A Bayesian's perspective of quenching via bulge evolution

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University of
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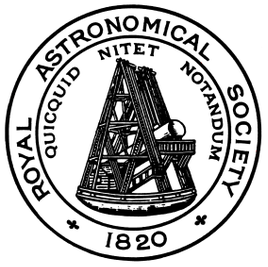
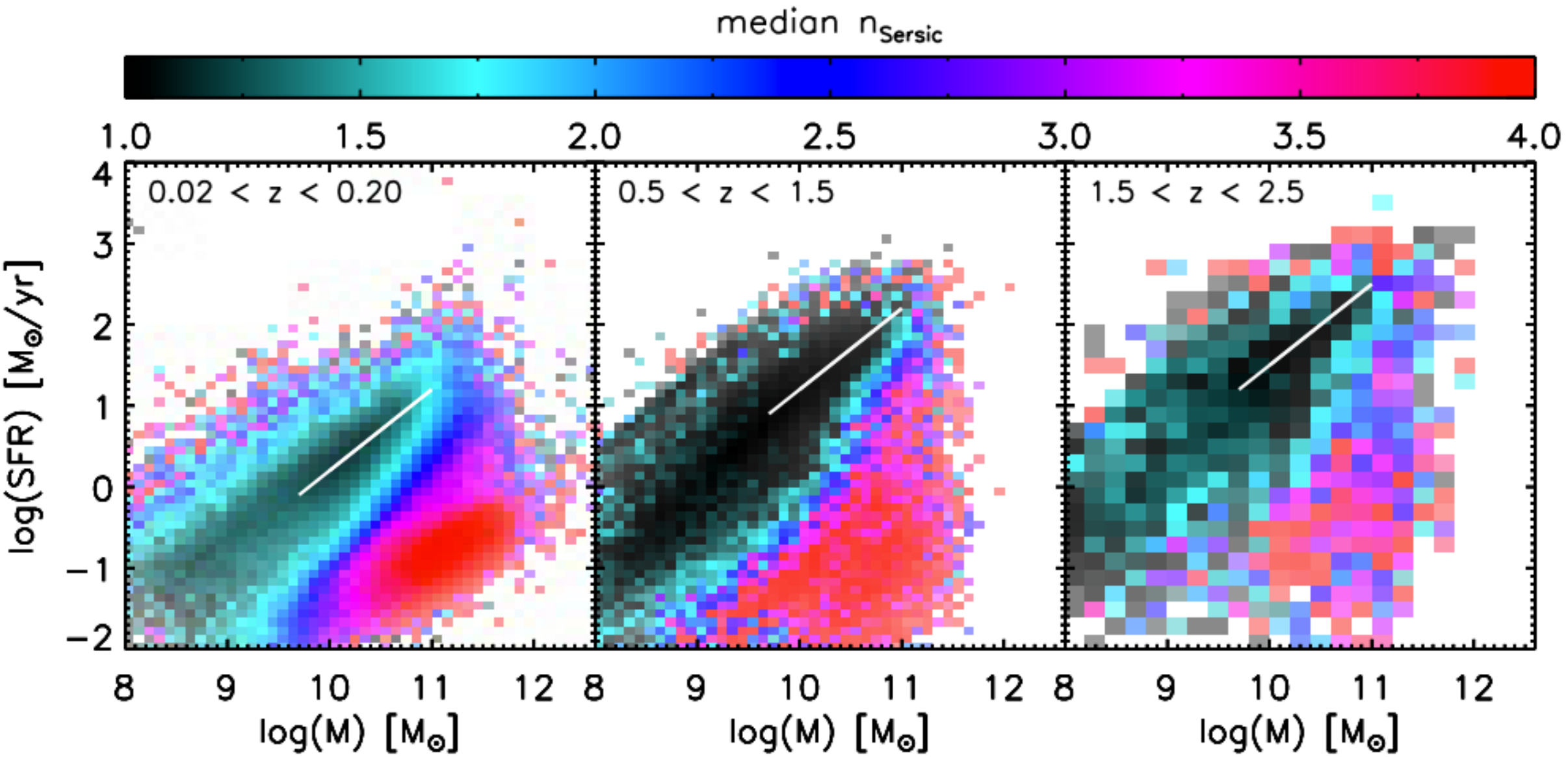


The Morphology - Quenching connection



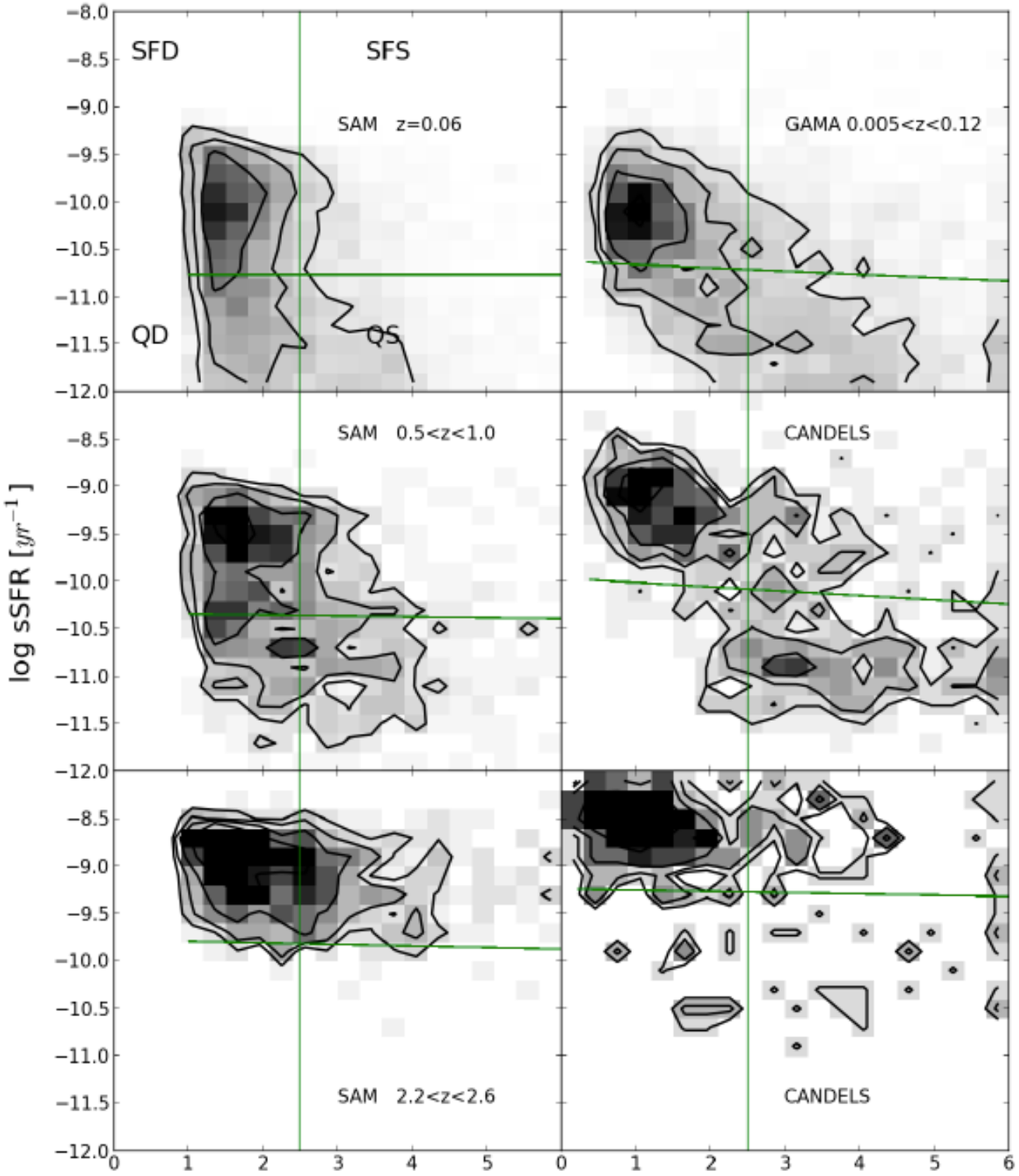
Wuyts et al 2011

Quenching and galaxy bulges

Quiescence correlates well with:

- Sérsic index (Bell et al. 2012)
- Central velocity dispersion (Teimoorinia et al. 2016)
- Bulge mass (Bluck et al. 2014; Lang et al. 2014)
- Hubble Type (Gonzalez-Delgado et al. 2015)

Bulges directly cause quenching: morphological quenching (Martig et al. 2009)



