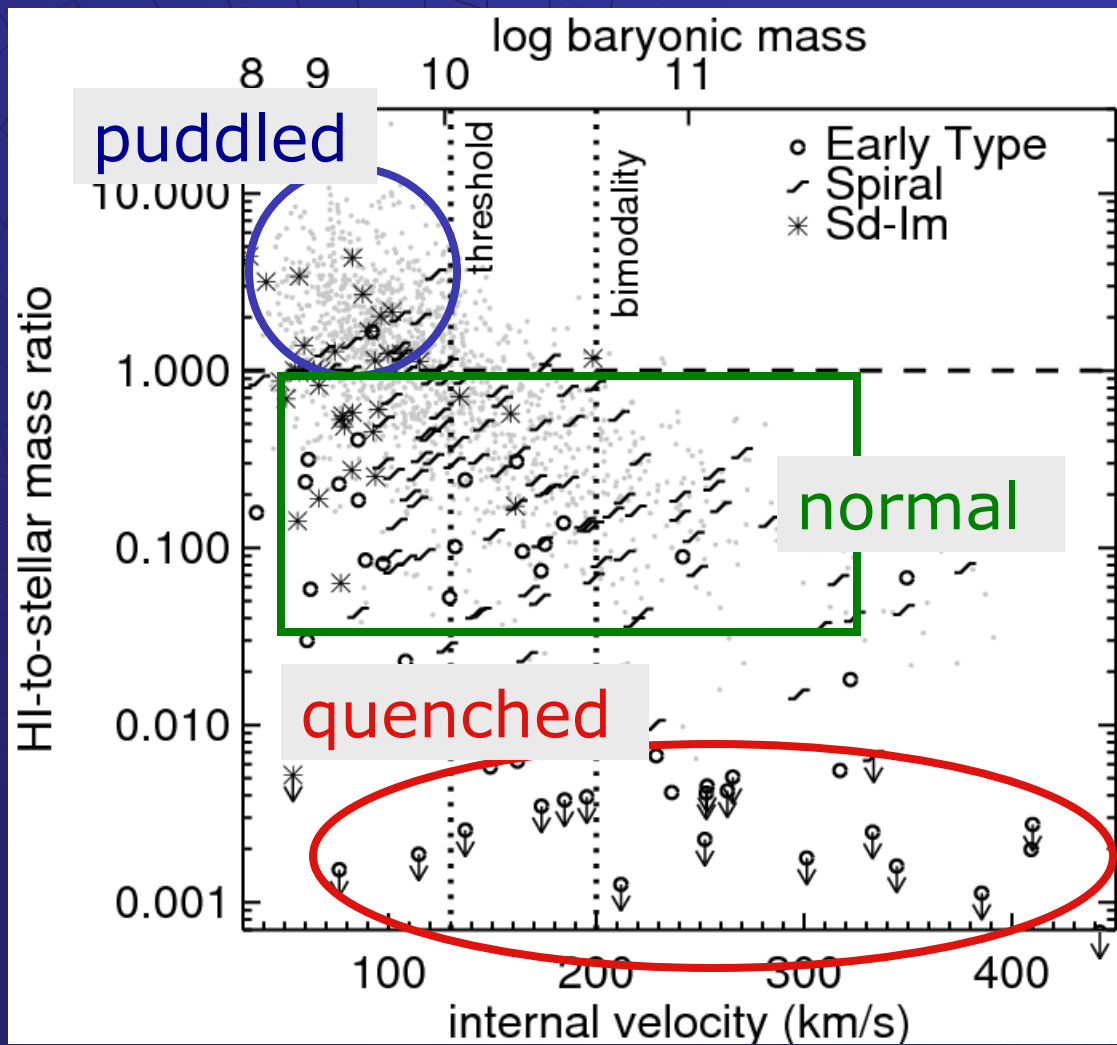
(new GBT data: Wei + 2010a; Kannappan + in prep)

discrete regimes?



