DUVET: sub-kiloparsec resolved star formation driven outflows in a sample of local starbursting disk galaxies

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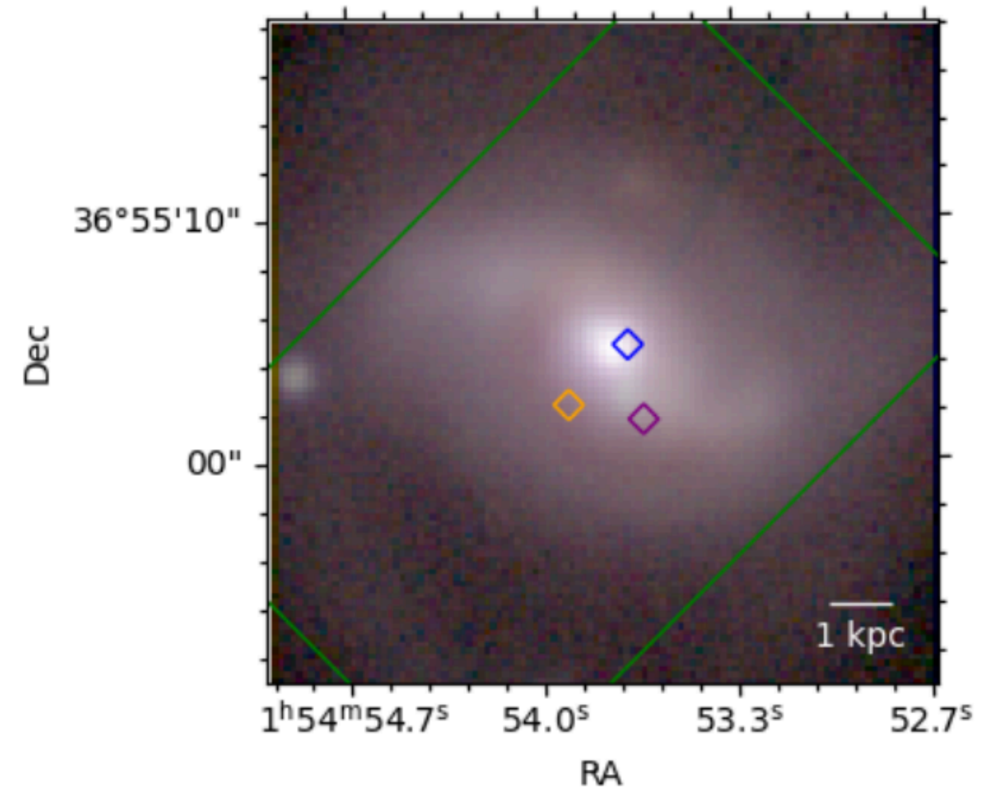
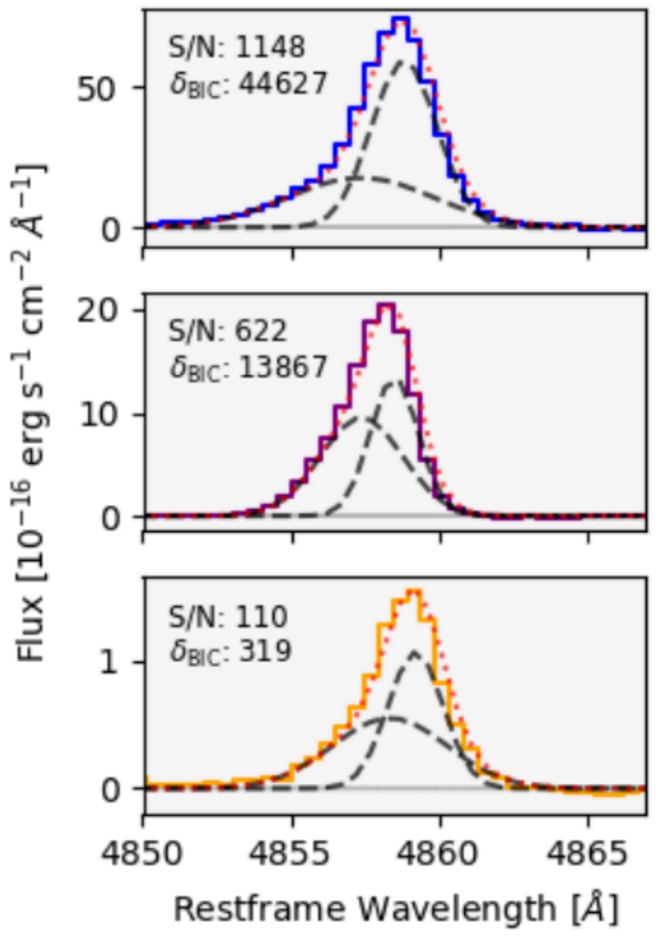
Background