Brennan et al 2015

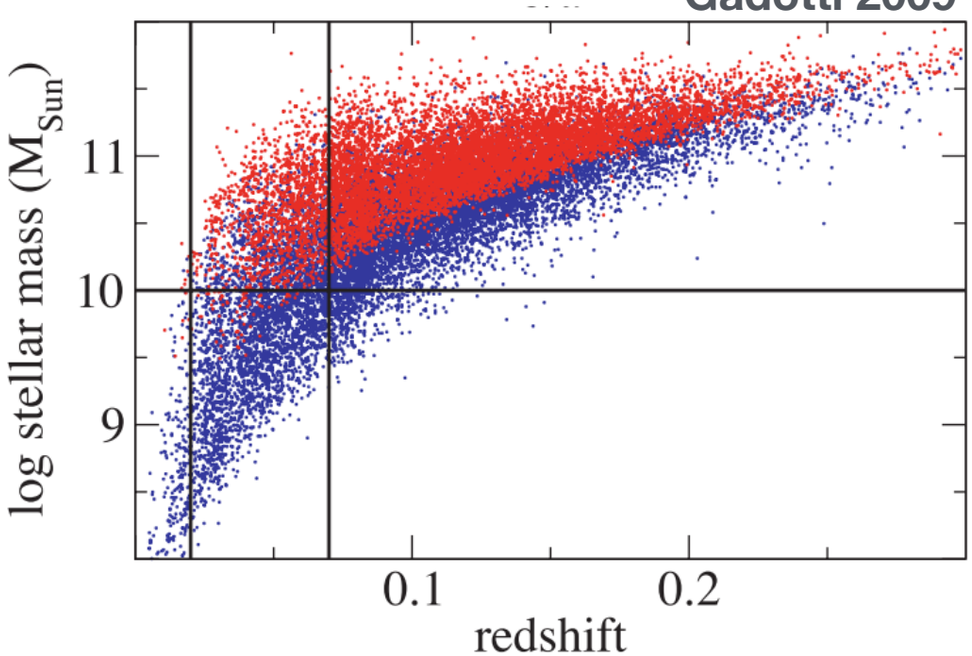
Sample Selection

SDSS sample:

(Gadotti 2009; Brinchmann et al 2004)

- Redshift range $0.02 \lesssim z \lesssim 0.07$
- Galaxy mass > 10^{10} M⊙
- Axial ratio $b/a \geq 0.7$
- Total number of galaxies: ~380

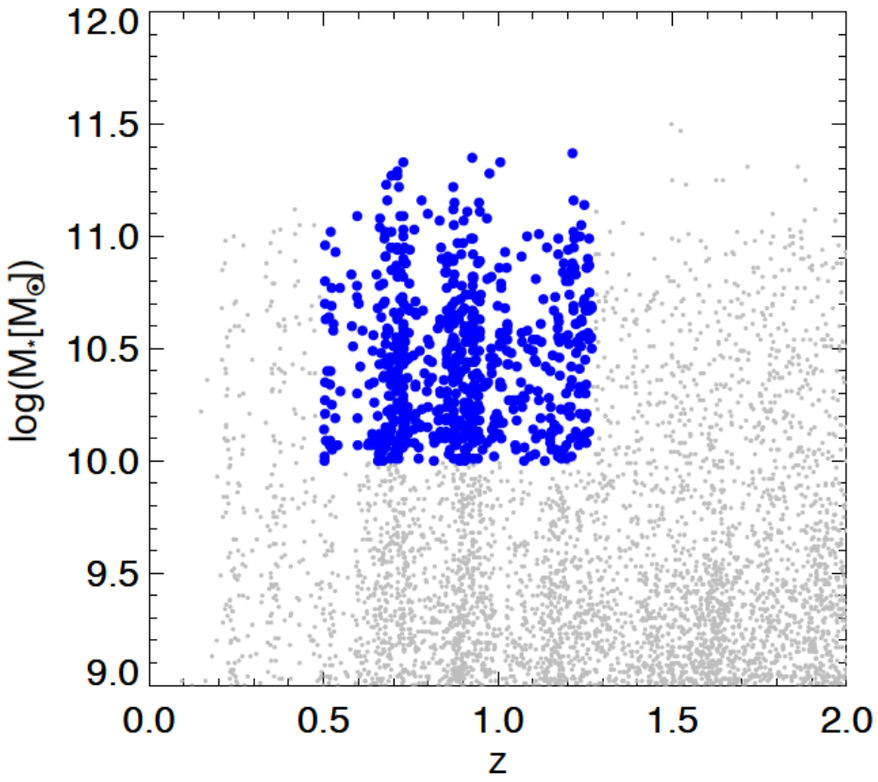
Gadotti 2009



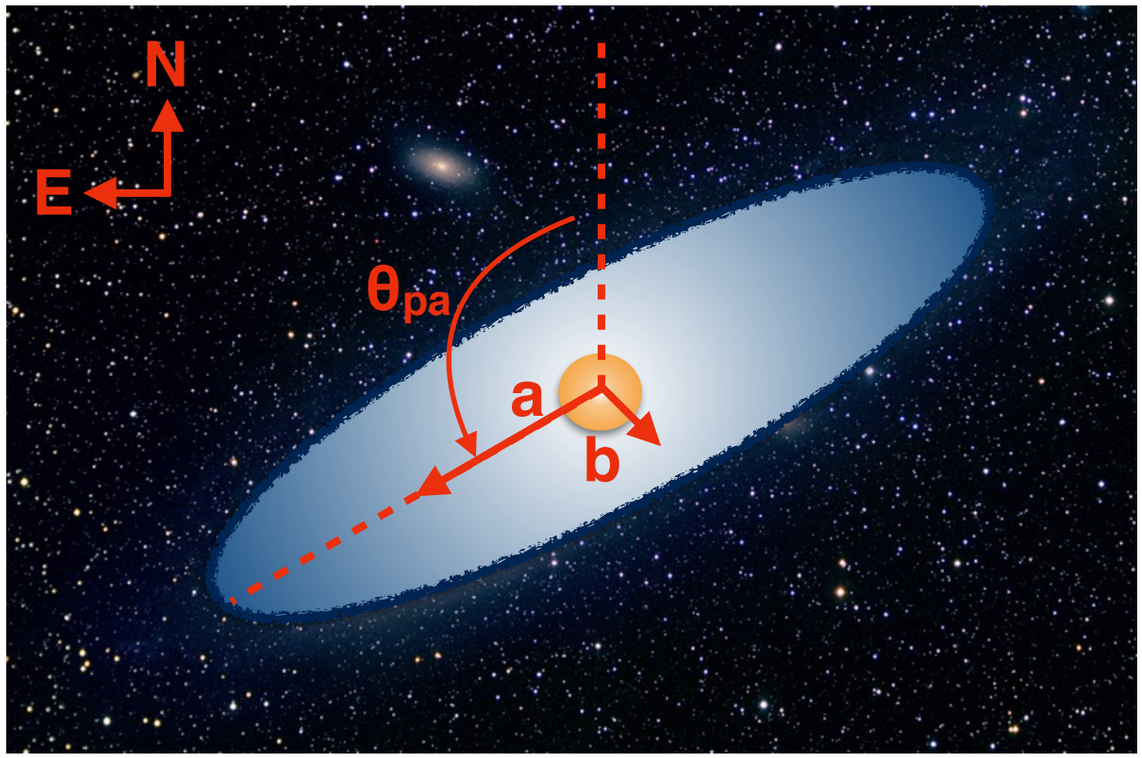
COSMOS sample:

(Skelton et al 2014)

- Redshift range $0.5 \lesssim z \lesssim 1.3$
- Galaxy mass > 10^{10} M⊙
- Axial ratio $b/a \geq 0.7$
- Total number of galaxies: ~780