Kannappan + 2012 in prep

discrete regimes?



puddled regime

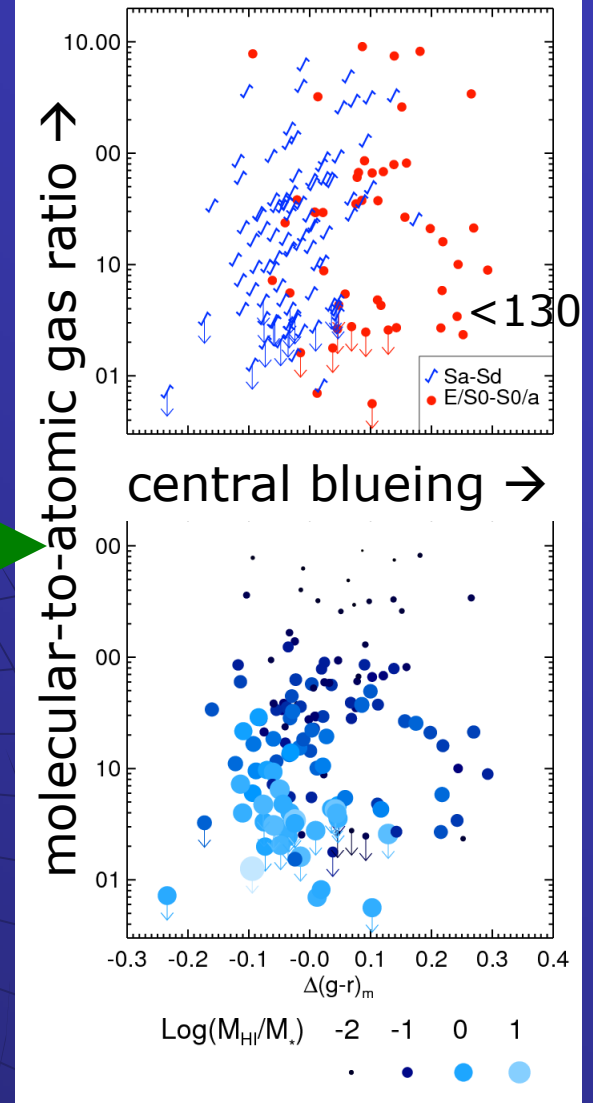
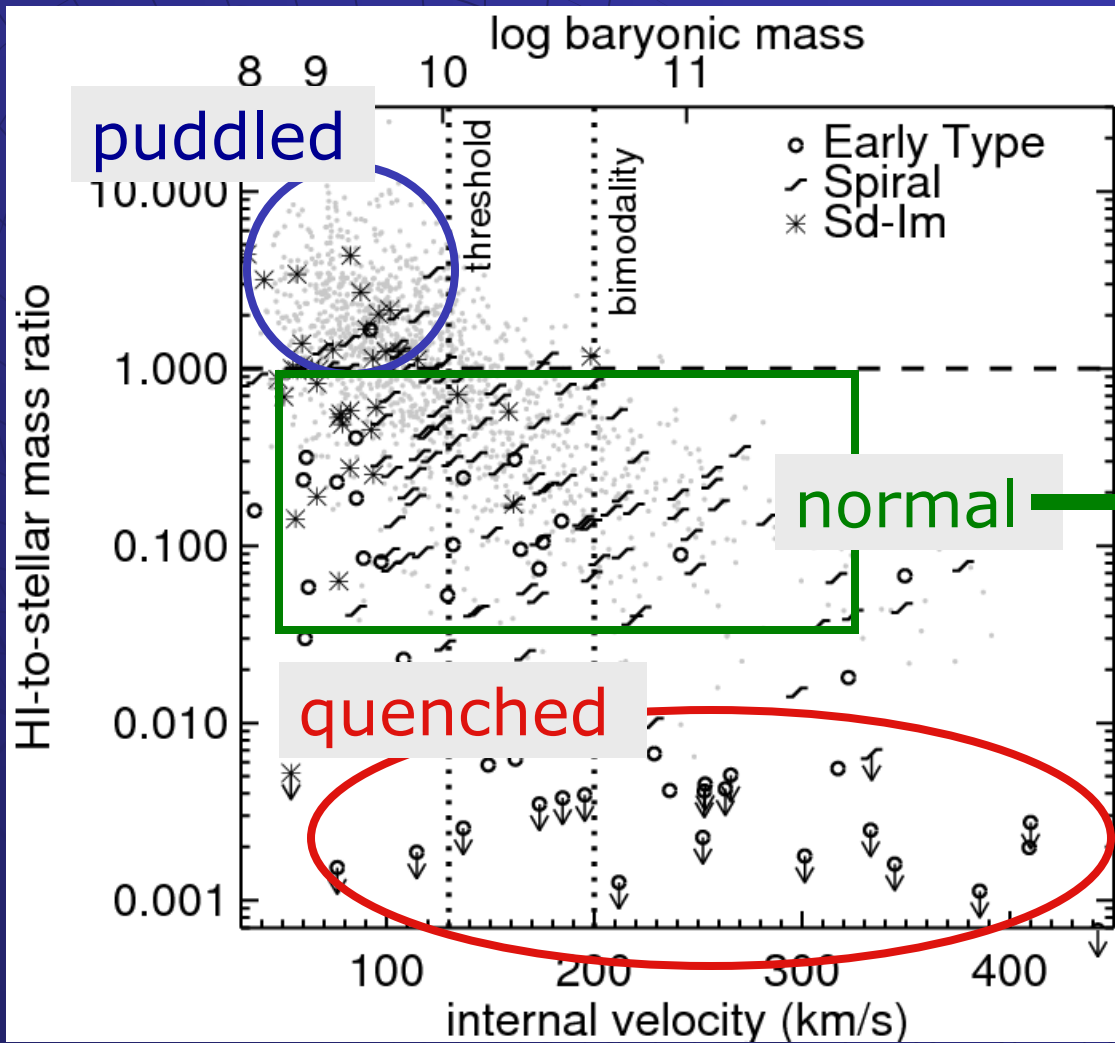
- divergence of stellar and baryonic Tully-Fisher relations

