JESSIE HIRTENSTEIN

DYNAMICAL EFFECTS OF STELLAR FEEDBACK IN LOW MASS GALAXIES AT Z~2

In collaboration with: Tucker Jones, Xin Wang, **Andrew Wetzel**, **Kareem El-Badry**, Austin Hoag, Tommaso Treu, Maruša Bradač, Takahiro Morishita

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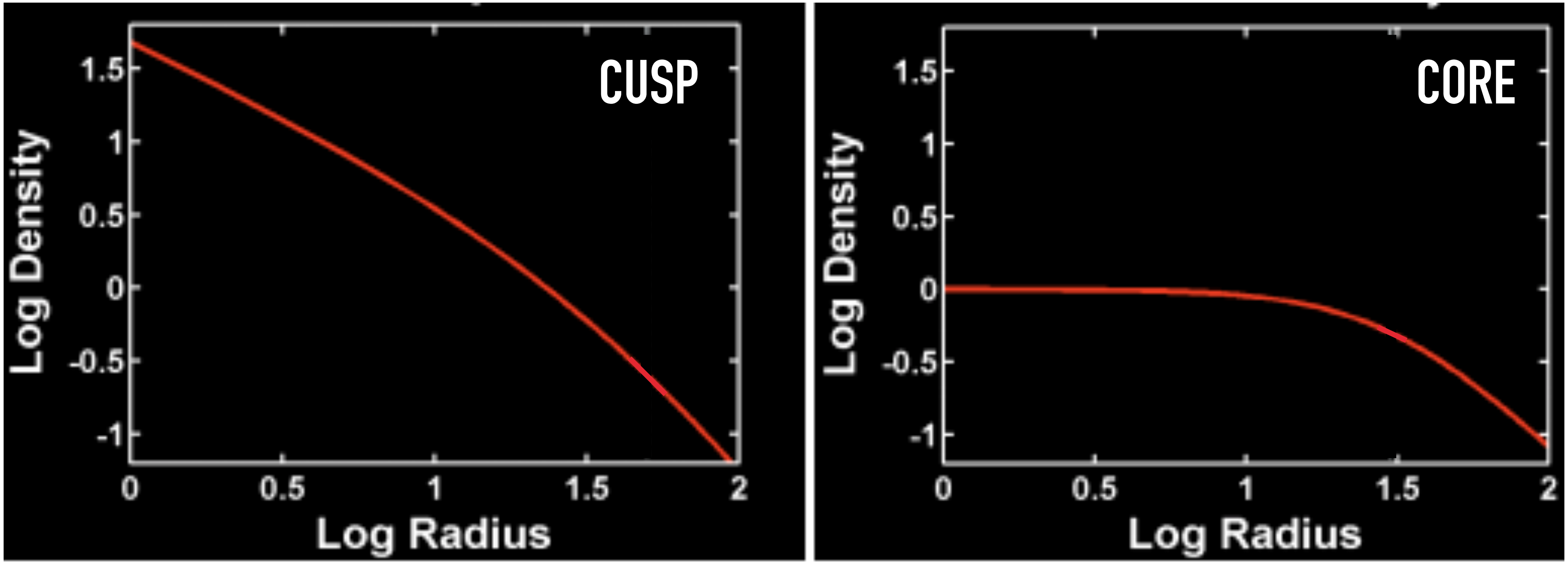
FIRE
Feedback In Realistic Environments

GLASS

THE CUSP-CORE PROBLEM

- Dark matter only simulations predict cusp-y central density profiles
- Observations reveal constant density cores



Dark matter only simulations | Observations

Del Popolo et al. (2016)

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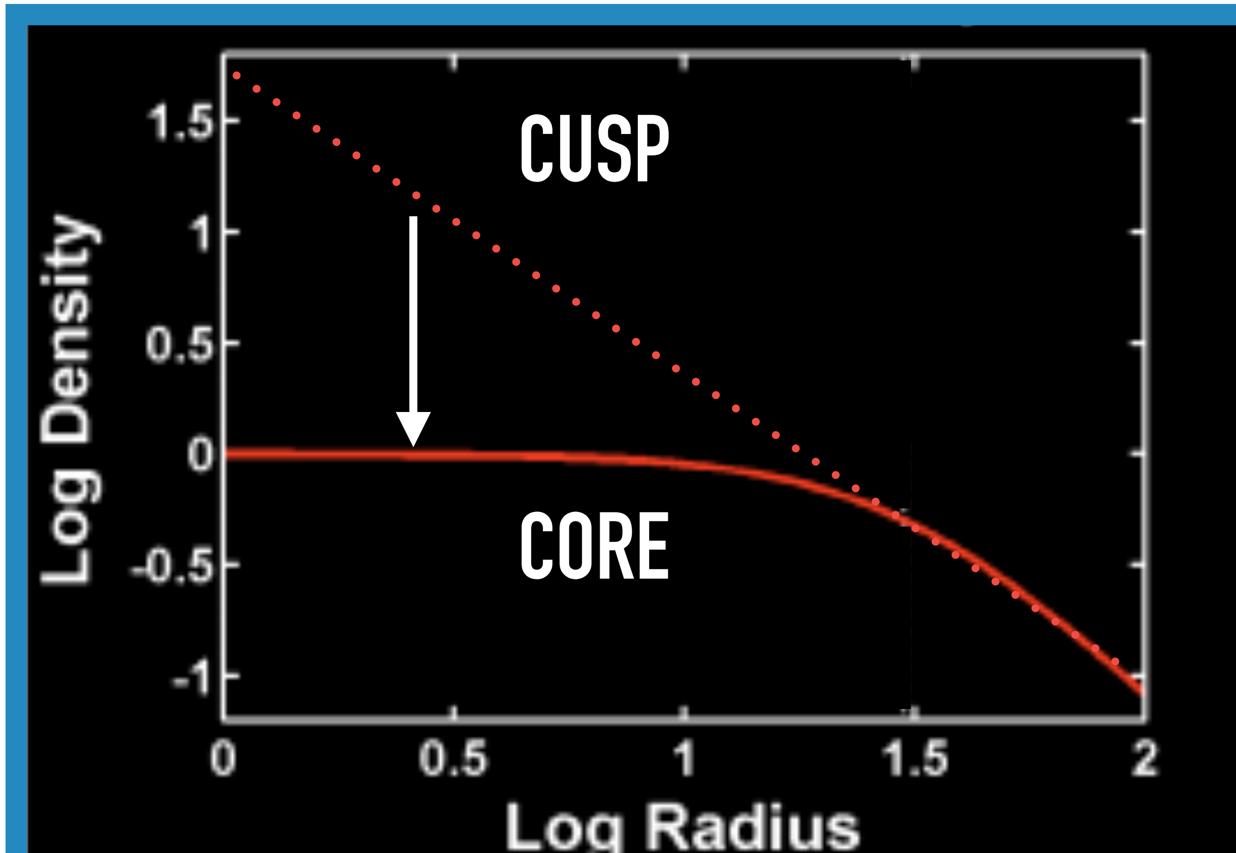
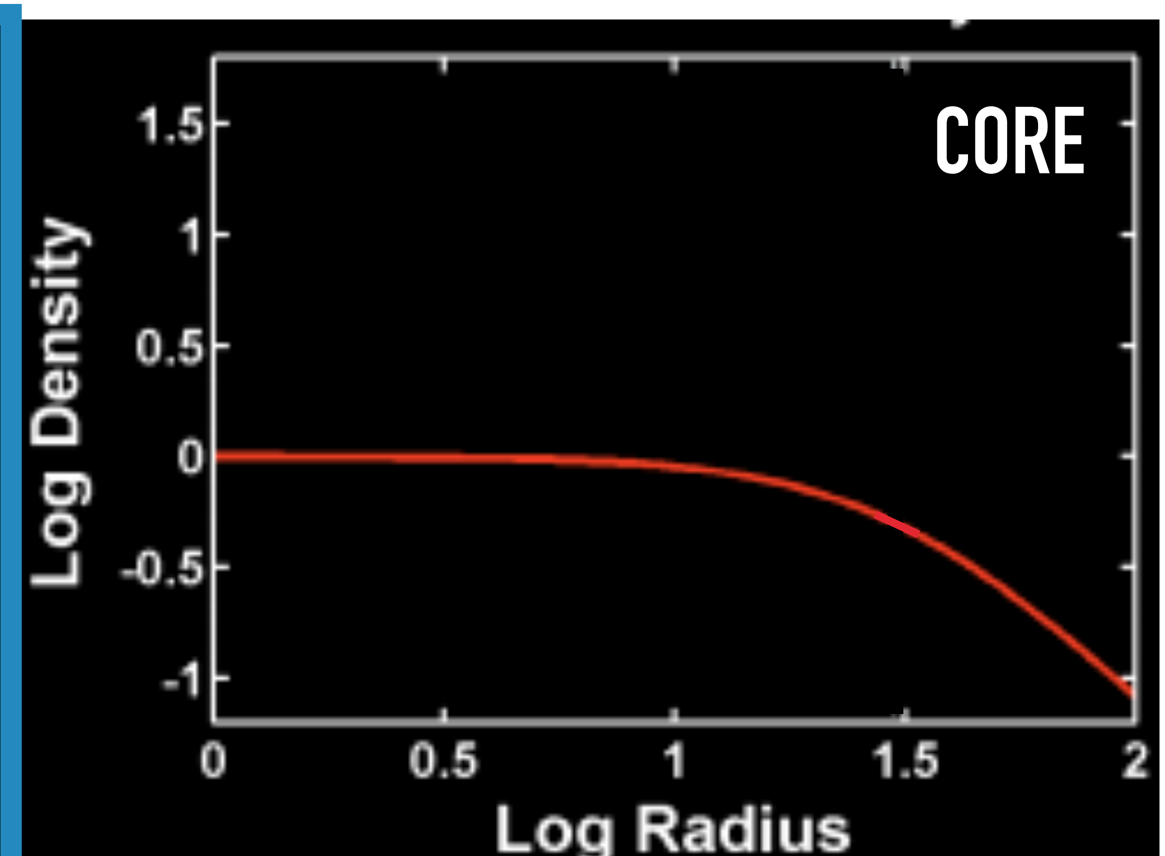


