Stellar Metallicities as a Star Formation History Diagnostic

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You can’t have stars without star formation

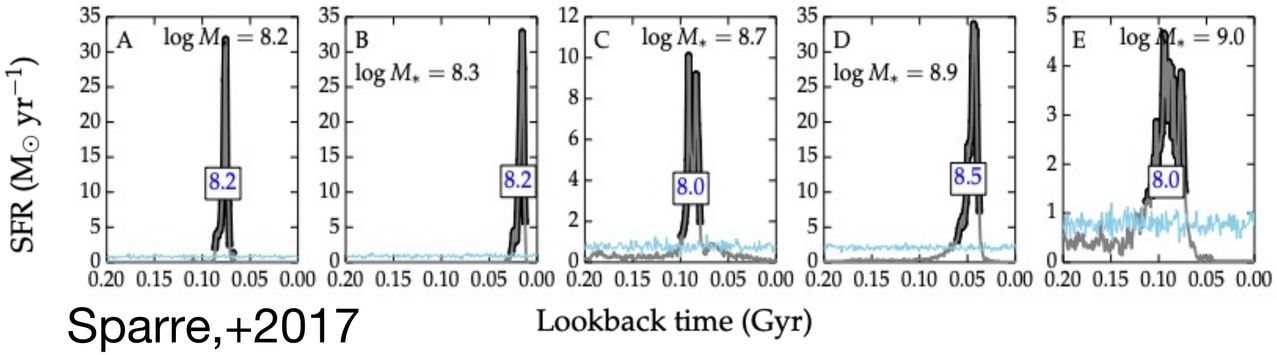
How fast do stars form within galaxies?

Star formation models in simulations

Two main prescriptions

Bursty star formation

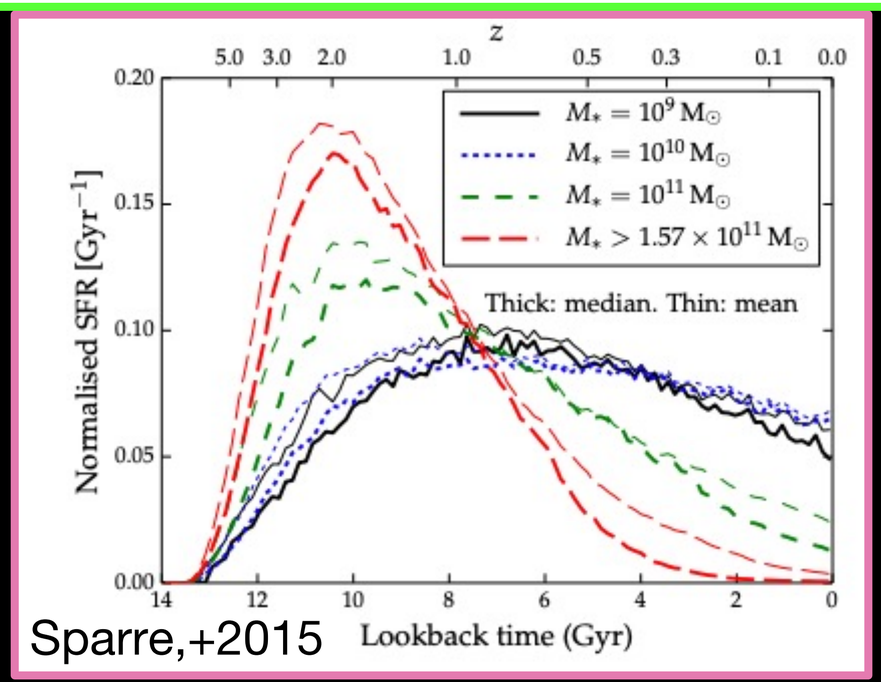
- A lot of stars in a short amount of time



