

Galaxy And Mass Assembly



# Multiwavelength indicators of star formation in galaxies

Andrew Hopkins  
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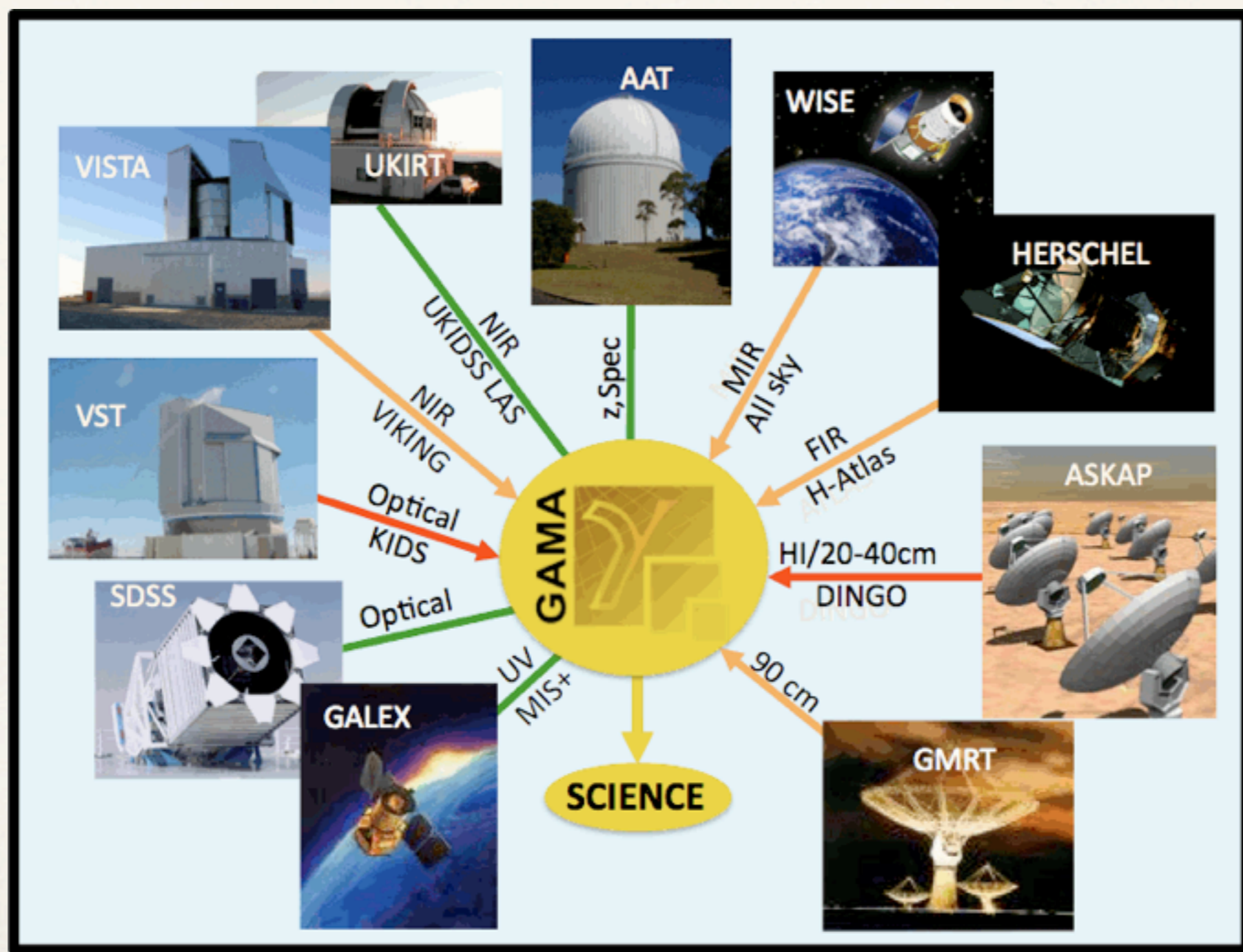
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# GAMA



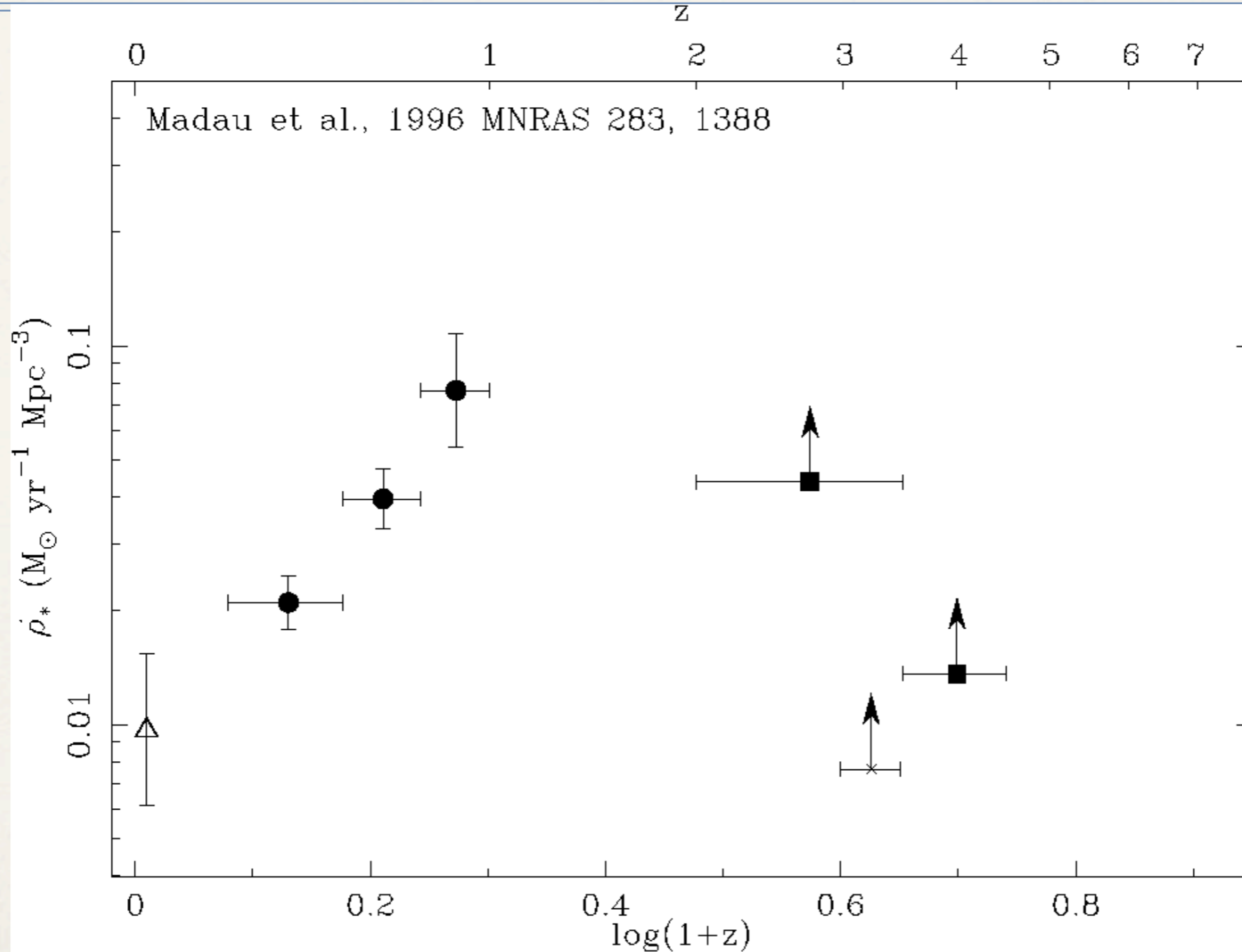


# GAMA Key Science

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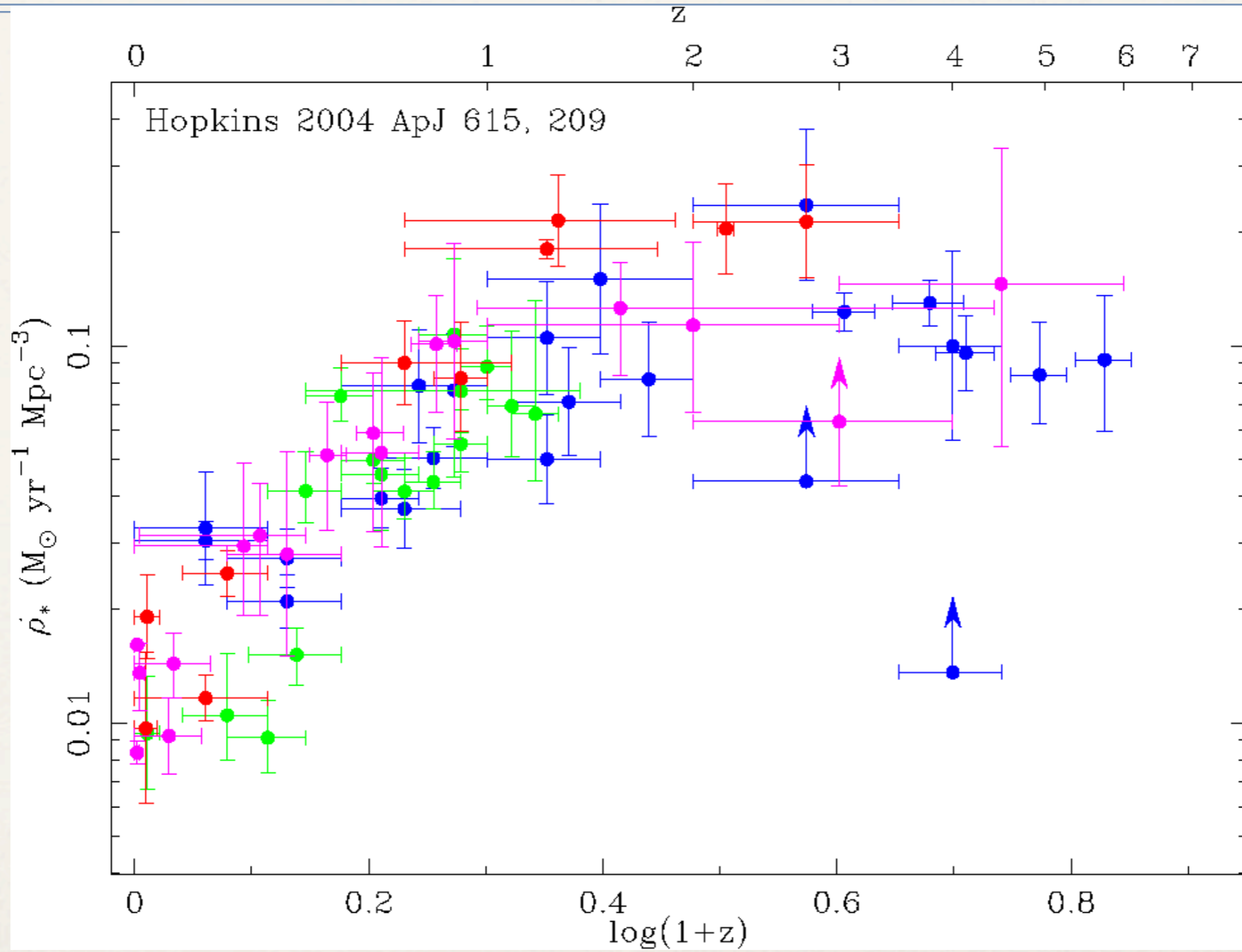
- ★ A measurement of the dark matter halo mass function of groups and clusters using group velocity dispersion measurements.
- ★ A comprehensive determination of the galaxy stellar mass function to Magellanic Cloud masses to constrain baryonic feedback processes.
- ★ A direct measurement of the recent galaxy merger rates as a function of mass, mass ratio, local environment and galaxy type.