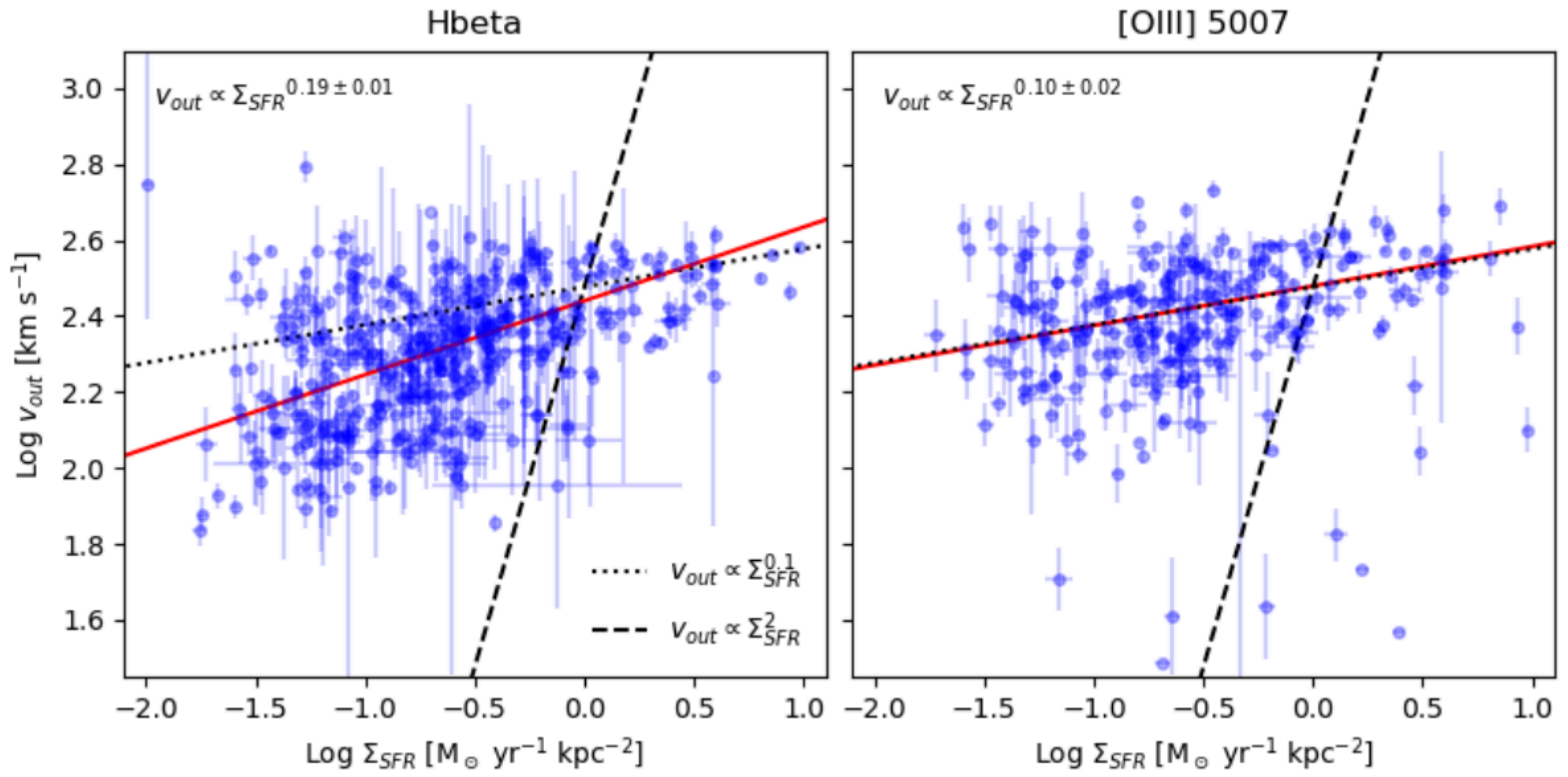
- Star formation-driven outflows play a crucial role in the baryon cycle, contributing to the enrichment of the circumgalactic medium (CGM) and suppressing star formation by removing gas.
- Characterizing scaling relationships between outflow properties and ΣSFR offers constraints on understanding the physical drivers of outflows (SNe or radiation from massive stars).