Sparre,+2017

Smooth star formation

- Star formation over a longer period



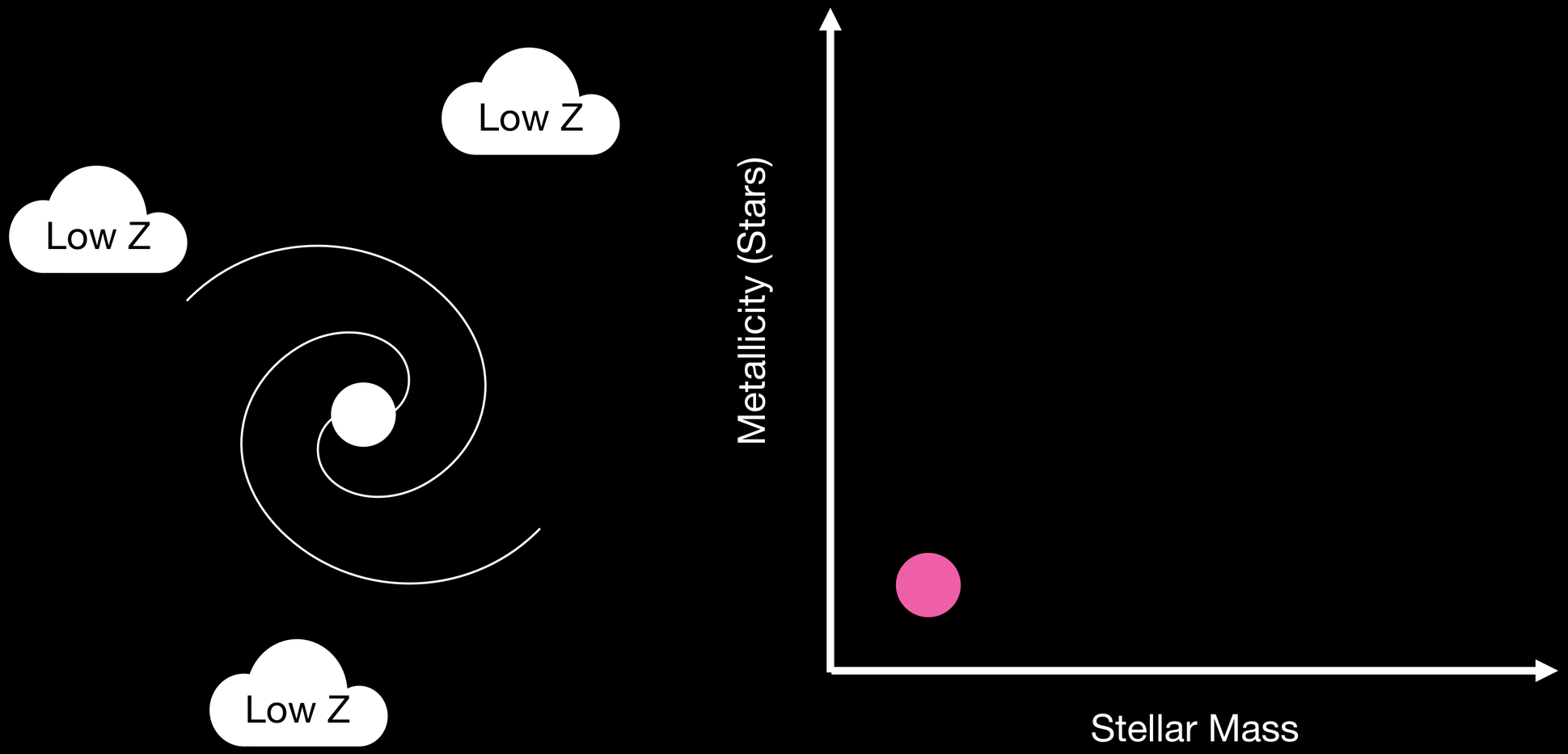
Sparre,+2015

“But Alex... What does this have to do with metallicity...?”