Simulations including baryonic feedback

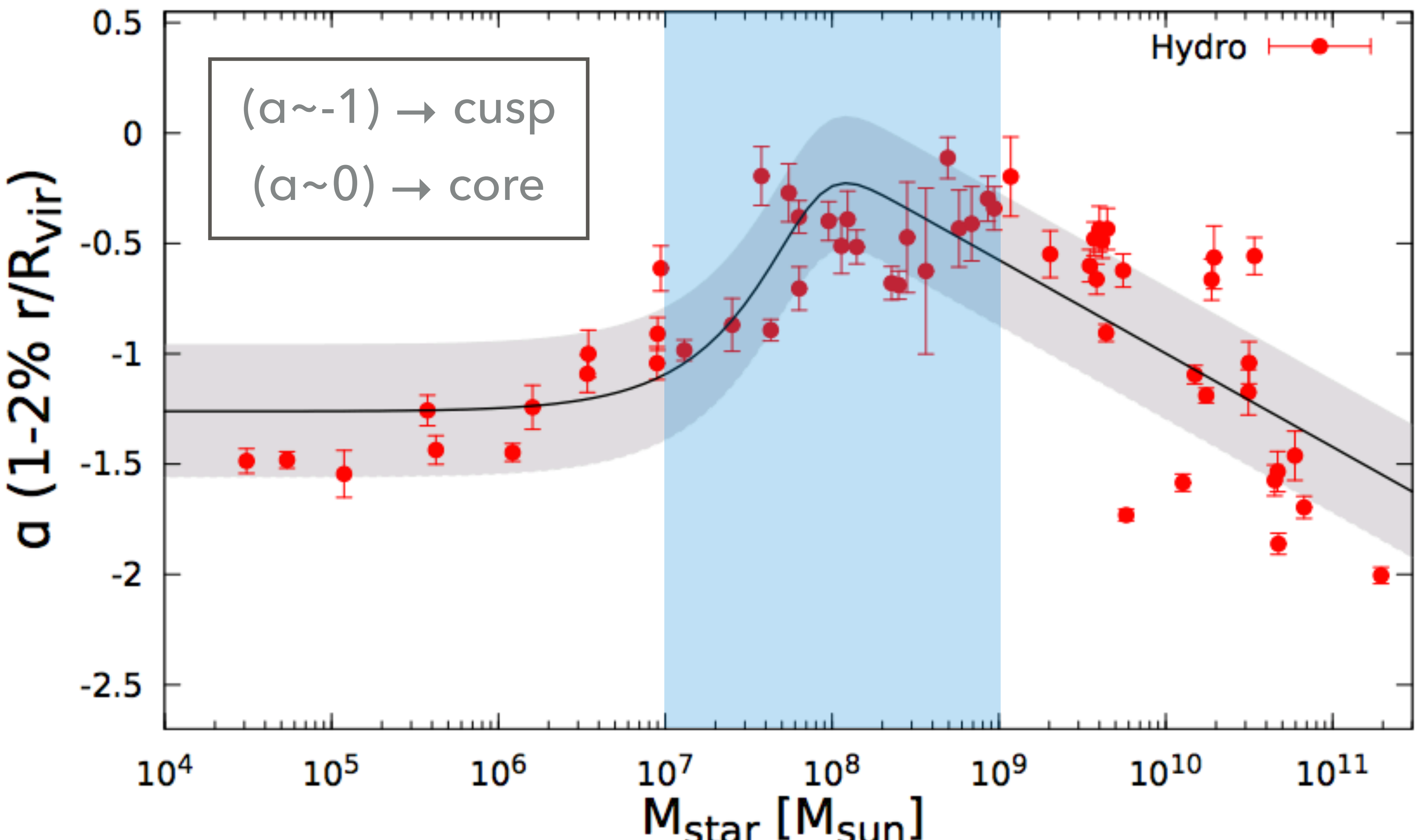


Observations

Del Popolo et al. (2016)

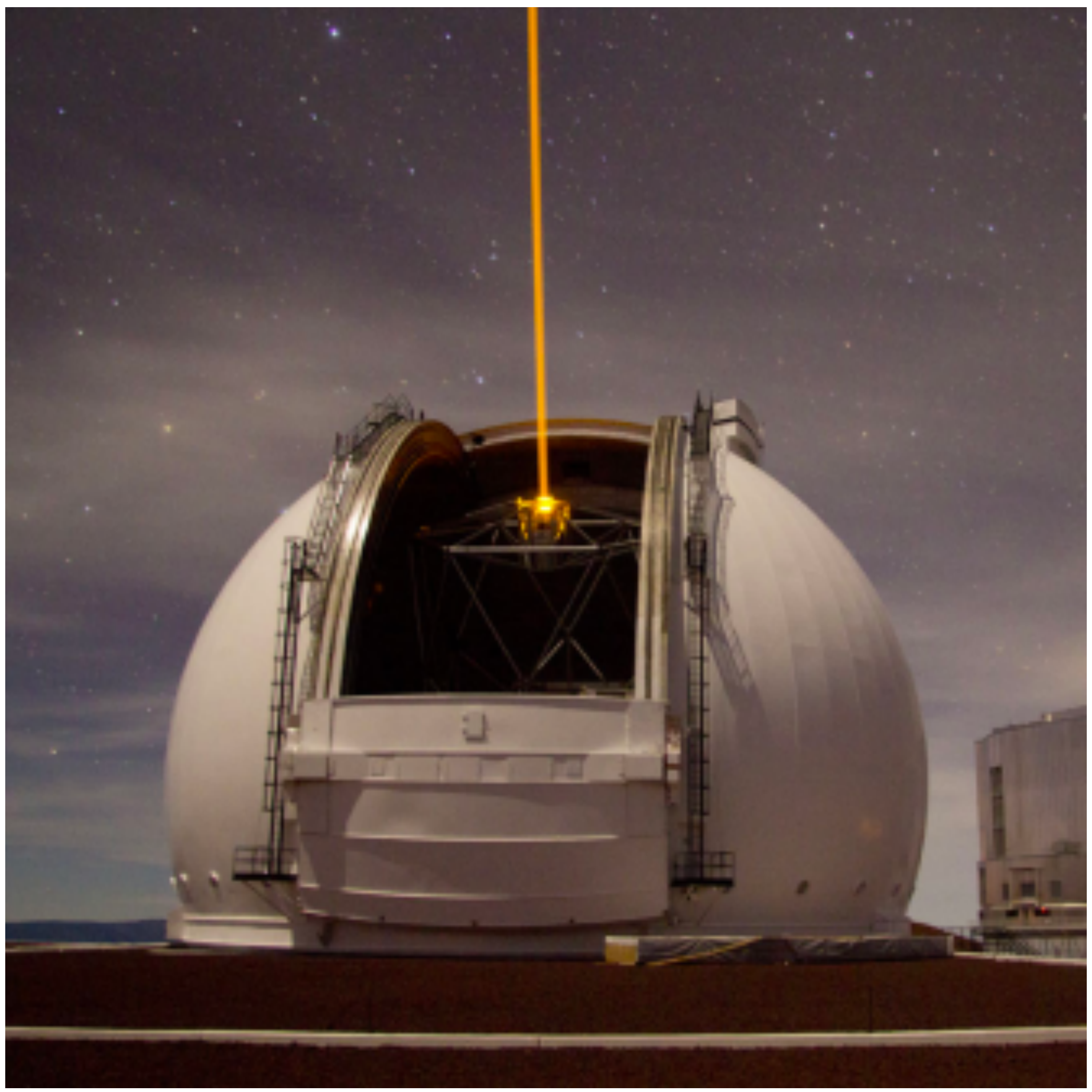
WHERE IS STELLAR FEEDBACK MOST DYNAMICALLY SIGNIFICANT?

- Most dynamically effective with **$7 \lesssim \log(M_*/M_\odot) \lesssim 9$**, at **$z \sim 2$**



Tollet, Macciò, Dutton et. al. (2016)

OSIRIS LENS-AMPLIFIED SURVEY (OLAS)

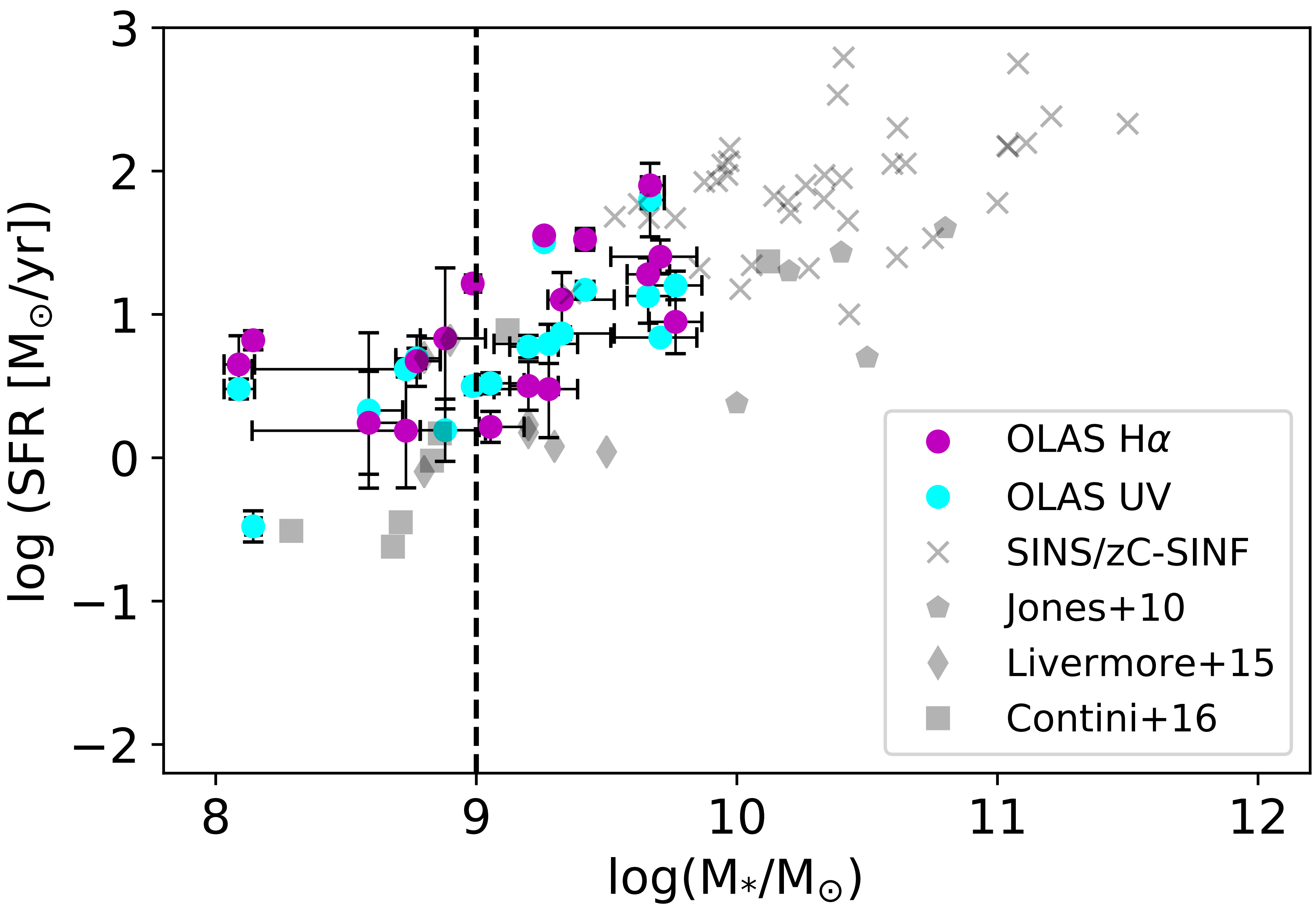


- IR spectrograph with AO + Integral Field Unit (IFU)
- Kinematic survey of lensed galaxies
  - Pre-selected for M_*, z, SFR, EL fluxes
  - 21 galaxies to-date
  - $8 \leq \log (M_*/M_\odot) \leq 9.8$
  - $1.25 < z < 2.29$