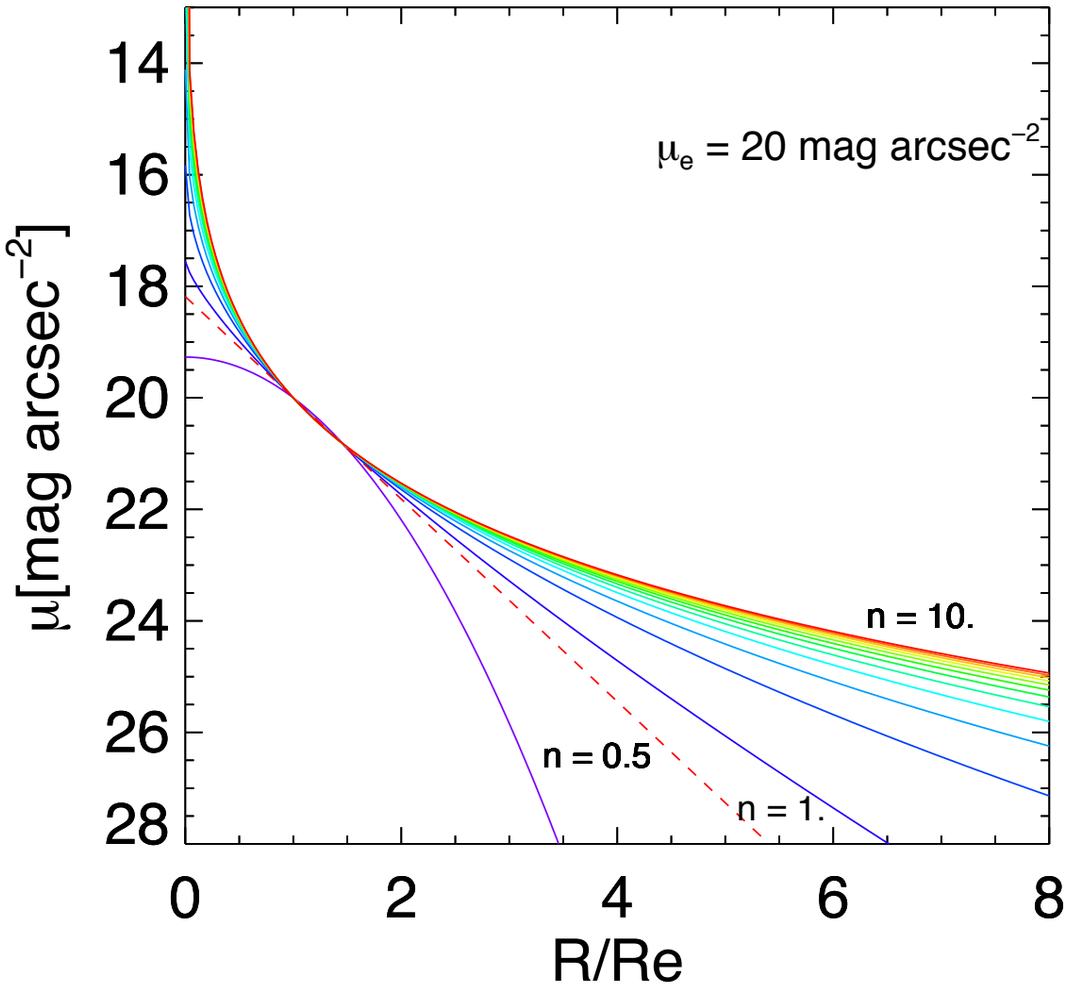
Bulge-Disc Decompositions



- Sérsic profile (Sérsic 1965)

$$I(R) = I_e exp\left\{-b\left[\left(\frac{R}{R_e}\right)^{1/n} - 1\right]\right\}$$

$$[\mu(R) = -2.5\ \log_{10} I(R)]$$



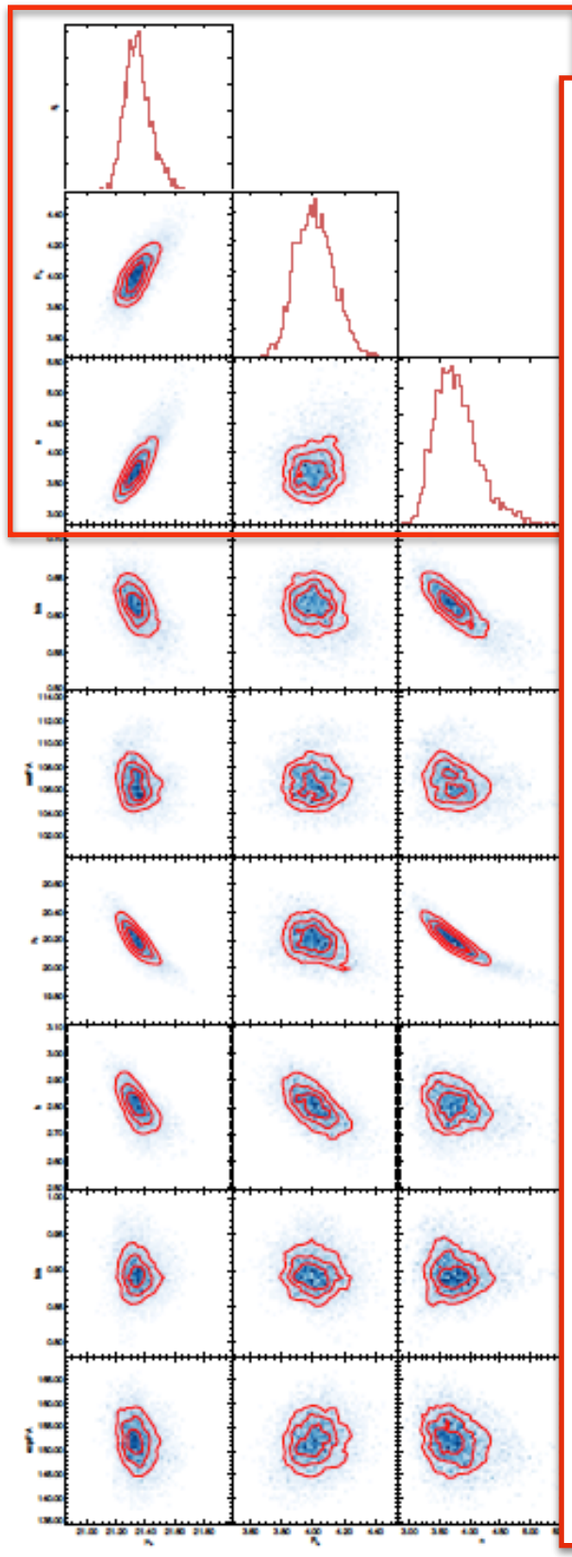
- Exponential profile

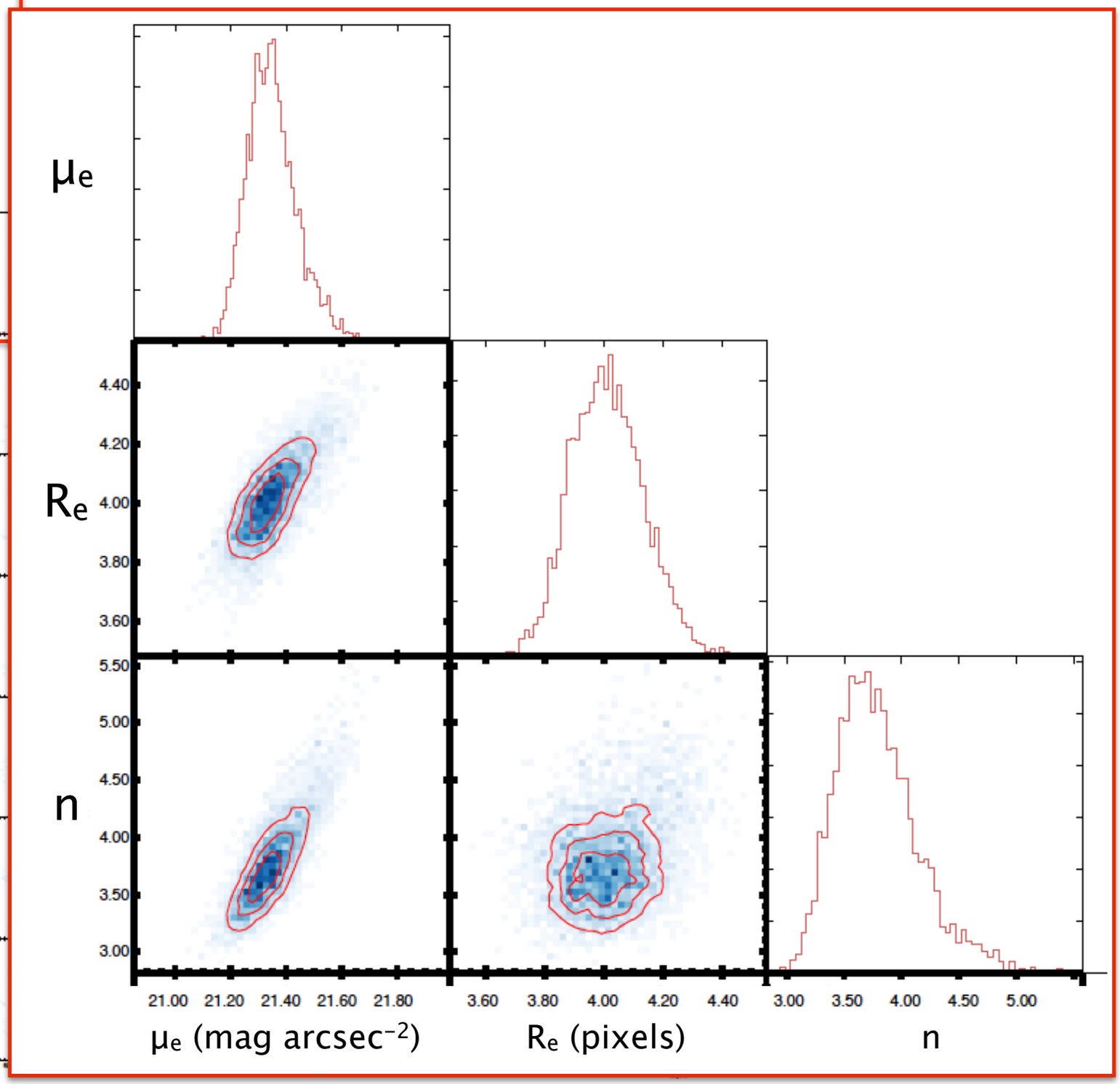
$$I(R) = I_0 \exp\left(-\frac{R}{h}\right)$$