We need an observable constraint for our models

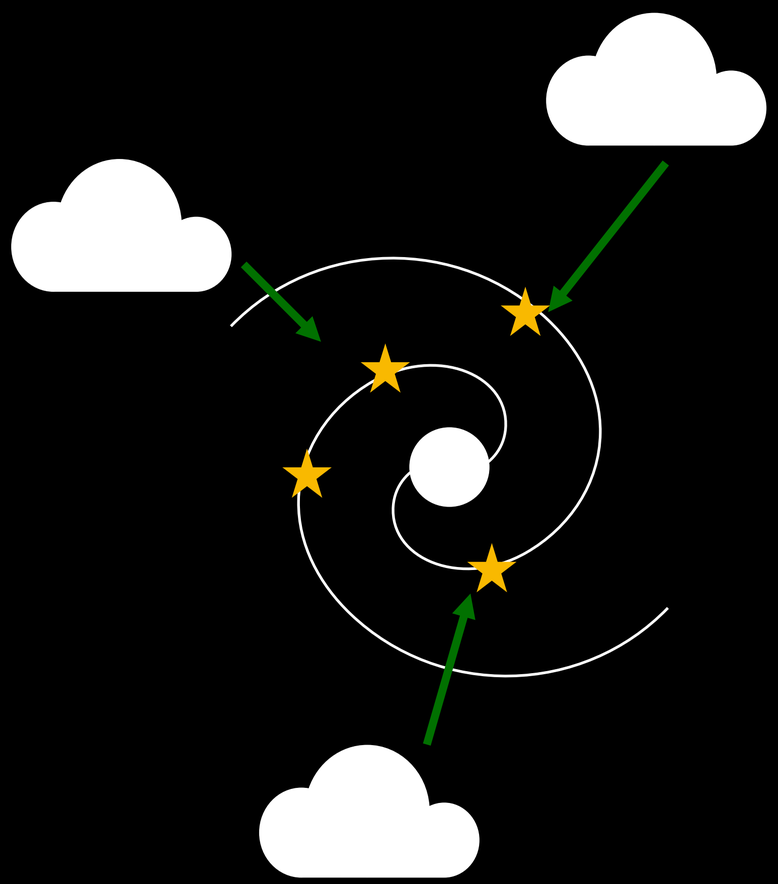
Smooth star formation

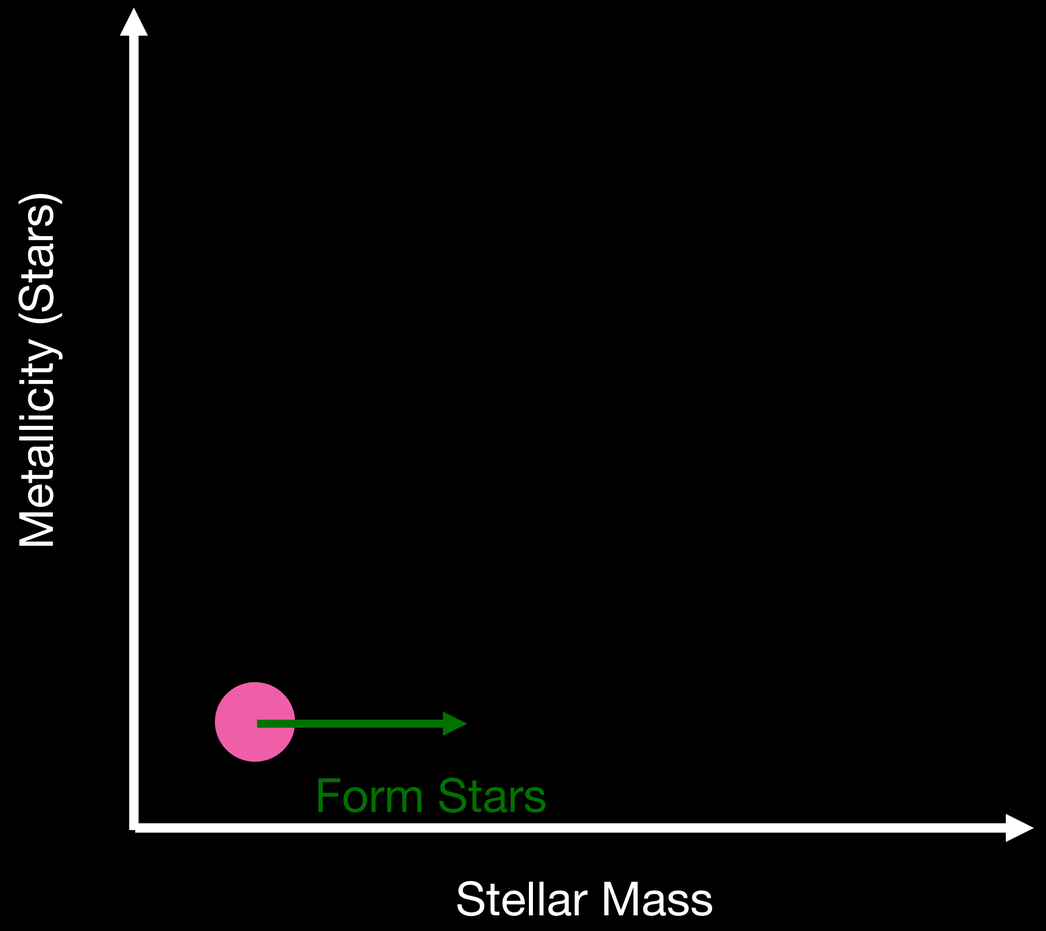
Stellar Metallicity