- sharp changes in metallicity and dust (Garnett 2002; Dalcanton + 2004)

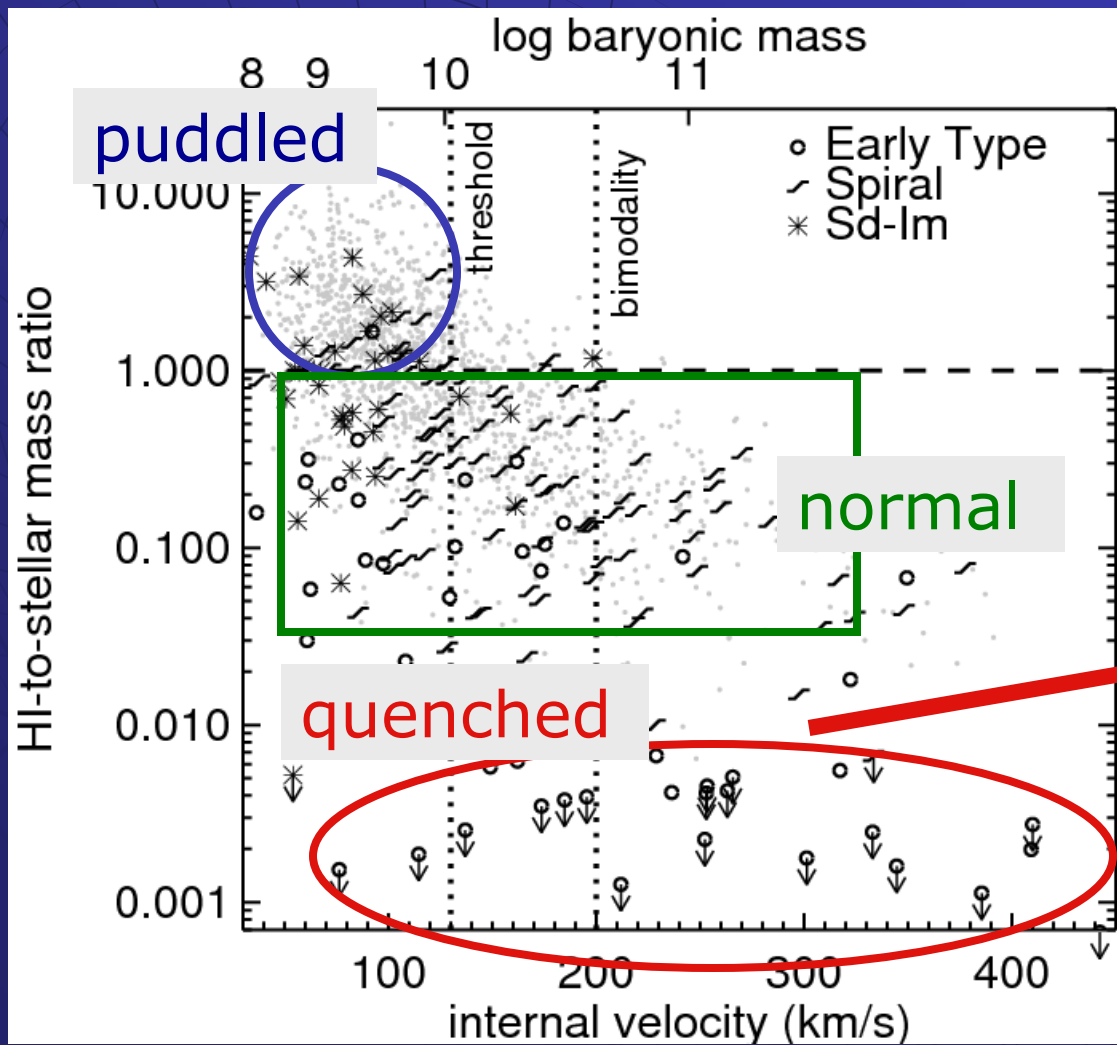
- connection to cold accretion scale? (Dekel & Birnboim 2006; Krumholz & Dekel 2012)