- Geometrical properties

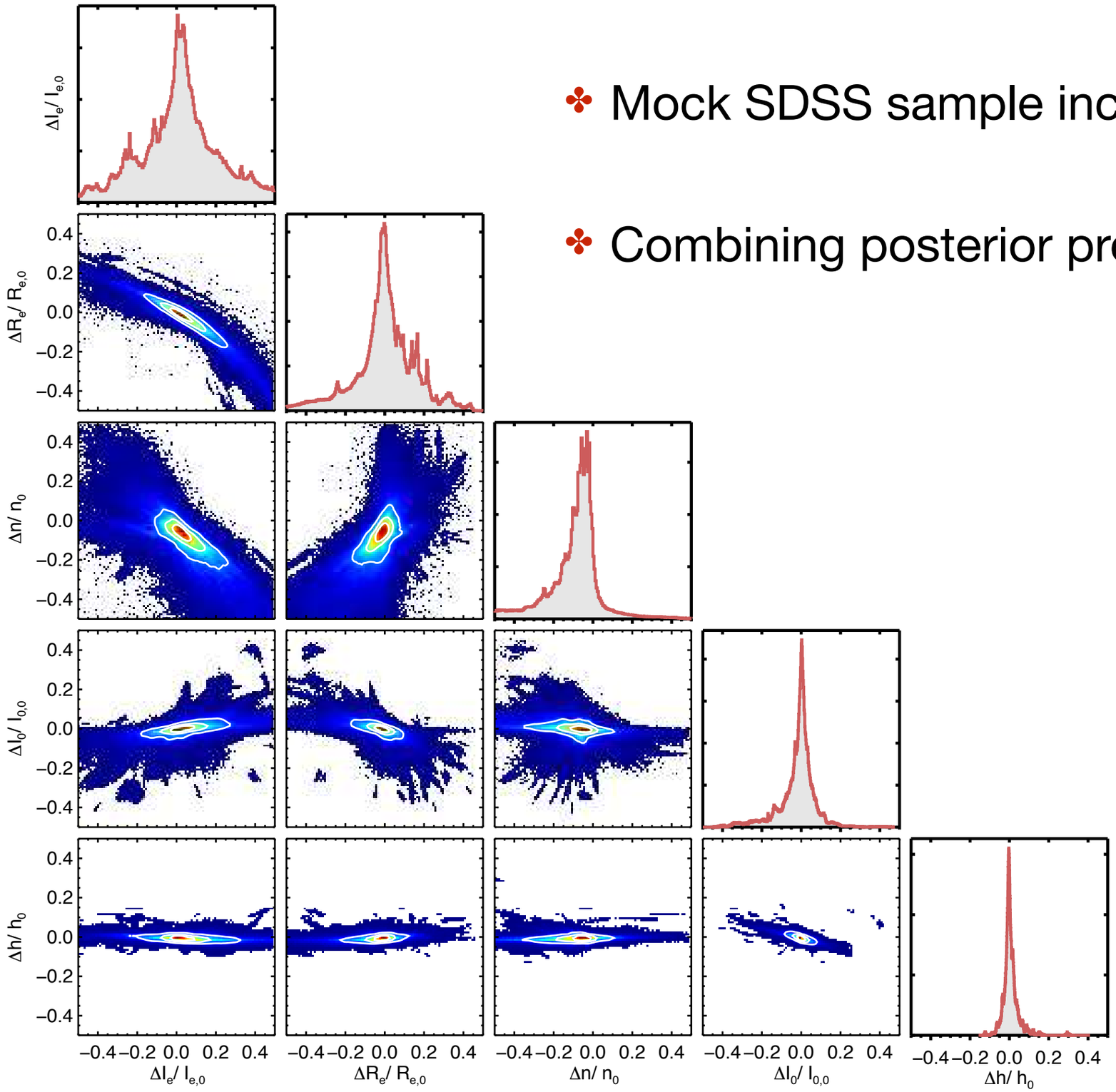
$$\epsilon = 1 - \frac{b}{a};\ \theta_{pa} = position\ angle$$