Smooth star formation

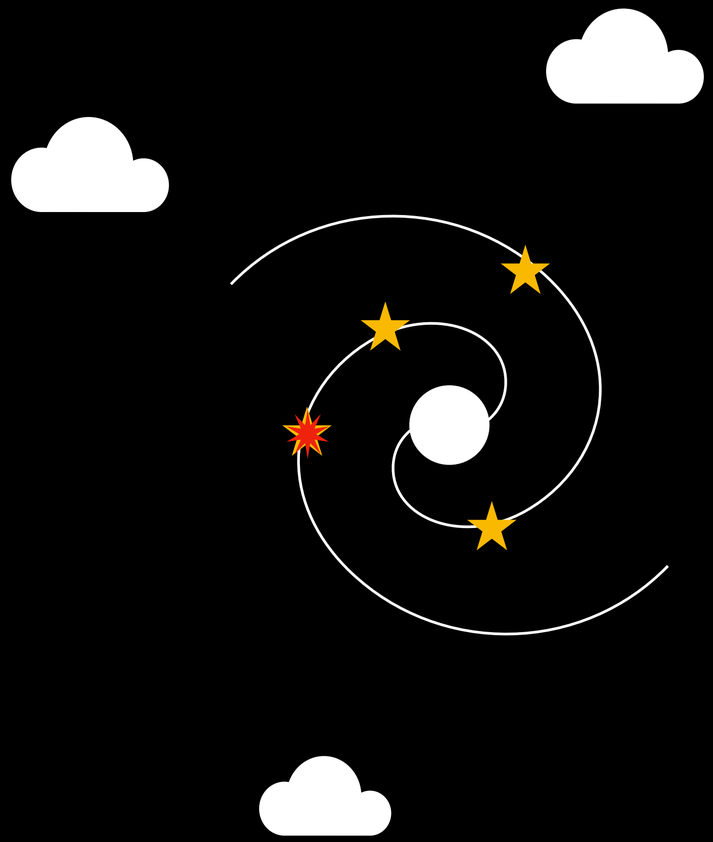
Stellar Metallicity

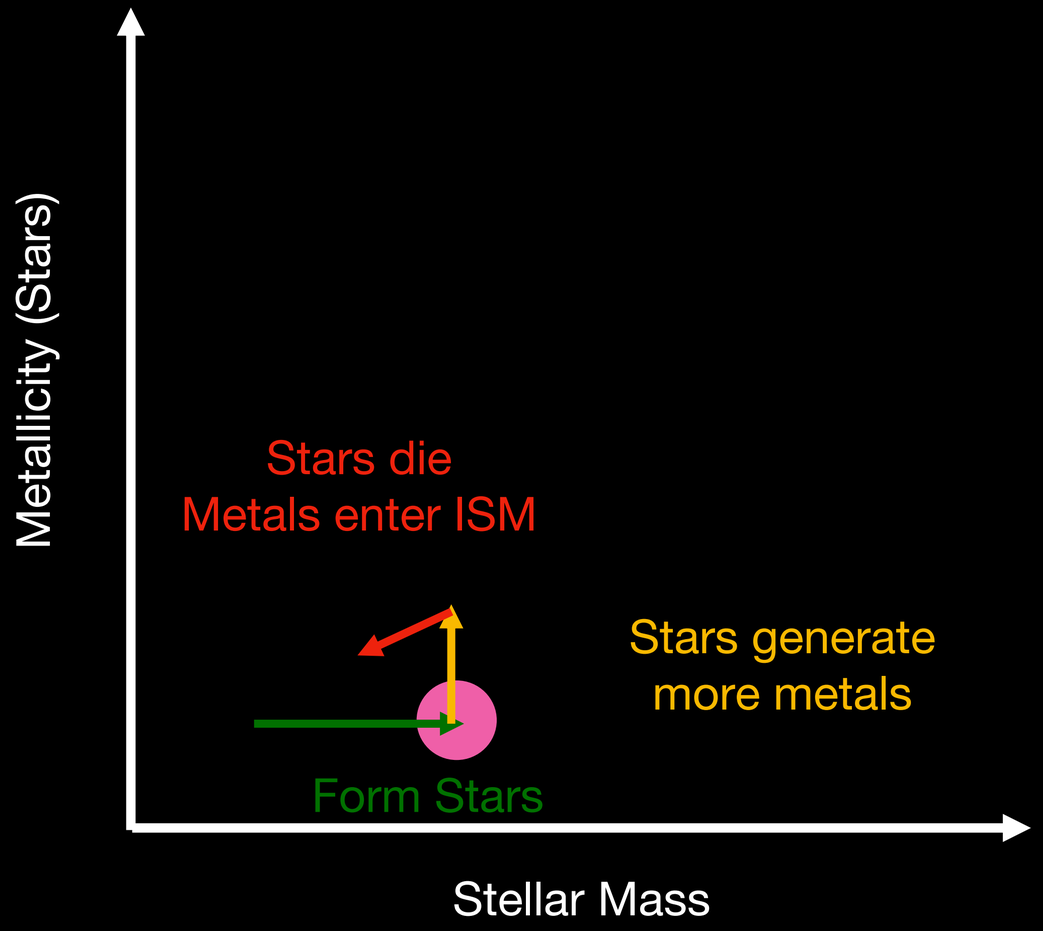




Smooth star formation

