On the role of cold gas in galaxy dynamics

Trieste, 25/09/2017

Anna Zoldan
Supervisor: Gabriella De Lucia

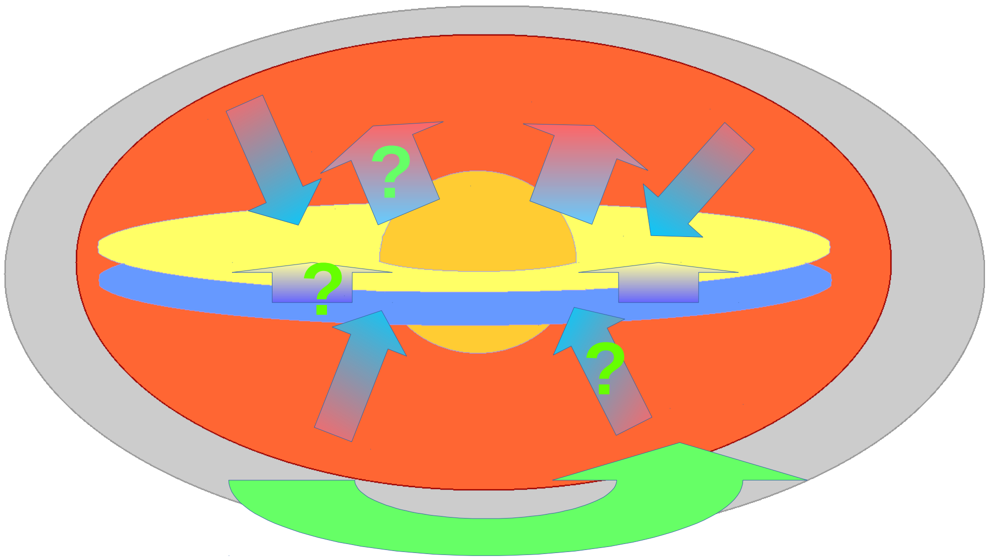
UNIVERSITÀ DEGLI STUDI DI TRIESTE

INAF
ISTITUTO NAZIONALE DI ASTROFISICA
OSSERVATORIO ASTRONOMICO DI TRIESTE

Purposes

Part #2

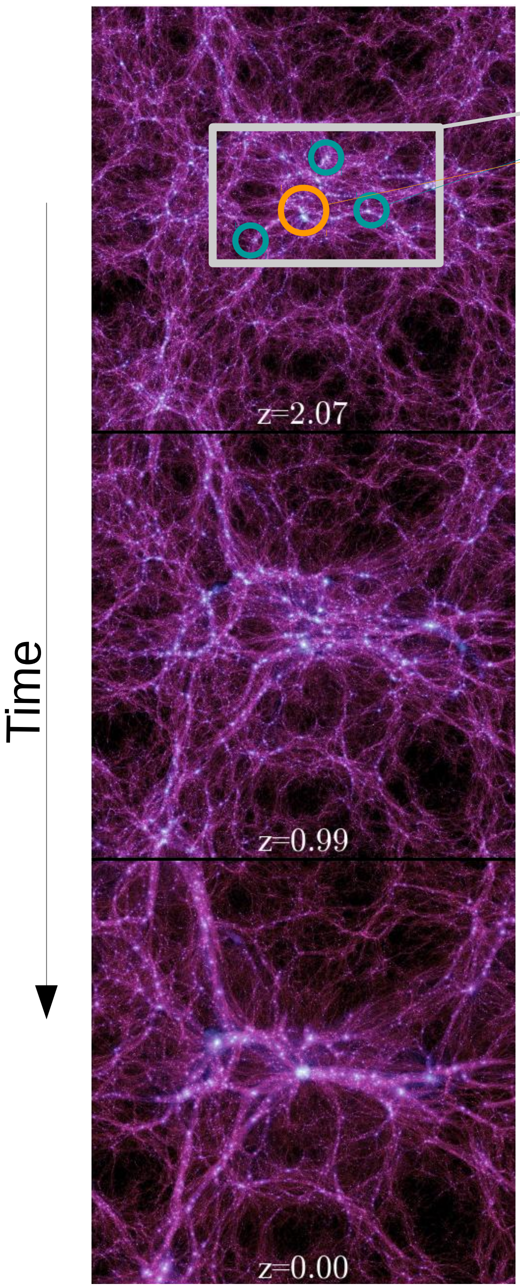
Understand the **role of cold gas in the dynamical evolution** of the galaxies