Bayesian Statistical Inference





Stacked Probabilities

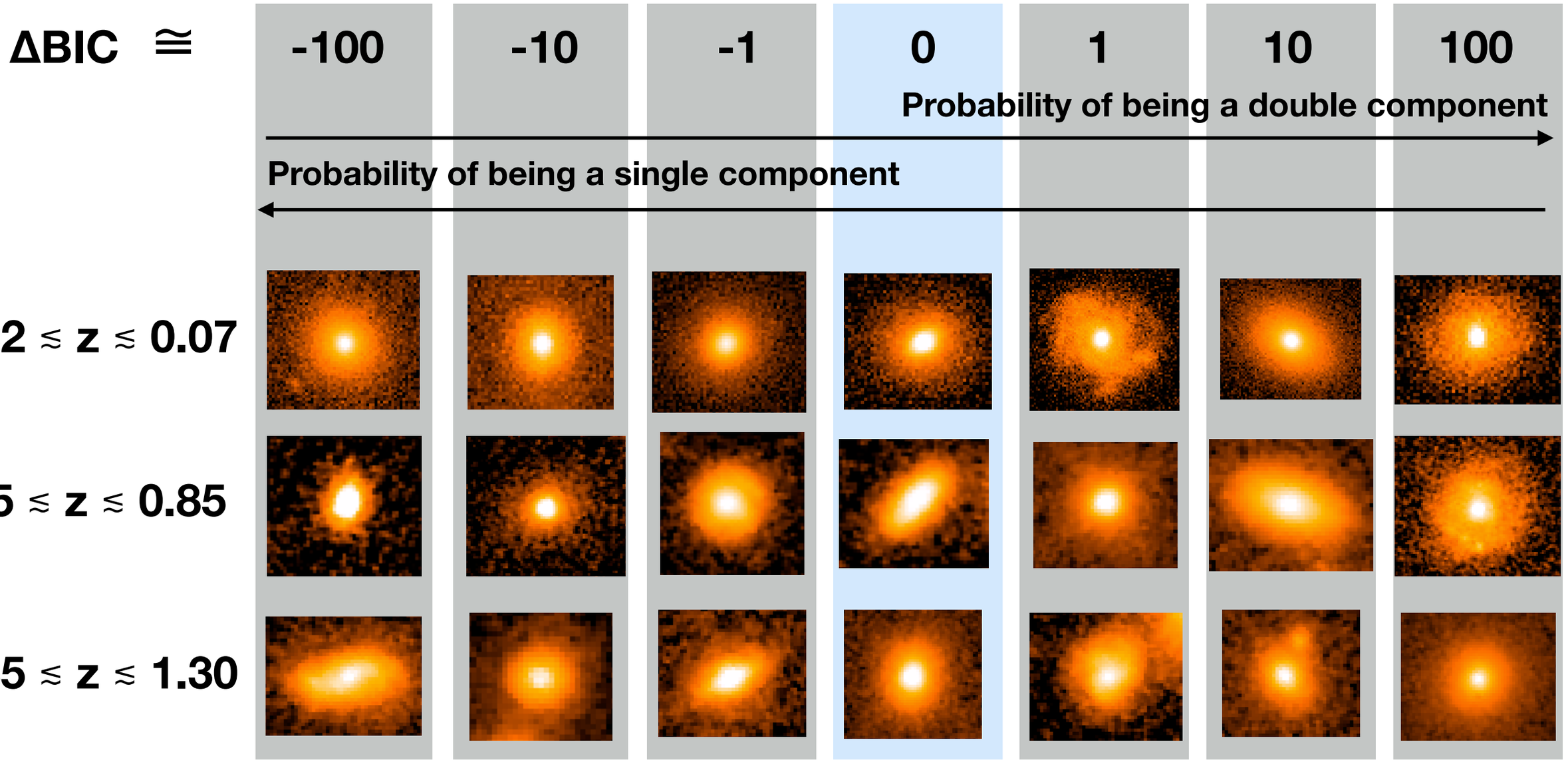


- Mock SDSS sample including noise
- Combining posterior probabilities

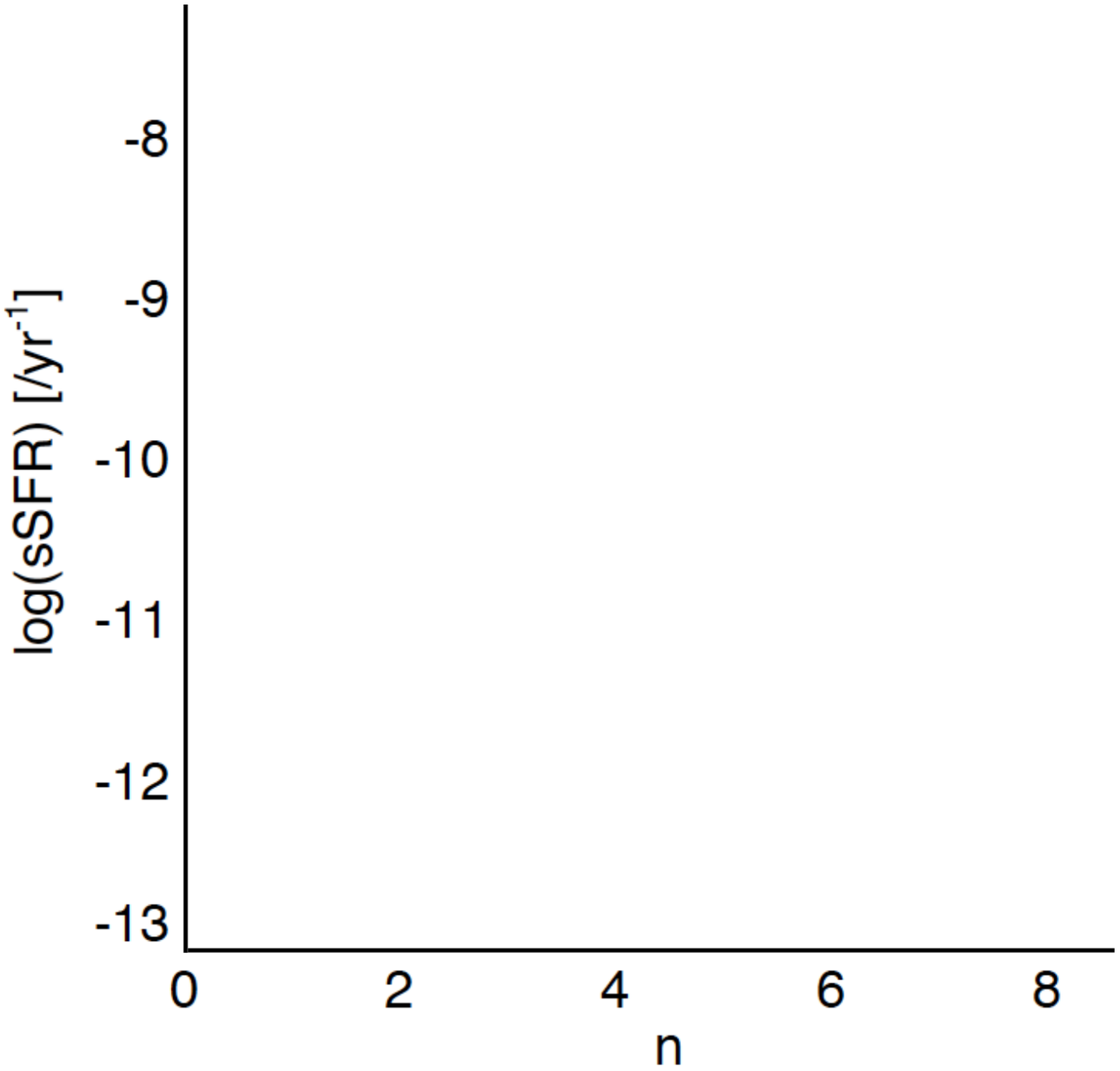
Classification with BIC

Bayesian Information Criterion (Kass and Raftery 1995);

$BIC = -2 \log(\mathcal{L}) + k \log(n)$ $\quad\quad$ $\Delta BIC = BIC_{Sérsic} - BIC_{Sérsic + Exponential}$



sSFR - Sérsic index (n) plane



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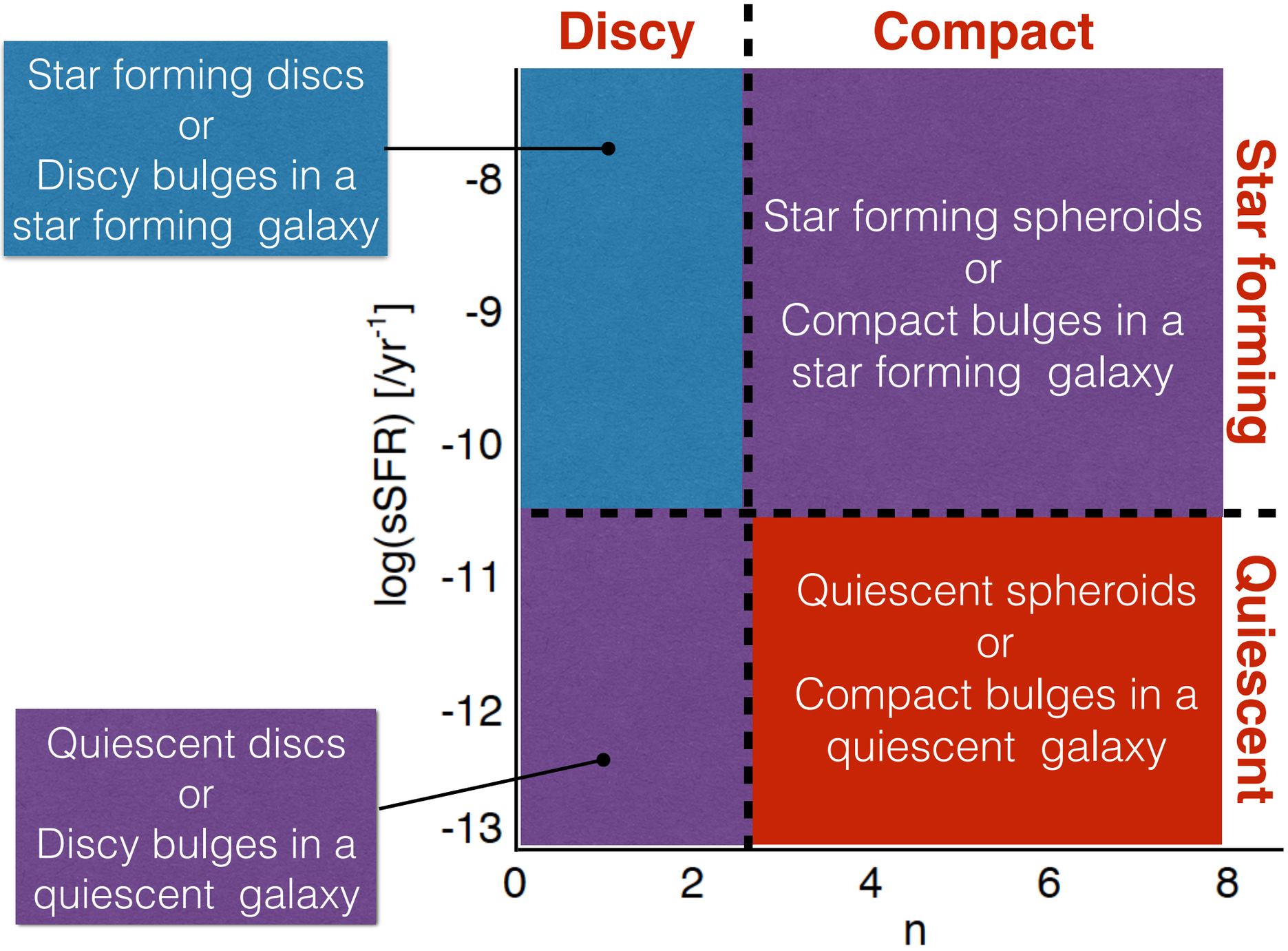
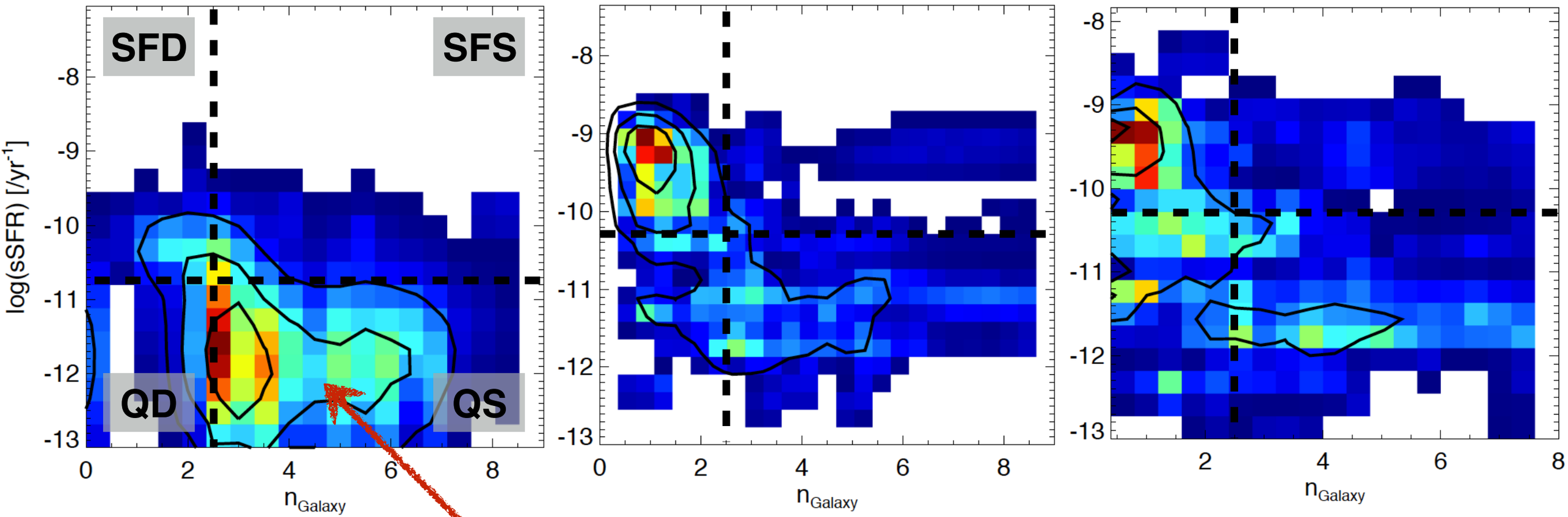