https://www2.keck.hawaii.edu

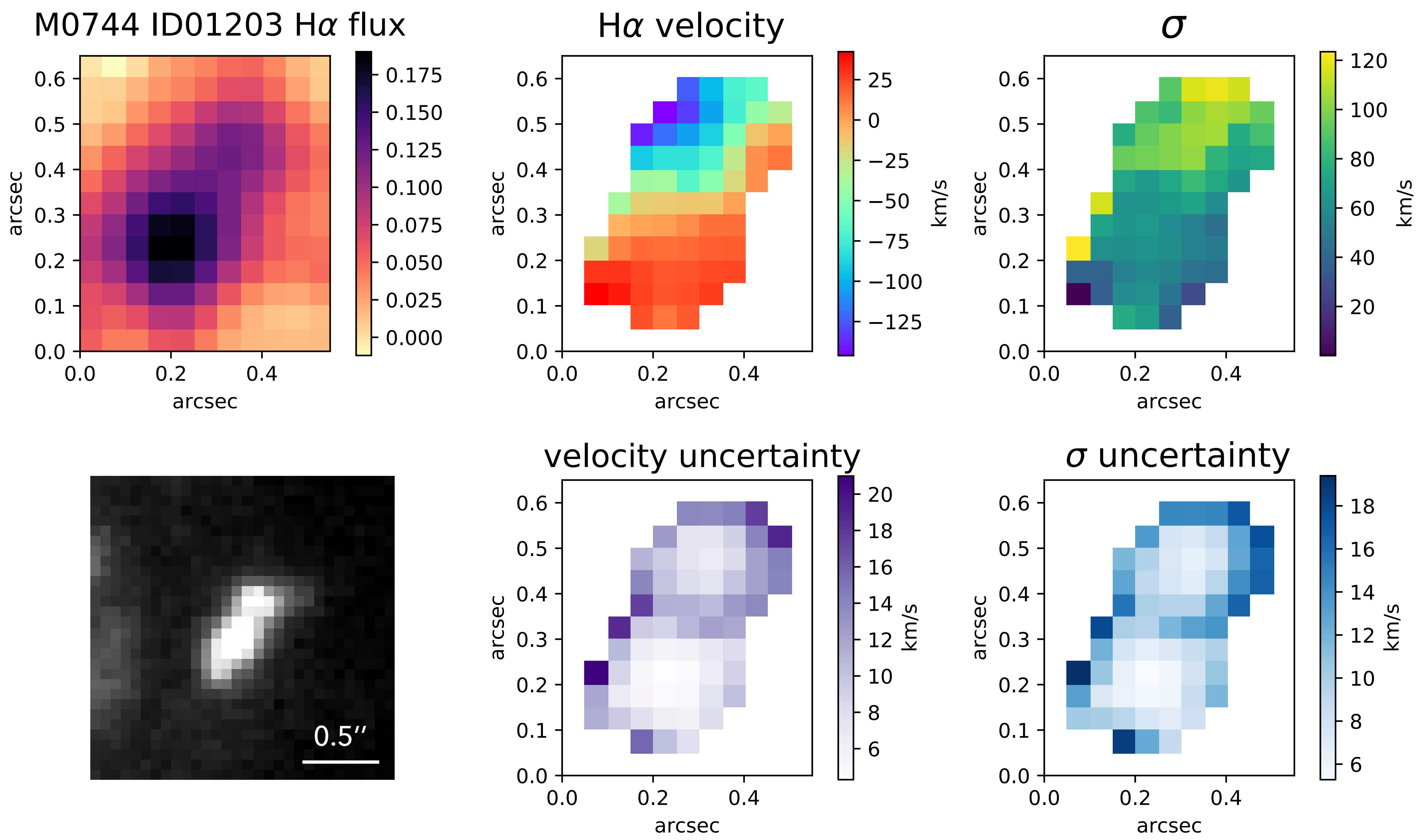
OVERVIEW OF SAMPLE – MASS VS SFR

- OLAS pushes 1.5 orders of magnitude lower in M_*, SFR



Hirtenstein et al. 2019

EXAMPLE IMAGE PLANE KINEMATICS



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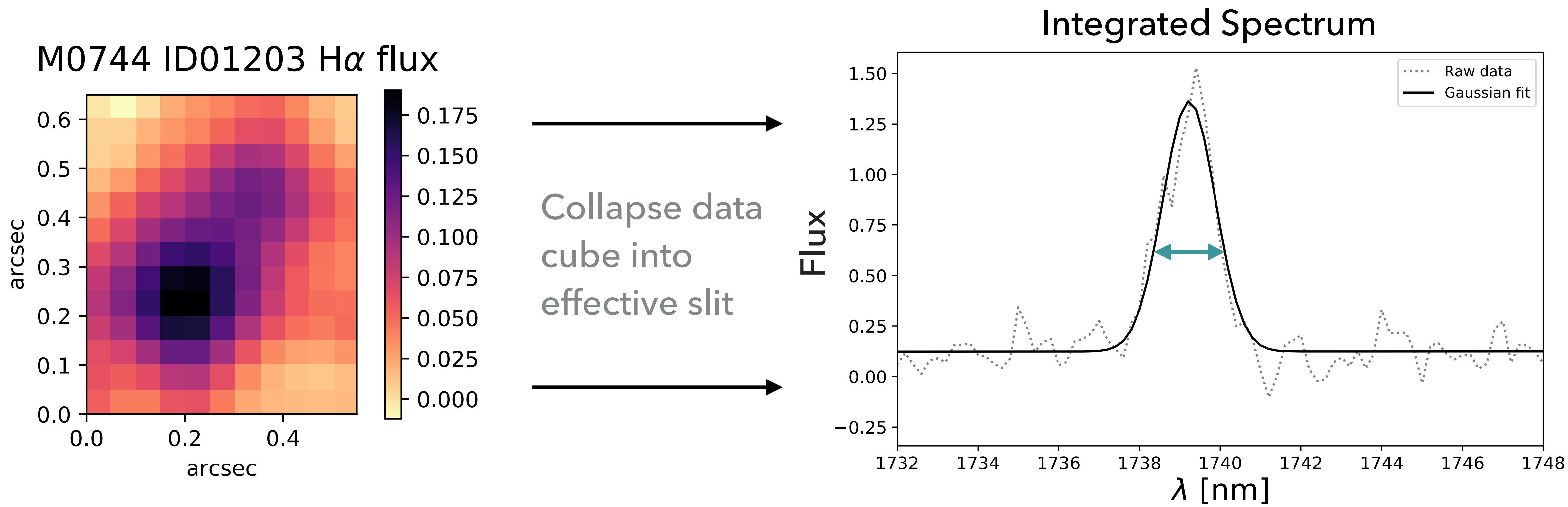
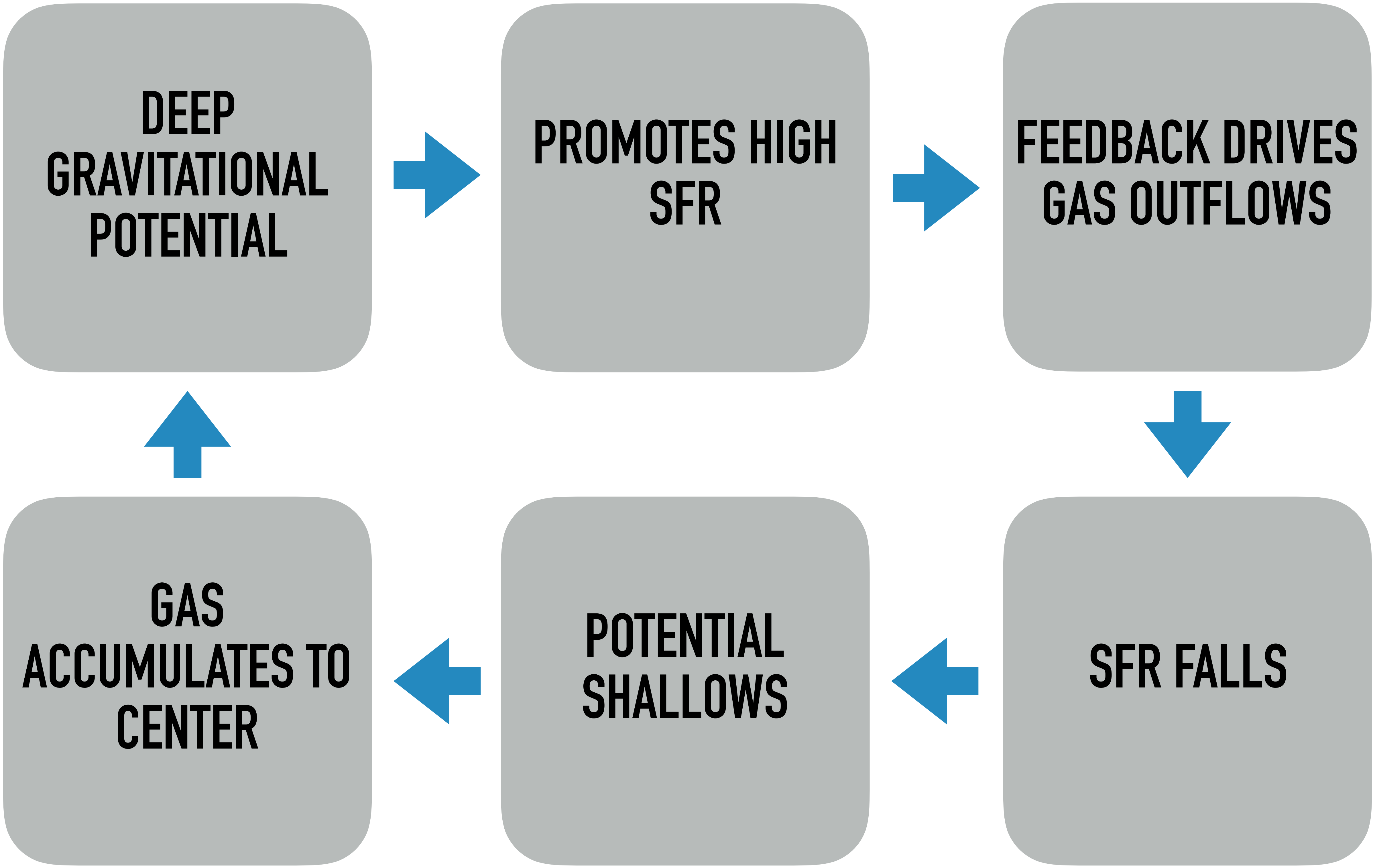
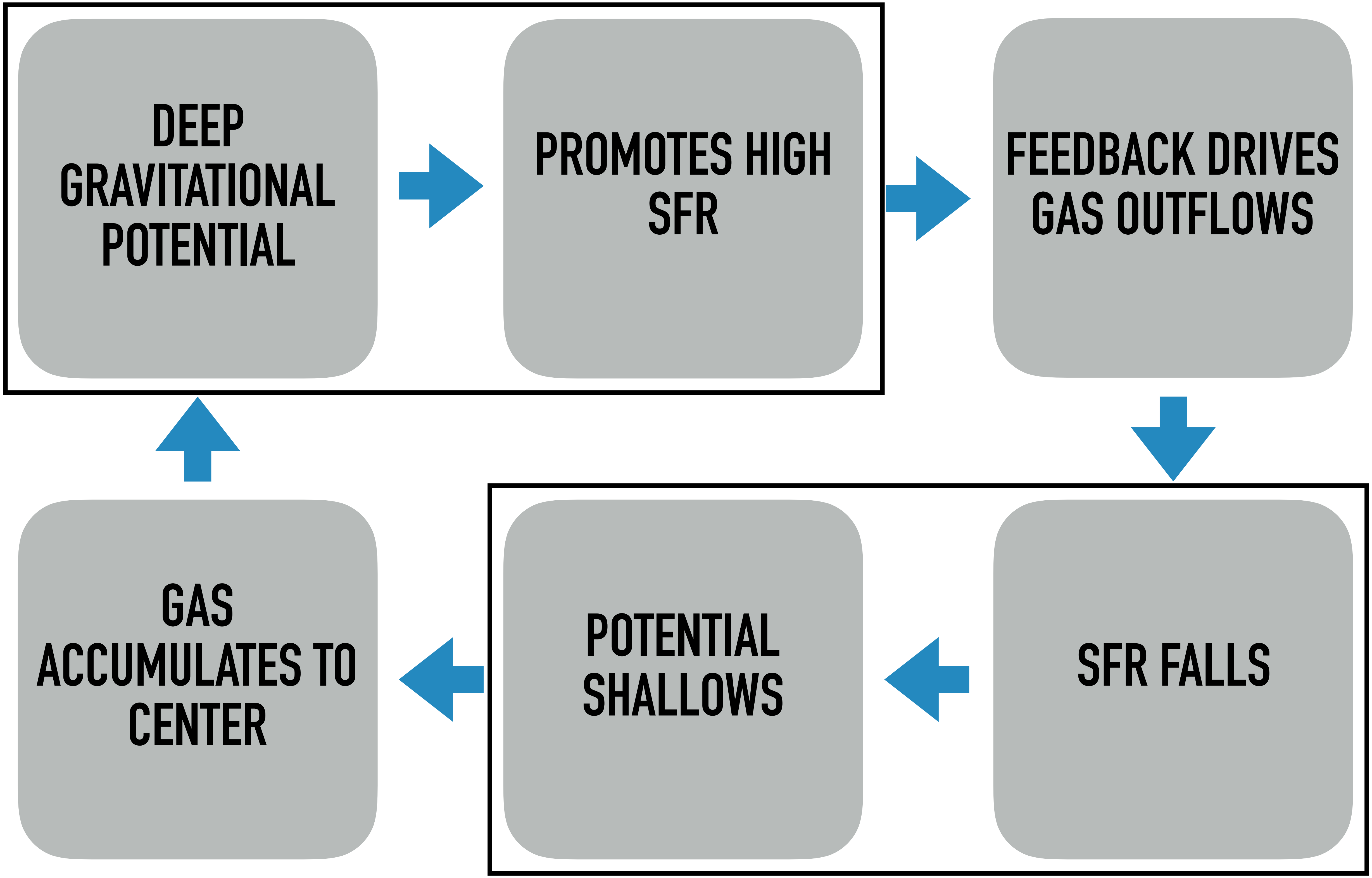
INTEGRATED HII REGION VELOCITY DISPERSIONS