Data

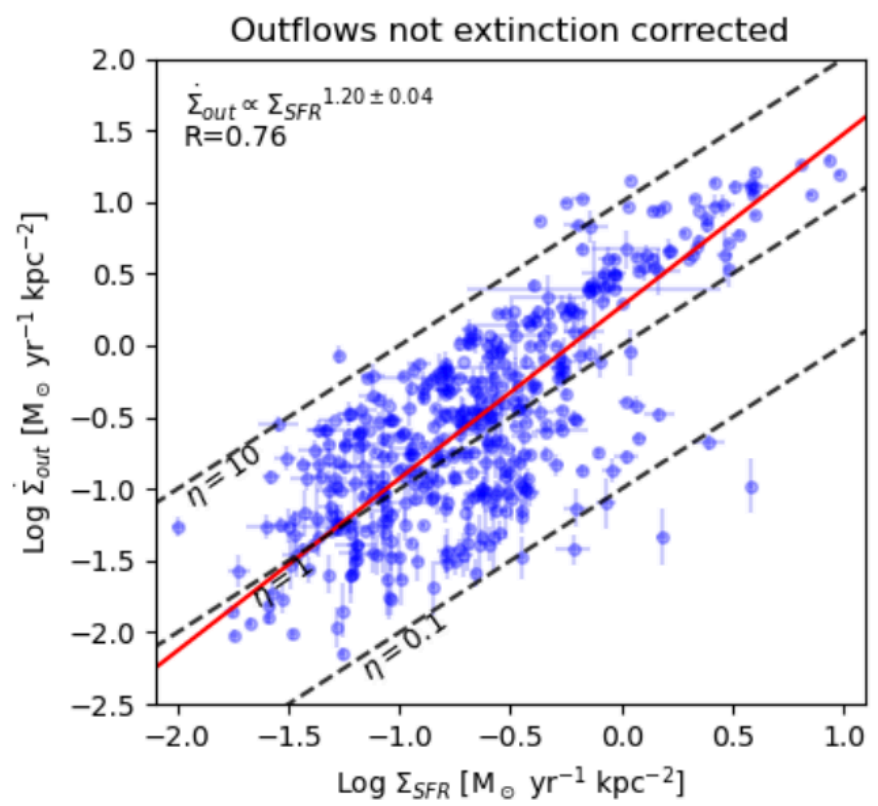
- 10 starburst edge-on galaxies
  - 0.02 < z < 0.04
  - 10 < log M* < 11.5
  - 0.5 < log SFR(IR) < 1.6
- Keck/KCWI observations (IFU) of Hb and [OIII]5007
  - Spaxel size 0.87” x 0.87” (typical seeing 0.7”)
  - Double gaussian fitting to detect outflow components