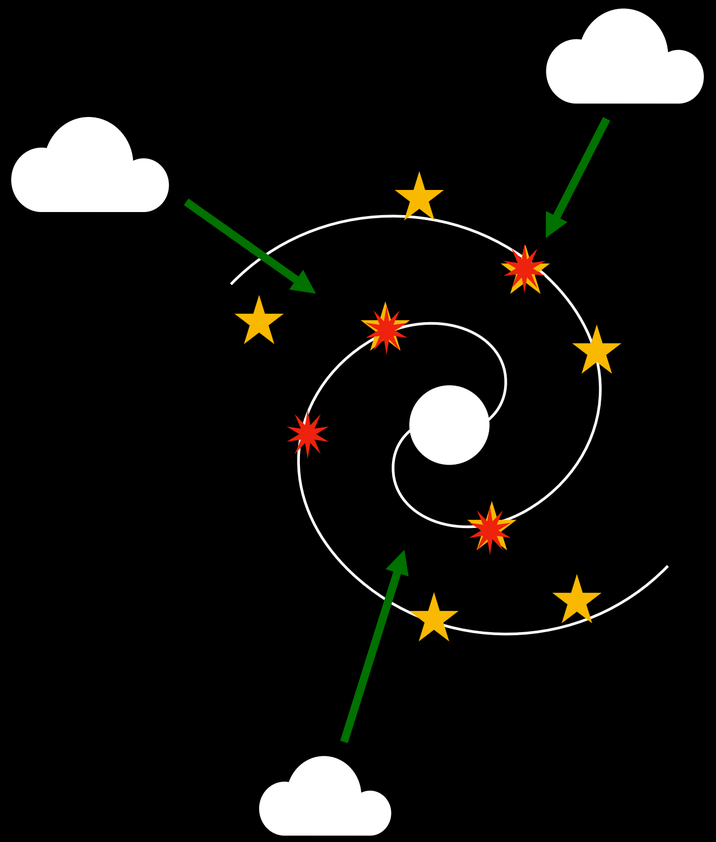
Stellar Metallicity

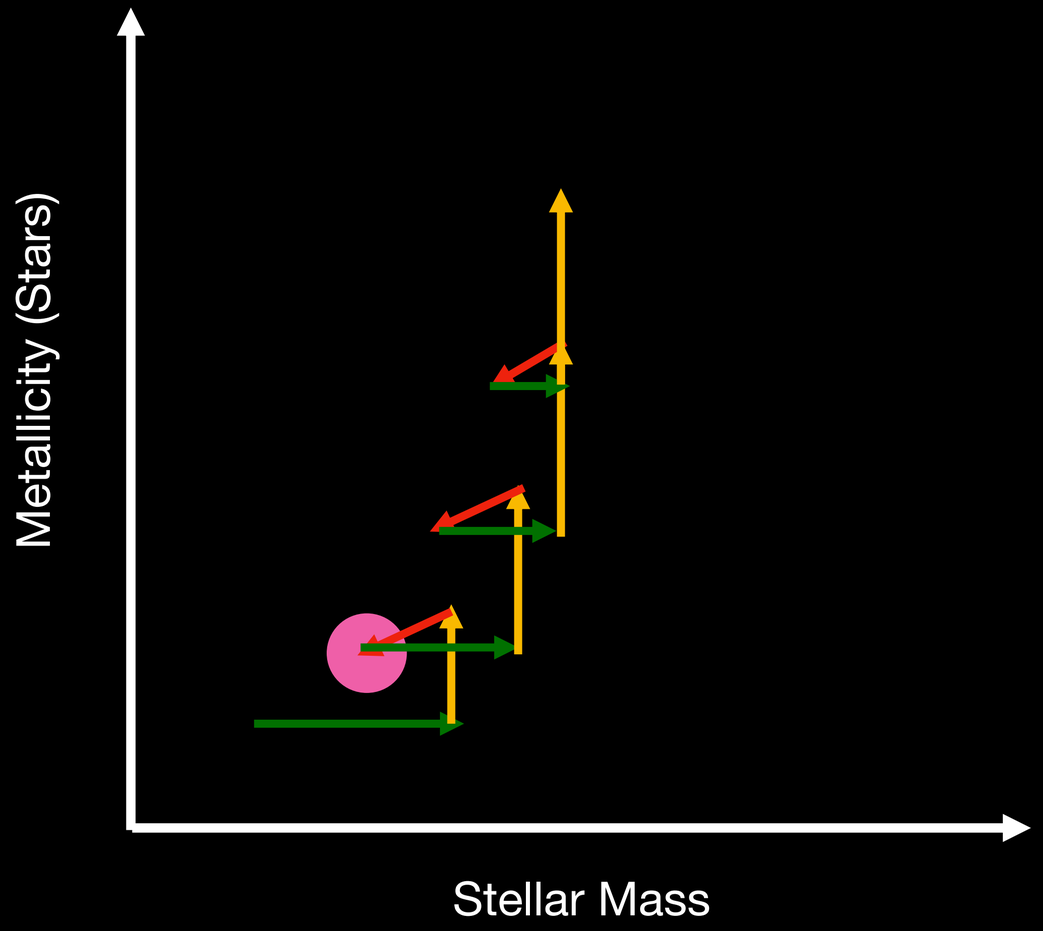




Smooth star formation

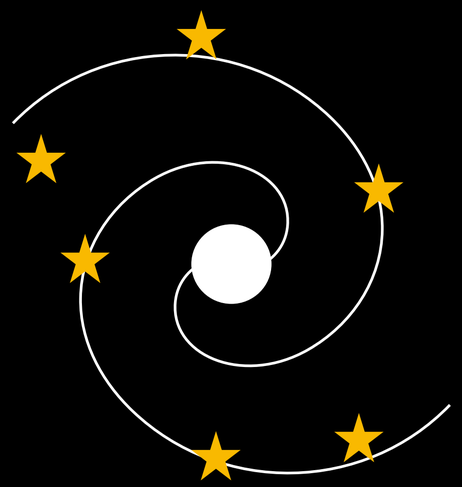
Stellar Metallicity