- **Velocity dispersion** from width of integrated Hα emission line
  - Traces depth of potential well


DEEP GRAVITATIONAL POTENTIAL
PROMOTES HIGH SFR
FEEDBACK DRIVES GAS OUTFLOWS
SFR FALLS
POTENTIAL SHALLOWS
GAS ACCUMULATES TO CENTER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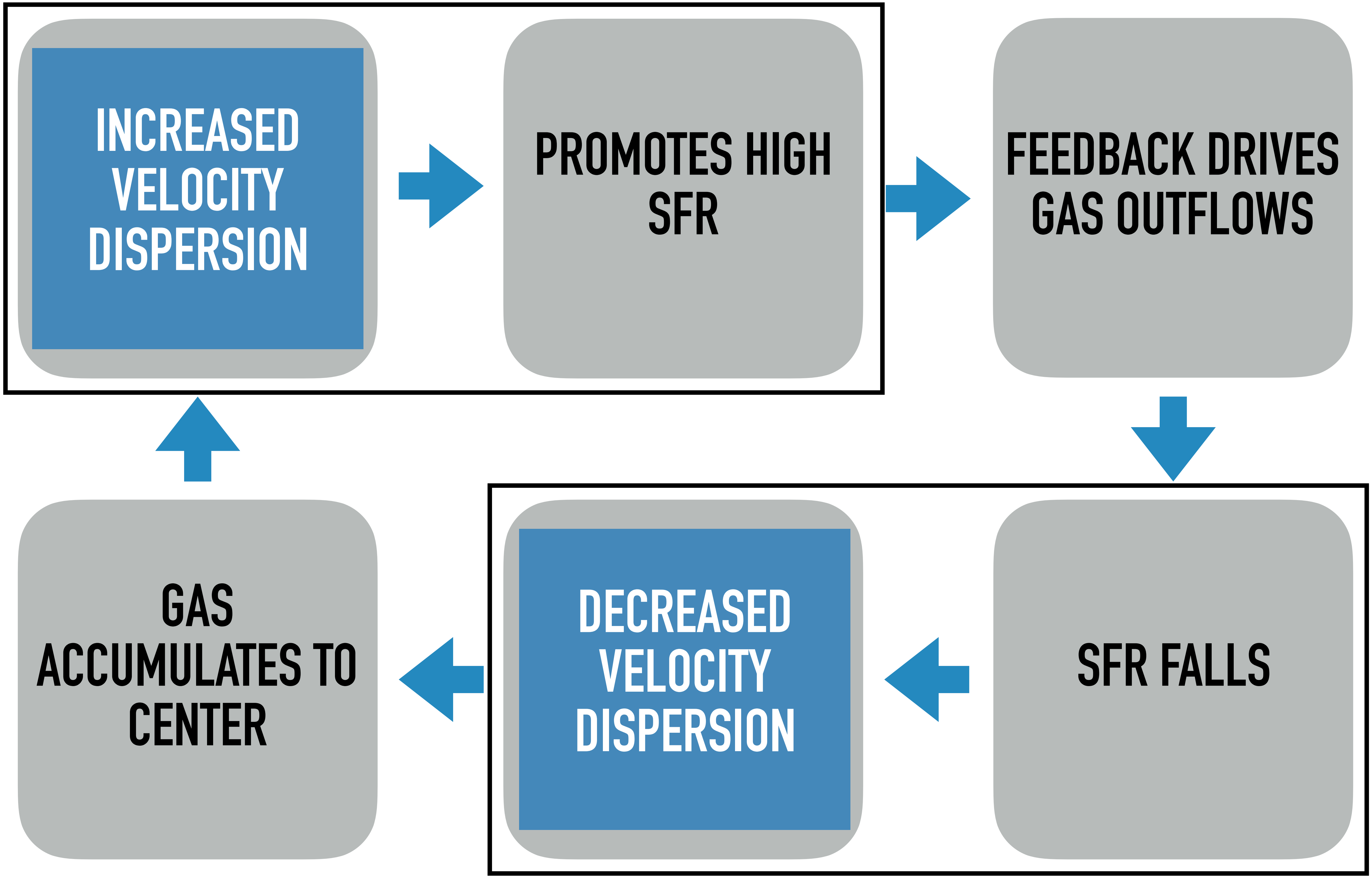
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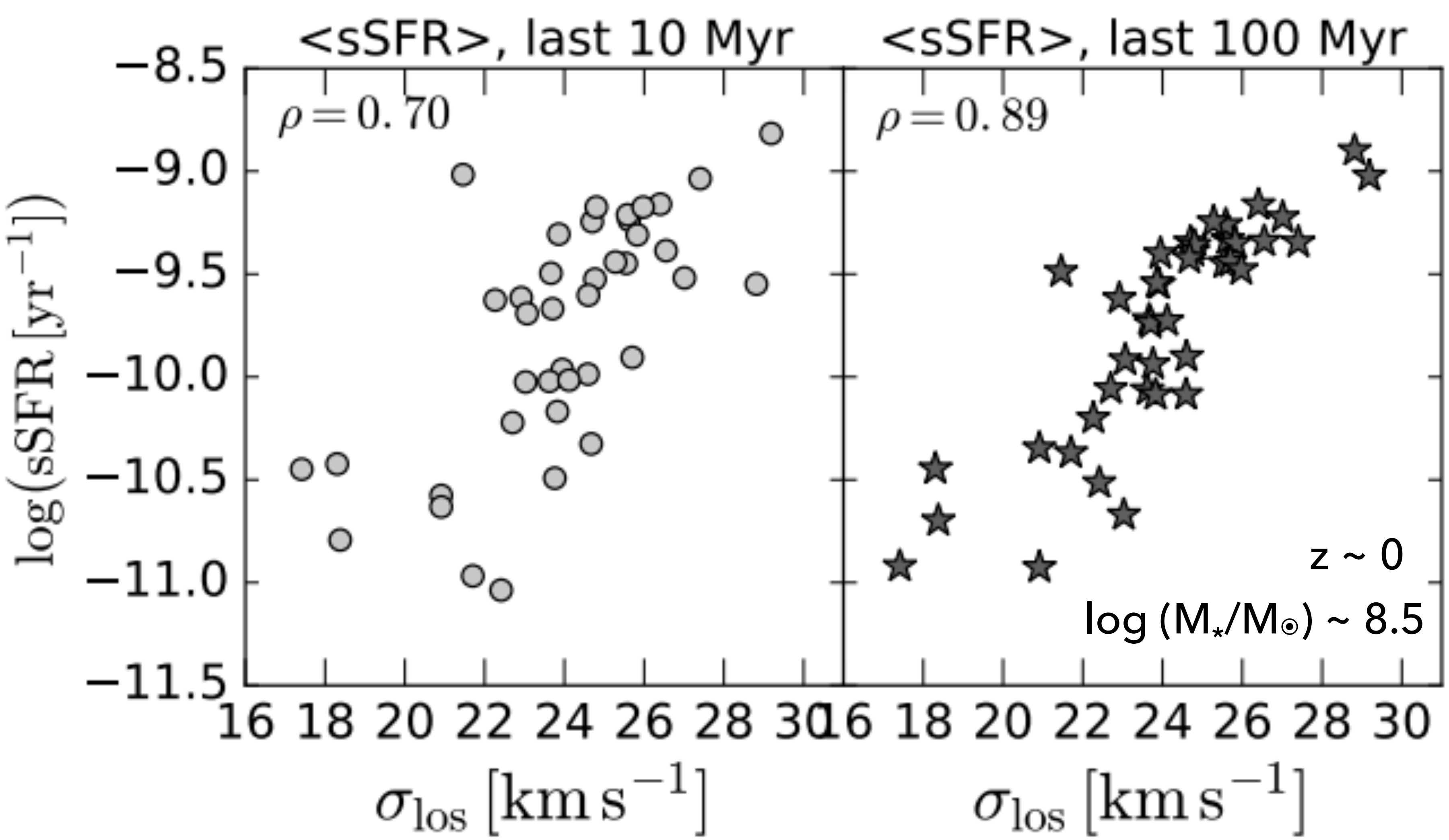
GAS ACCUMULATES TO CENTER