discrete regimes?

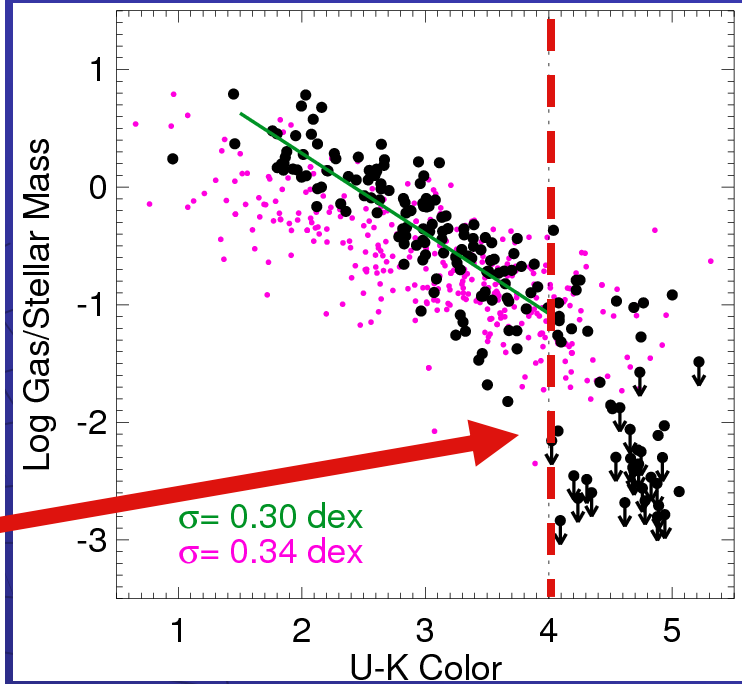
"fueling diagram"
(Stark talk Tues.)



discrete regimes?