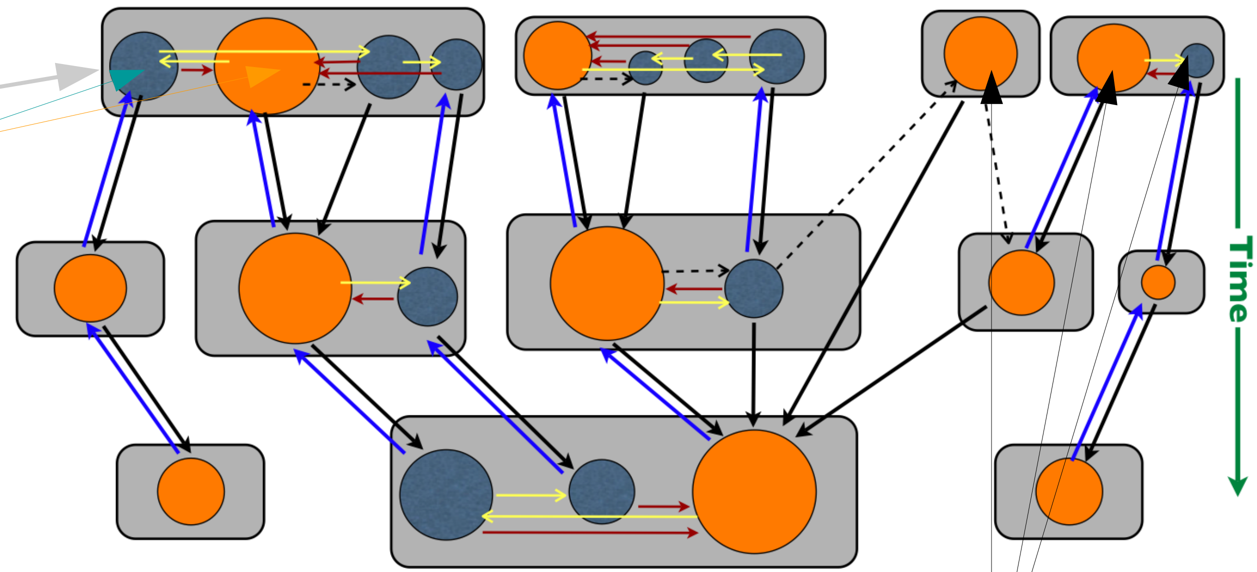
We use **semi-analytic models of galaxy formation and evolution**:

- **Controlled environment;**
- Analysis of **different prescriptions** for the same process;
- Can **follow the evolution** of the single galaxy;

Tool: the semi-analytic model



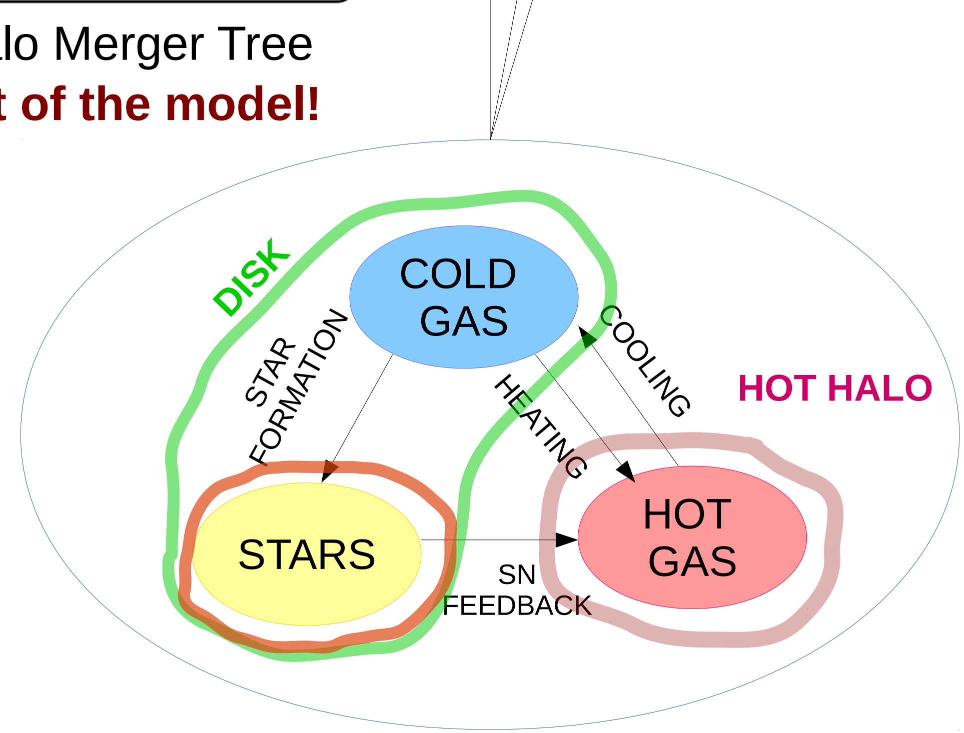
N-body DM simulation



Halo Merger Tree

Input of the model!

Semi-analytic model



The specific model

We use **Xie et al. 2017** model, a development of **GAEA** model (Hirschmann et al., 2016), that includes:

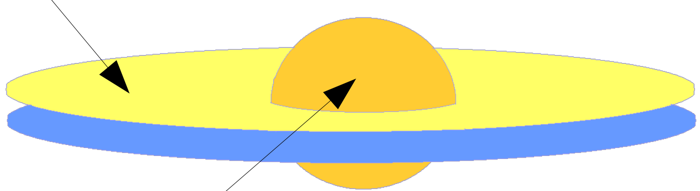
- **Complex chemical** evolution **scheme** (no IRA);
- **Complex stellar feedback scheme**, using a parametrization of the outflows based on FIRE results (Muratov et al., 2015);
- **HI-H_2 self-consistent partition** based on Blitz & Rosolowsky (2006);
- **Star Formation based on H_2** surface density;