RELATIONSHIP BETWEEN VELOCITY DISPERSION AND SSFR

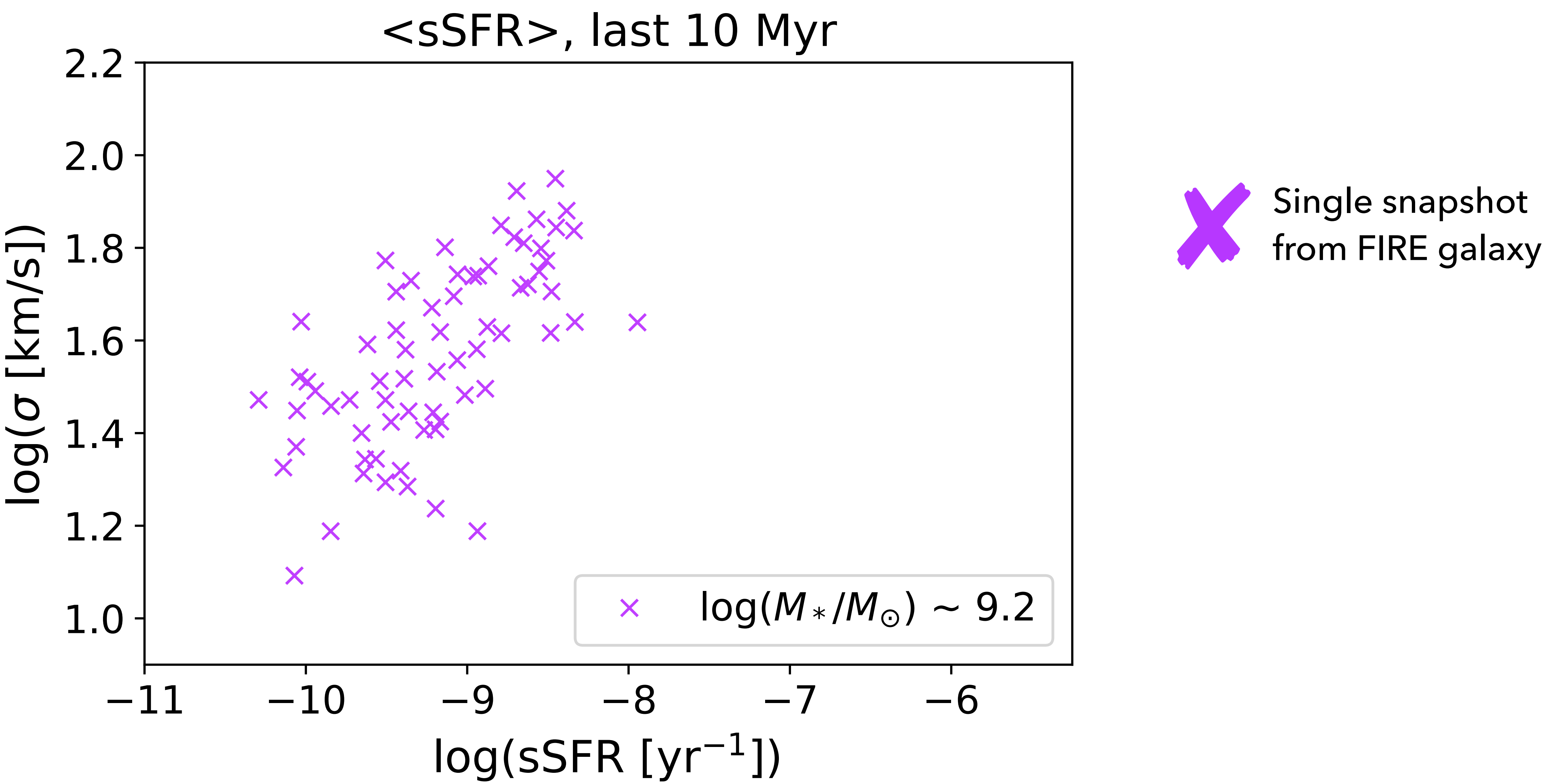
- Relationship is a result of feedback cycle, which may drive core formation



= 1 snapshot

El-Badry et al. (2017)

COMPARING WITH THE FIRE SIMULATIONS



Hirtenstein et al. 2019

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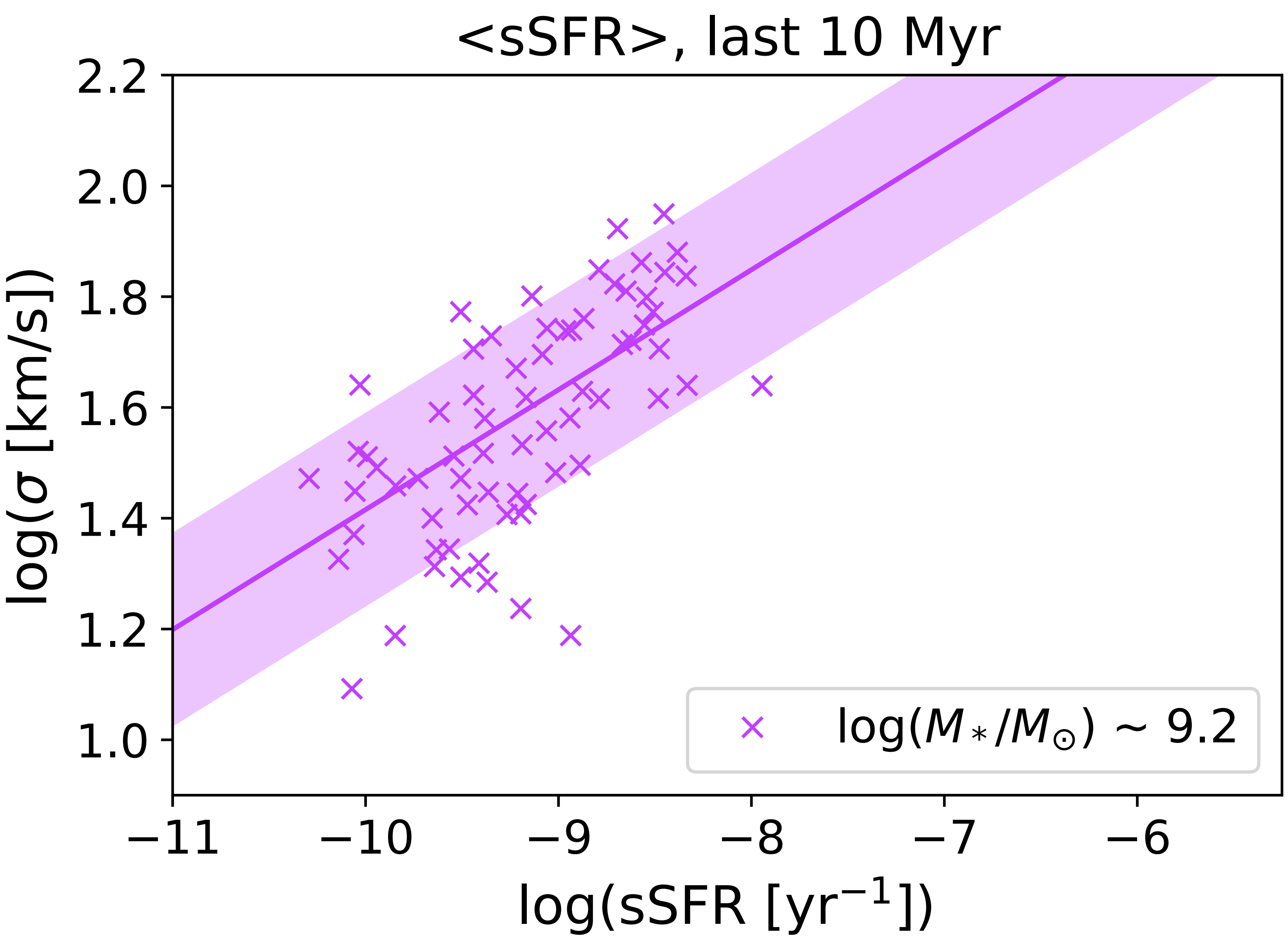