sSFR - Sérsic index (n) plane

FULL SAMPLE WITH SINGLE SÉRSIC

SFD - Star forming discs
SFS - Star forming spheroids
QD - Quenched discs
QS - Quenched spheroids

0.02 ≲ z ≲ 0.07 | **0.5 < z < 0.85** | **0.85 < z < 1.3**



Stacked probabilities

sSFR - Sérsic index (n) plane

ALL ONE COMPONENTS

SFD - Star forming discs
SFS - Star forming spheroids
QD - Quenched discs
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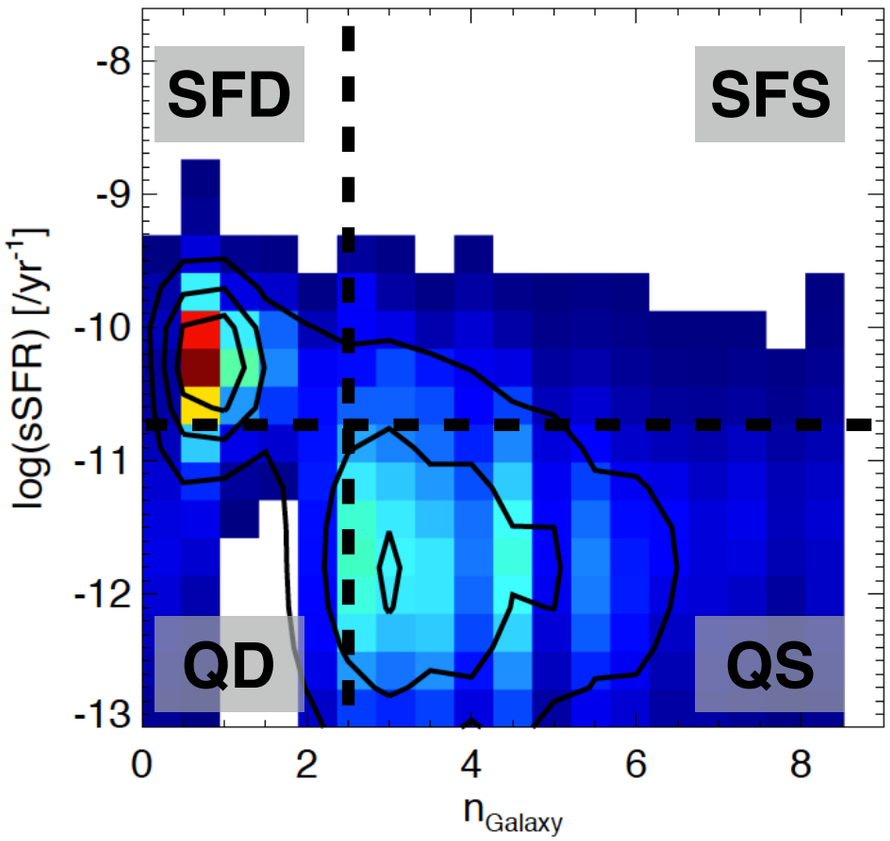
0.02 ≤ z ≤ 0.07



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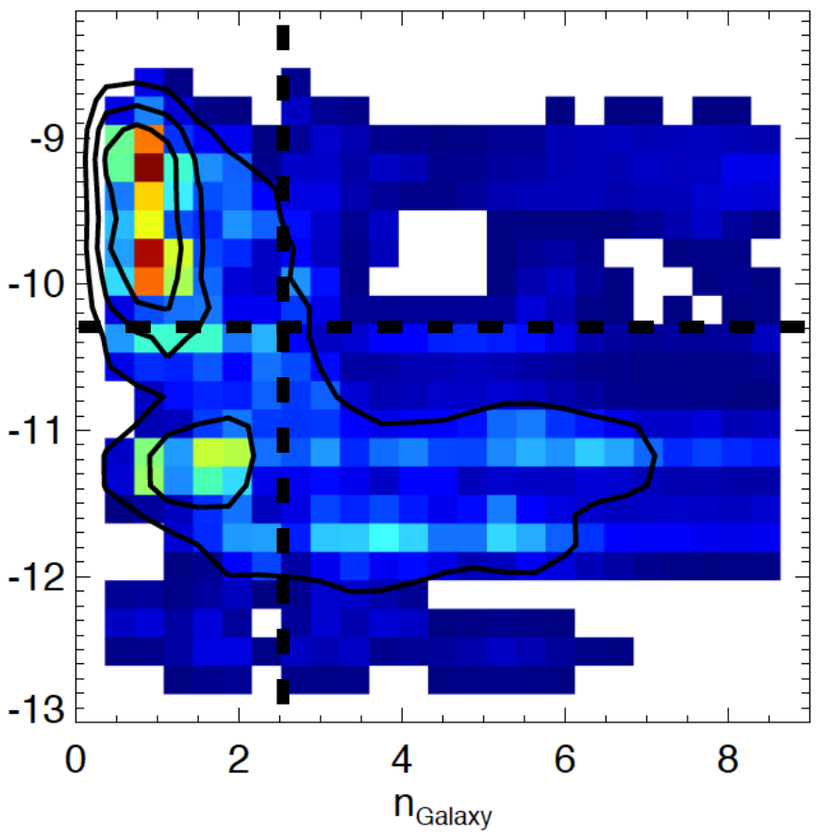