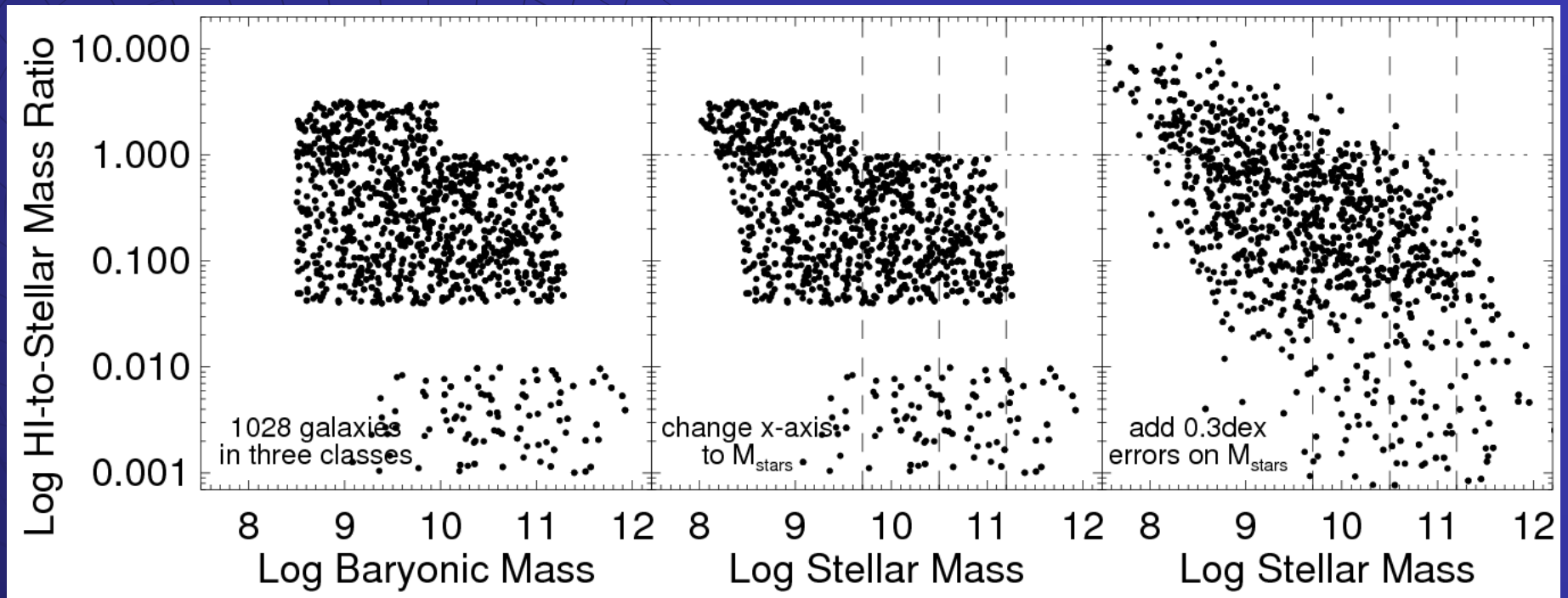


quenched regime
clear in U-K color:



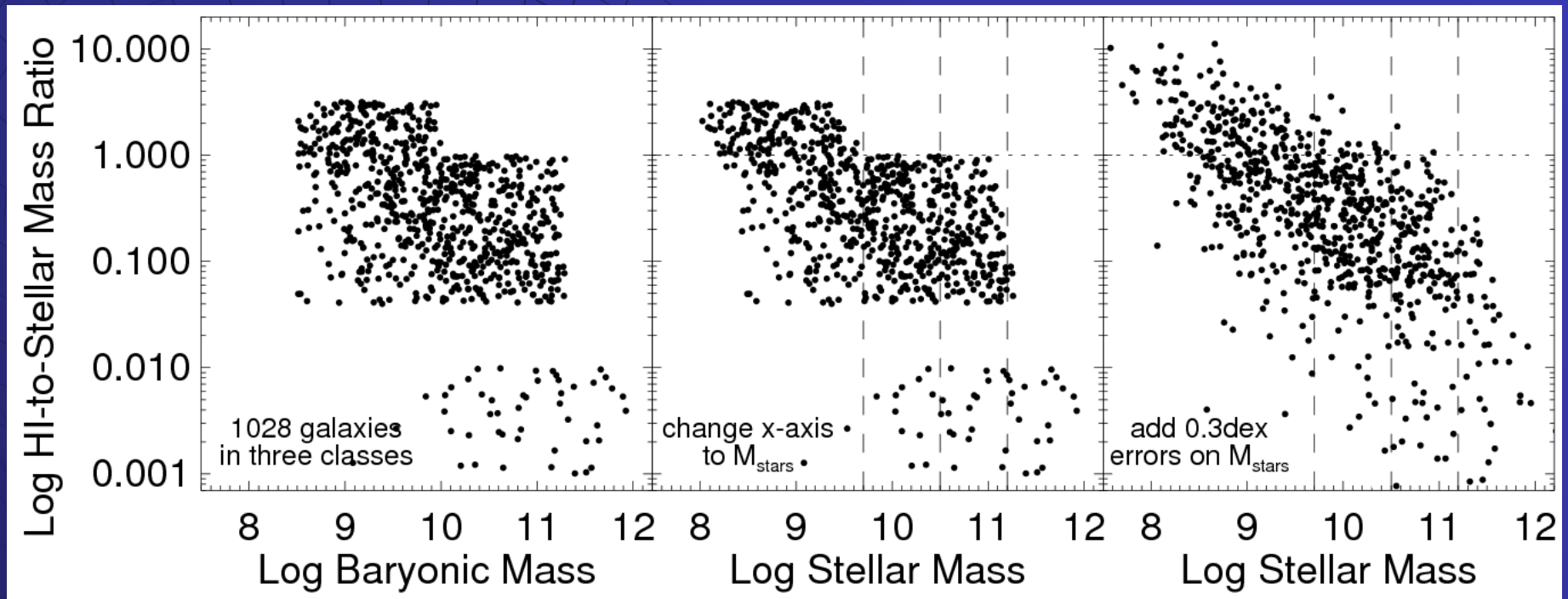
(notice what does
correlate with M_{HI}/M_*
 \rightarrow accretion again?)

