Refining Dust Extinction Corrections for Hα Luminosity Functions Using Radio-Based Calibration

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1. BACKGROUND

Star formation rates (SFRs) are key to studying **galaxy evolution**.

Optical tracers of SFR are limited by **dust attenuation**, which absorbs starlight and re-emits it in the infrared [3]. This **dust obscuration** introduces errors in direct SFR measurements [2].

Additionally, SFR estimates depend on the assumed stellar **initial mass function**, which influences inferred rates [1].

We introduce a radio-calibrated method to correct **Hα luminosity functions** for dust extinction, enabling SFRD estimates without direct attenuation measures.

2. OBJECTIVES

1. Apply a novel approach to correcting Hα luminosity functions for dust extinction by incorporating a radio-based calibration of luminosities.
2. **Refine Dust Correction Methods**, especially at higher redshifts (z>5) to account for new and upcoming data from JWST where traditional optical dust tracers are unavailable.
3. Determine how the star formation rate density over cosmic time is affected by such corrections.

3. SFR RELATIONSHIP

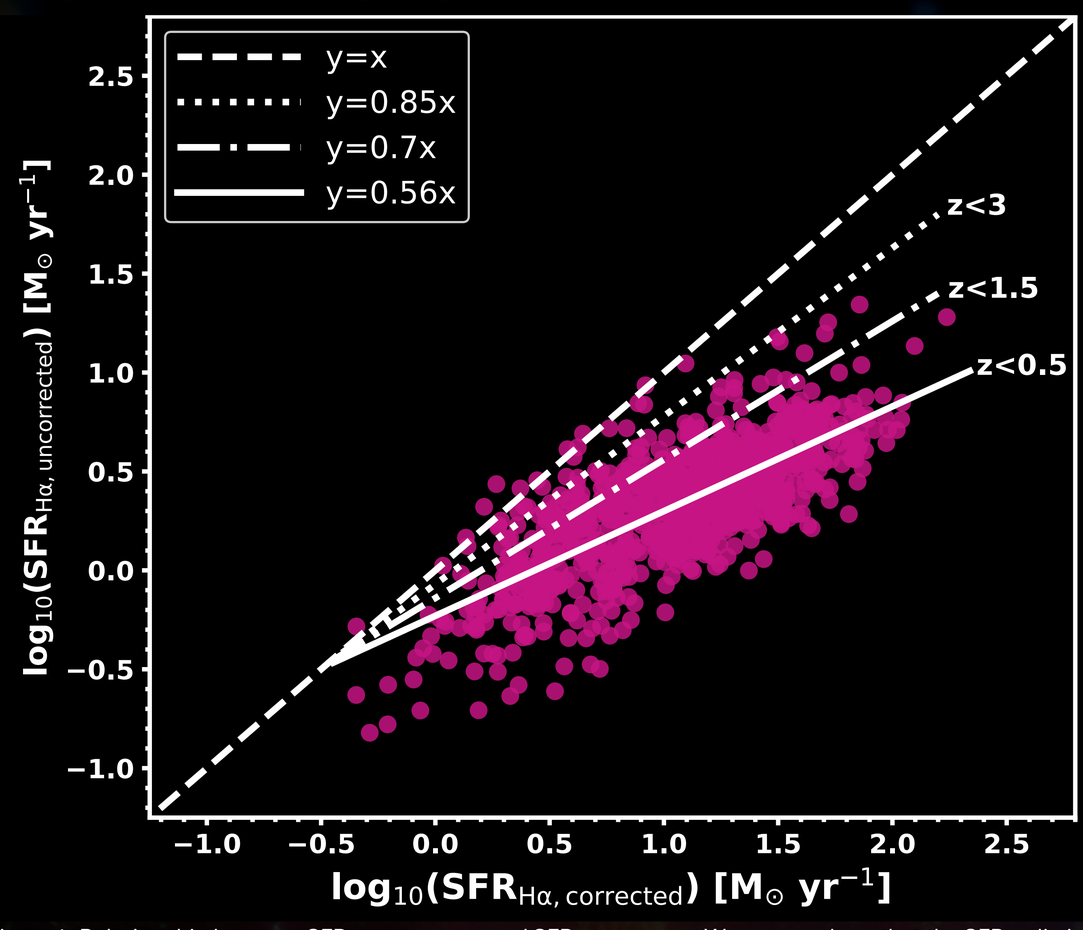

Figure 1: Relationship between $SFR_{Hα,uncorrected}$ and $SFR_{Hα,corrected}$. We assume here that the SFR radio is unaffected by dust and therefore can be considered as the '$SFR_{Hα,\ corrected}$' value. This is done for a fit to the data, assuming a 1:1 relationship and two slopes in between.

4. METHODS

Raw or de-corrected published Hα luminosities (0<z<8) → Convert to $SFR_{Hα,uncorrected}$ → Convert using $SFR_{Hα,corrected} \equiv SFR_{Radio}$ → $SFR_{Hα,corrected}$ scaled back to corrected Hα luminosities

5. LUMINOSITY FUNCTIONS

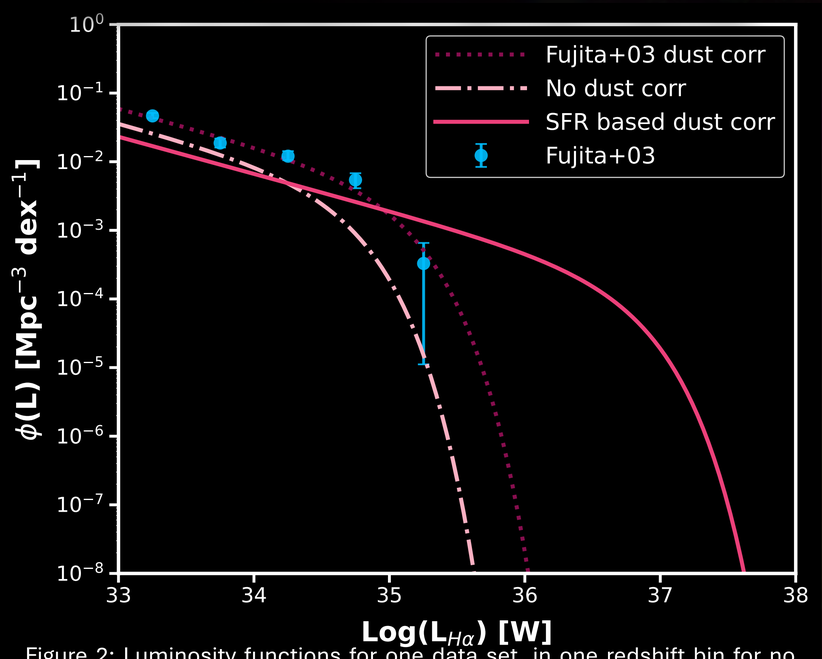

Figure 2: Luminosity functions for one data set, in one redshift bin for no dust correction, paper adopted correction, and our maximum correction.

