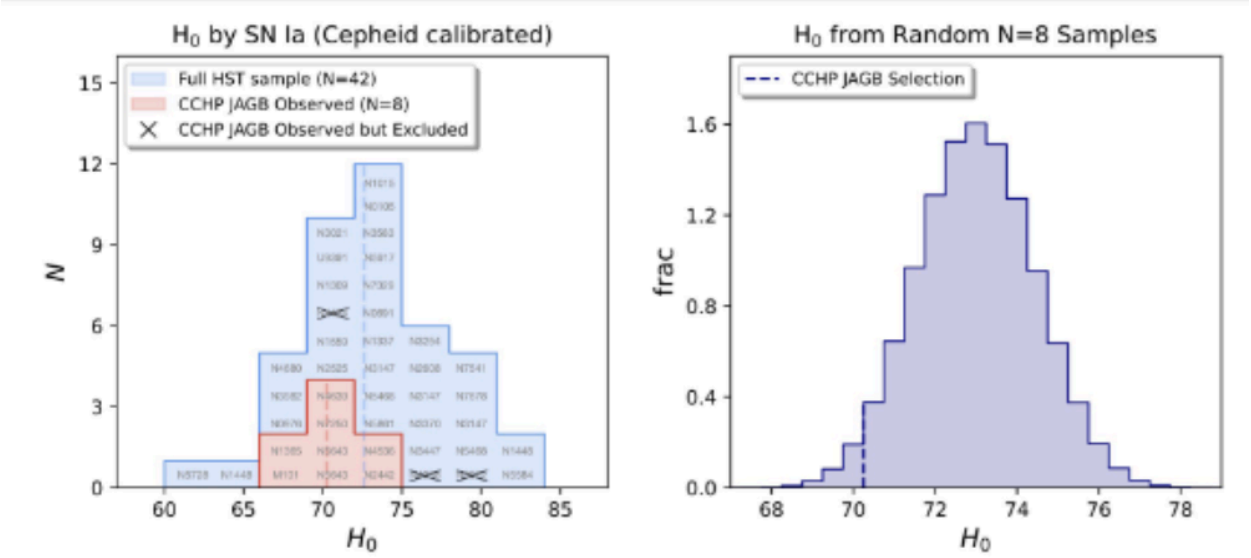
Dan Scolnic Tweet Aug 13, 2024

(1) Very interested to see status report posted by CCHP on three-probe measurement of H0 (H0=70+-1+-1). On one hand, what they actually measure, distances to SN Ia hosts with JWST 3 ways, agrees *super* well with the previous HST Cepheids (SH0ES) (see below). On other, lower H0 can be explained by a small+skewed SN selection and low uncertainty seems to come from a puzzling error analysis. Excited to dive in! :)

(2) CCHP selected a set of ~10 SN Ia which start a couple sigma off from the mean of the 42 from HST which source the tension (see our plot, or their Fig. 15) which is the key point. If HST SH0ES used only these exact same 10 SN Ia of the 42 in SH0ES we would get H0 ~ 70. So the differences in H0 here are entirely consistent with the differences in SN selection.




(3) The CCHP uncertainty on H0 appears low because it looks to me like they treat 10 SN Ia measured 3 ways like they are 30 independent SN Ia, so their Bayesian baseline error appears too small by square root of ~3. It looks like they multiplied the PDFs of each method together (see plot), but each measures the same ~10 SNe, so shouldn't do that, as they are fully correlated. I think their "frequentist" analysis keeps each method separate so has more realistic) uncertainty , +/- ~2.