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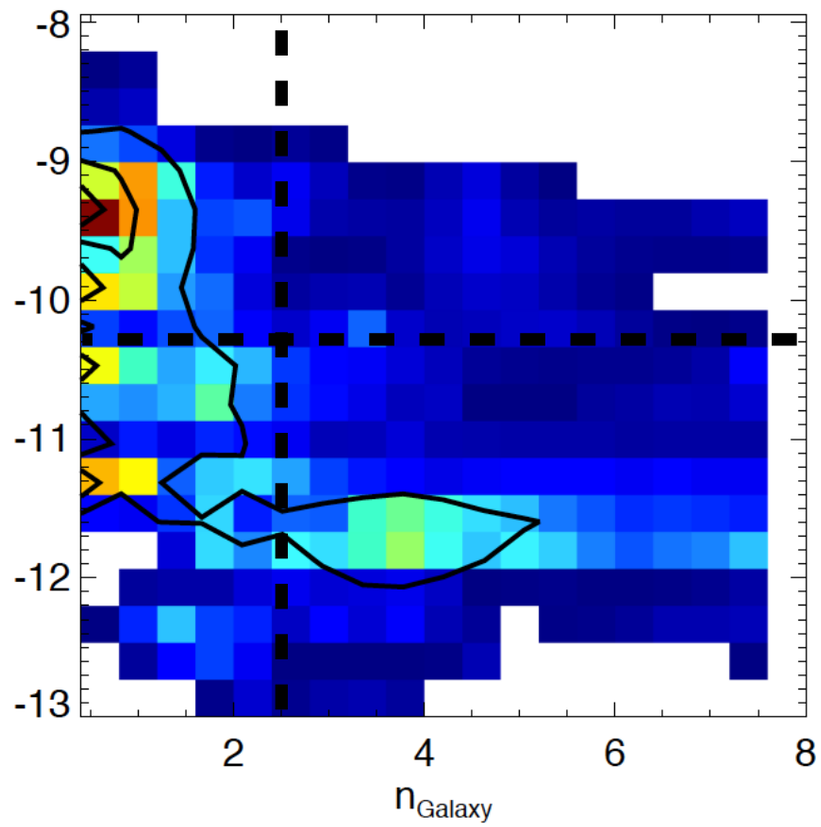

sSFR - Sérsic index (n) plane

ALL TWO COMPONENTS

SF+DB - Star forming galaxy with discy bulges
SF+CB - Star forming galaxy with compact bulges
Q+DB - Quenched galaxy with discy bulges
Q+CB - Quenched galaxy with compact bulges

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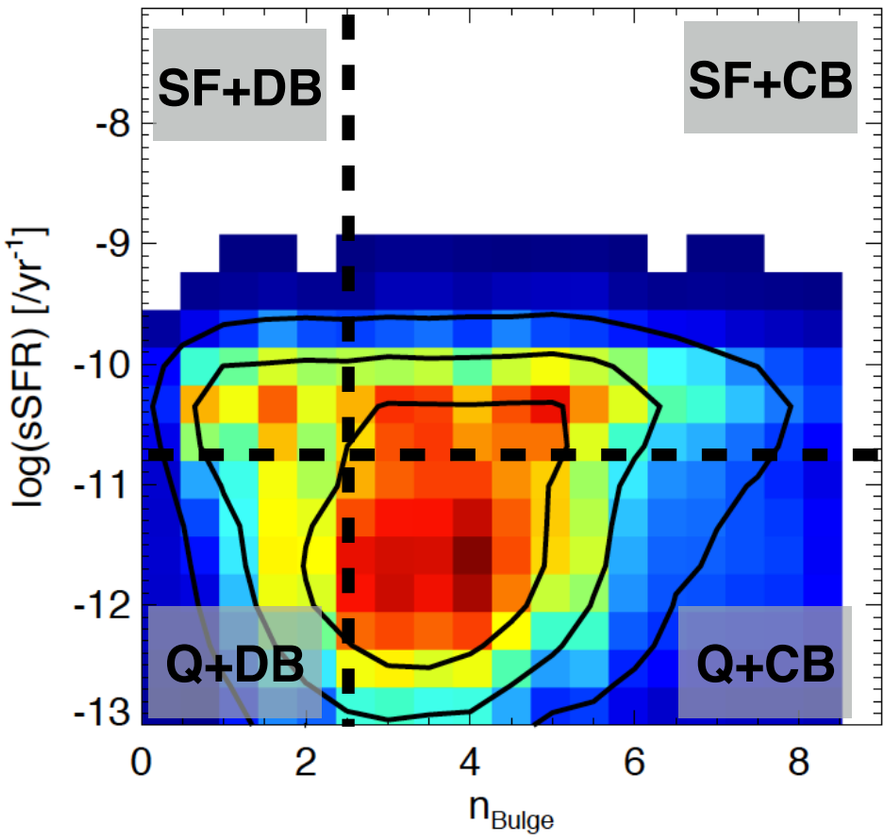

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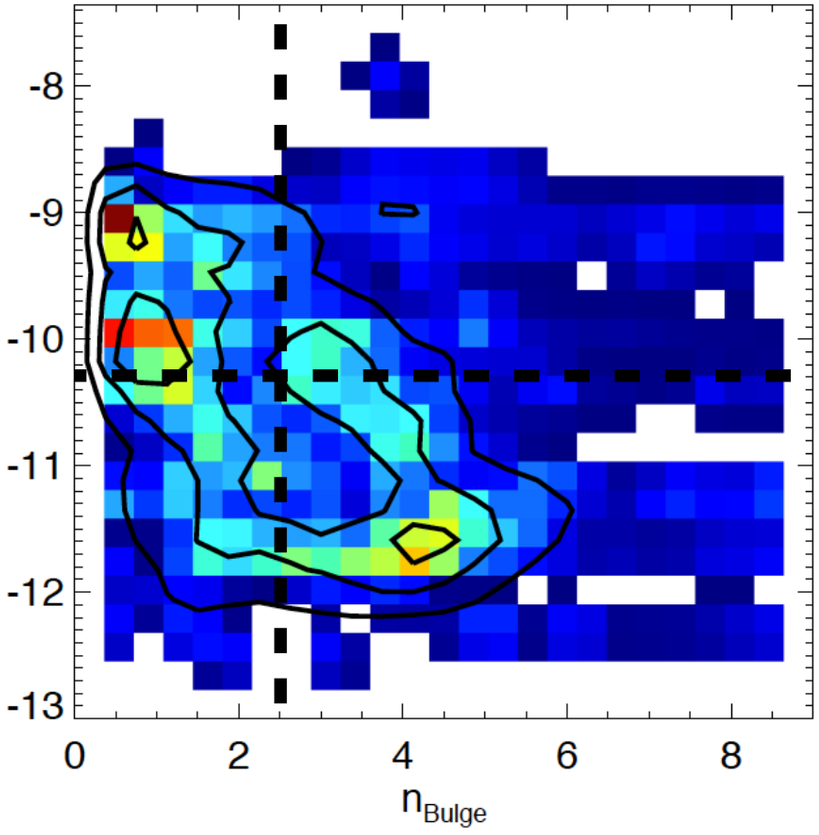

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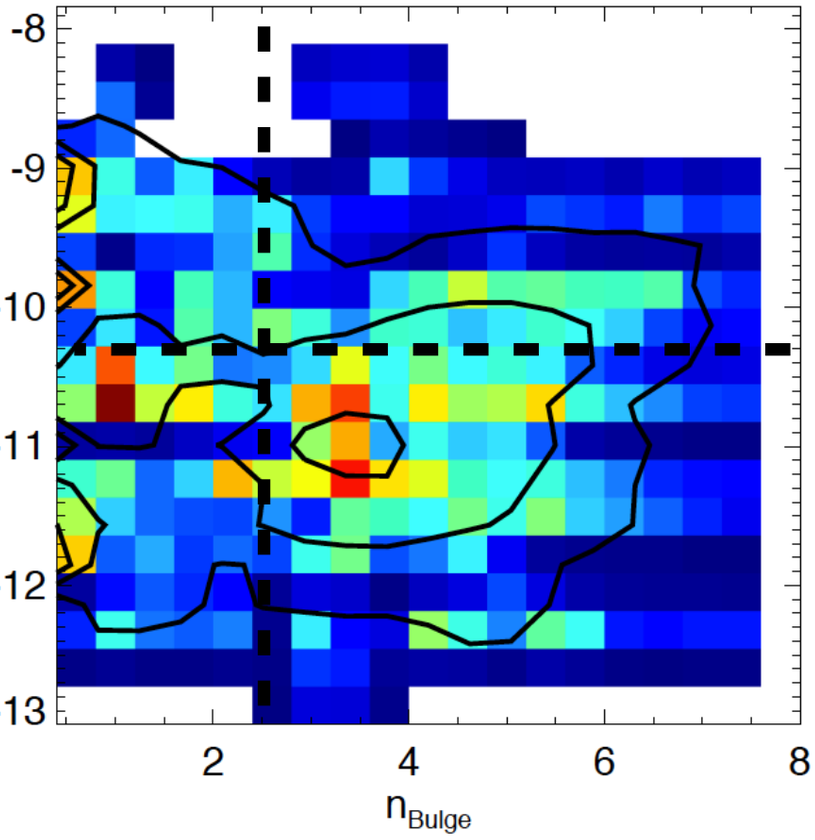