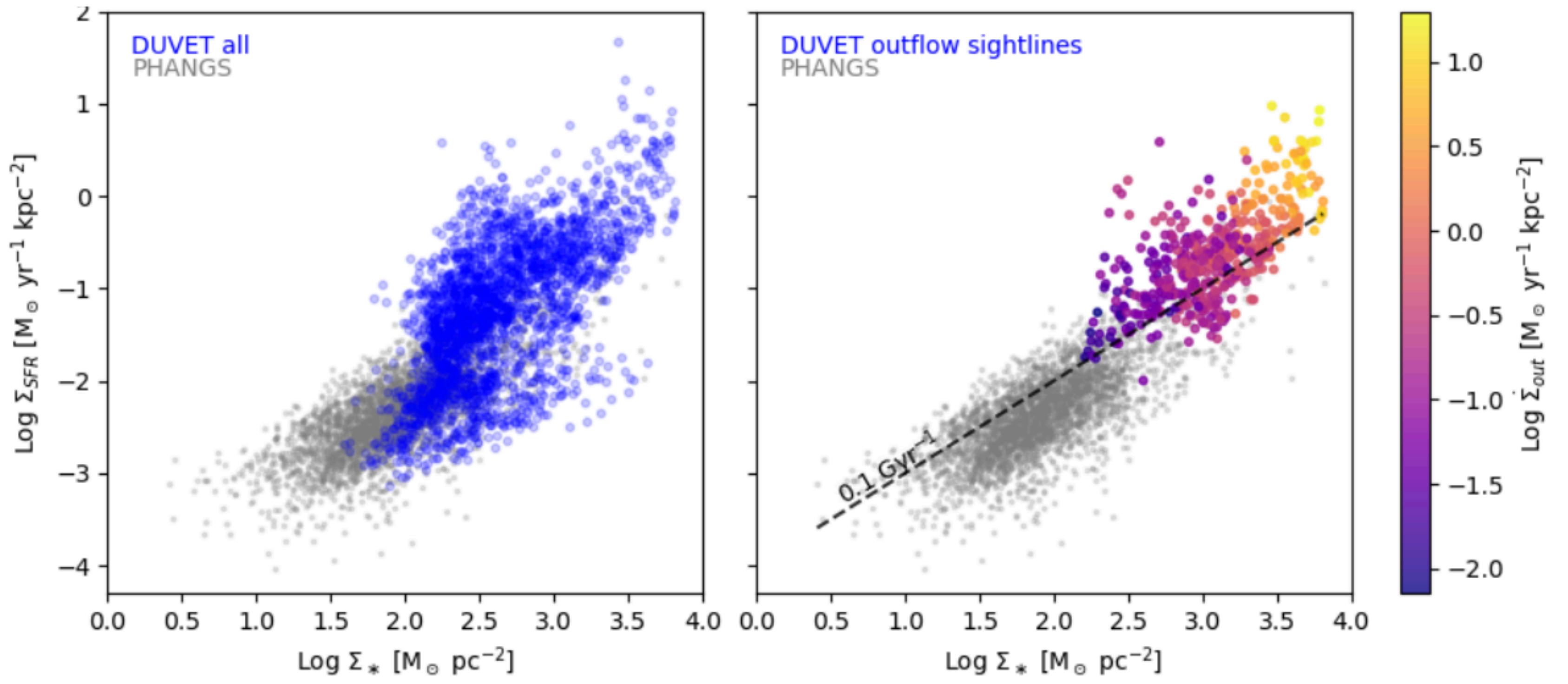
- Maximum outflow velocity v_out = |v_narrow-v_broad|+2σ_broad
- Model prediction:
  - v_out ∝ ΣSFR^2 for wind from massive stars
  - v_out ∝ ΣSFR^0.1 for SNe
- v_out shows shallow relationships with the star formation rate surface density for both Hb and [OIII] λ5007, suggesting SNe as the dominant energy source driving the wind.