# Evolution of Star Formation



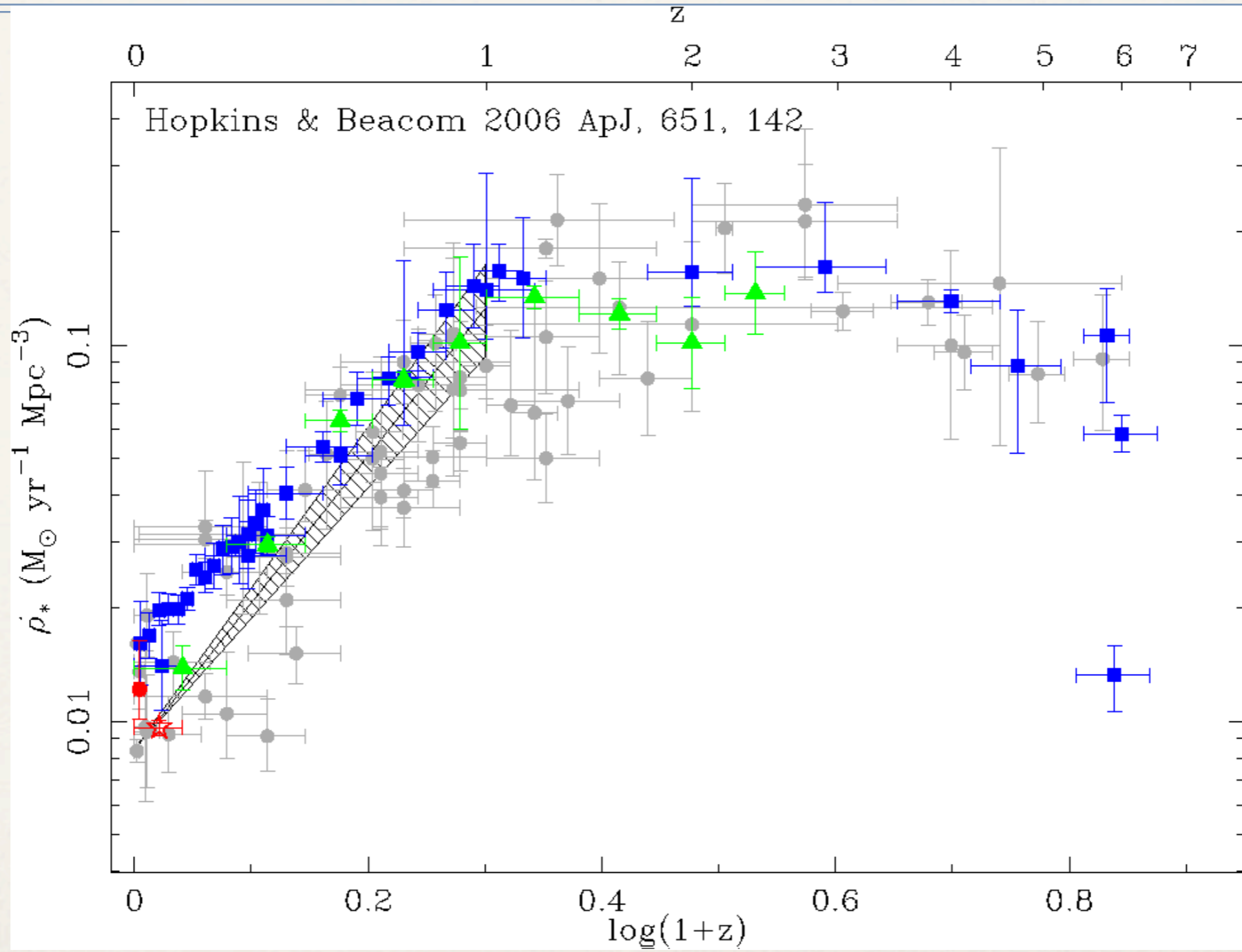


# Evolution of Star Formation



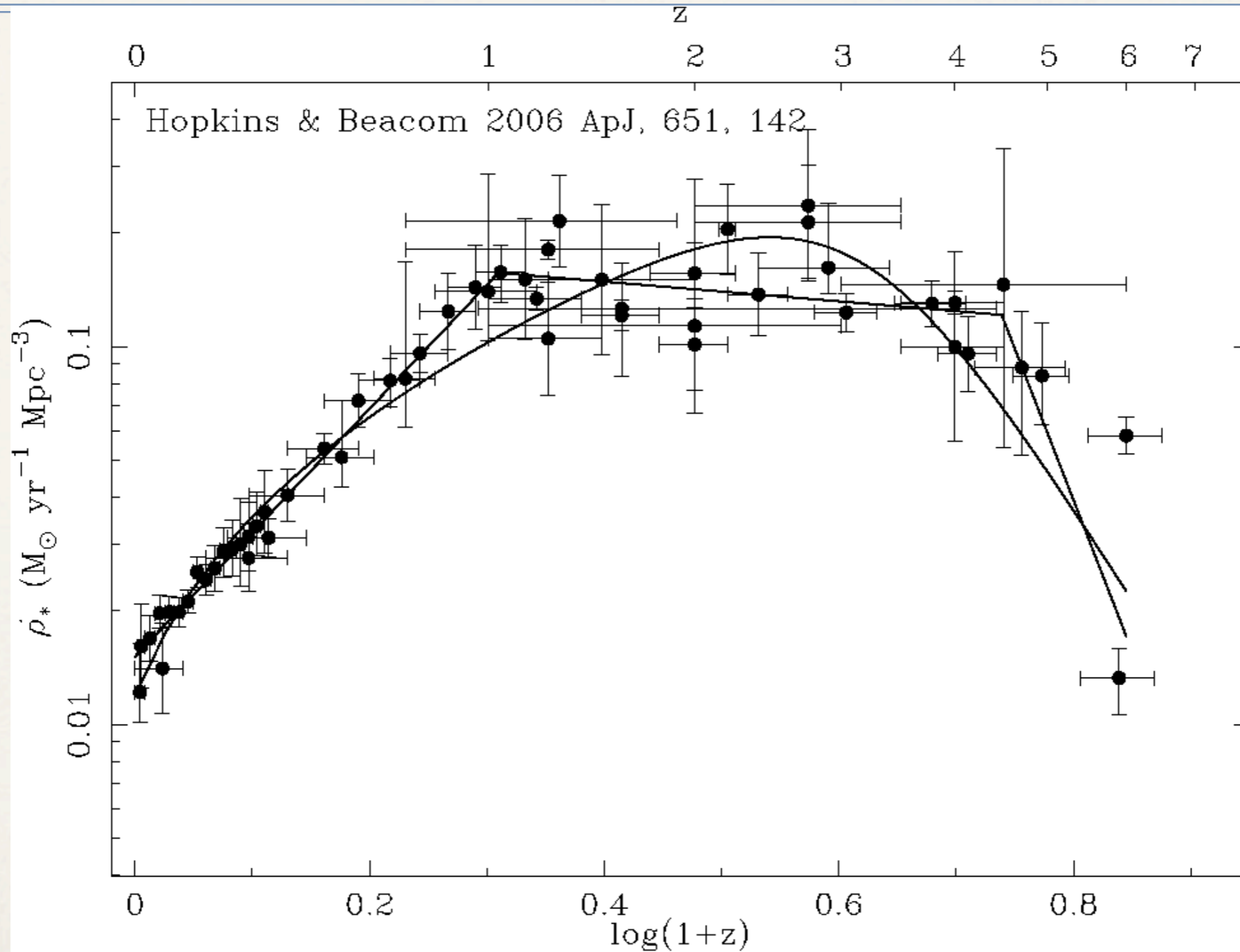


# Evolution of Star Formation



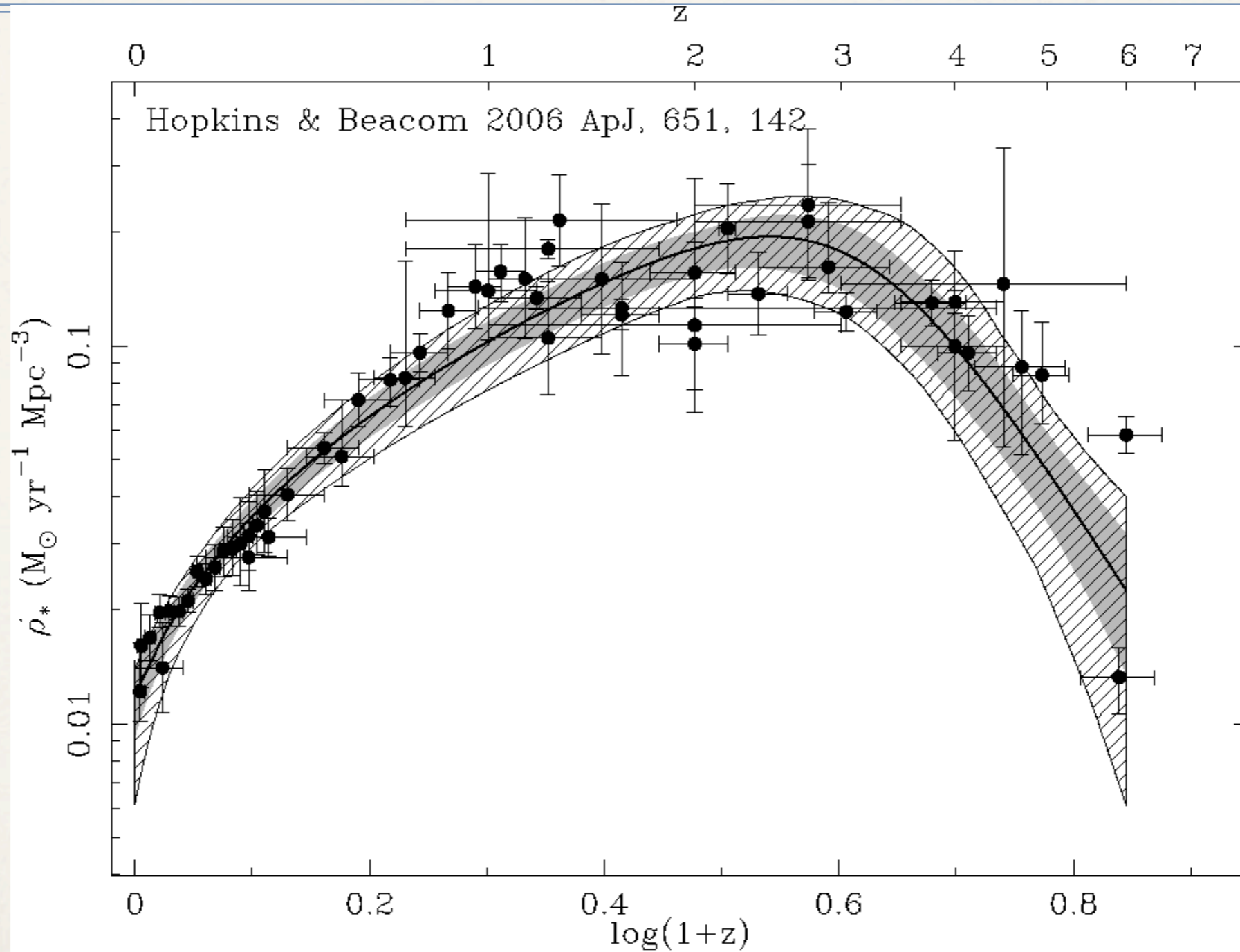


# Evolution of Star Formation



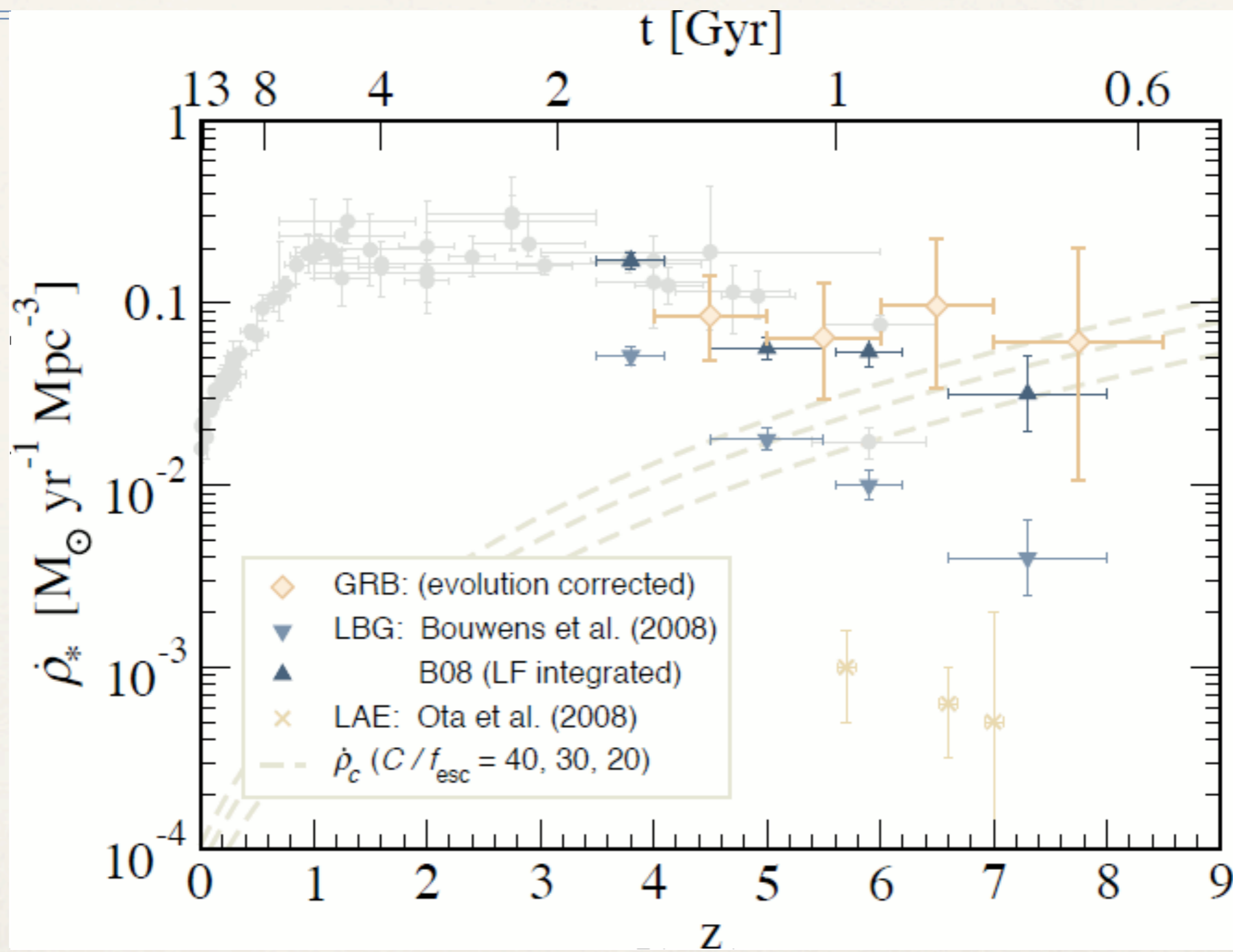


# Evolution of Star Formation





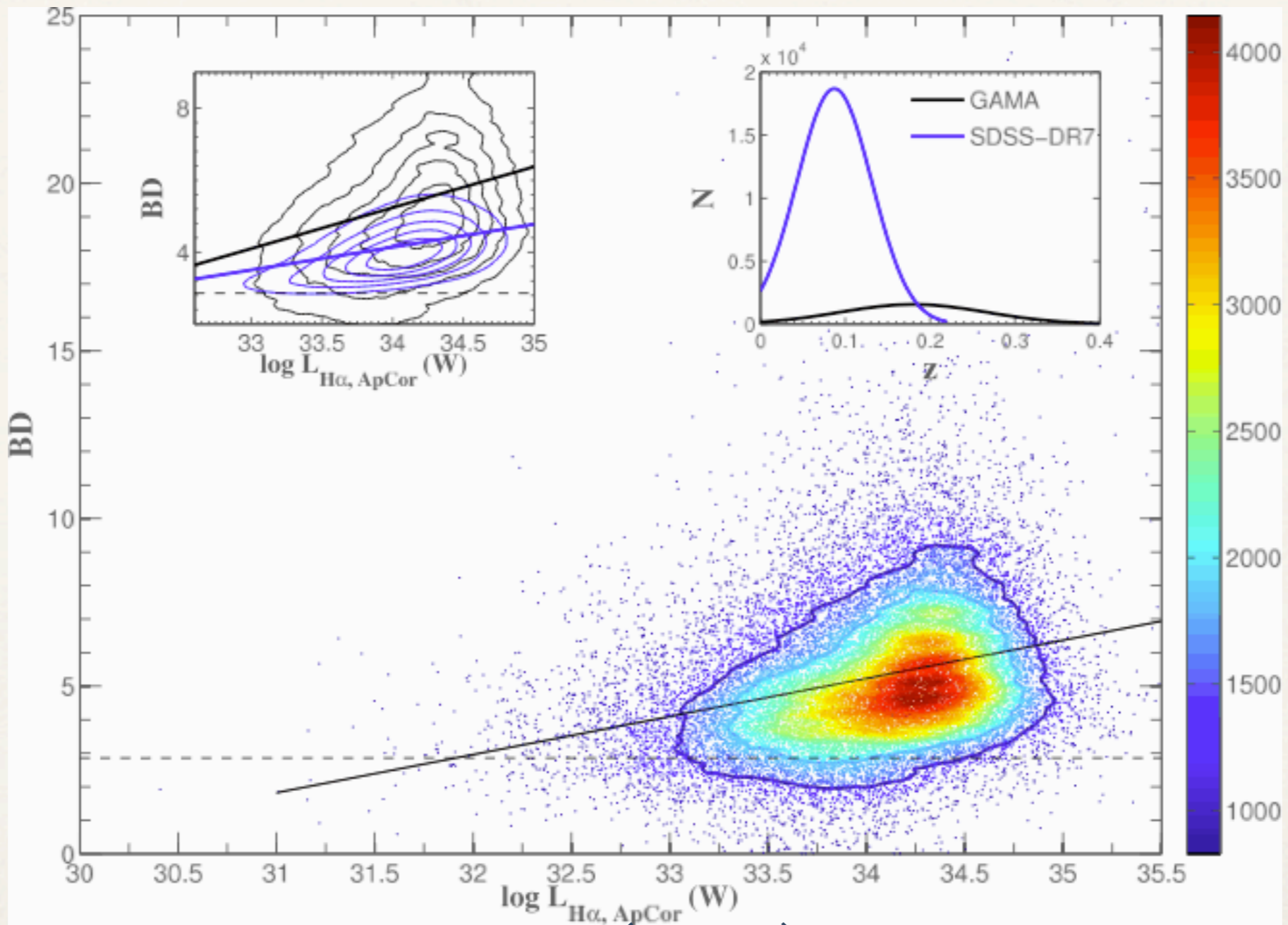