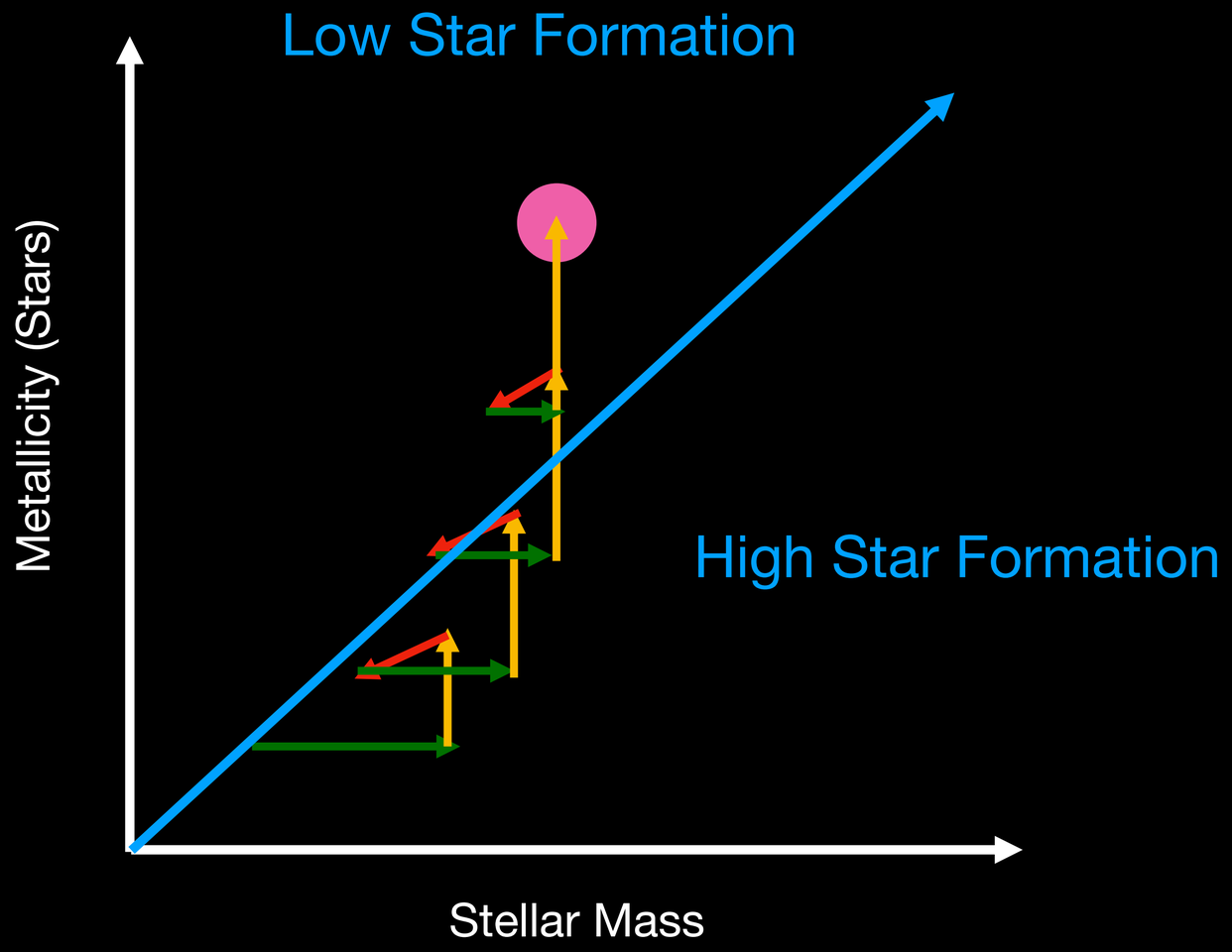




Smooth star formation

Stellar Metallicity



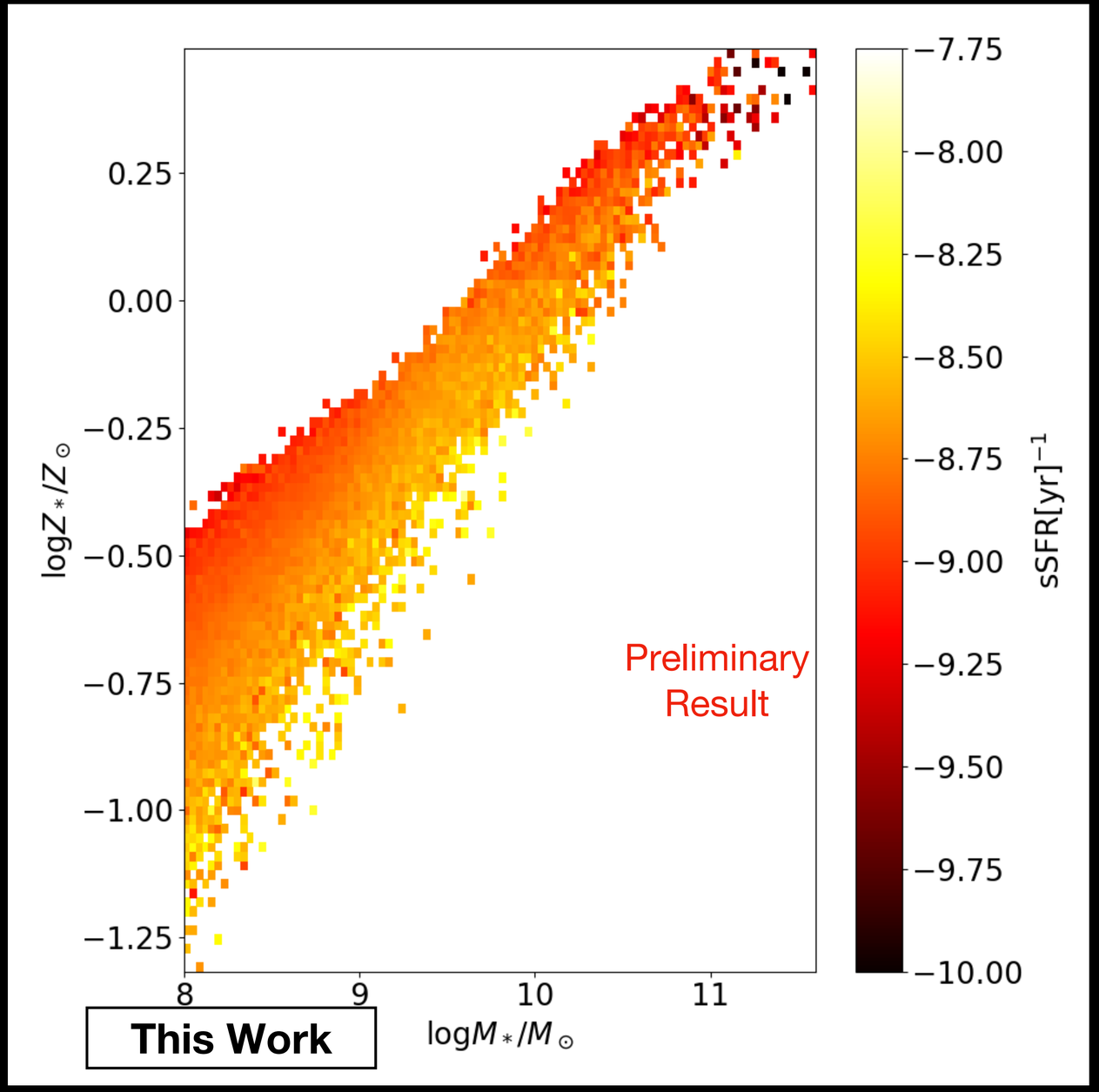


Fundamental Metallicity Relation

