

# Radio constraints on SFR

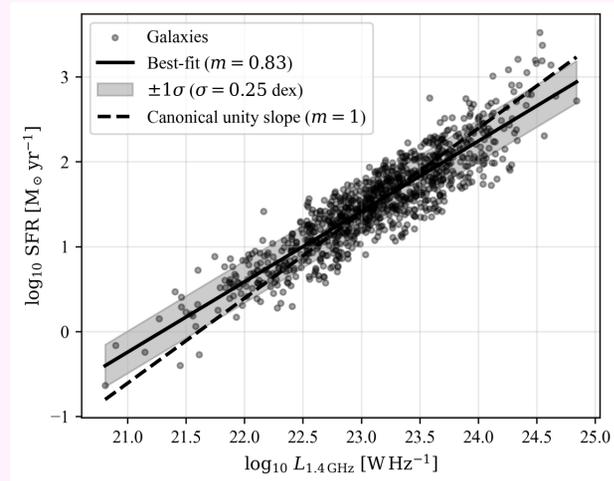
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How much star formation variance can 1.4GHz Radio emission reveal?

Shingirai Makechemu, James Chibueze, and Brooke Simmons. ApJ 2026 (in review)

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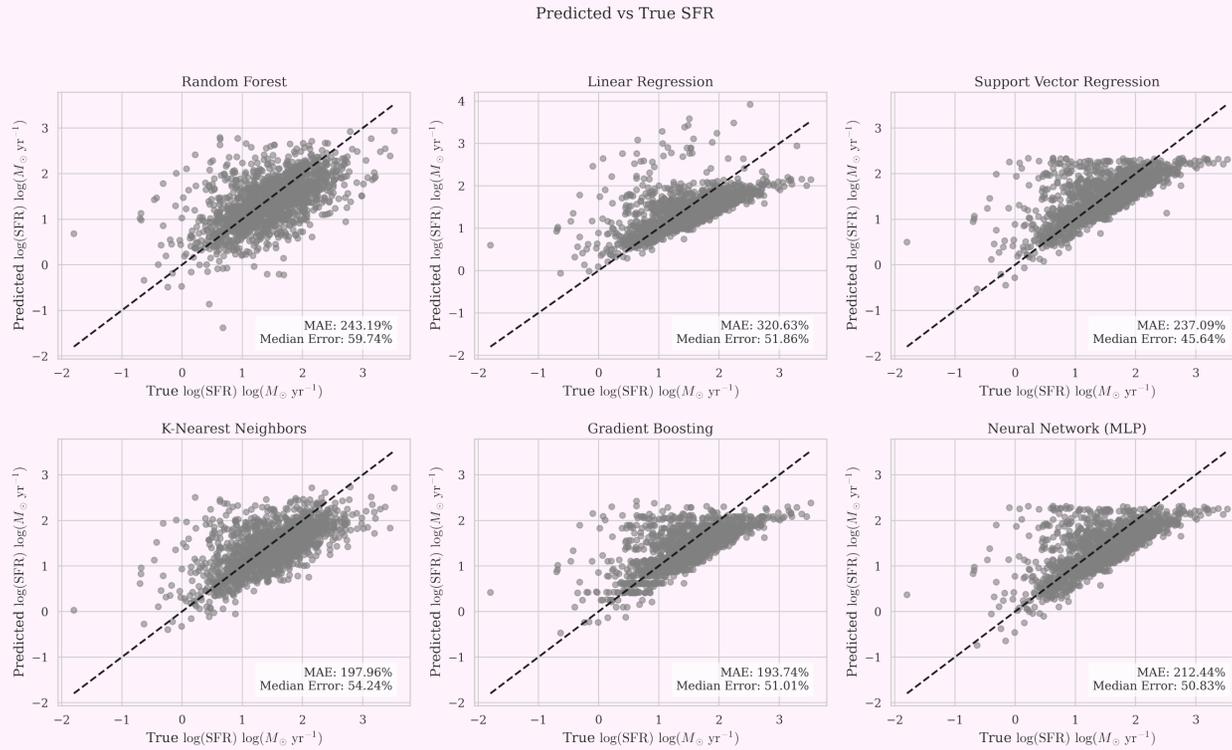
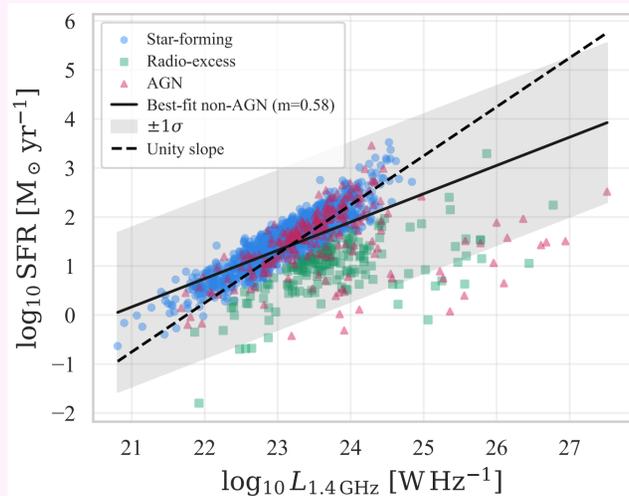


**Rest-frame 1.4 GHz radio luminosity versus infrared-derived SFR for the matched COSMOS sample.** Star-forming galaxies are shown as blue open circles, radio-excess sources as green open squares, and AGN hosts as red open triangles. The solid black line shows the best-fit linear relation excluding AGN; the shaded region indicates the  $1\sigma$  intrinsic scatter. The dashed line shows a unity-slope relation normalized at the sample median that radio luminosity alone cannot reliably recover SFR.

## Canonical radio 1.4GHz - SFR relation (Radio-SFR relation).

*Useful* because it is largely insensitive to dust extinction and can be observed efficiently over wide areas (Condon1992, murphy2011, Smolcic2017)

*However*, radio luminosity depends not only on star formation but also on magnetic field strength, cosmic-ray transport, and energy-loss processes that vary with galaxy mass, structure, redshift, and environment (lacki2010a, murphy2009, Schleicher2016)



**Predicted versus true SFRs for the full suite of regression models trained using radio-only inputs.**

The dashed line indicates the 1:1 relation. Even flexible non-linear models fail to recover accurate SFRs, indicating a fundamental information

**Cumulative cross-validated R2 for predicting log LTIR,SF as a function of information-ladder rung (fixed matched sample, N = 4843; seed = 42).**

MLP error bars show the standard deviation across K = 5 folds. The dominant performance jump occurs at the morphology rung (Gini, concentration, asymmetry), which alone provides a gain ( $\Delta R^2 = 0.12$ ) exceeding the cumulative contributions of all other auxiliary variables by a factor of  $\sim 15$ .