# Evolution of Star Formation



Kistler et al, 2009, ApJ, 705, L104

# Luminosity-dependent obscuration

Balmer decrement

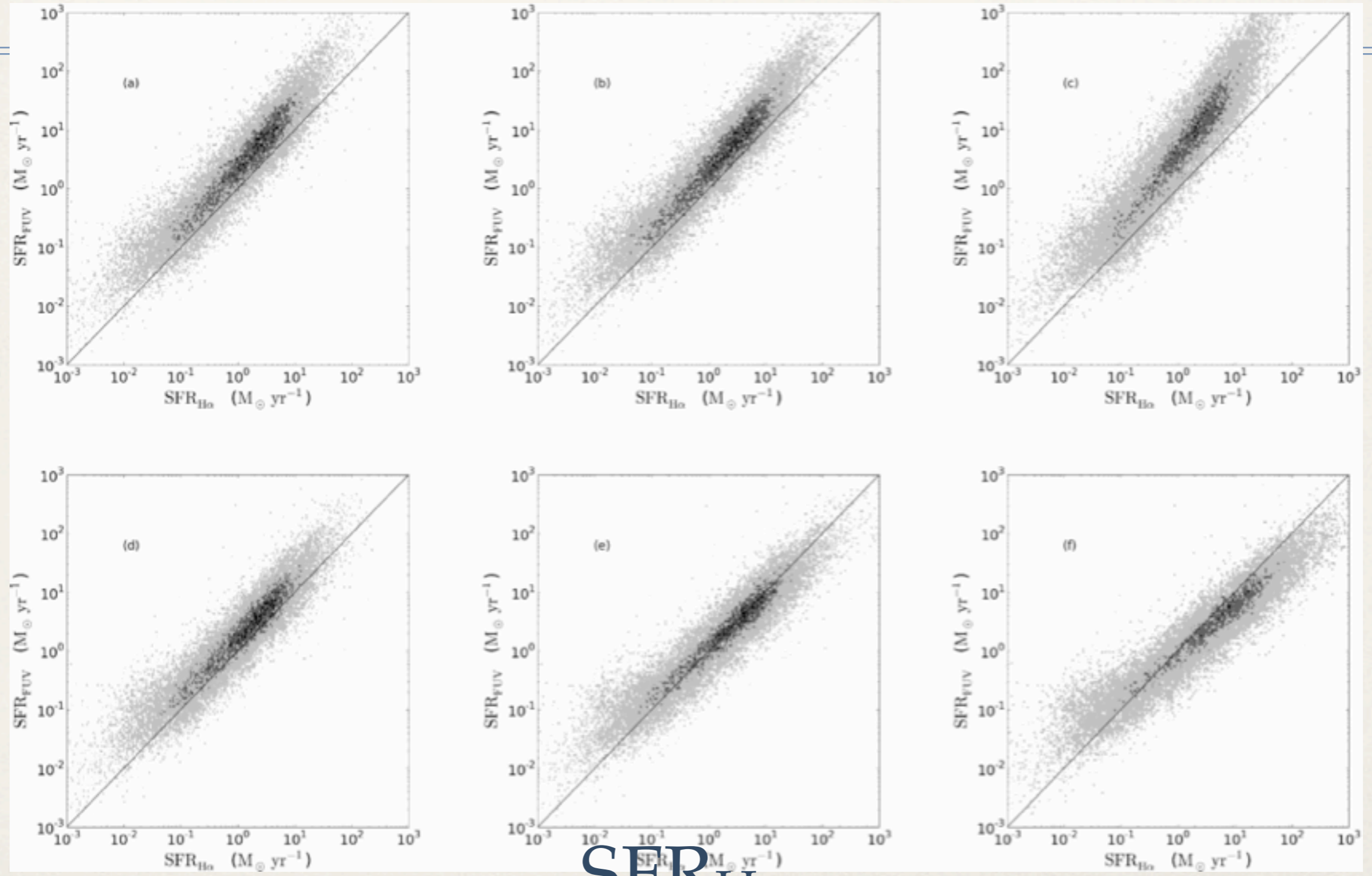


$\log(L_{\text{H}\alpha})$



# MW SFR: FUV vs H $\alpha$

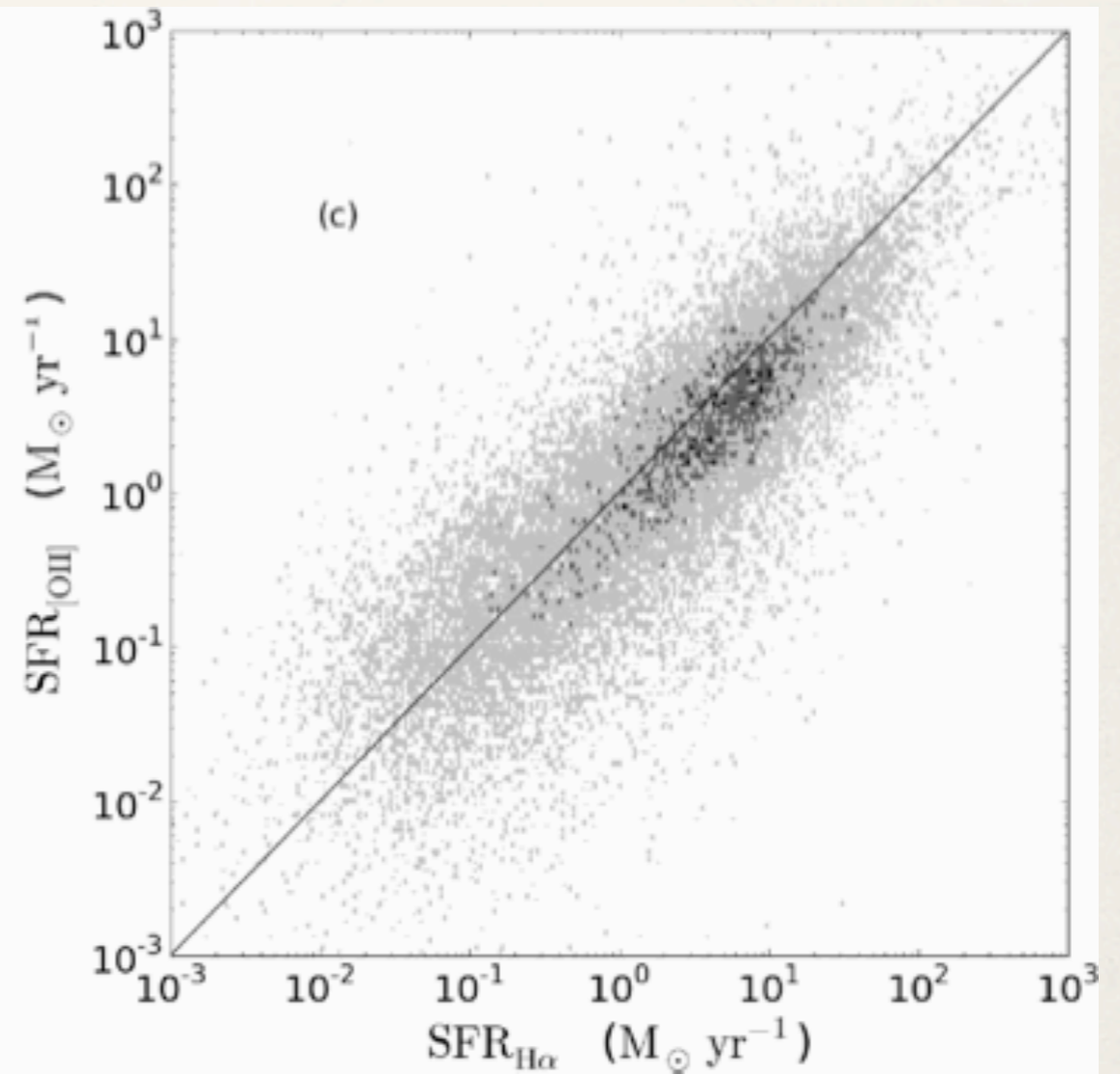
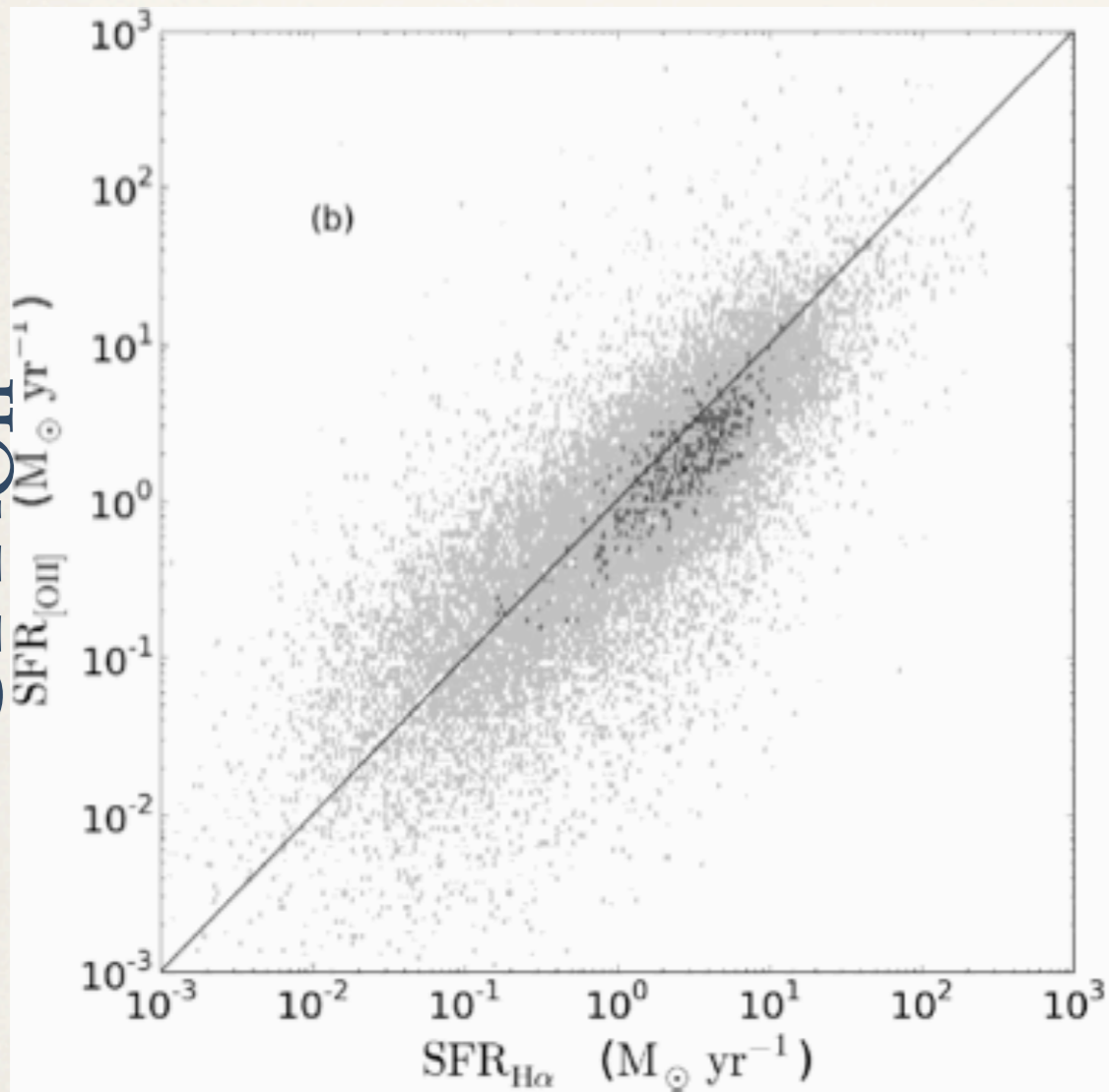
SFR<sub>FUV</sub>