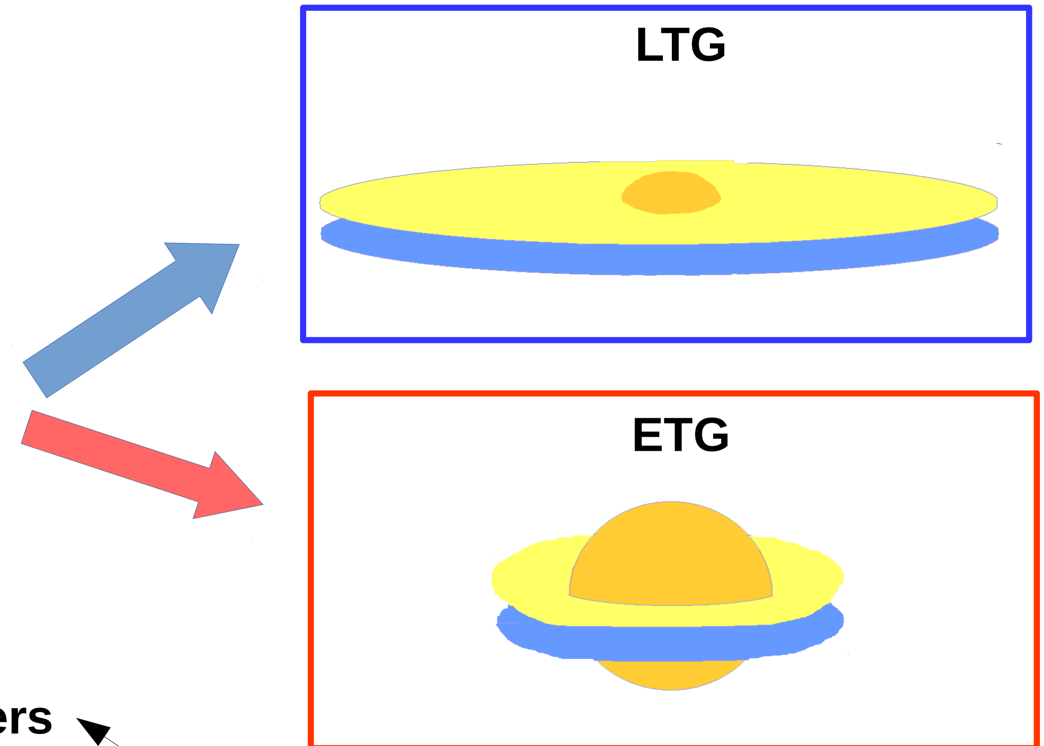
Early and Late Type Galaxies

B/T → Bulge over total ratio

Disk:
- Exponential disk;
- **Rotation** supported;

Forms from:
- Star Formation;





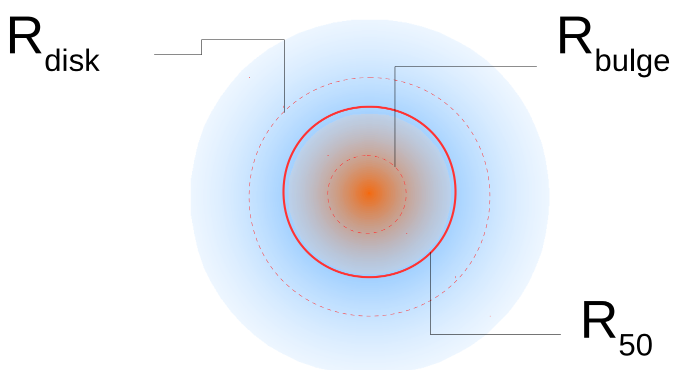
Bulge:
- Spheroid;
- **Dispersion** dominated;

Forms during:
- Galaxy **mergers** → **B/T** in **[0.7-1.0]**;
- **Disk instabilities** → **B/T** in **[0.1-0.7]**;

I included a prescription for **gas dissipation in mergers:**
More realistic bulge sizes!