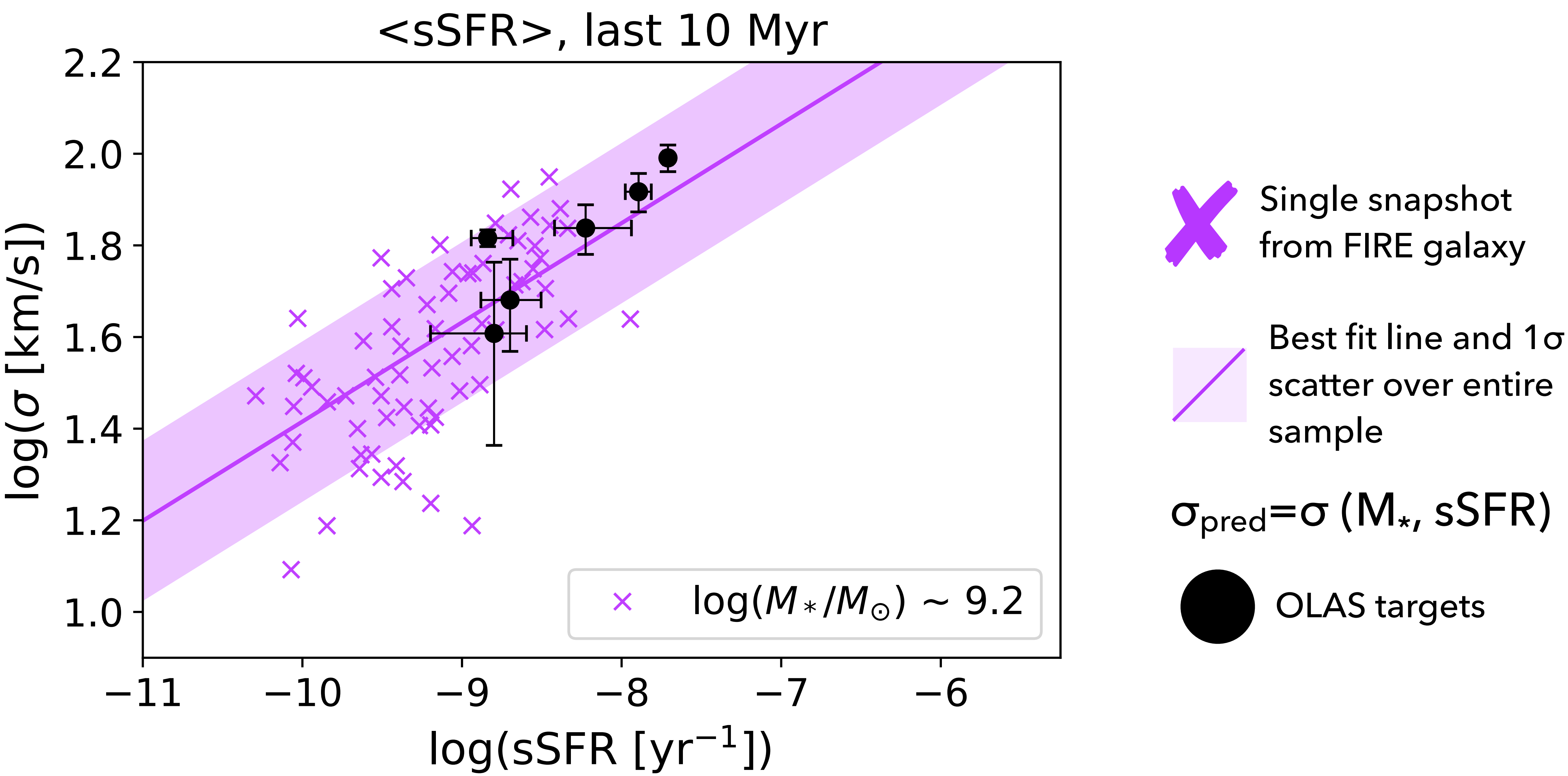
Single snapshot from FIRE galaxy

Best fit line and 1σ scatter over entire sample

$\sigma_{pred}=\sigma\ (M_*, \text{sSFR})$

Hirtenstein et al. 2019

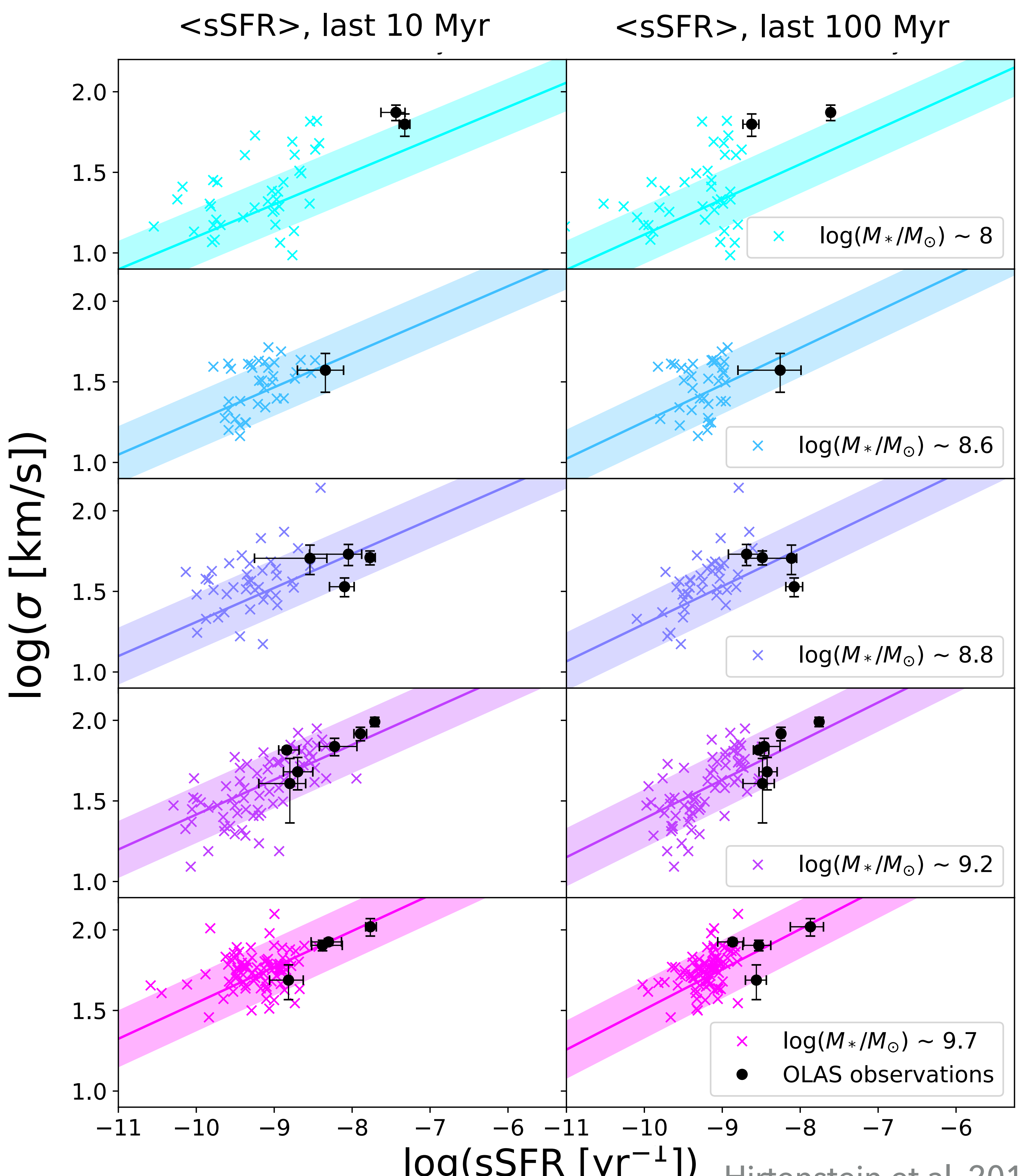
COMPARING WITH THE FIRE SIMULATIONS



Hirtenstein et al. 2019

COMPARISON AT FIXED M_*

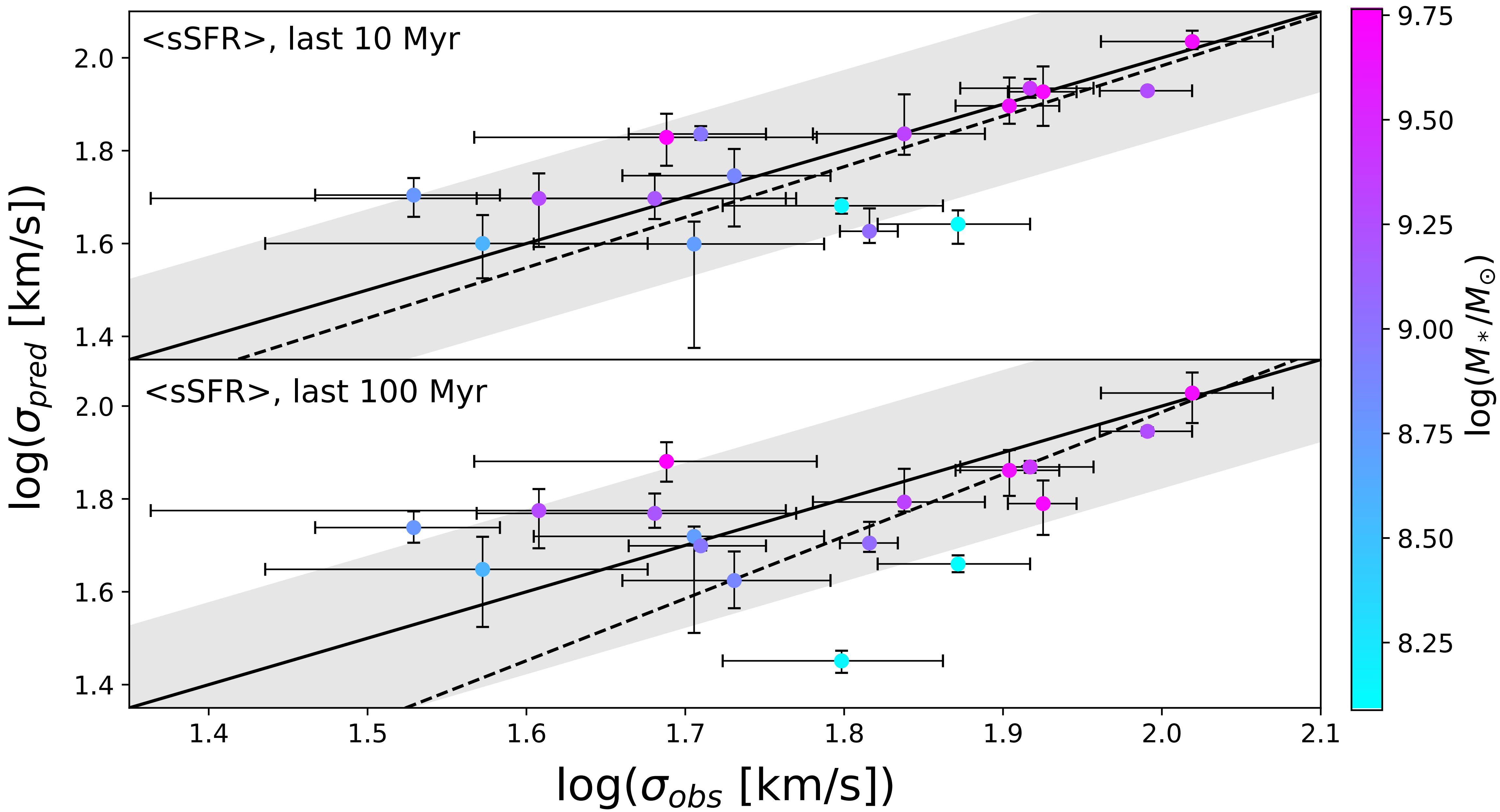
- OLAS galaxies exhibit same trends as in FIRE
  - Over both 10 and 100 Myr timescales
- OLAS samples at high end of sSFR



Hirtenstein et al. 2019

1-SIGMA AGREEMENT BETWEEN PREDICTED VS EXPECTED DISPERSION

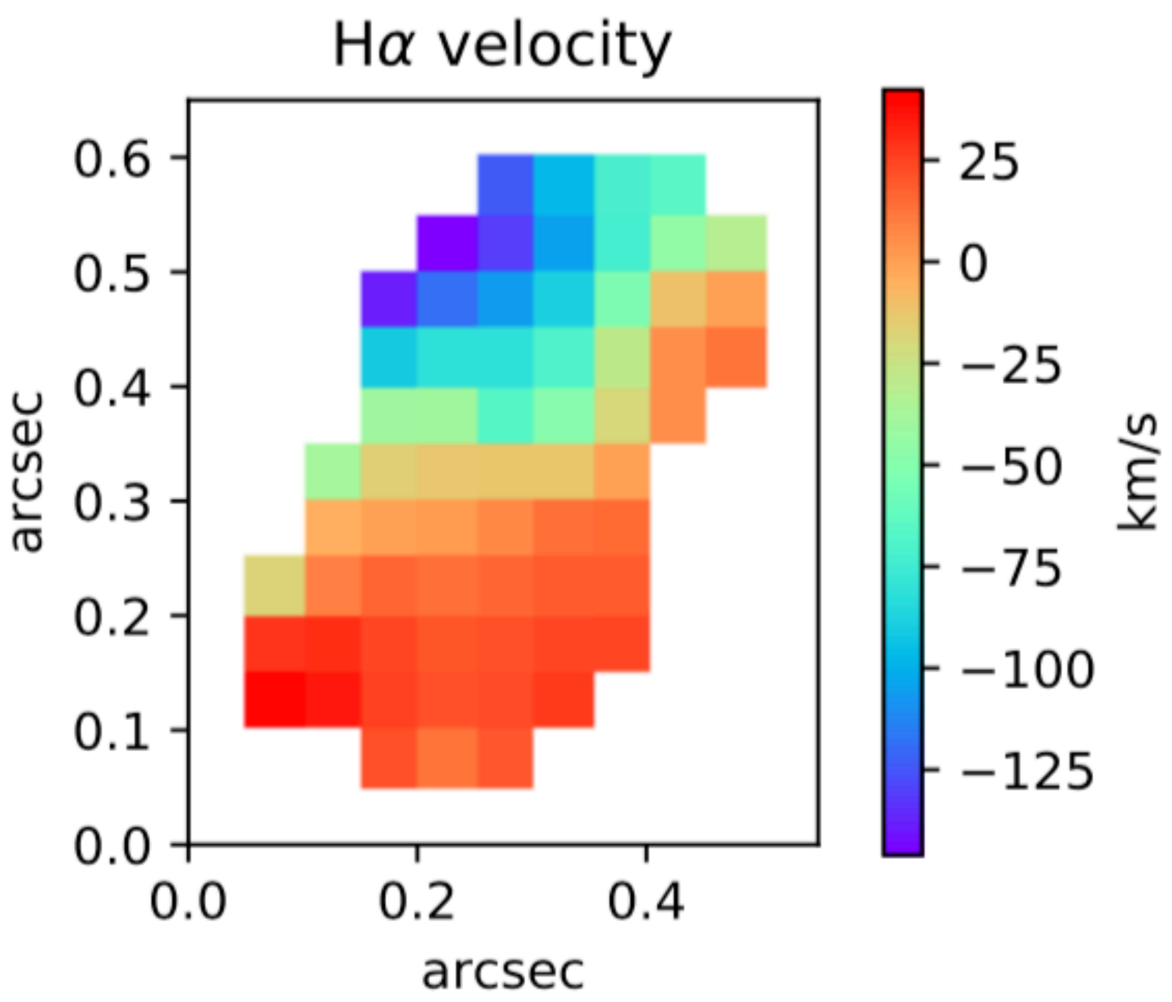
- OLAS supports feedback-induced core formation