SFR<sub>H $\alpha$</sub>

# MW SFR: H $\alpha$ vs [OII]

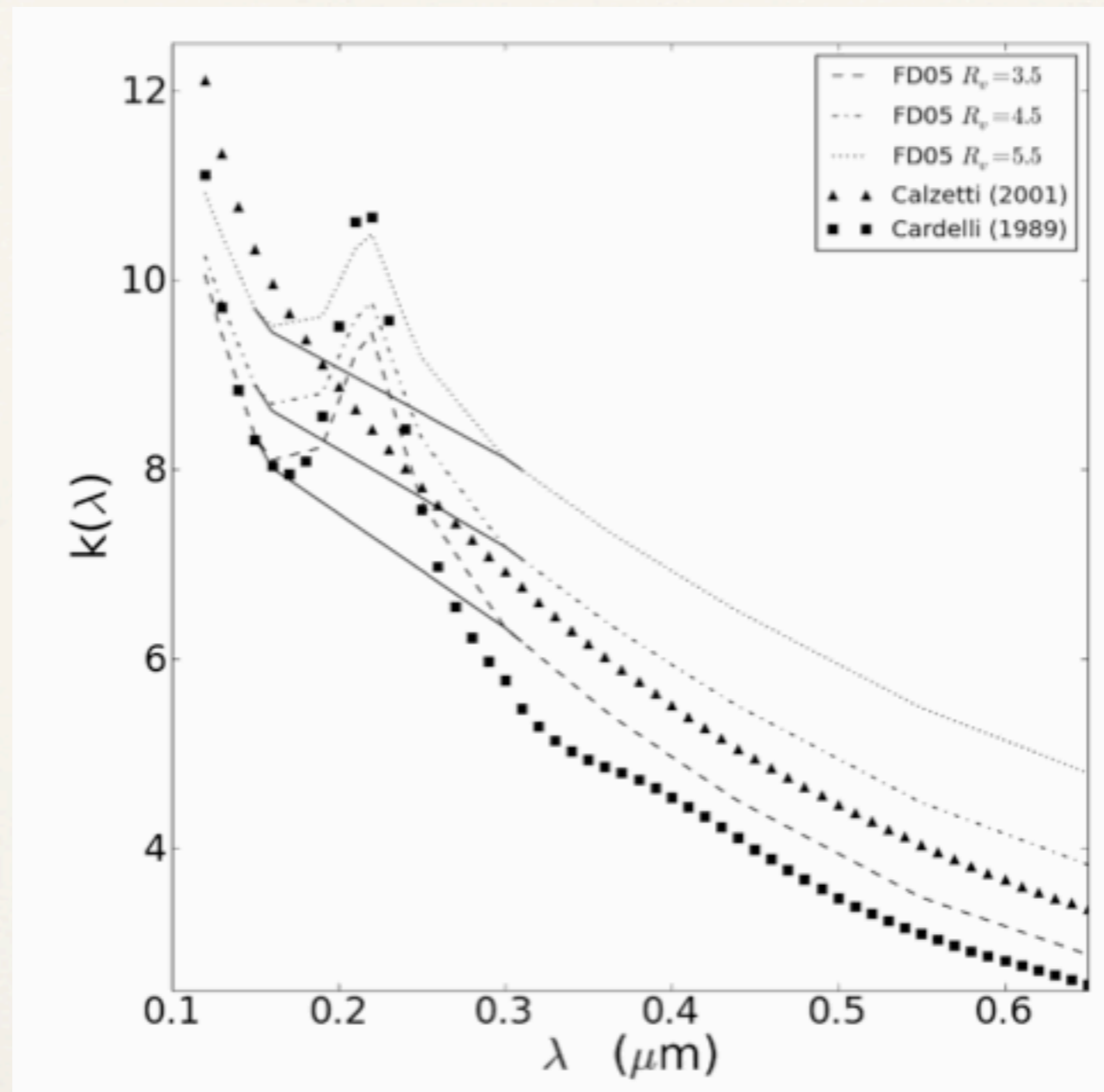
SFR<sub>[OII]</sub>



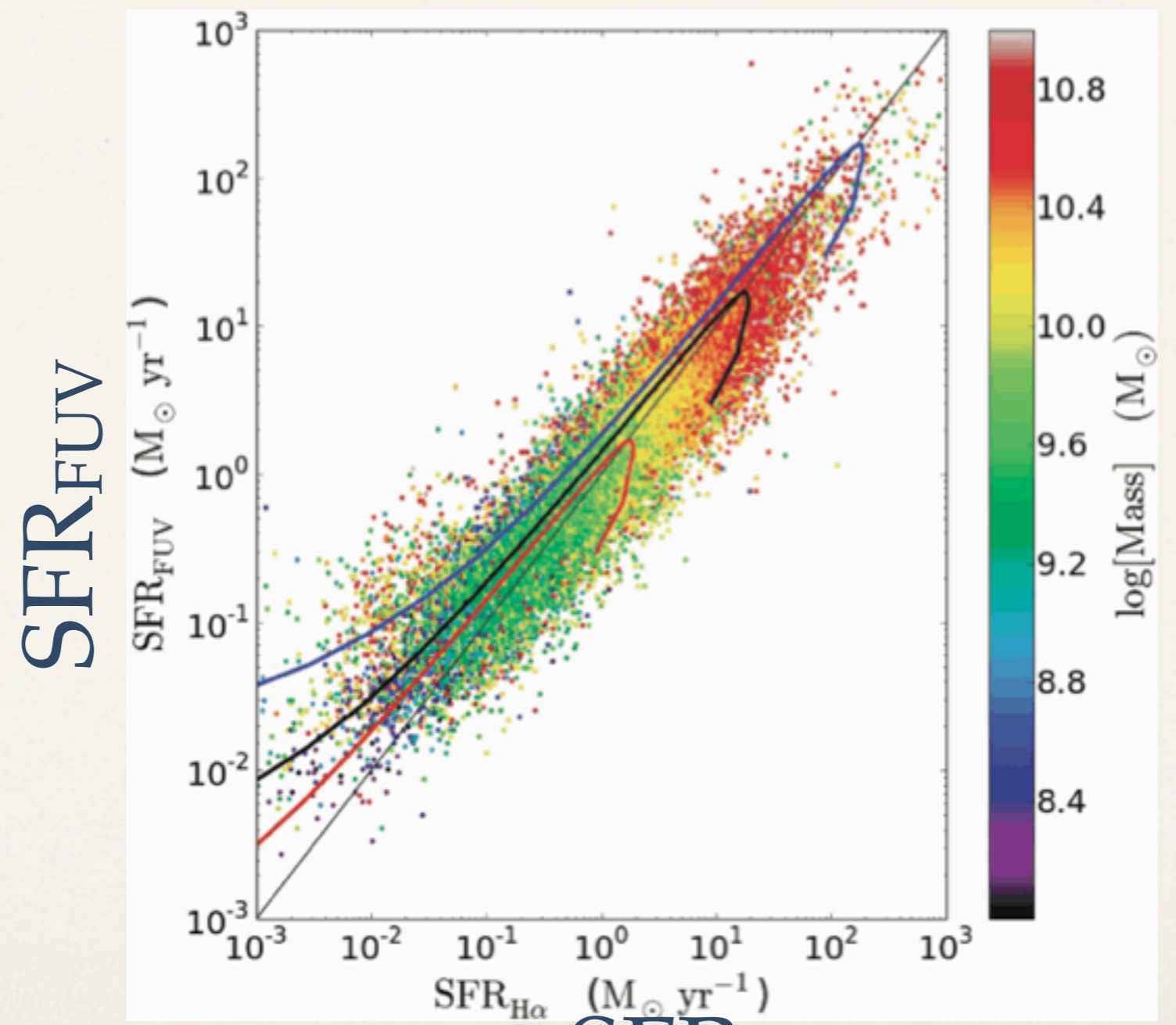
SFR<sub>H $\alpha$</sub>



# Obscuration curves



# FUV vs H $\alpha$

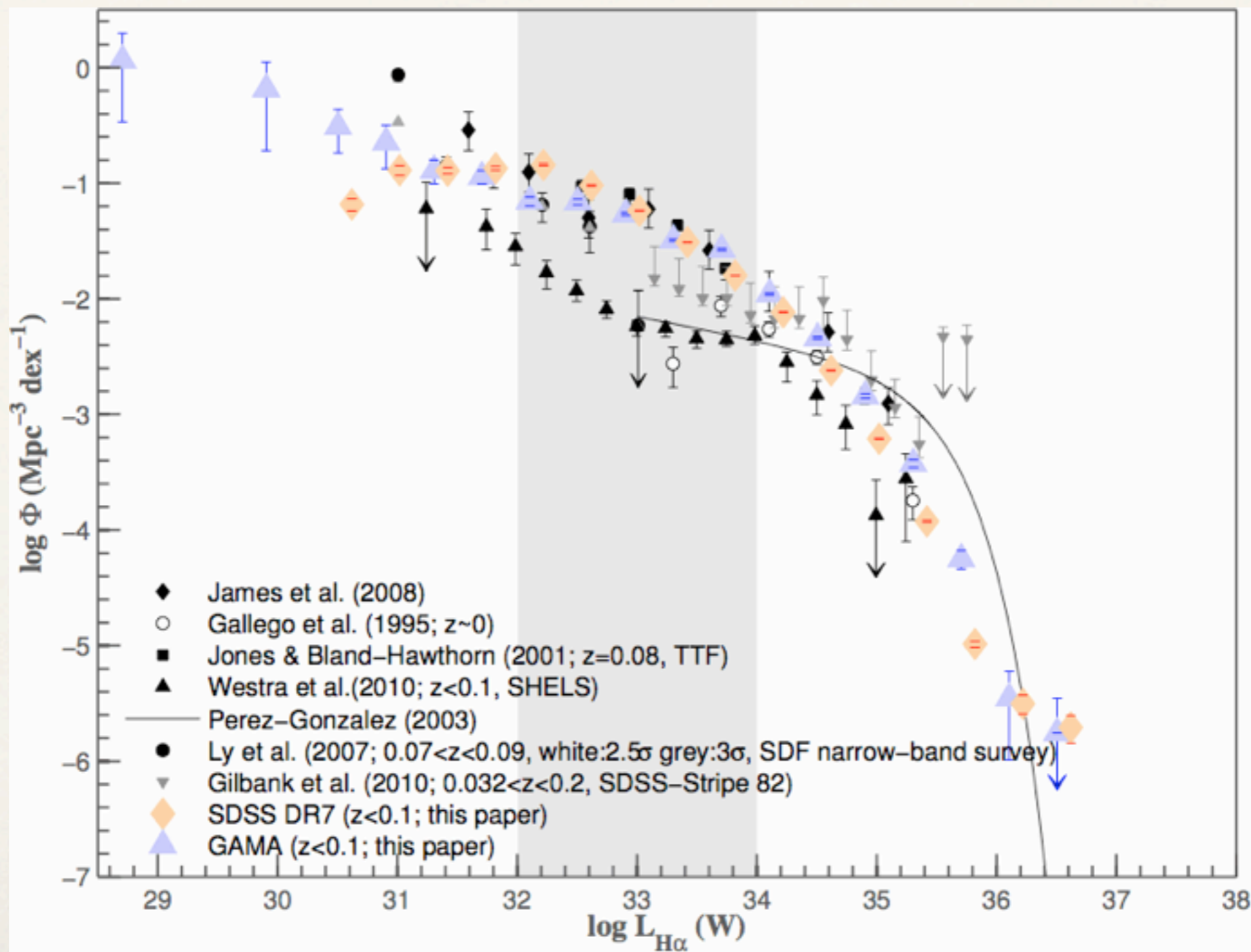