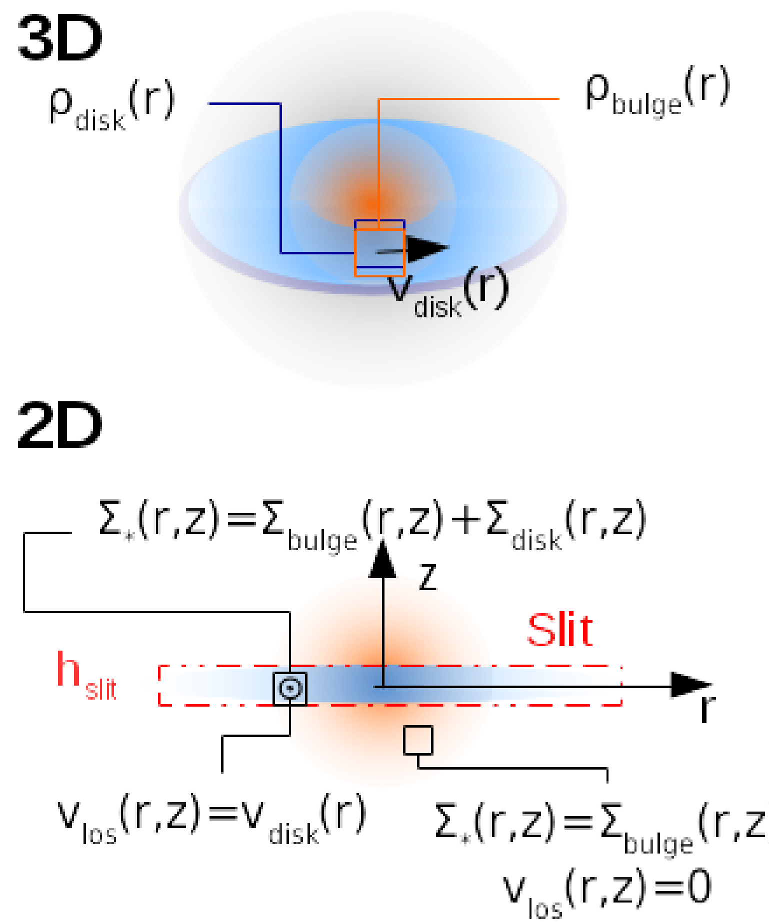
Dynamical properties: $R_{1/2}$ and j_*

Size → **half mass radius** $\mathbf{R_{1/2}}$