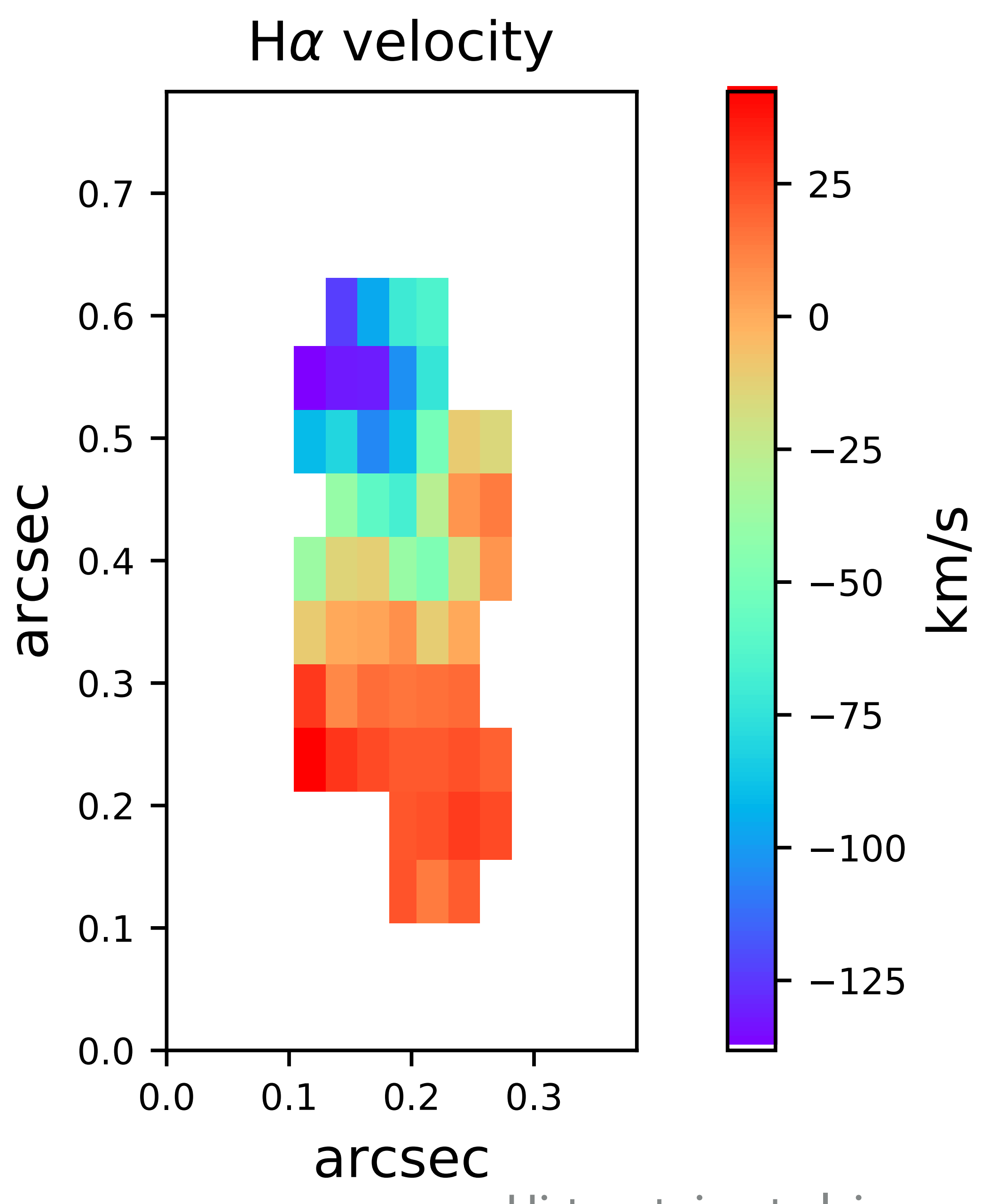
Hirtenstein et al. 2019

CONSTRAINING DWARF GALAXY MASS BUDGETS – PRELIMINARY!

Image plane



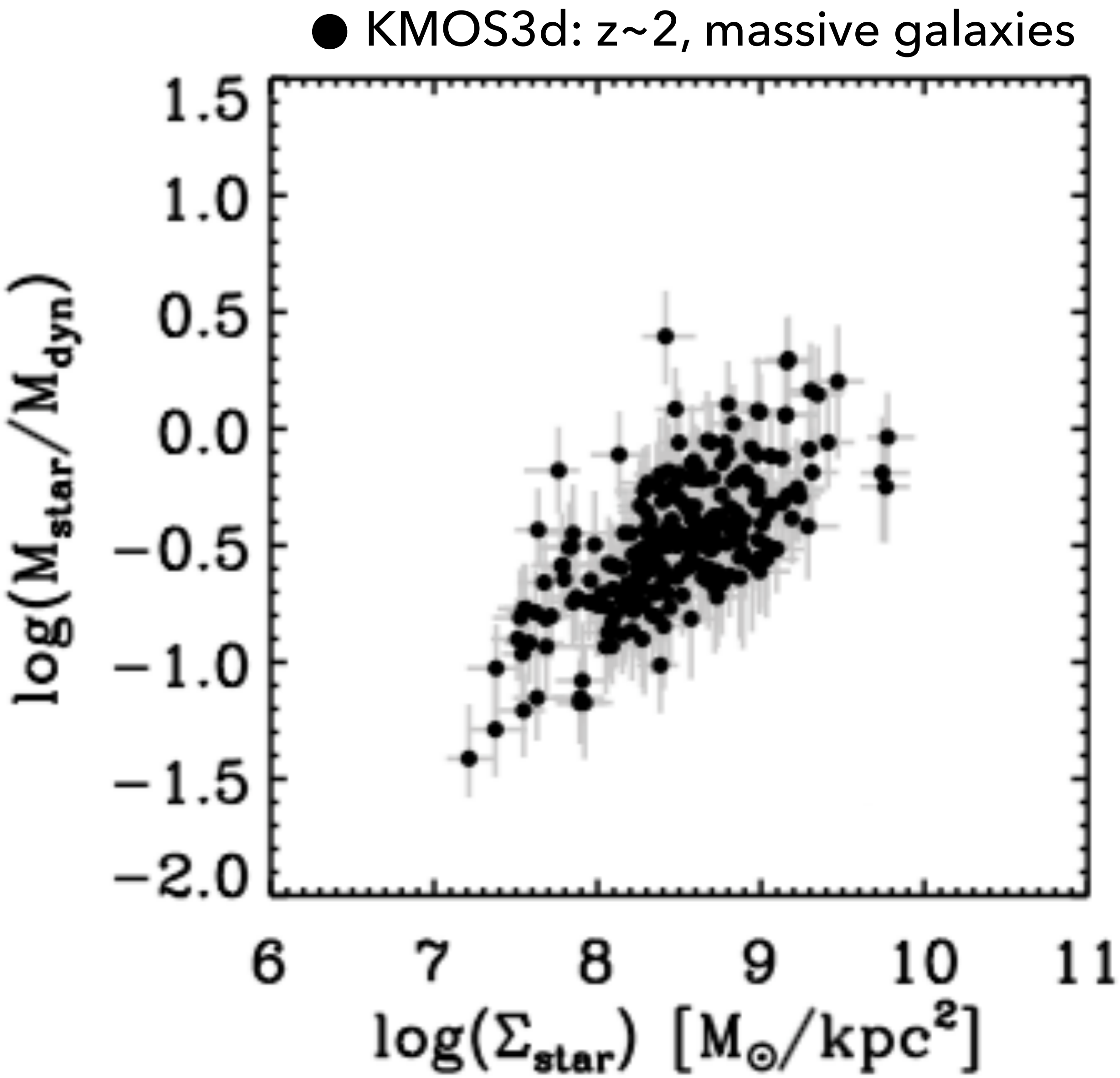
Source plane



Hirtenstein et al. in prep

CONSTRAINING DWARF GALAXY MASS BUDGETS – PRELIMINARY!

- Does this relationship hold for lower mass galaxies?
- Need dynamical mass of galaxies
  - $M_{dyn} = M_* + M_{gas} + M_{DM}$
- Examining the DM distribution in high redshift dwarfs:
  - Cusp → higher f_{DM} → lower f_*
  - Core → lower f_{DM} → higher f_*



Wuyts et al. 2016

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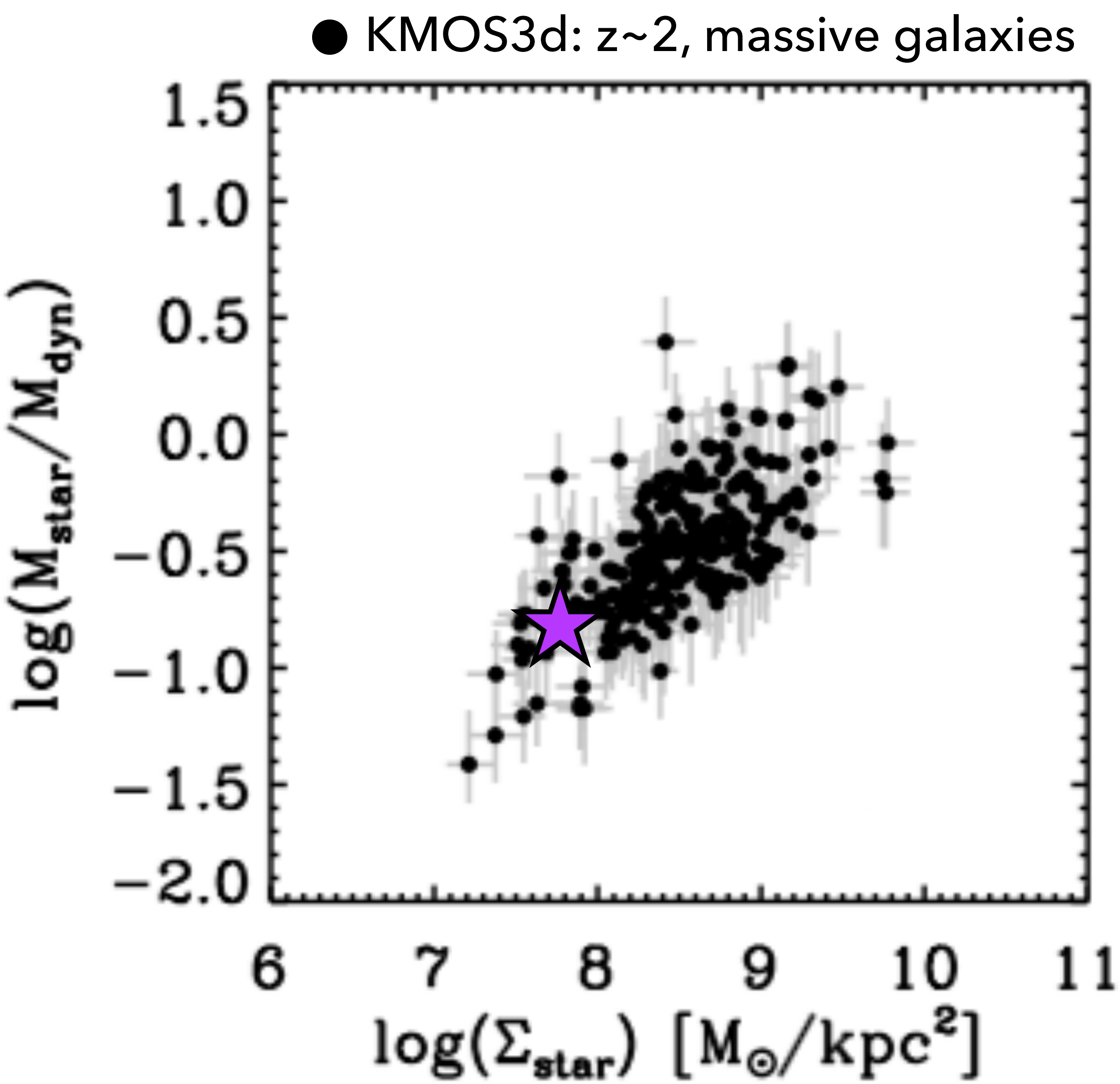