$SFR_{FUV}$

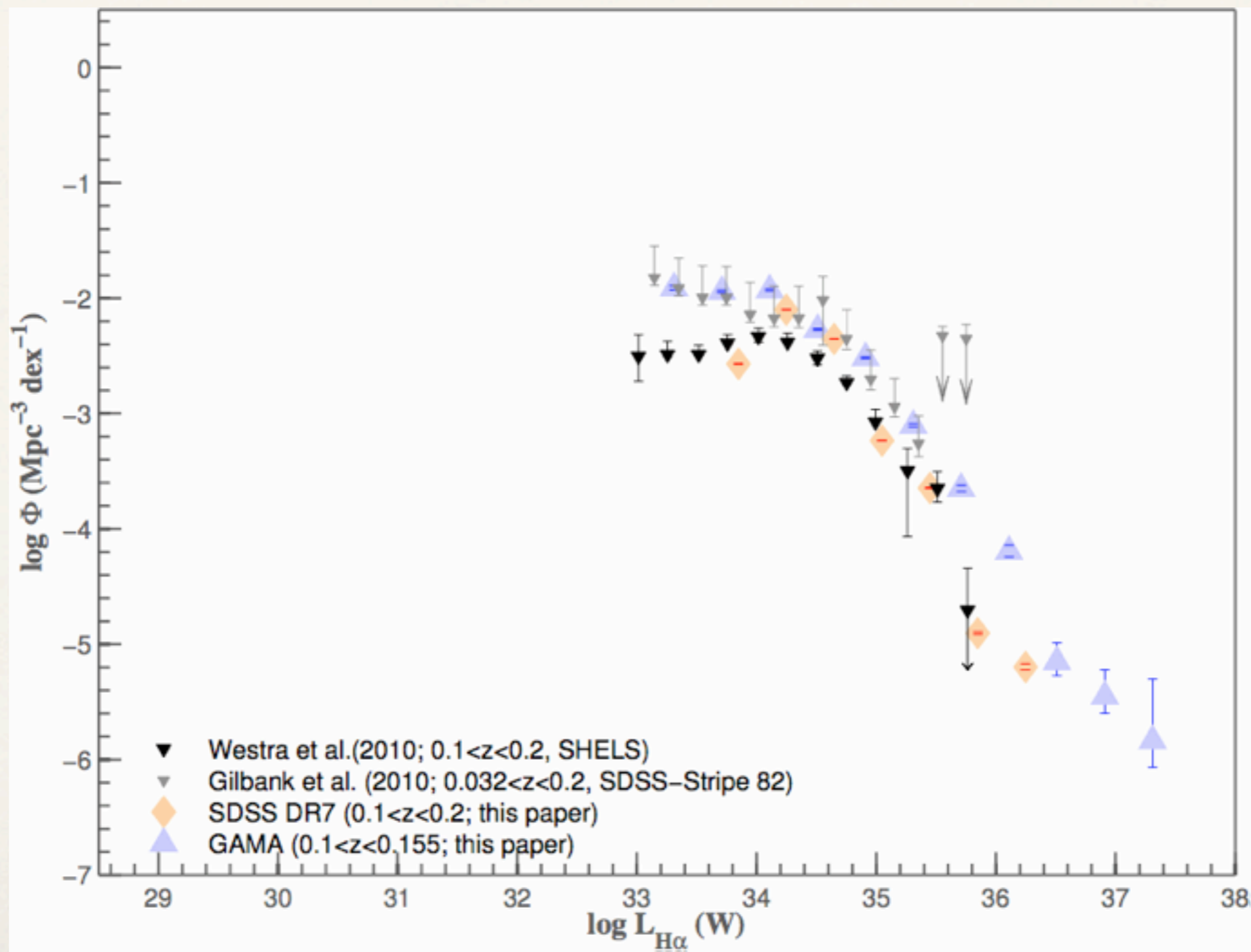
$SFR_{H\alpha}$



# The GAMA H $\alpha$ Luminosity Function

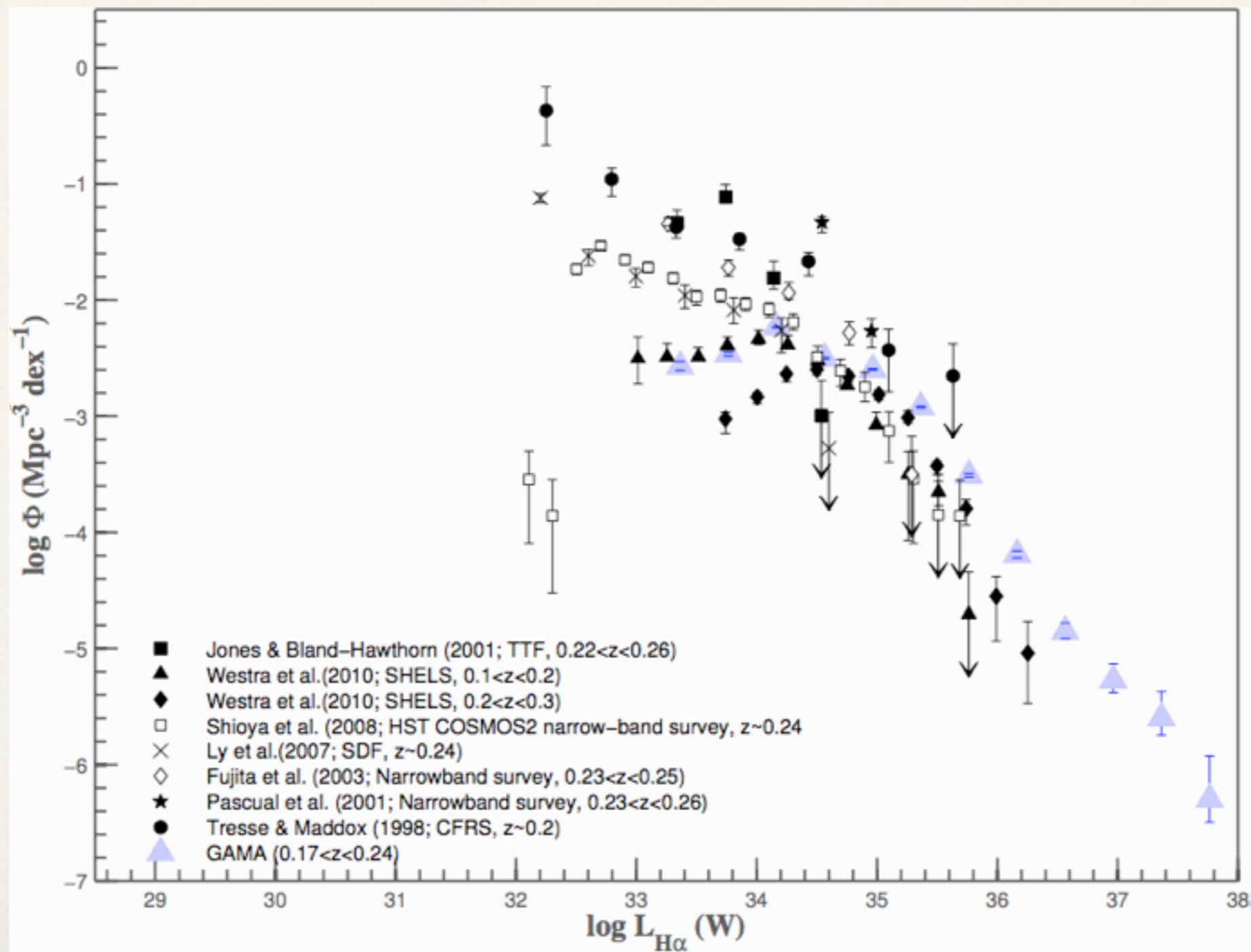


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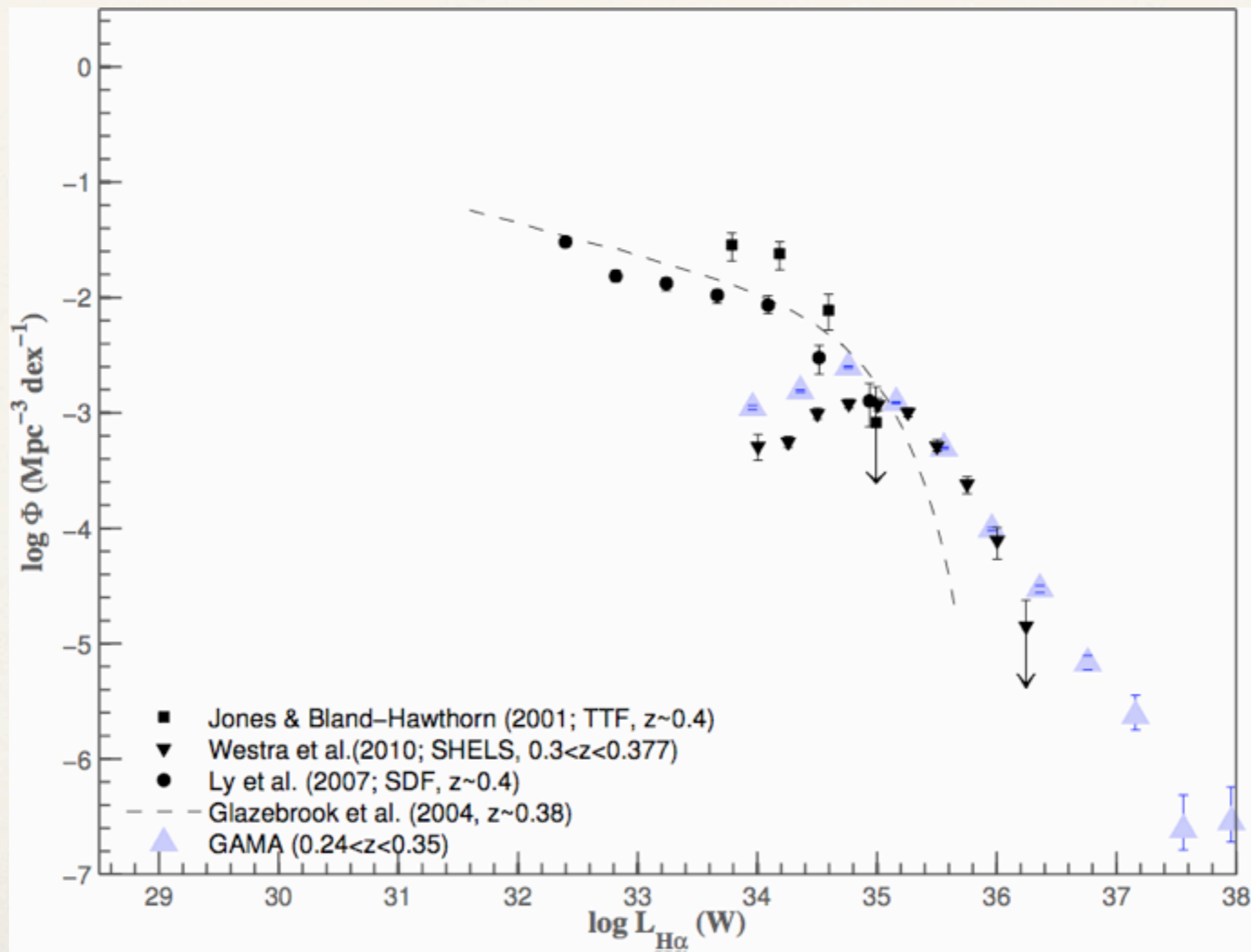