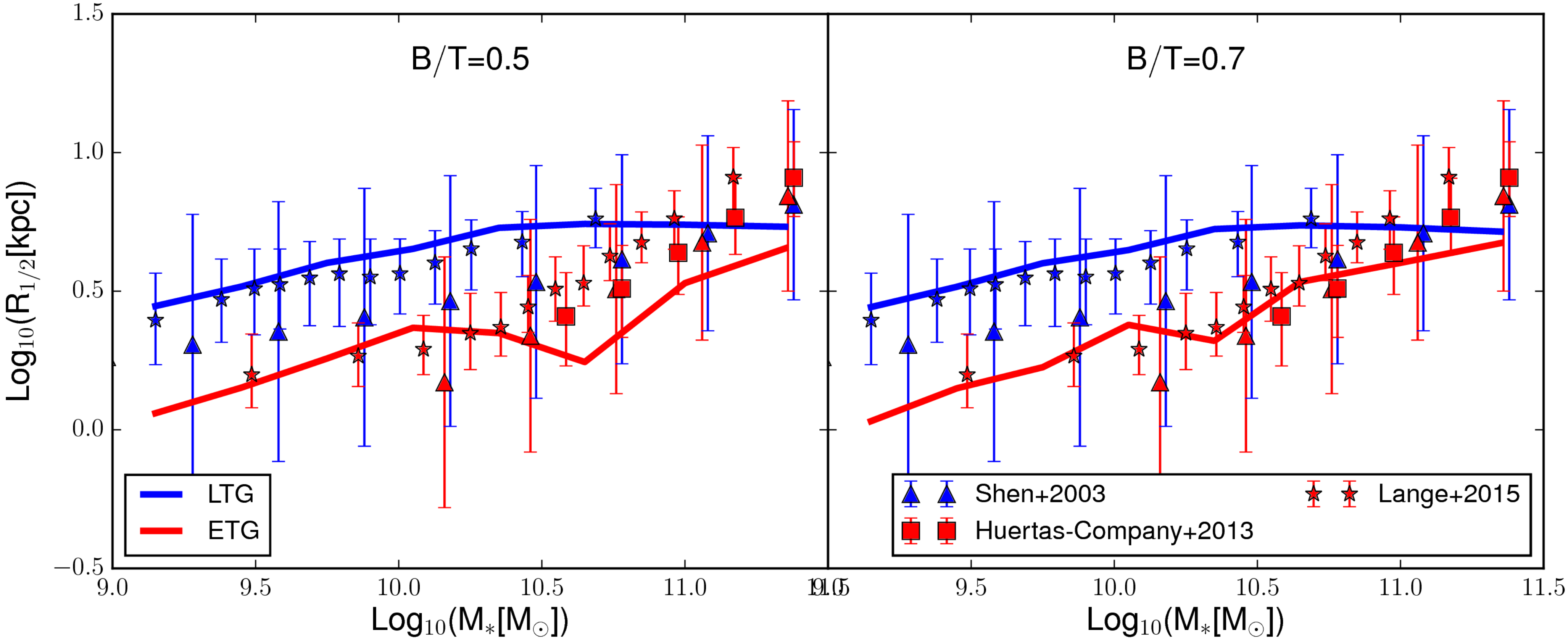


Specific angular momentum $\mathbf{j_*}$

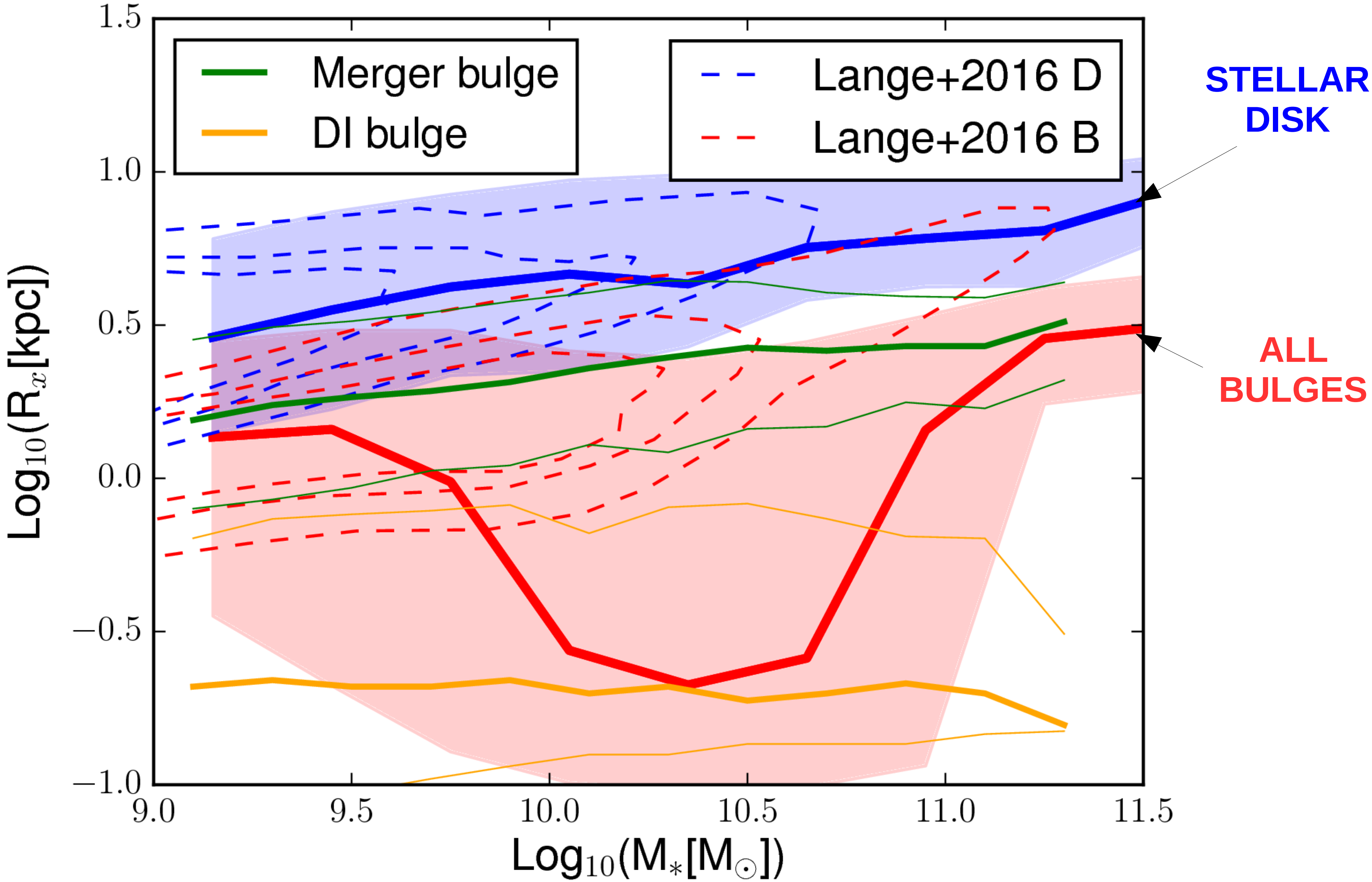
$$dJ = dm\, dr \times dv$$
$$j = J/M$$



