# **DOES THE FUNDAMENTAL METALLICITY RELATION**



# **EVOLVE WITH REDSHIFT?**

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- THE EVOLUTION OF METALS IS A PROXY FOR THE PHYSICS UNDERPINNING THE BARYON CYCLE
- FUNDAMENTAL METALLICITY RELATION (FMR) IS RELATIONSHIP BETWEEN STELLAR MASS, GAS-PHASE METALLICITY, AND SFR OF GALAXIES
- Low-z observations suggest FMR *might be* redshift-invariant...
  JWST results at high-z seems to suggest otherwise...

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### **SIMULATIONS**

ILLUSTRIS, ILLUSTRISTNG, EAGLE, AND SIMBA

• STAR-FORMING CENTRAL GALAXIES



## How FMR Works Physically

- GAS INFLOWS ADD PRISTINE GAS AND FUEL NEW SFR
   (LOW METALS & HIGH SFR)
- NEW SFR ENRICHES ISM AND DEPLETES GAS

(HIGH METALS & LOW SFR)





### **RESULTS**

- 1. THE ROLE OF SFR IN SETTING THE SCATTER ABOUT THE MZR CHANGES IN EVERY SIMULATION!! (ABOVE)
  - "WEAK" FMRS ALL FOUR SIMULATIONS' SFR IMPORTANCE VARY!
- 2. THE CHANGING IMPORTANCE WITH REDSHIFT ALSO HAS IMPLICATIONS FOR THE NORMALIZATION OF THE MZR!! (RIGHT)
  - TNG AND EAGLE UNDERPREDICT METALLICITY EVOLUTION!
    ("DYNAMIC" FMR)
  - ILLUSTRIS AND SIMBA APPROXIMATELY CORRECTLY PREDICT METALLICITY EVOLUTION ("STATIC" FMR)

#### WHY DOES THIS MATTER?

- THE FMR DIRECTLY TRACES THE BARYON CYCLE OF GALAXIES
- THE CURRENT FMR FRAMEWORK COMPLETELY IGNORES(!!) SALIENT INFORMATION ABOUT HOW GALAXIES EVOLVE BY ASSUMING NO EVOLUTION





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#### BACKGROUND IMAGE CREDIT: EAGLE COLLABORATION