# The GAMA H $\alpha$ Luminosity Function

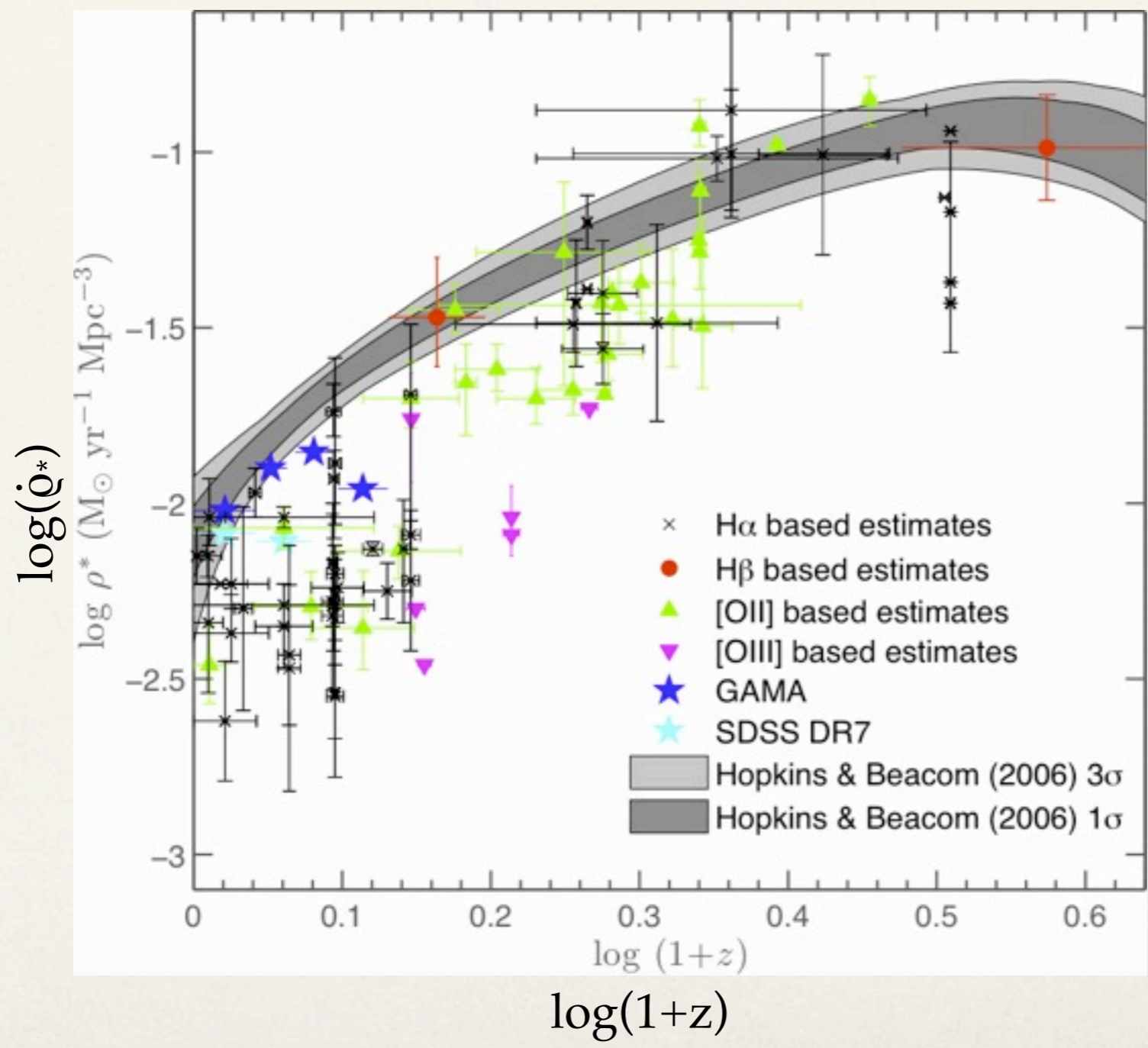


# The GAMA H $\alpha$ Luminosity Function

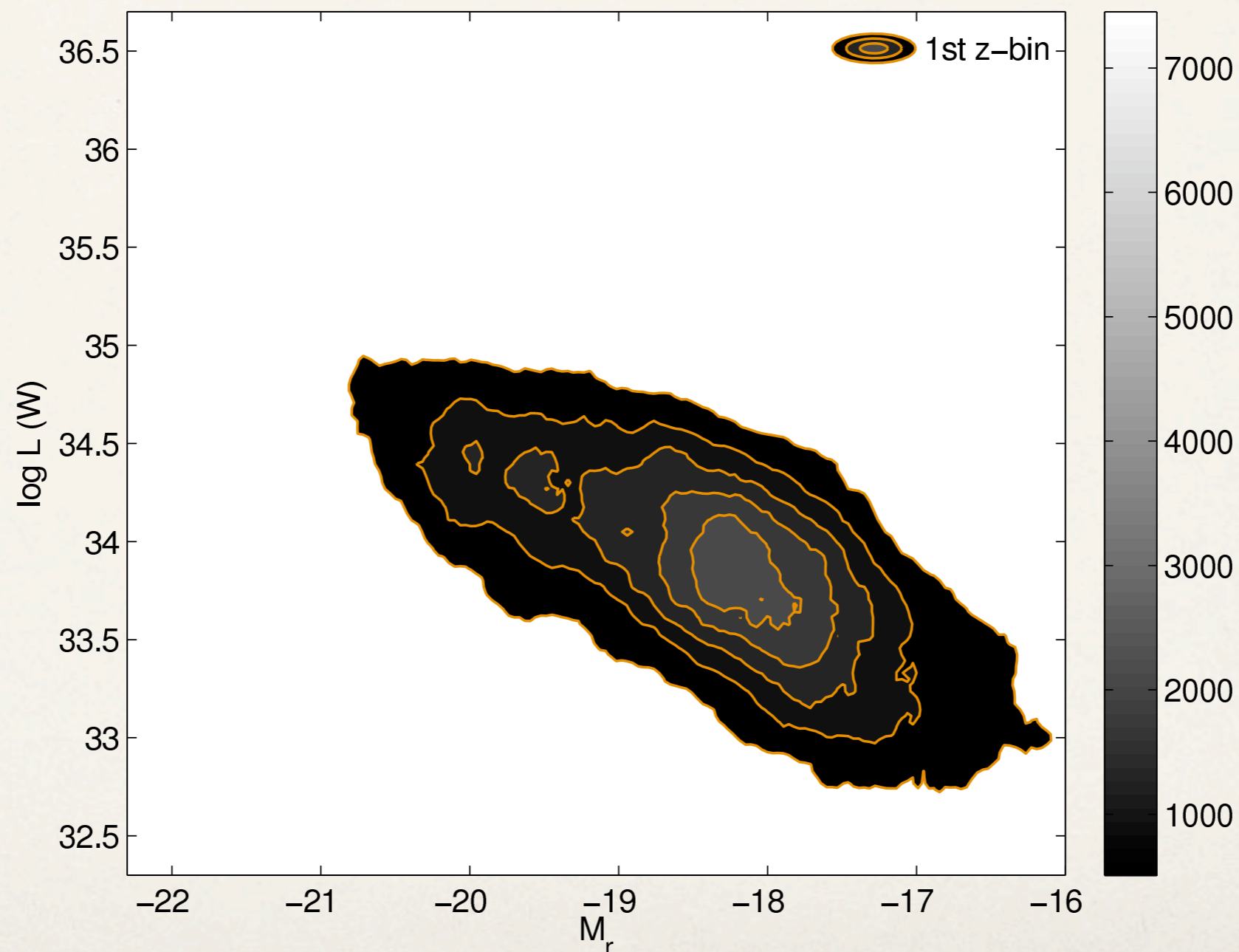




# Cosmic SFR density



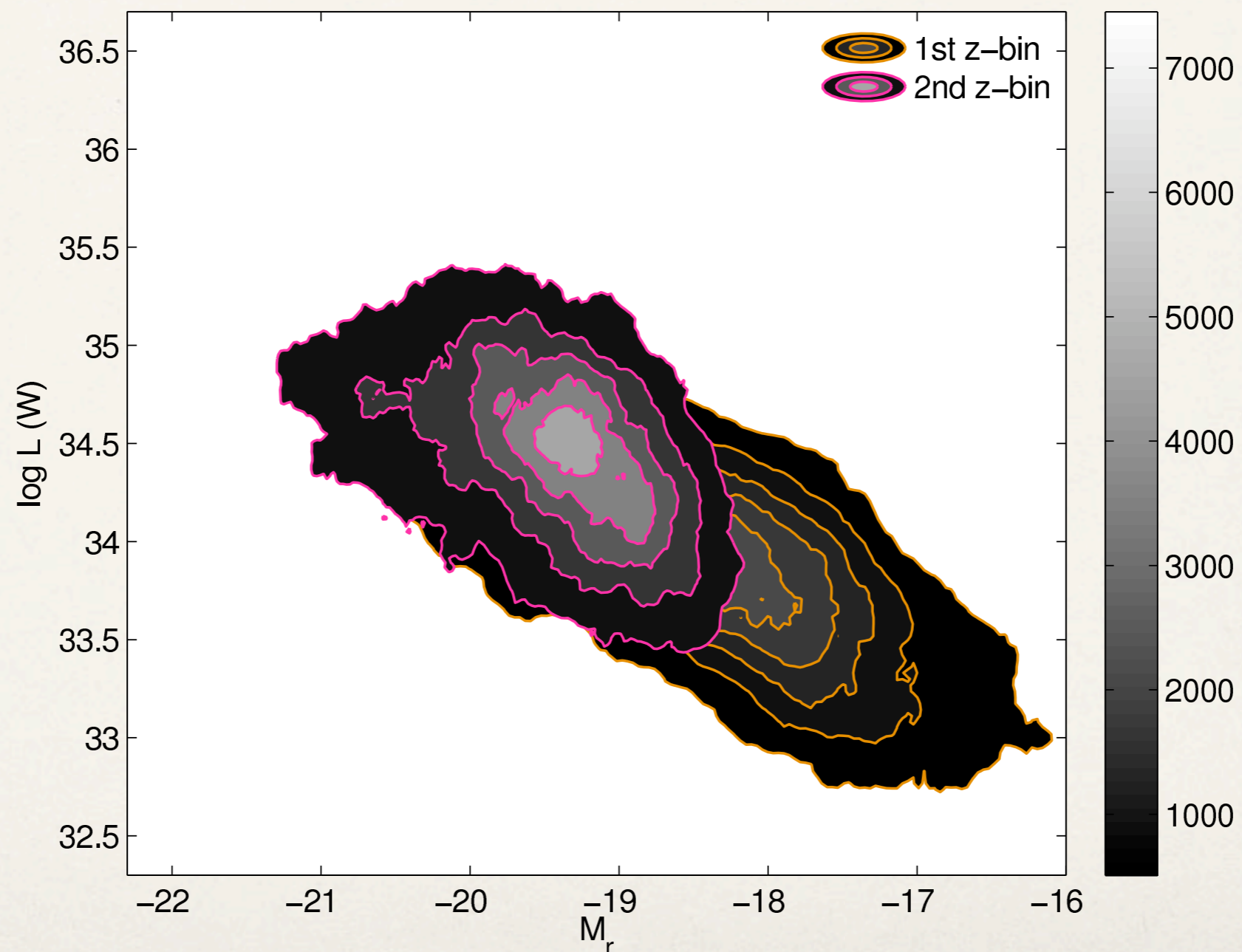
# Bivariate $H\alpha$ - $M_r$ luminosity distribution



Gunawardhana et al (in prep)

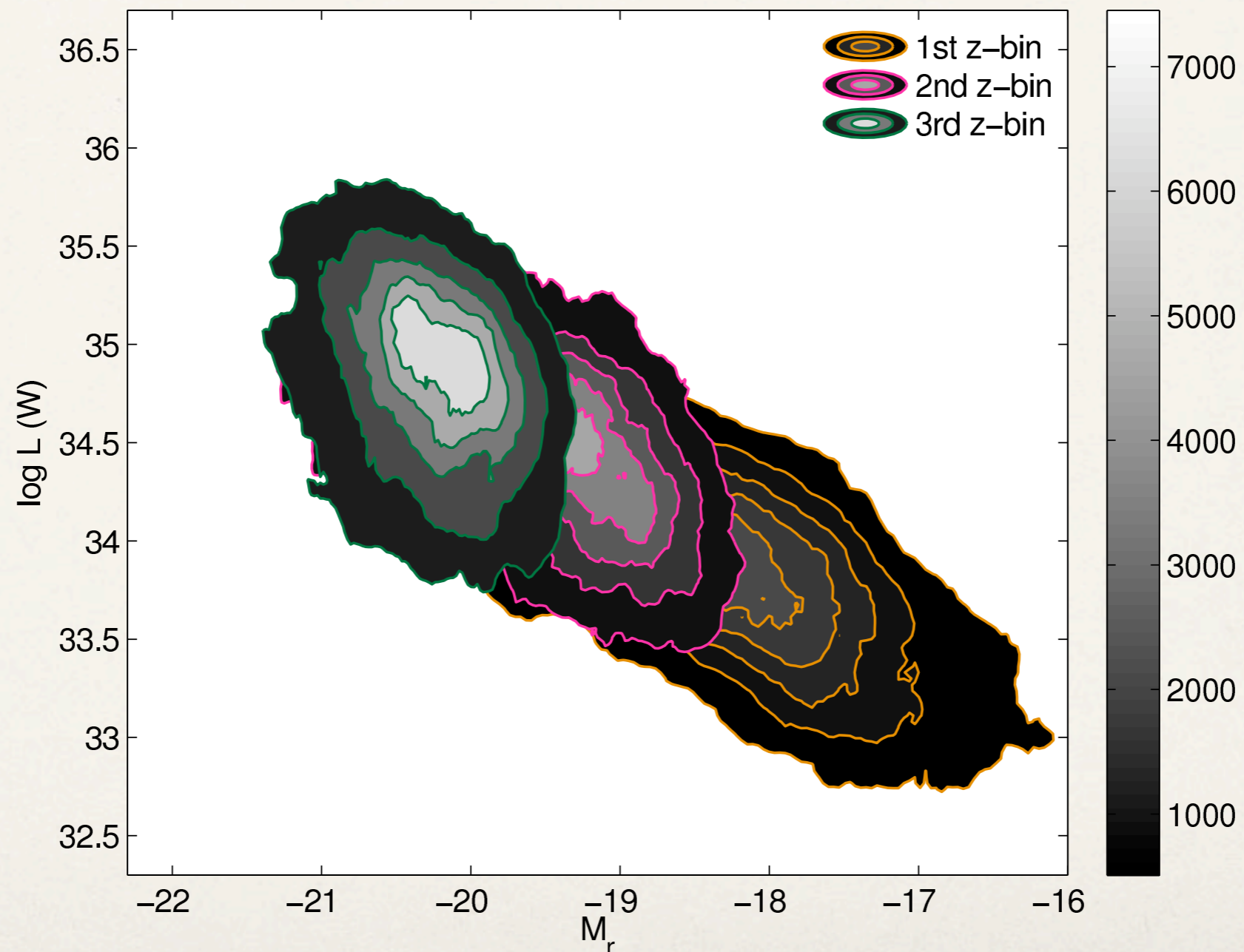


# Bivariate $H\alpha$ - $M_r$ luminosity distribution



Gunawardhana et al (in prep)

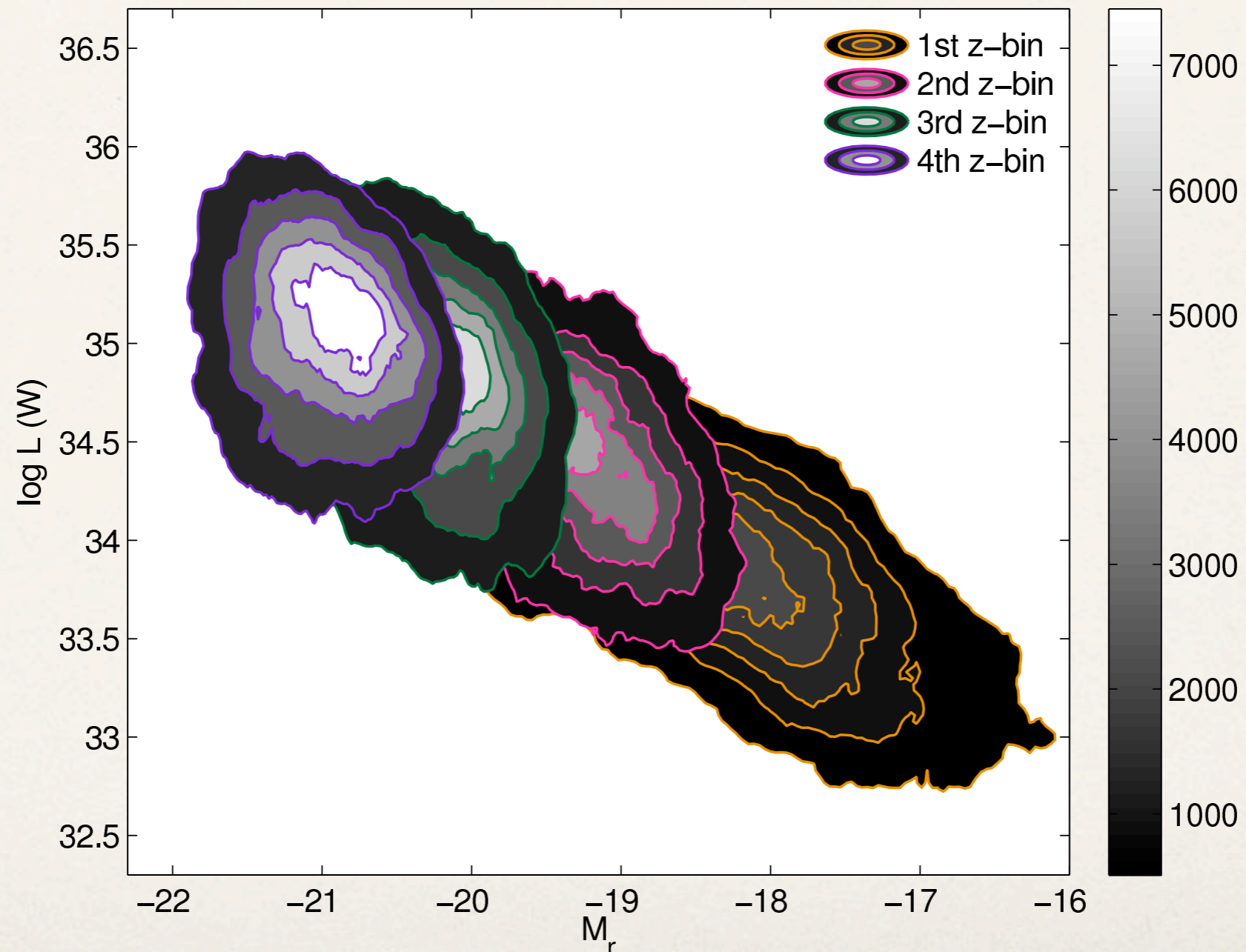
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Gunawardhana et al (in prep)

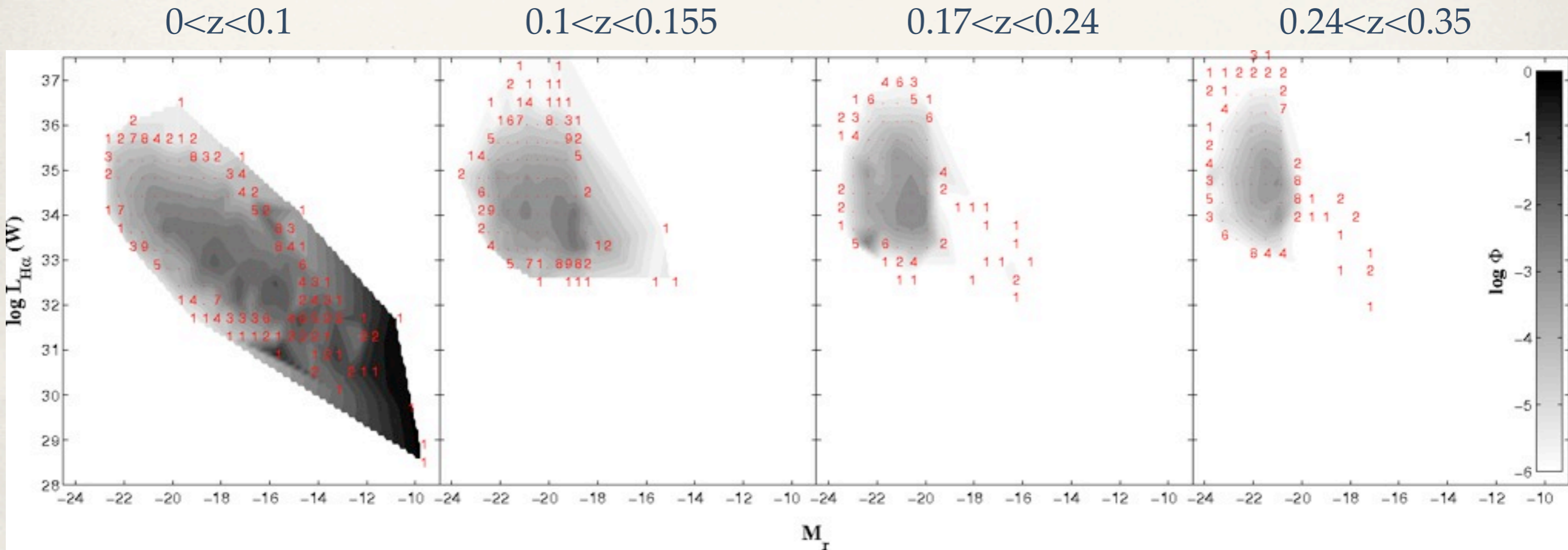


# Bivariate $H\alpha$ - $M_r$ luminosity distribution



Gunawardhana et al (in prep)