Part#2: $R_{1/2}$-M_* relation

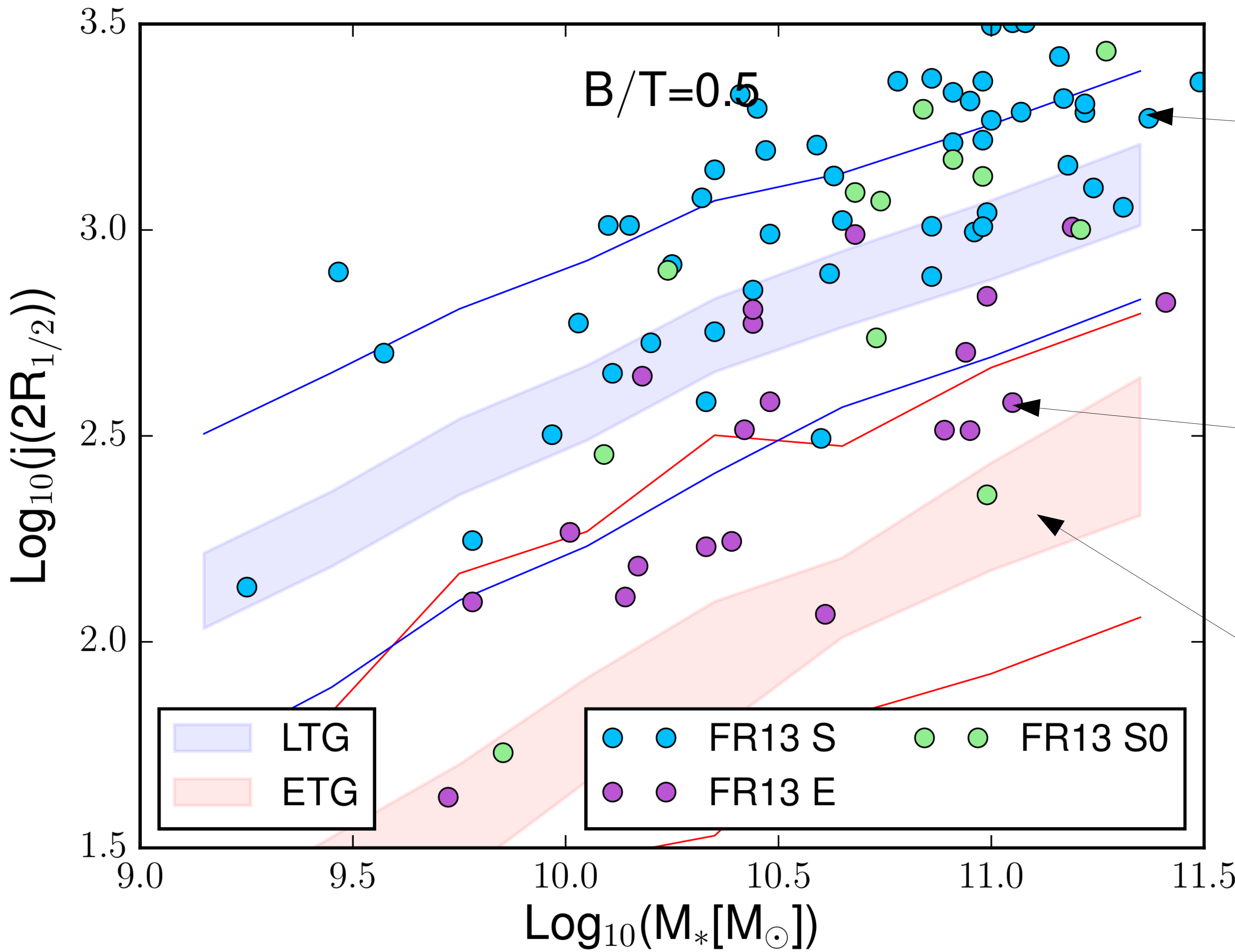


Size of the components



Problem: too small bulges from disk instabilities!