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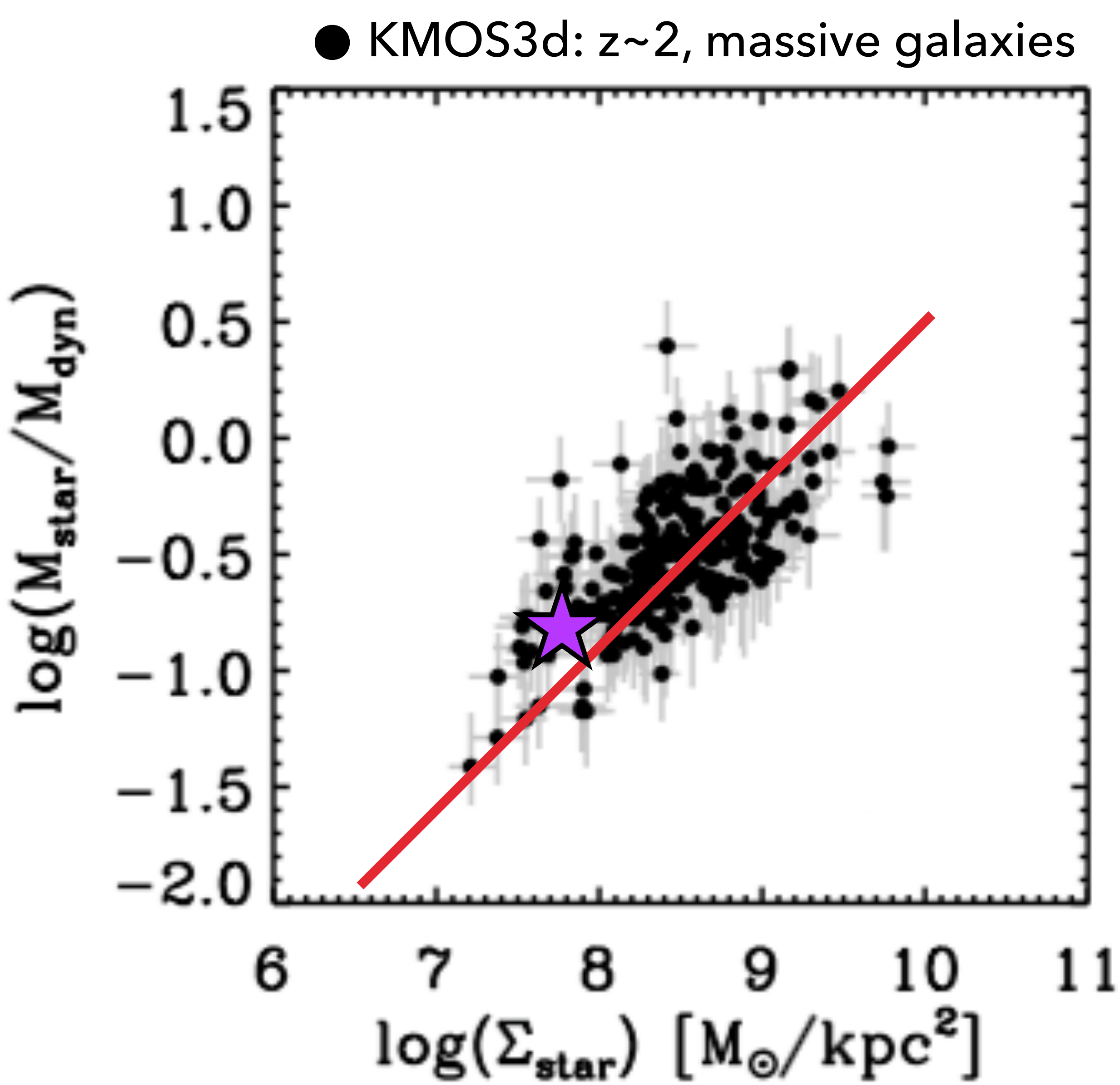

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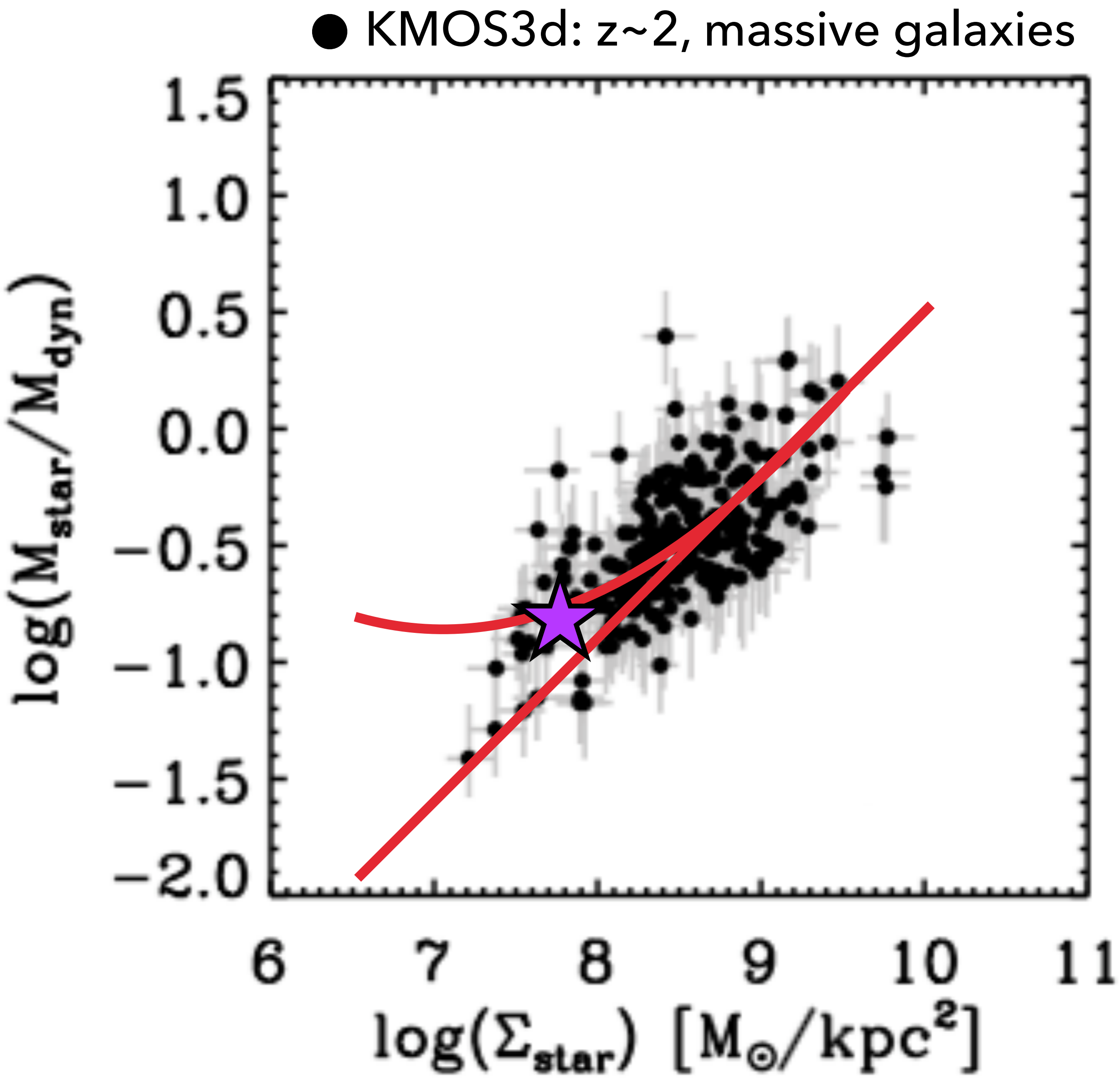

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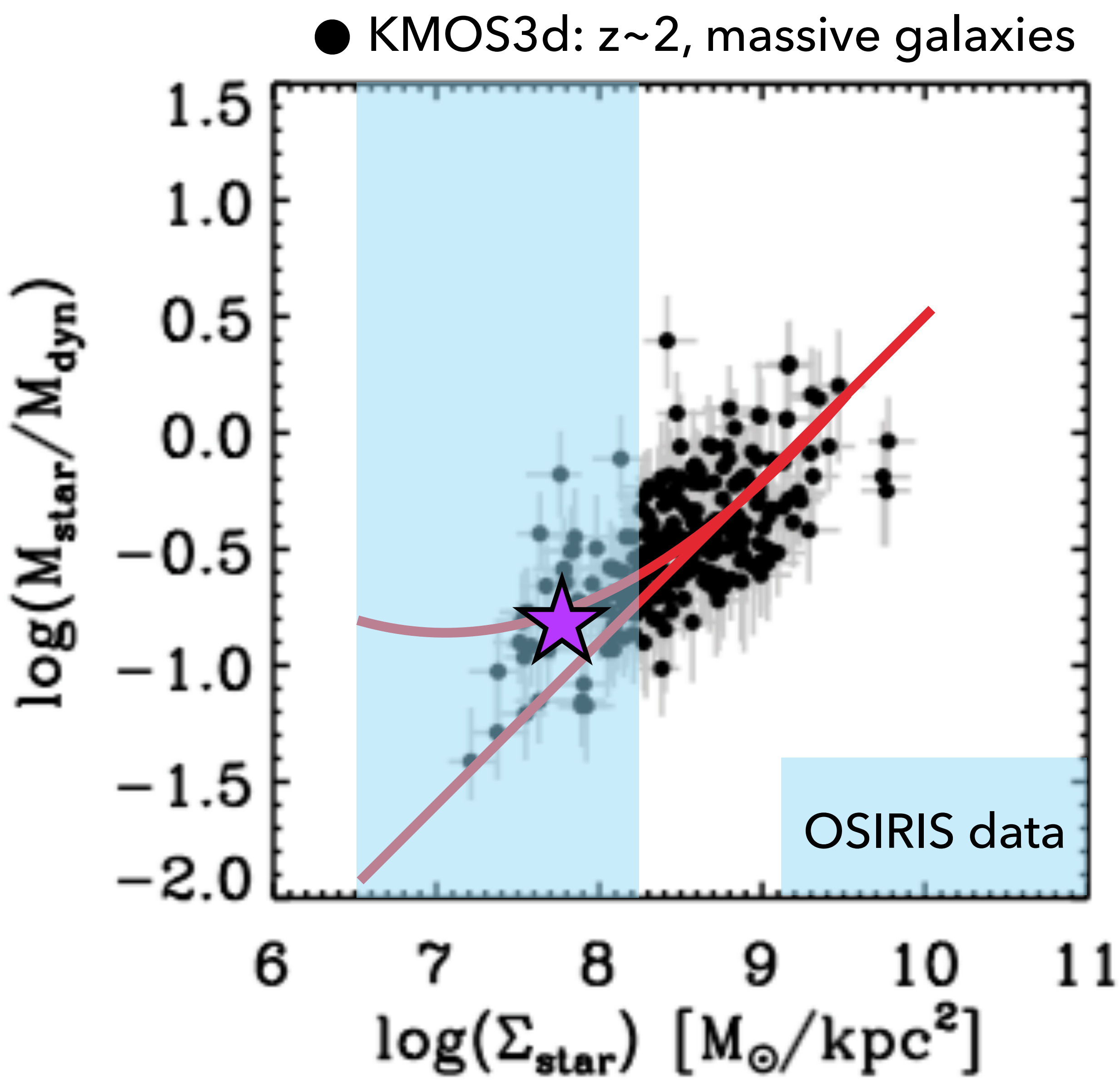

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SUMMARY

- Observed direct relationship between sSFR and velocity dispersion
  - OLAS observations agree with FIRE gas kinematics to within 1σ
- Kinematic signature of feedback altering kinematics
- OLAS supports stellar feedback induced core formation

PRELIMINARY RESULTS

- Constraining z~2 dwarf galaxy mass budgets
- Independent analysis of cusp-core using dynamical mass profiles