Recalibration of the Cosmic Flows 4 Catalogue

A Study of the Systematics

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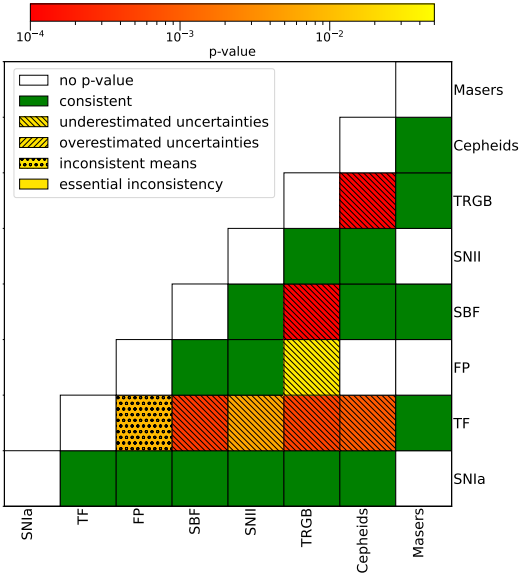
Inconsistencies in the Cosmic Flows 4 Catalogue



- 8 distance indicators, ∼56k galaxies.
- There are strong inconsistencies, particularly with the Tully-Fisher relation, and TRGB.
- Disagreement propagates into H_0.

Nájera et al. 2026, in prep

Recalibration of CF4

$$\tilde{\mu}'_{ij} = \mu_{ij} + \Delta\mu_j$$
$$\tilde{\sigma}^2_{ij} = \alpha_j \sigma^2_{ij}$$

- $\Delta\mu$ — zero-point recalibration off-set.
- α — error rescaling (our test suggests the quoted TF error bars are underestimated).
- Anchored to NGC 4258 masers: $\Delta\mu_{\rm mas} \equiv 0$, $\alpha_{\rm mas} \equiv 1$.
- We recalibrate the three rungs.

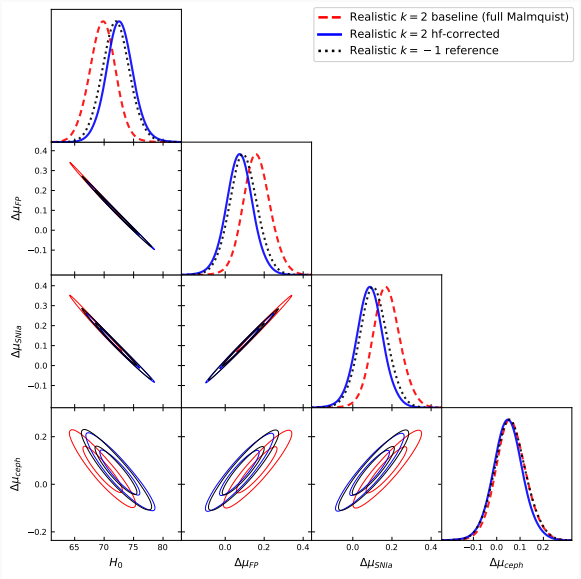
Malmquist + Selection Bias Modelling

- Magnitude- and redshift-limited surveys preferentially see *bright*, *nearby* objects.
- Inferred distances biased (the Universe is uniform in comoving volume, not distance modulus) (r_c^2 Malmquist Bias correction term)
- We marginalise the bias out, per galaxy, jointly across all methods that observed it.

$$P(S{=}1 \mid \theta) \propto \int d\mu \; r_c^{\,k} \, \frac{dr_c}{d\mu} \times \prod_{i=1}^{N_\mu} \Phi\left(\frac{\mu_{\mathrm{lim},i} + \Delta\mu_i - \mu}{\sqrt{\tilde{\sigma}_{\mu,i}^2 + \sigma_{\mu,i}^2}} \right) \times \prod_{j=1}^{N_z} \Phi\left(\frac{cz_{\mathrm{lim},j} - f(H_0 r_c, q_0)}{\sqrt{\tilde{\sigma}_v^2 + \sigma_v^2}} \right)$$

$$f\,(H_0 r, q_0, j_0) \equiv H_0 r + \frac{1+q_0}{2c}(H_0 r)^2 + \frac{3q_0^2 + 5q_0 + j_0 + 2}{6c^2}(H_0 r)^3. \qquad (1)$$

Cosmological constraints



H_0 Constraints

Table 1: Hubble constant from the CF4 forward-modelling pipeline. *Baseline* applies the r^k/Malmquist selection correction to all methods; *hf-corr* trusts the CF4-precorrected flux-limited methods (SNIa, TF, FP, SBF) as already de-biased and forward-models only SNII, TRGB and Ceph. The $k=-1$ column is the no-Malmquist and no-selection correction reference.

Selection	Pipeline	H_0 (k=2) [km s^{-1} Mpc^{-1}]	H_0 ($k=-1$) [km s^{-1} Mpc^{-1}]
Realistic	baseline	69.77 ± 2.26	72.00 ± 2.39
	hf-corr	72.61 ± 2.32	72.40 ± 2.40
Redshift	baseline	78.62 ± 3.24	72.86 ± 2.48
	hf-corr	78.65 ± 3.24	72.82 ± 2.45
Magnitude	baseline	69.23 ± 2.25	72.17 ± 2.39