The specific angular momentum



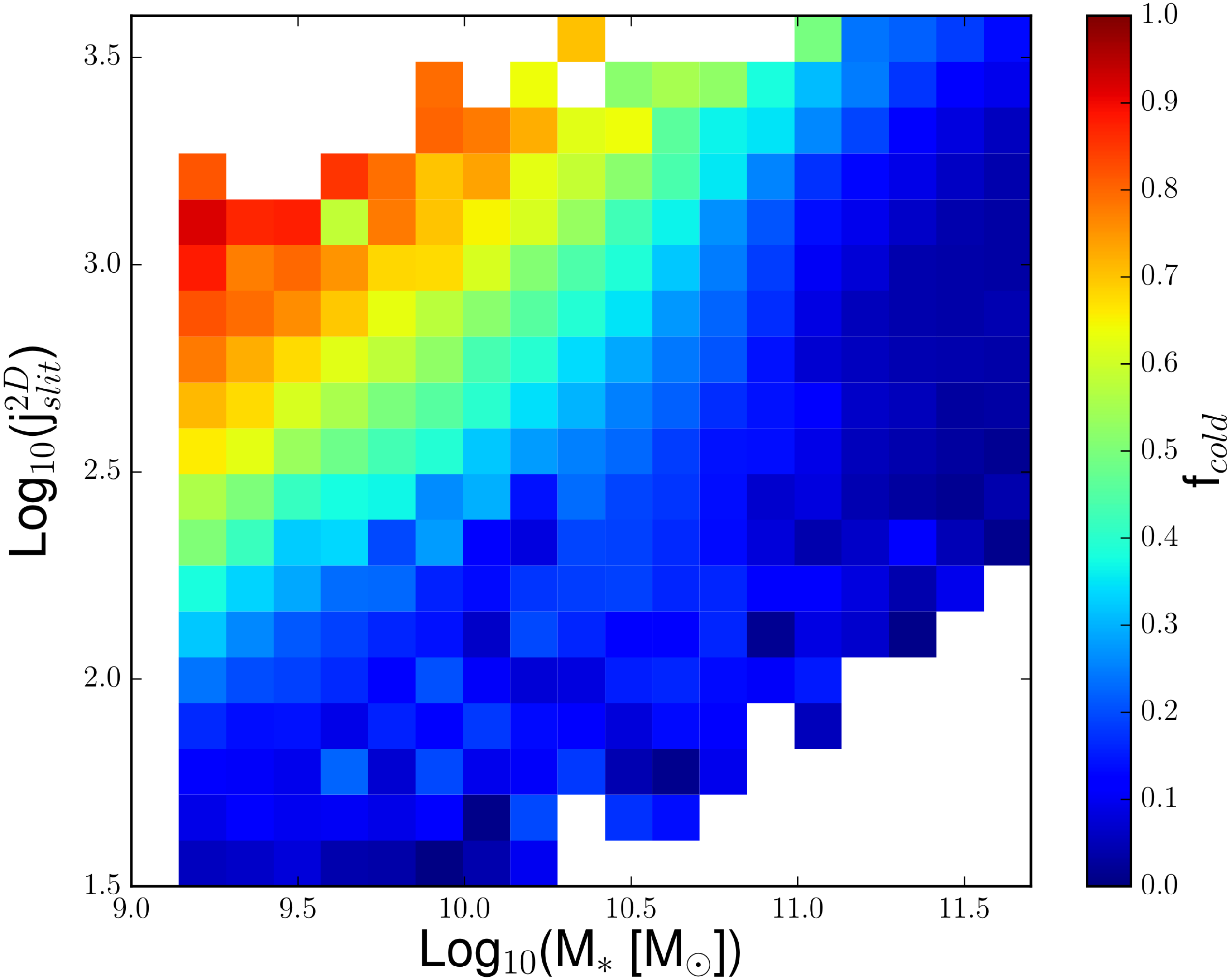
Observed **LTGs** are **gas rich...**

Observed ETGs are **fast rotators** ≠dispersion dominated

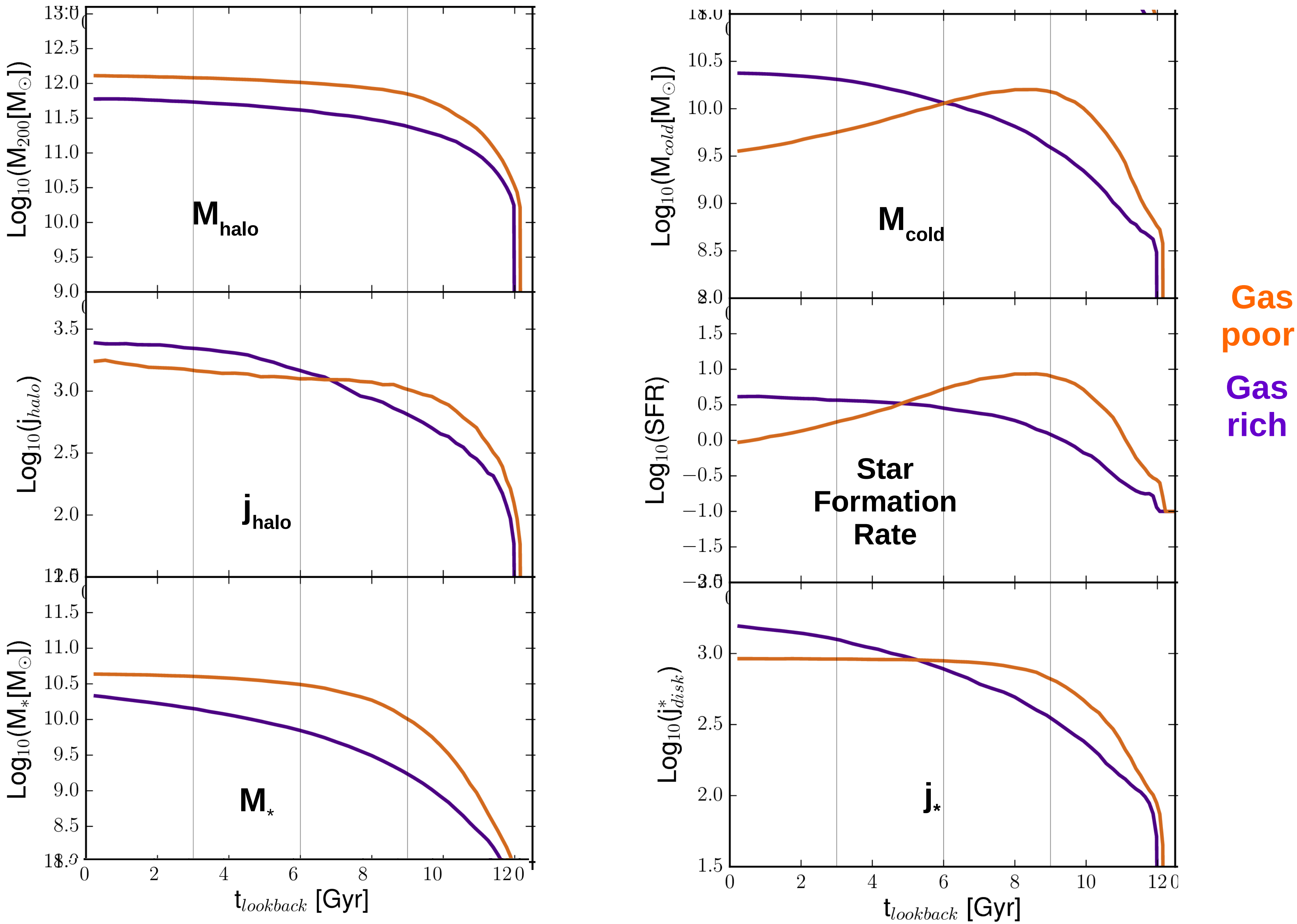
Model ETGs have **dispersion only** in their bulges