...so is there any continuous mass dependence?



simulated data in very simple model:
first add covariance, then M_* errors...

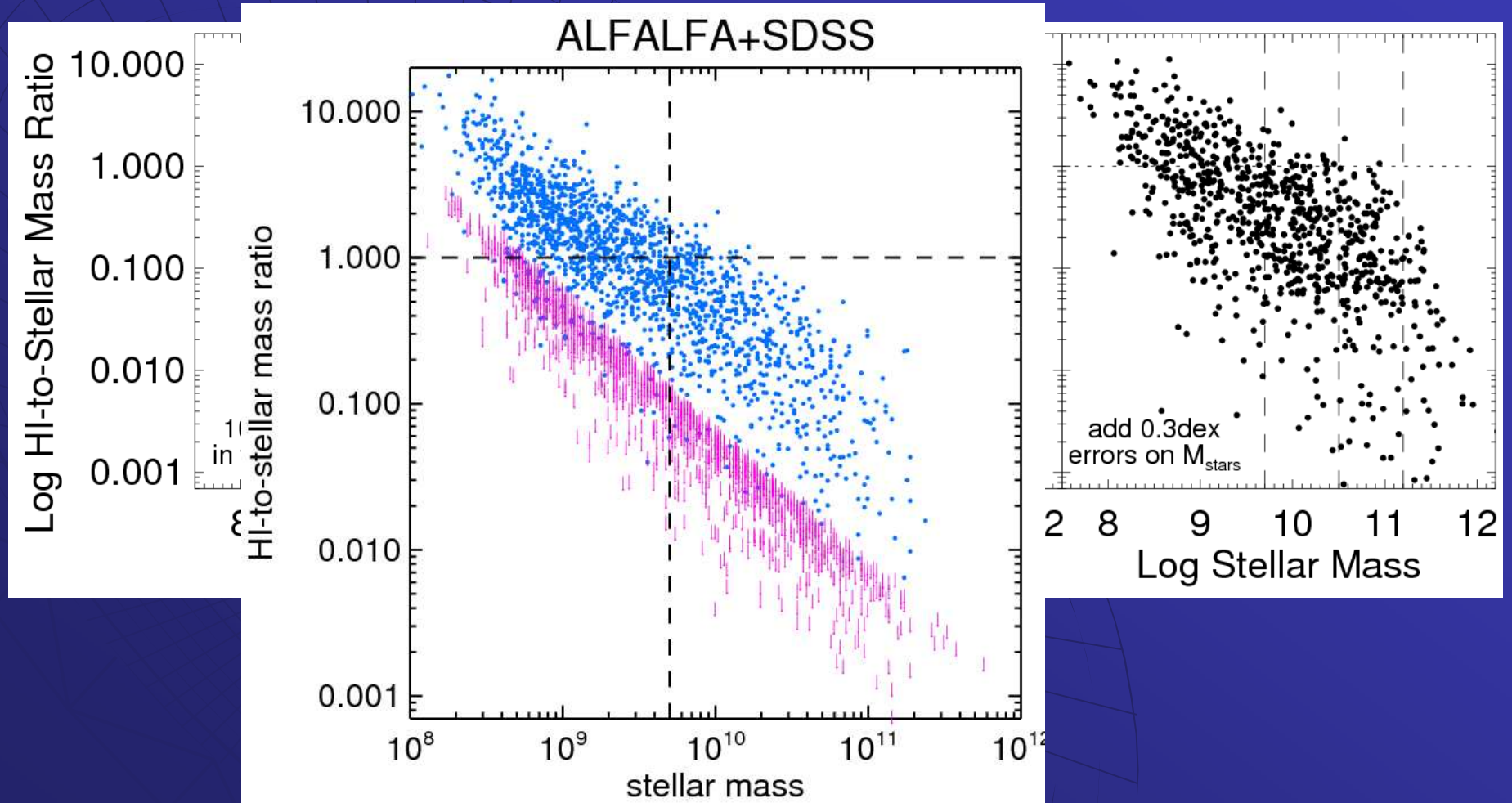
...so is there any continuous mass dependence?



simulated data in very simple model:
first add covariance, then M_* errors...

then flux-limited selection

...so is there any continuous mass dependence?



conclusions

- ◆ HI content correlates poorly with mass
- ◆ we must entertain the possibility that the rise & fall of three discrete regimes (puddled, normal, quenched) creates any correlation we see
- ◆ these three regimes might simply be defined by excess accretion, normal cyclic accretion-inflow-consumption, and quenched accretion