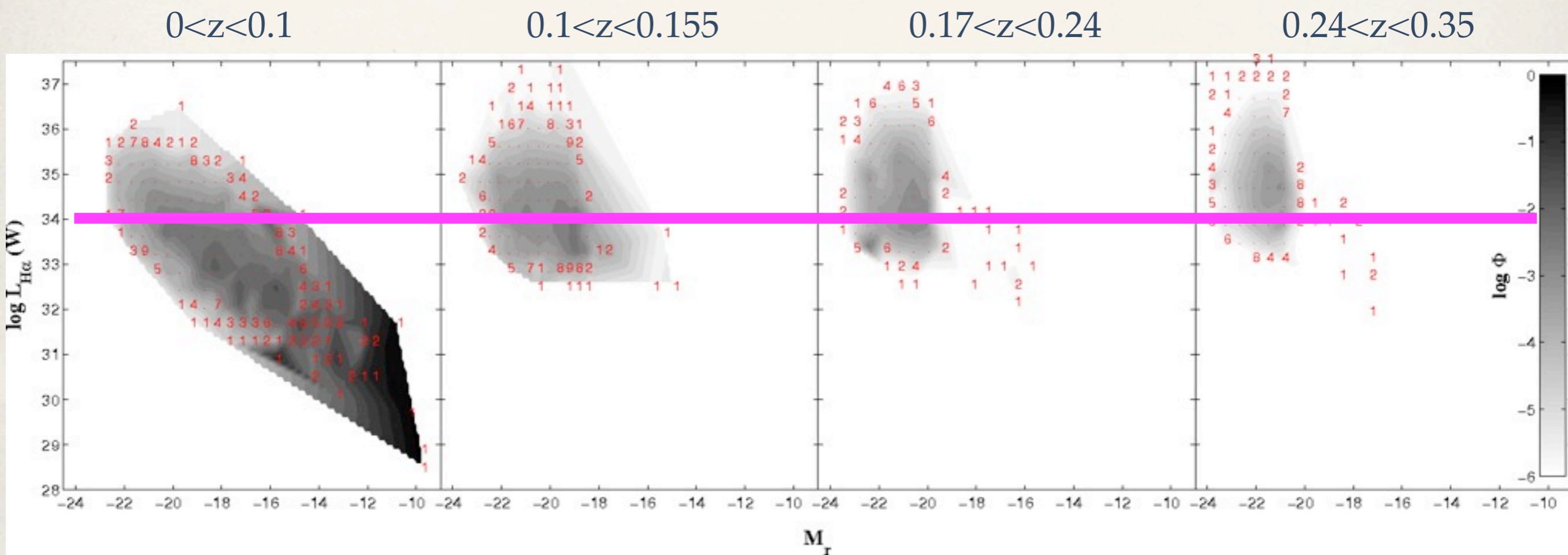
# Bivariate $H\alpha$ - $M_r$ luminosity function



Gunawardhana et al (in prep)

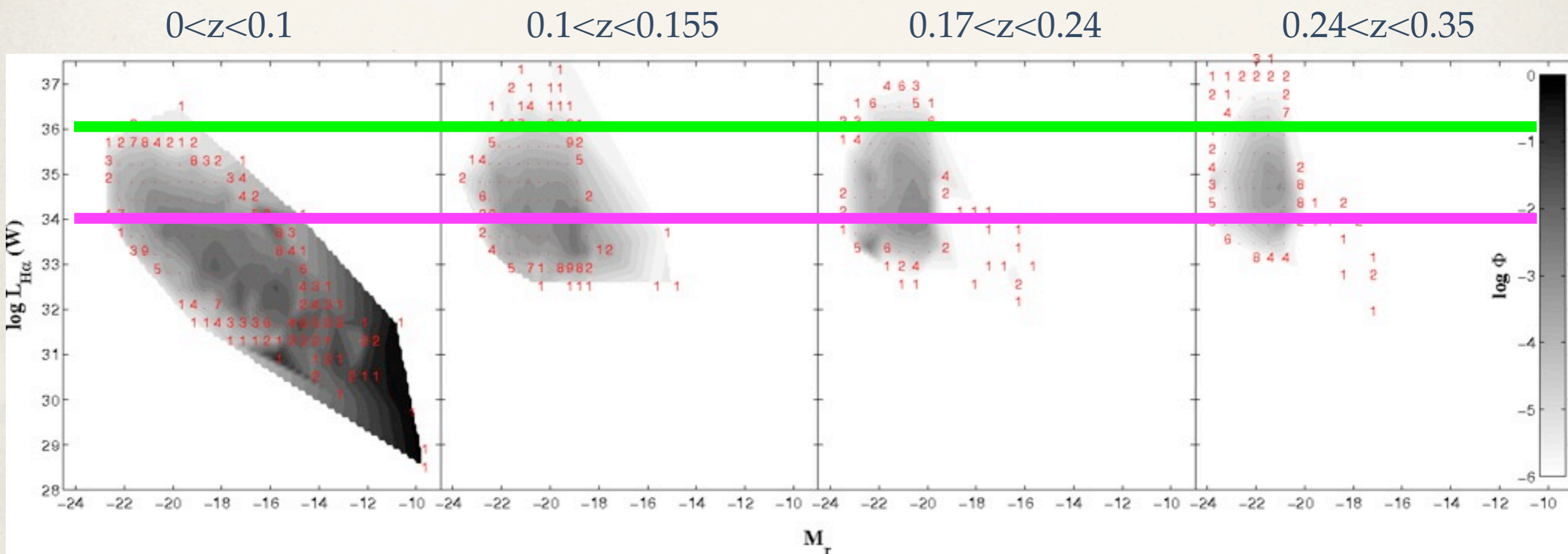


# Bivariate $H\alpha$ - $M_r$ luminosity function



Gunawardhana et al (in prep)

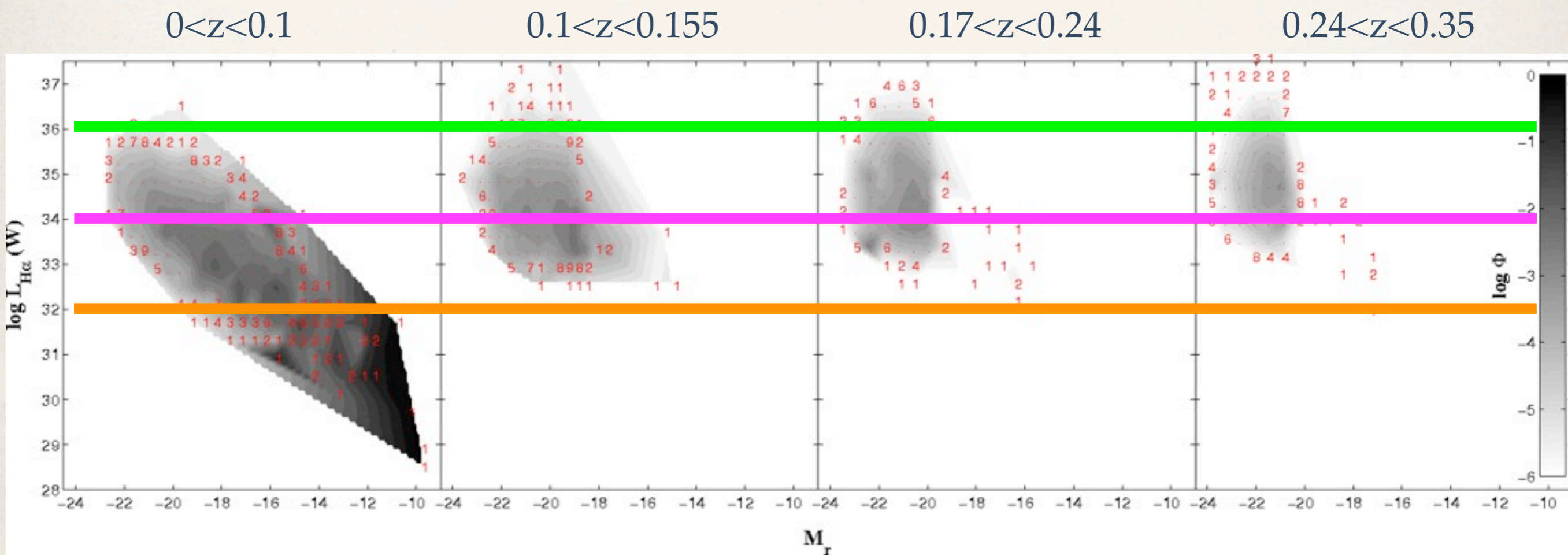
# Bivariate $H\alpha$ - $M_r$ luminosity function



Gunawardhana et al (in prep)

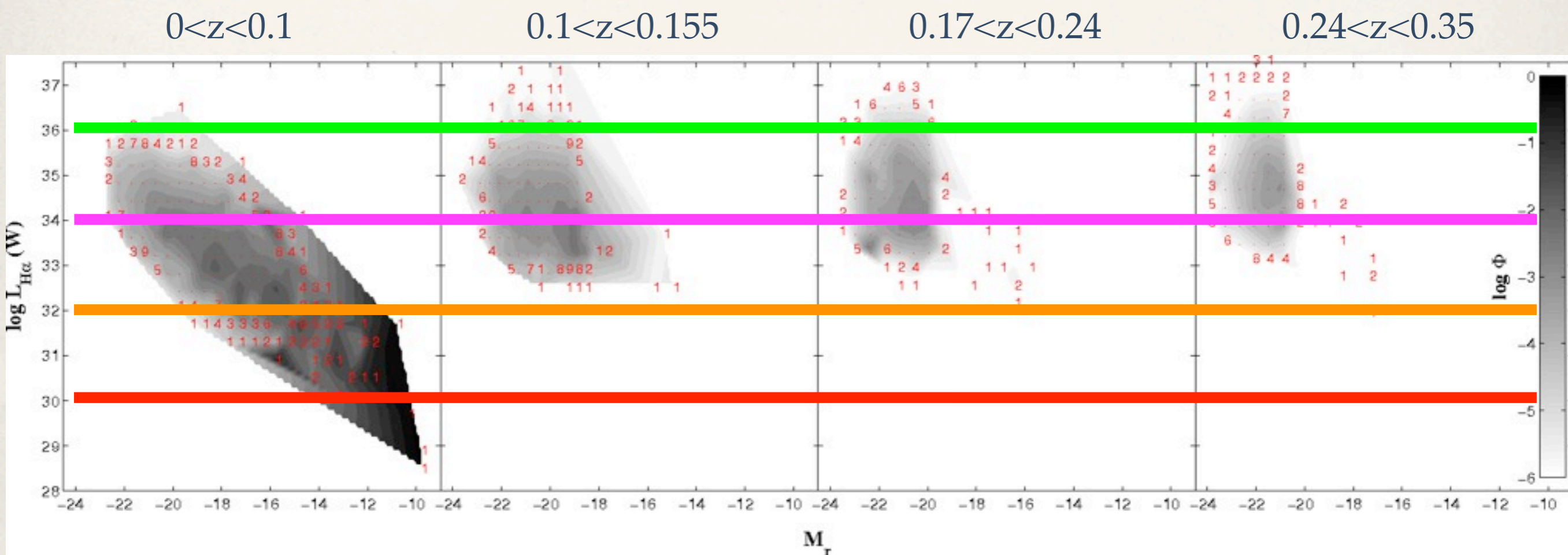


# Bivariate $H\alpha$ - $M_r$ luminosity function



Gunawardhana et al (in prep)

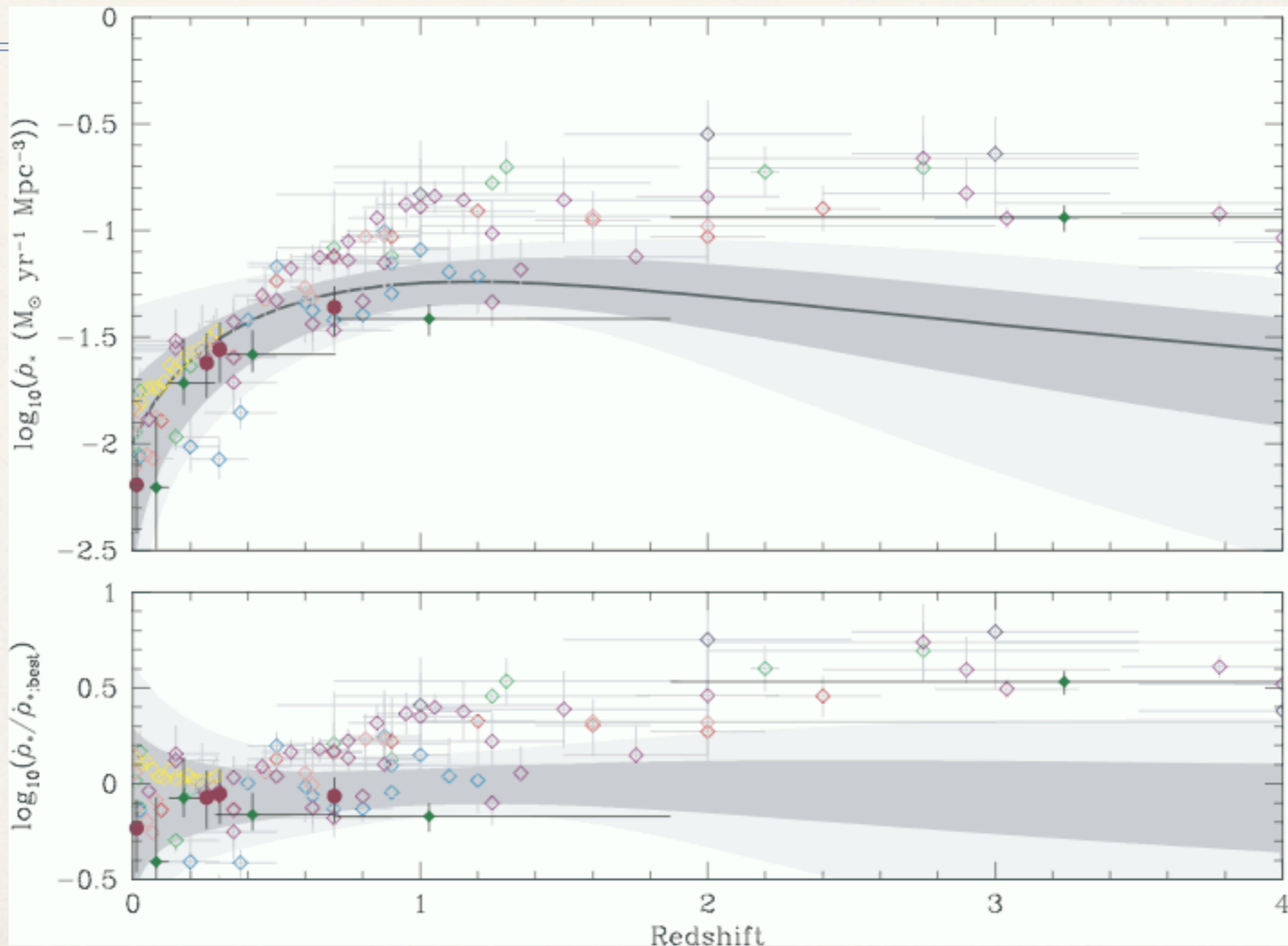
# Bivariate $H\alpha$ - $M_r$ luminosity function