j_* and cold gas fraction

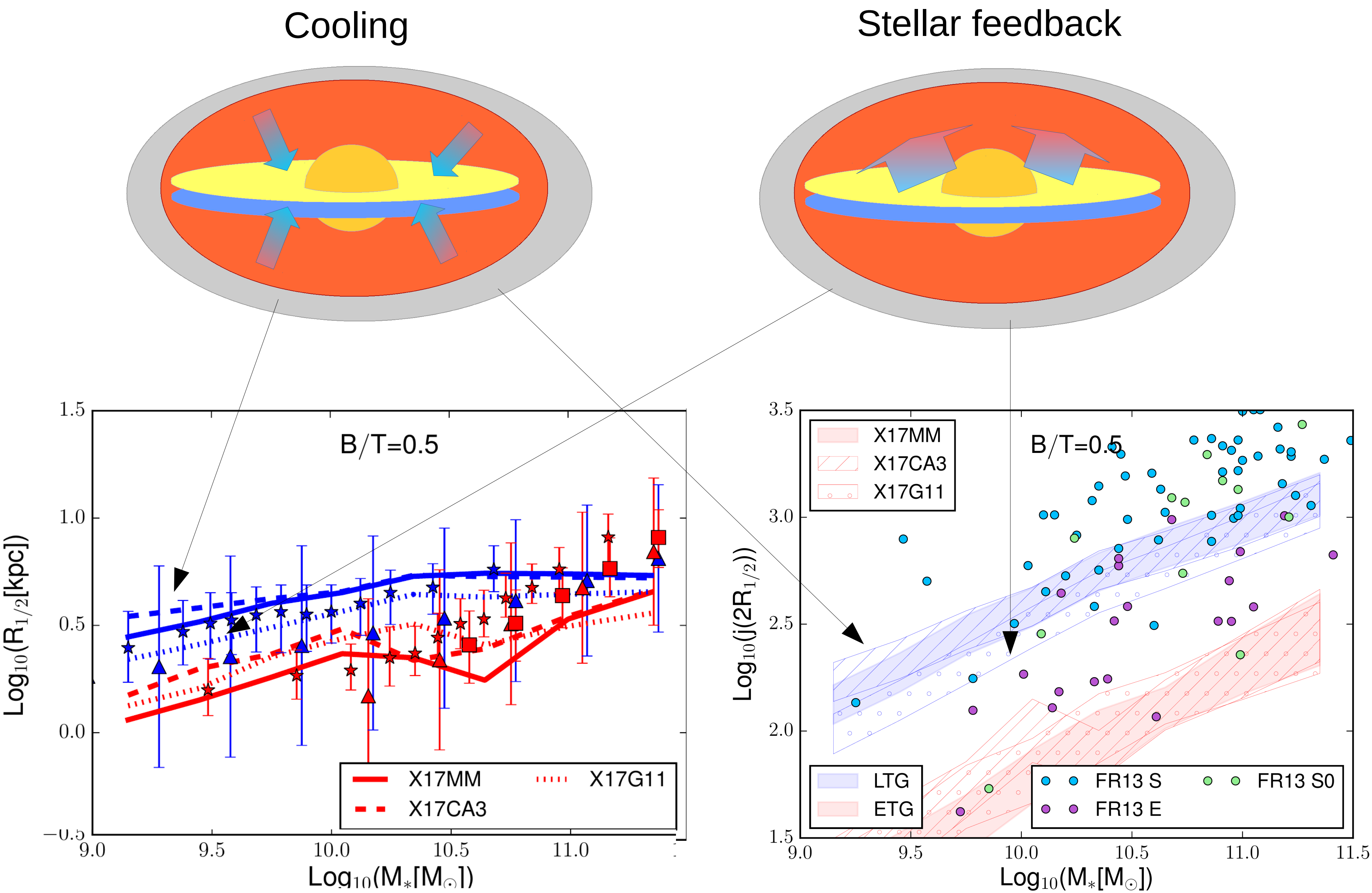
$f_{cold} = M_{cold} / (M_{cold} + M_*)$



Cold gas and history



Different prescriptions



Conclusions and future perspectives

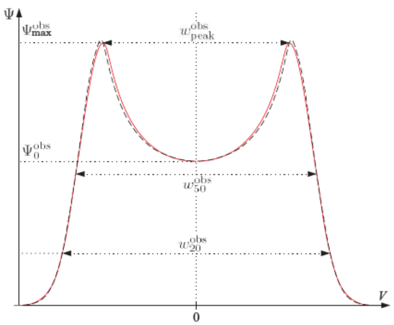
Results:

1) **XBR16** can reproduce the observed $\mathbf{R_{1/2}}$**-**$\mathbf{M_*}$ and $\mathbf{j_*}$**-**$\mathbf{M_*}$ relations;
2) $\mathbf{j_*}$ is strongly **correlated with** the **cold gas** fraction;
3) Cold **gas rich galaxies form stars gradually**, acquiring the higher j_{cold} at recent times;

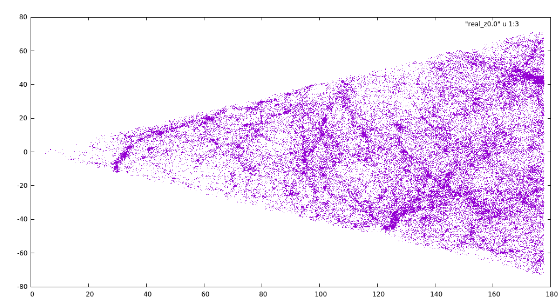
Future perspectives:

XBR16 has a **consistent treatment for HI**, and info on its **specific angular momentum**.

We can build **mock catalogs of realistic 21 cm lines**.



+



Zoldan et al.
MNRAS, 465, 2236–2253 (2017)