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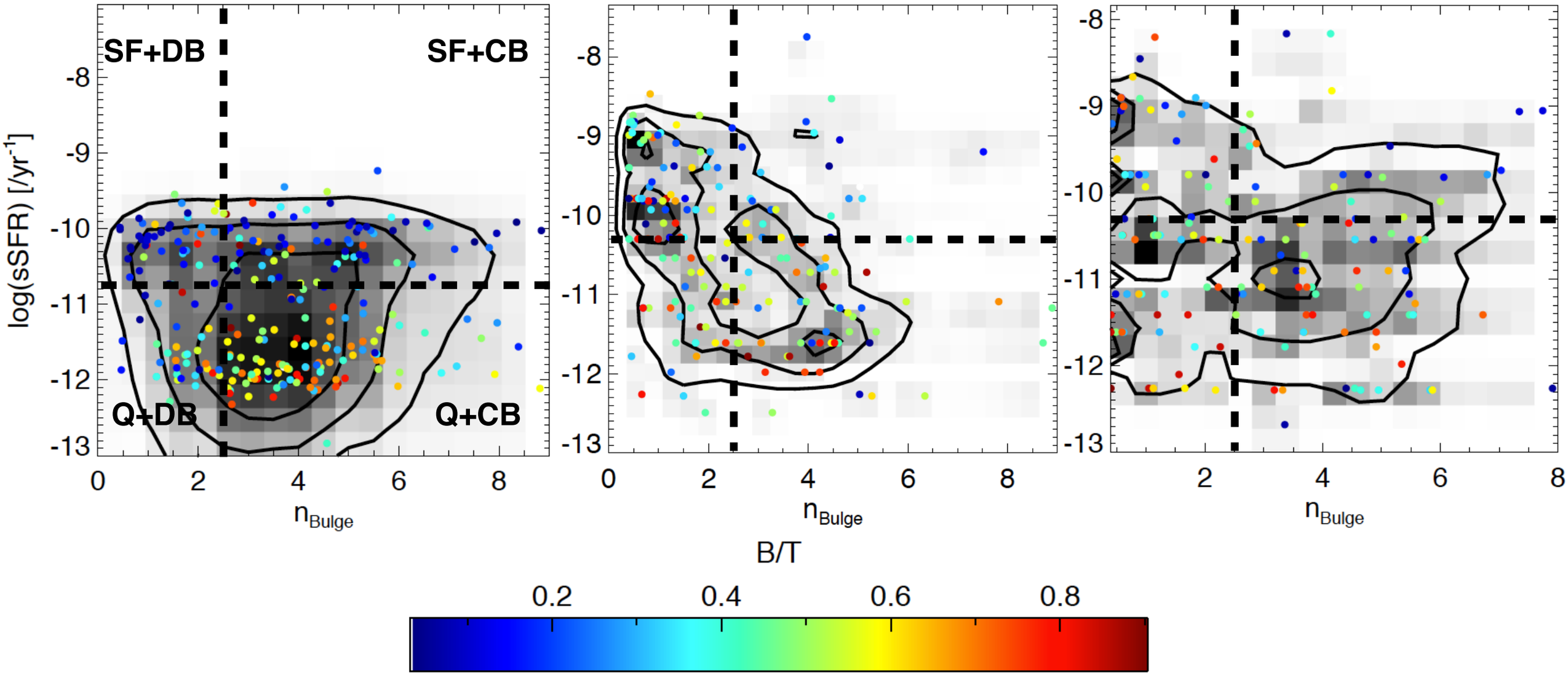
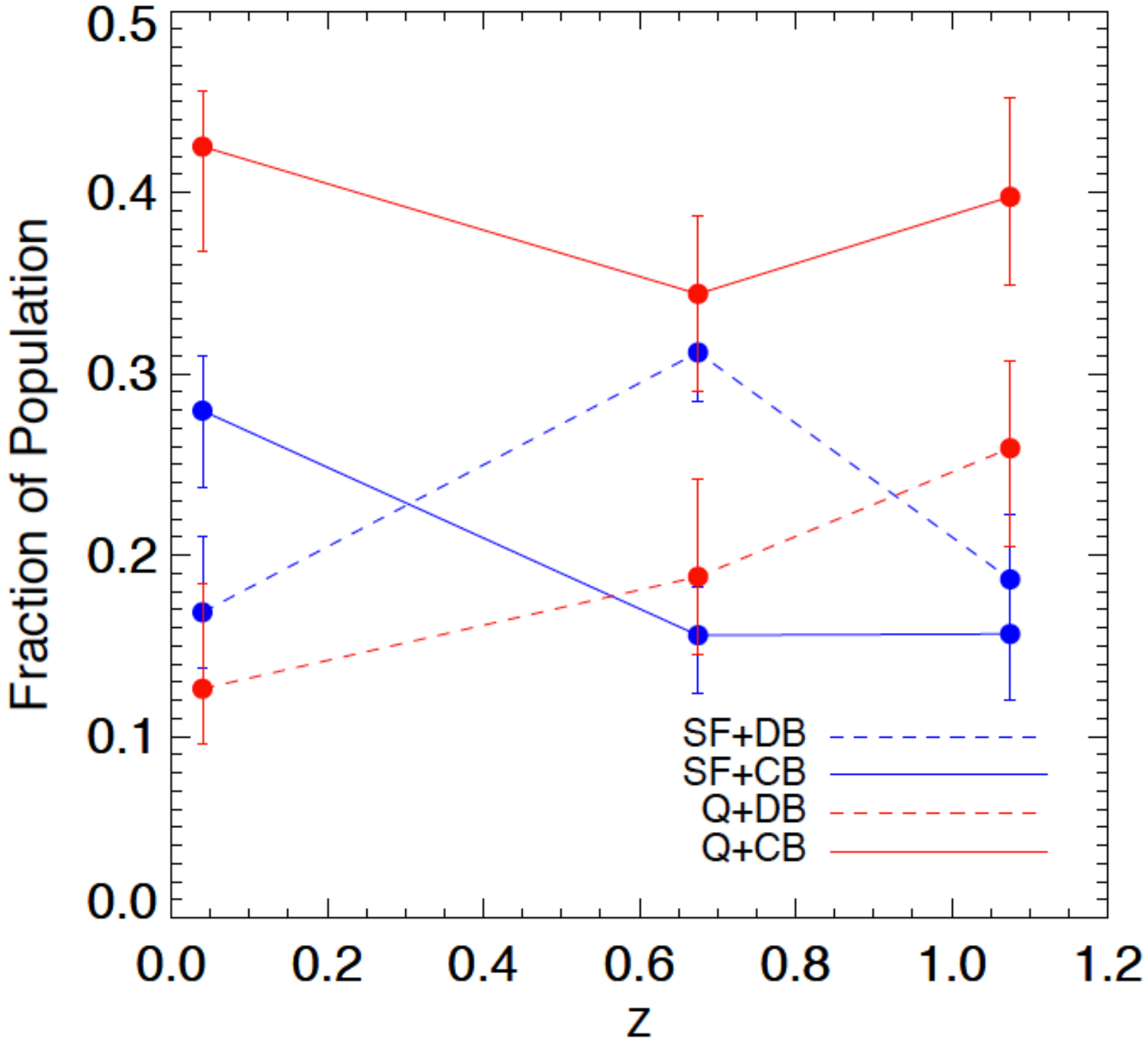


Bulge populations



Summary

- **A new Bayesian algorithm to perform the photometric decomposition of galaxies has been developed.**

- **We have studied the build-up of different bulge populations using the sSFR versus Sérsic index plane.**

- **Compact bulges appear to be consistently in quenched galaxies across redshift.**

- **Our Bayesian perspective of galaxy structures opens up a new way to understand the physical process driving the formation and evolution of galaxies.**

Thank you