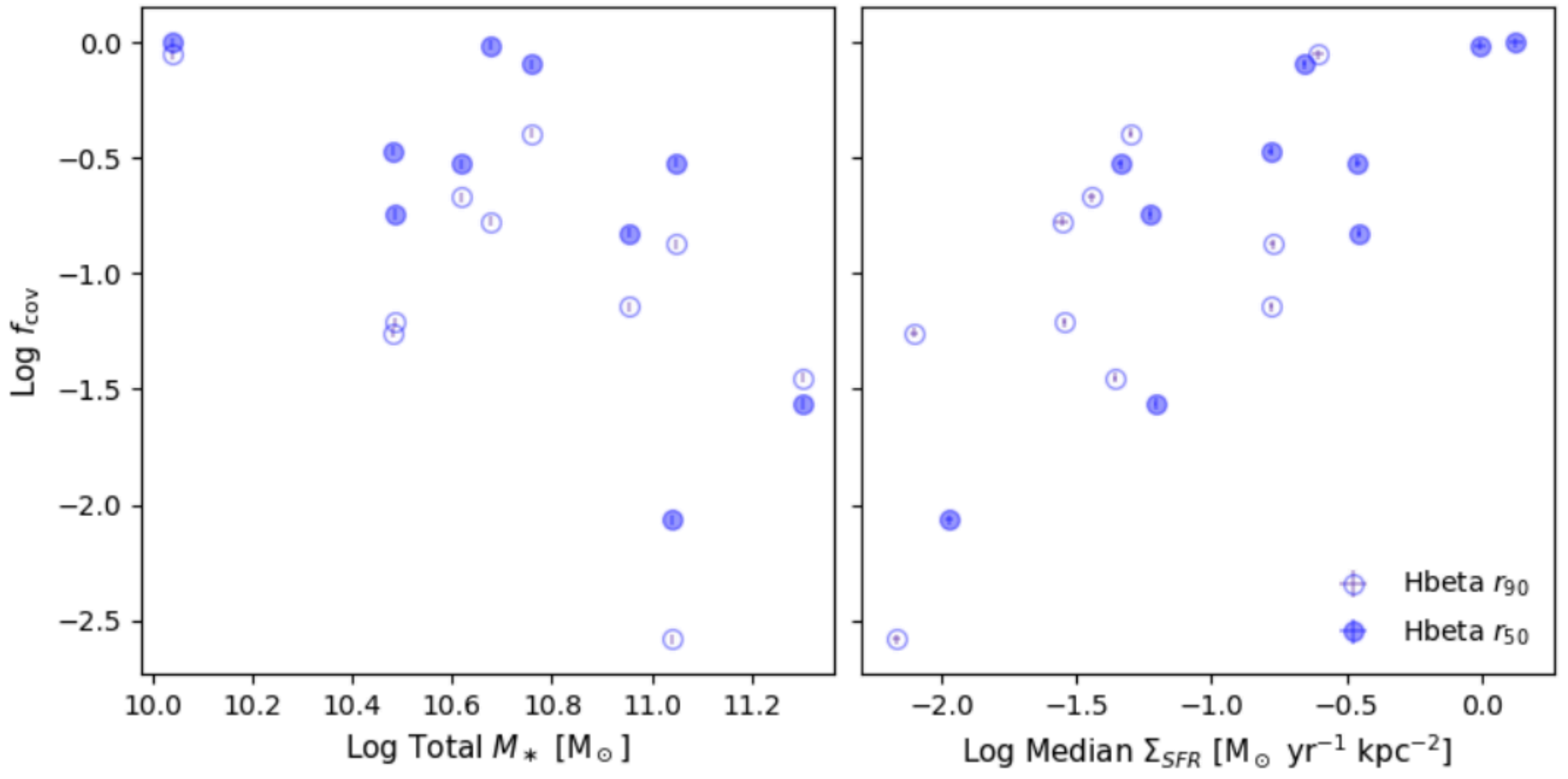
Mass loading factor $\eta = \dot{\Sigma}_{out}/\Sigma_{SFR}$

← constant η lines

- Mass outflow flux $\dot{\Sigma}_{out} = \frac{1.36 m_H}{\gamma H\beta n_e}\left(\frac{v_{out}}{R_{out}}\right) L_{H\beta,broad} 10^{0.4A_{H\beta}}/Area$
  - Assumption: γ_Hb=1.24e-25 [erg cm^3 s^-1] (case B)
    n_e = 100 [cm^-3]
    R_out = 0.5 [kpc]
- Ionized gas mass loading factors range from ~ 0.1 to ~ 10.
- A flat relationship is observed between the mass loading factor and the star formation rate surface density, indicating a linear correlation between winds and the SFR surface density.



- Outflows are more common for ΣSFR/Σ* > 0.1 Gyr^−1.
- This is explained by the increased energy provided by higher ΣSFR and the gravitational effects of higher stellar mass surface density (Σ*).



- f_cov = N_outflow/N_total
- a negative correlation with stellar mass and a positive correlation with median SFR surface density.
- This is consistent with the picture where galaxies of higher mass have a larger gravitational potential well, and require more concentrated star formation to drive gas out of the disk.

Summary

- SNe are the primary driving force behind outflows.
- Outflowing mass has a nearly linear correlation with ΣSFR.
- ΣSFR/Σ* > 0.1 Gyr^−1 is a threshold for outflow event.