Fundamental Metallicity Relation

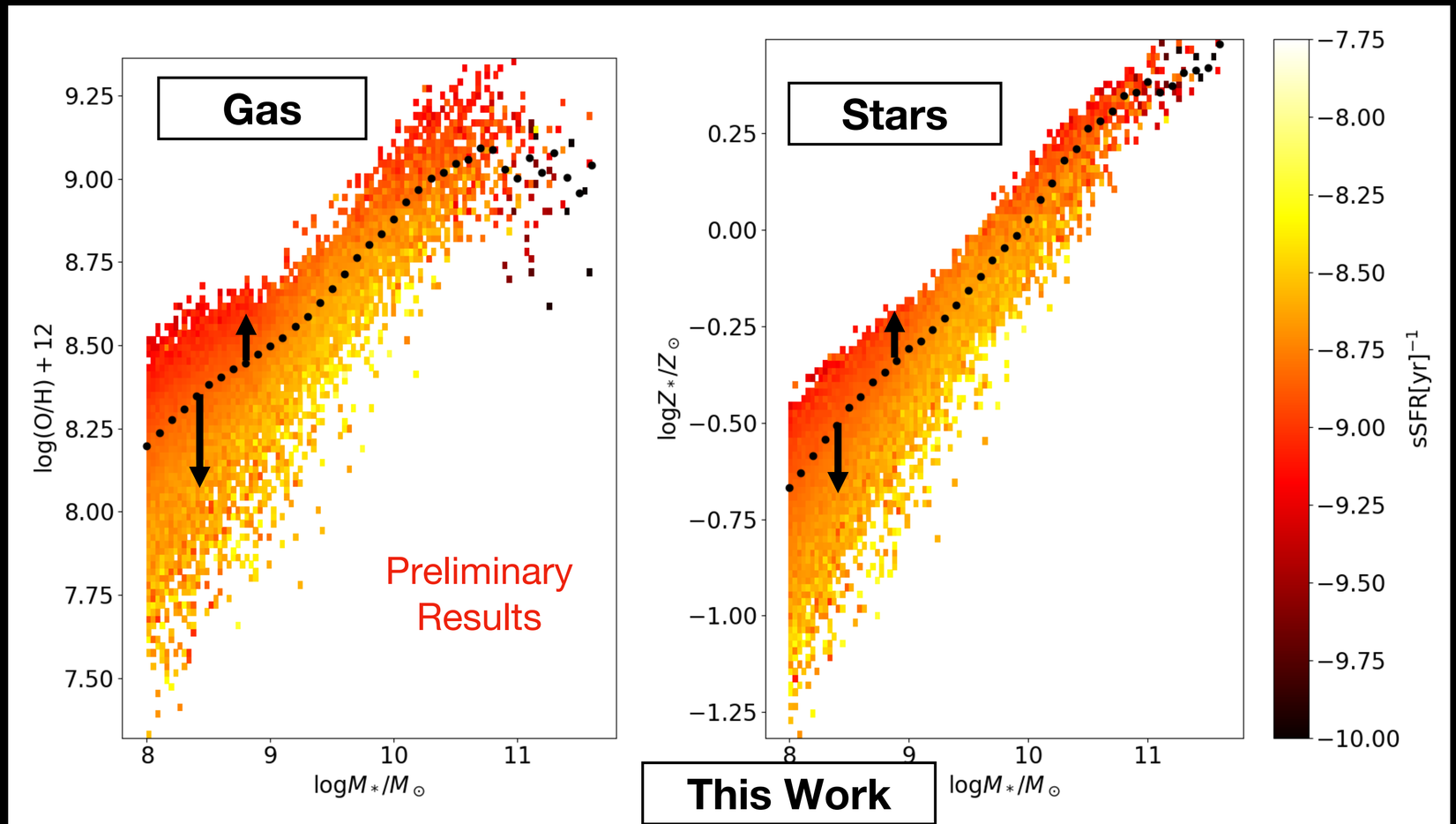
- For a given stellar mass
  - Low Metallcity → High Star formation
  - High Metallicity → Low Star formation