6. RESULTS

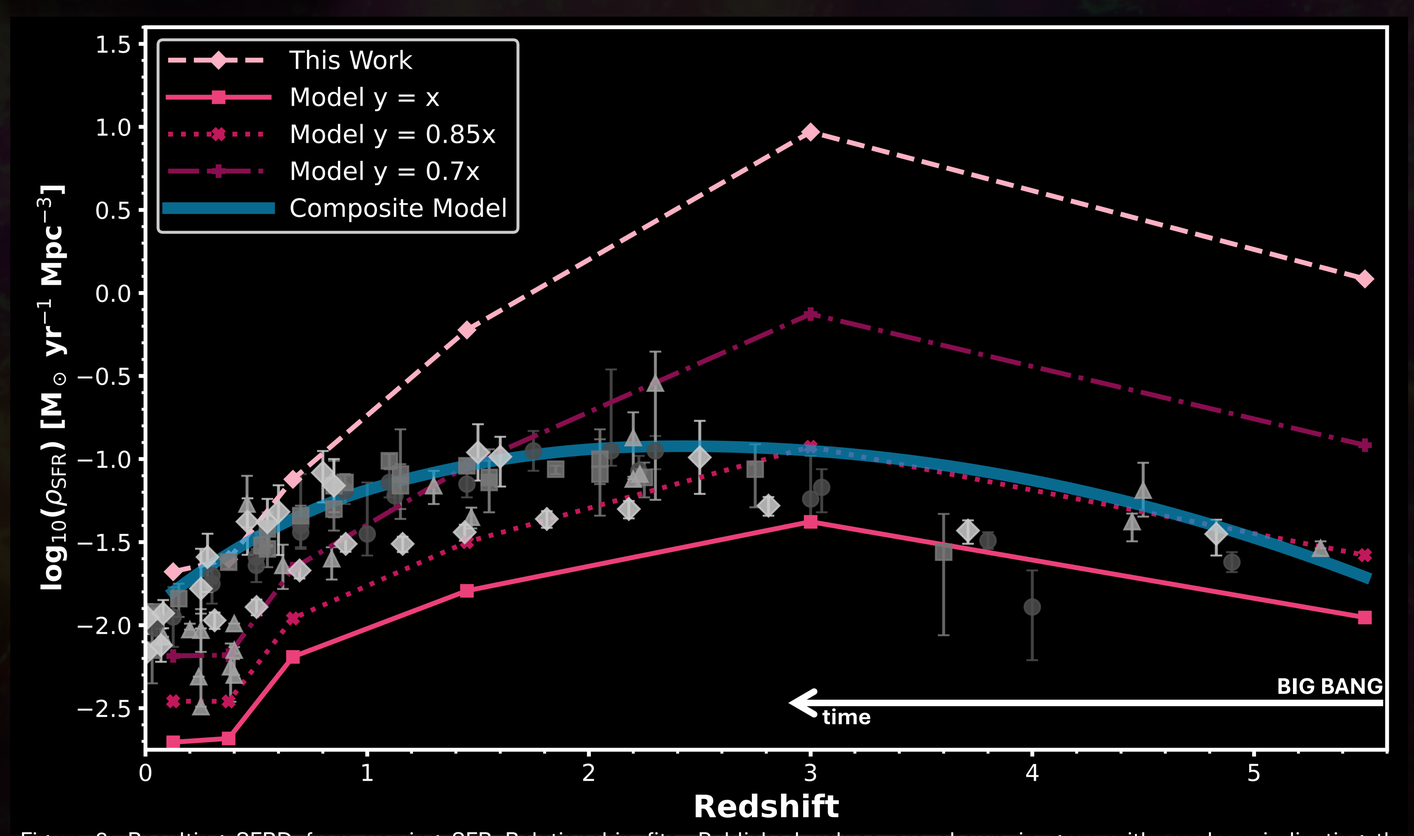

Figure 3: Resulting SFRD from varying SFR Relationship fits. Published values are shown in grey, with markers indicating the observational tracer: UV (circles), Hα (triangles), infrared (squares), and radio (diamonds). Blue is the model combination that best fits the published data.

- Using our dust correction relationships, we can find the corrected luminosities allowing us to find the SFR and **SFRD** in each redshift bin.
- Our results show that the local fitted relationship is an **extreme** upper limit for correction further back in cosmic time.
- Through our interim model ranges we **provide constraints** on the inferred time - dust relationship
- We show that the **dust model likely evolves over time** with some dependence on luminosity.

7. CONCLUSIONS

- At higher redshifts, like those probed by JWST, direct dust correction isn't possible, so estimates rely on lower-redshift data.
- We find that a fitted SFR relation helps correct for dust locally, but it likely **evolves over cosmic time**.
- Our results suggest that **dust obscuration in star-forming galaxies decreases with increasing redshift compared to the nearby universe.**

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