Gunawardhana et al (in prep)

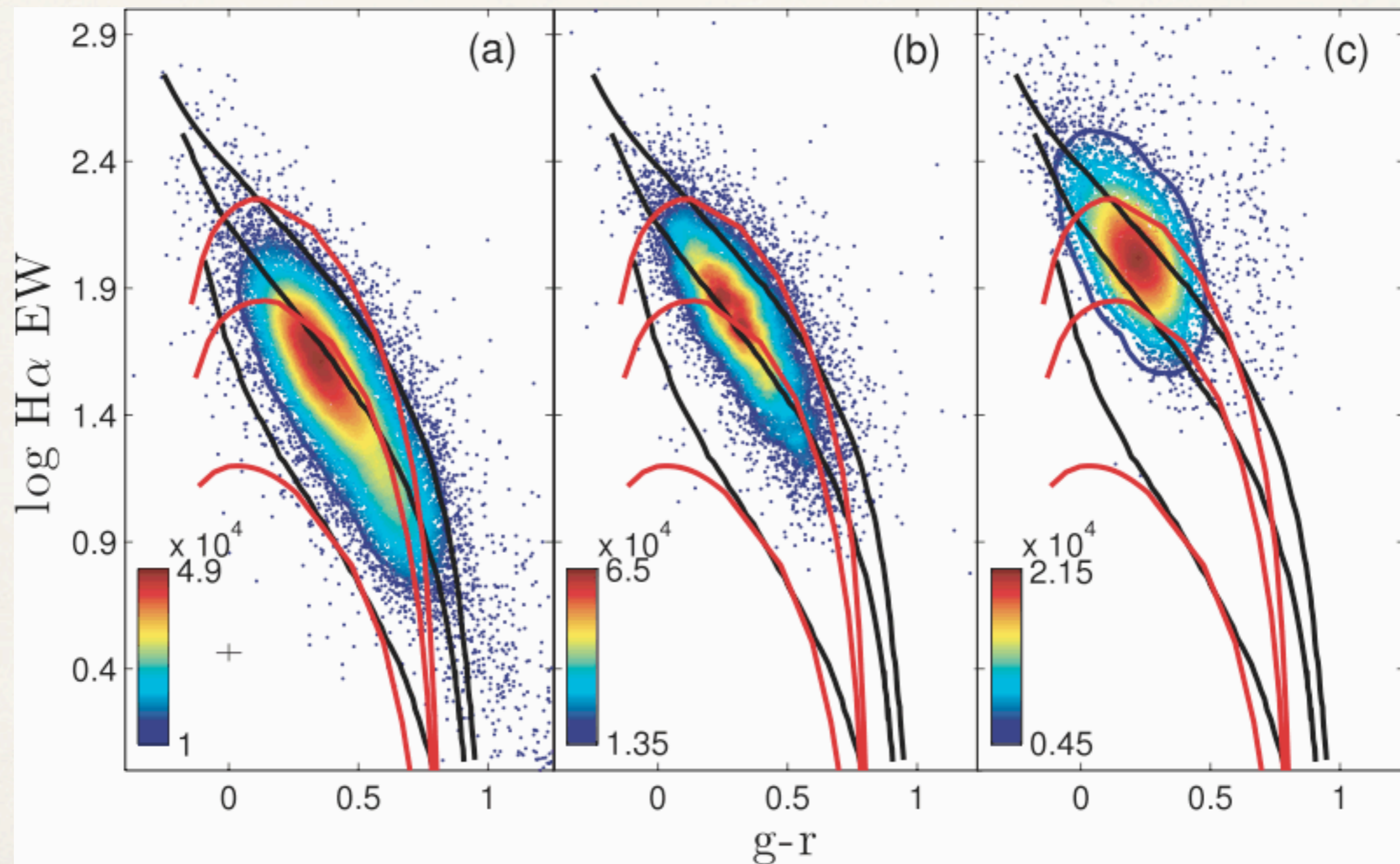


# Evolution of the stellar initial mass function?



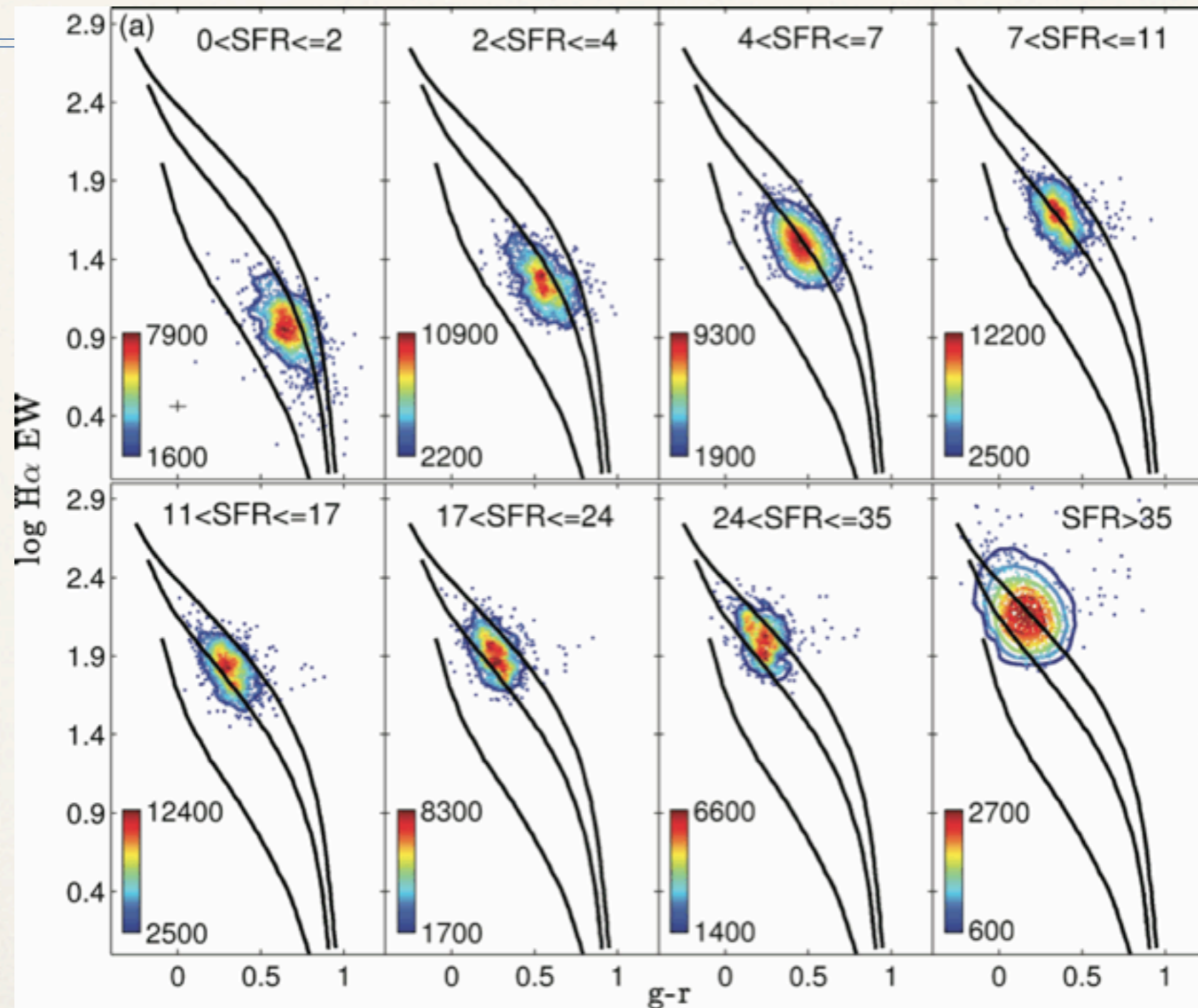


# Initial mass function variations?



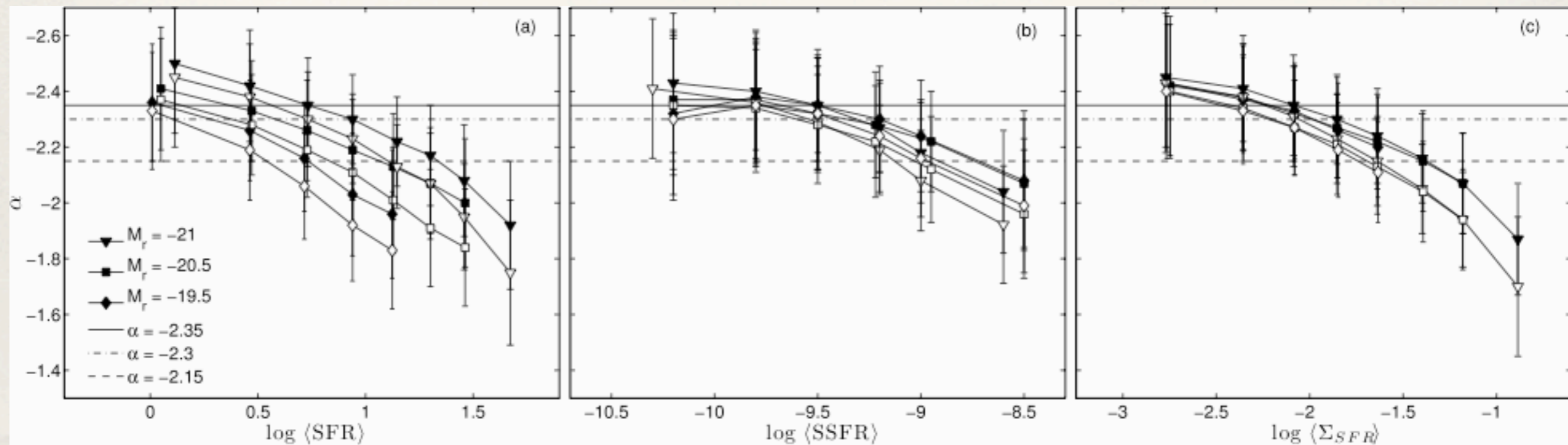


# Initial mass function variations?





# Initial mass function variations?



Gunawardhana et al., 2011, MNRAS, 415, 1647



# GAMA papers

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Driver et al, 2009, *A&G*, 50, 5.12  
Robotham et al, 2010, *PASA*, 27, 76  
Baldry et al, 2010, *MNRAS*, 404, 86  
Wijesinghe et al, 2011, *MNRAS*, 410, 2291  
Driver et al, 2011, *MNRAS*, 413, 971  
Hill et al, 2011, *MNRAS*, 412, 765  
Brough et al, 2011, *MNRAS*, 413, 1236  
Wijesinghe et al, 2011, *MNRAS*, 415, 1002  
Gunawardhana et al, 2011, *MNRAS*, 415, 1647  
Robotham et al, 2011, *MNRAS* (in press; arXiv:1106.1994)  
Taylor et al, 2011, *MNRAS* (in press; arXiv:1108.0635)  
Prescott et al, 2011, *MNRAS* (in press; arXiv:1107.0141)

Amblard et al, 2010, *A&A*, 518, L9  
Dye et al, 2010, *A&A*, 518, L10  
Jarvis et al, 2010, *MNRAS*, 409, 92  
Hardcastle et al, 2010, *MNRAS*, 409, 122  
Bracco et al, 2011, *MNRAS*, 412, 1151  
Guo et al, 2011, *MNRAS*, 412, 2277  
Smith et al, 2011, *MNRAS*, (in press; arXiv:1007.5260)  
Dunne et al, 2011, *MNRAS*, (in press; arXiv:1012.5186)  
Dariush et al, 2011, *MNRAS*, (in press; arXiv:1106.6195)

Wijesinghe et al, 2012, *MNRAS* (in prep)  
Foster et al, 2012, *MNRAS* (in prep)  
Gunawardhana et al, 2012, *MNRAS* (in prep)  
Taylor et al, 2012, *MNRAS* (in prep)  
Driver et al, 2012, *MNRAS* (in prep)  
Baldry et al, 2012, *MNRAS* (in prep)  
Christodolou et al, 2012, *MNRAS* (in prep)  
Loveday et al, 2012, *MNRAS* (in prep)  
Hopkins et al, 2012, *MNRAS* (in prep)  
Liske et al, 2012, *MNRAS* (in prep)  
Brough et al, 2012, *MNRAS* (in prep)  
Bauer et al, 2012, *MNRAS* (in prep)  
Lara-Lopez et al, 2012, *MNRAS* (in prep)

Bourne et al, 2012, *MNRAS* (in prep)  
Rowlands et al, 2012, *MNRAS* (in prep)  
van Kampen et al, 2012, *MNRAS* (in prep)



# Conclusions

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# Conclusions

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- ★ <http://www.gama-survey.org/>
- ★ GAMA has been remarkably successful to date, with lots of exciting science already being produced, such as the best local estimate to date of the H $\alpha$  luminosity function, and its evolution.
- ★ Star formation in galaxies follows a Saunders (or two-power law) form, **not** a Schechter function.
- ★ The H $\alpha$  luminosity function from GAMA and SDSS confirms this for the first time, making H $\alpha$  finally consistent with other wavelength estimators of SFR.
- ★ (Bivariate!) selection effects are crucially important.
- ★ Dust corrections need to be accounted for carefully!