- Qualitatively holds for stellar metallicities in IllustrisTNG at high redshift
  - (shown for gas-phase Torrey,+2018)



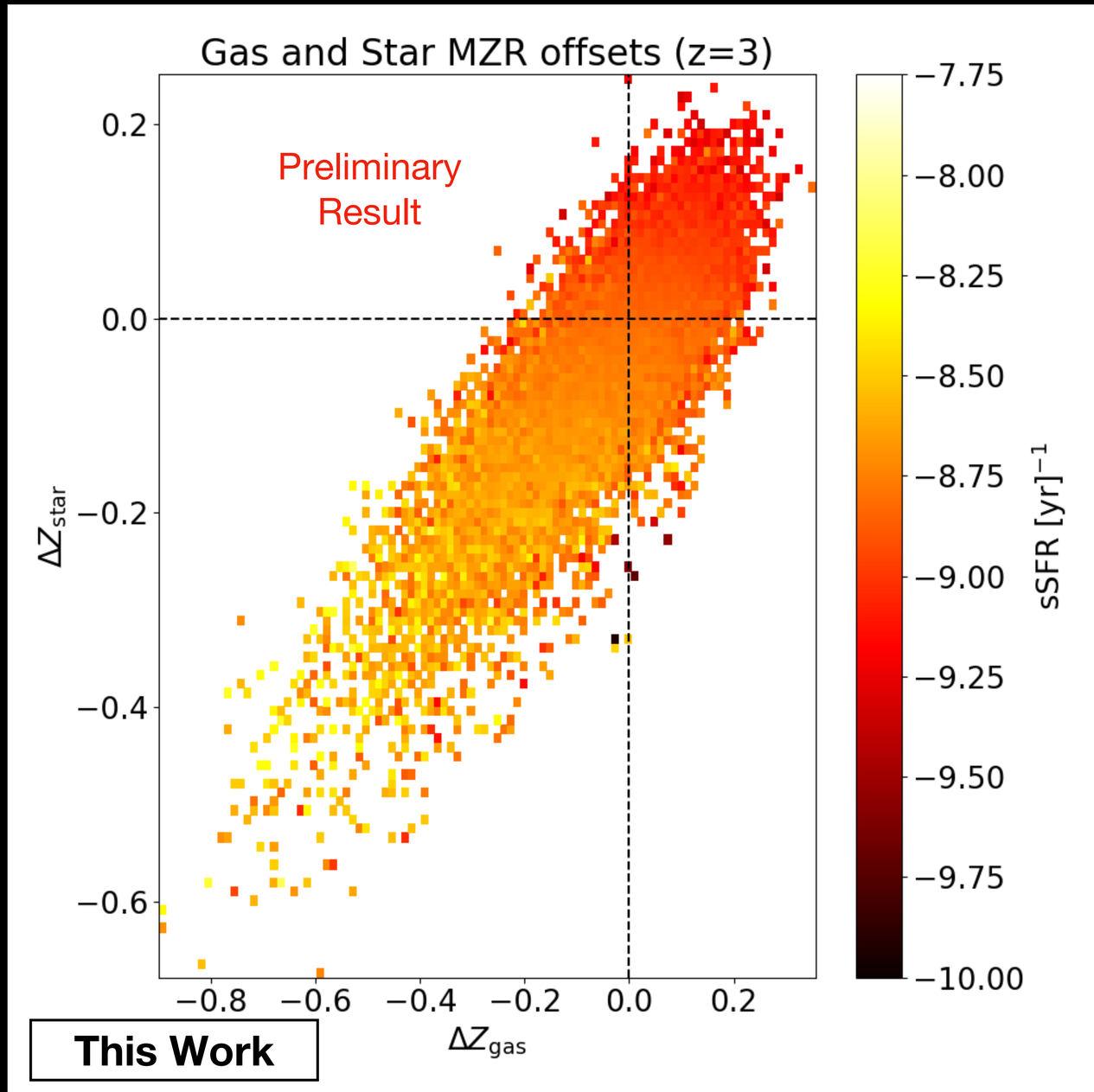
Quantifying FMR

- Define Mass-Metallicity Relationship
  - Gas-phase AND stellar
- Get offsets



Quantifying FMR

- Very similar relationship between both gas-phase and stellar metallicities
- FMR seems to hold in a very similar manner for both gas-phase and stellar metallicities
- Implicit assumption...
  - Smooth star formation!



What about bursty star formation?

More difficult to constrain

- Not obvious that an FMR should exist
  - More complex interactions
- FMR is a potential discriminator between star formation models
- Contention in literature so far... Unclear whether FMR exists observationally

Future Work

High redshift observations

- Currently high redshift observations are preferentially star-forming

- JWST

- Offer predictions for upcoming observations