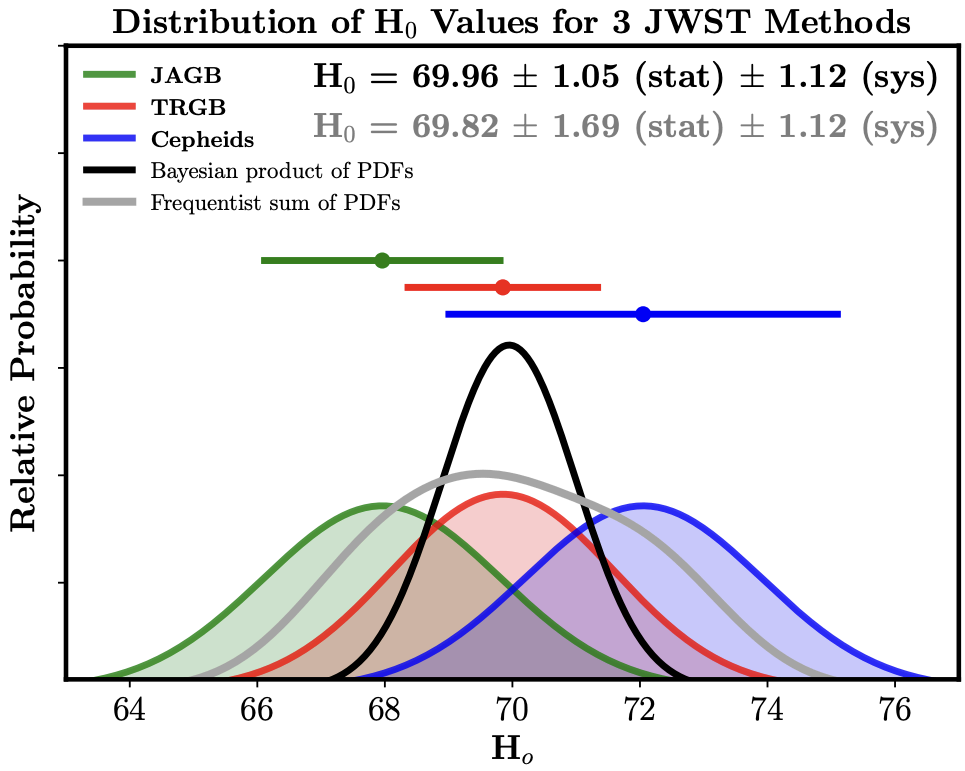
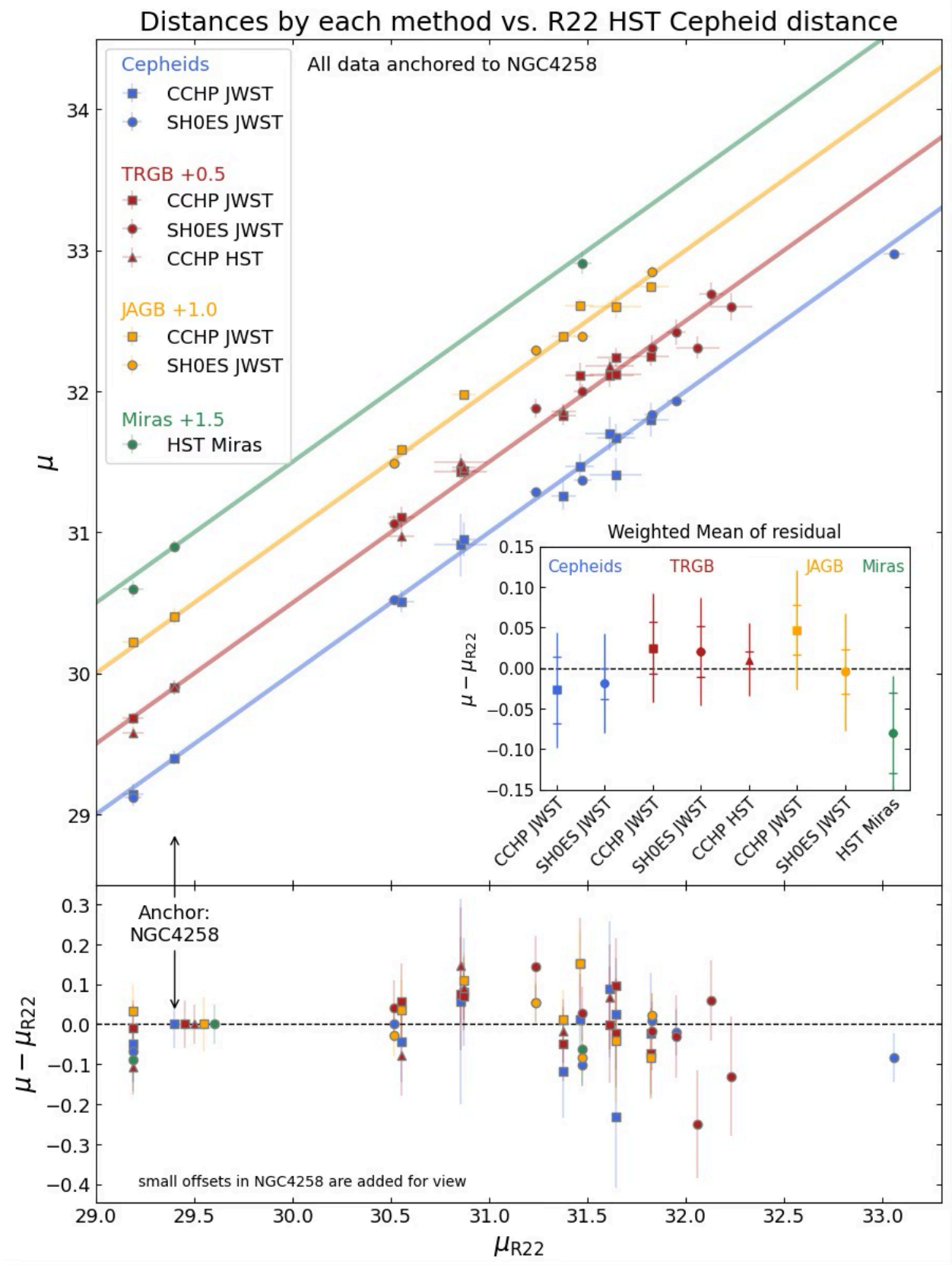


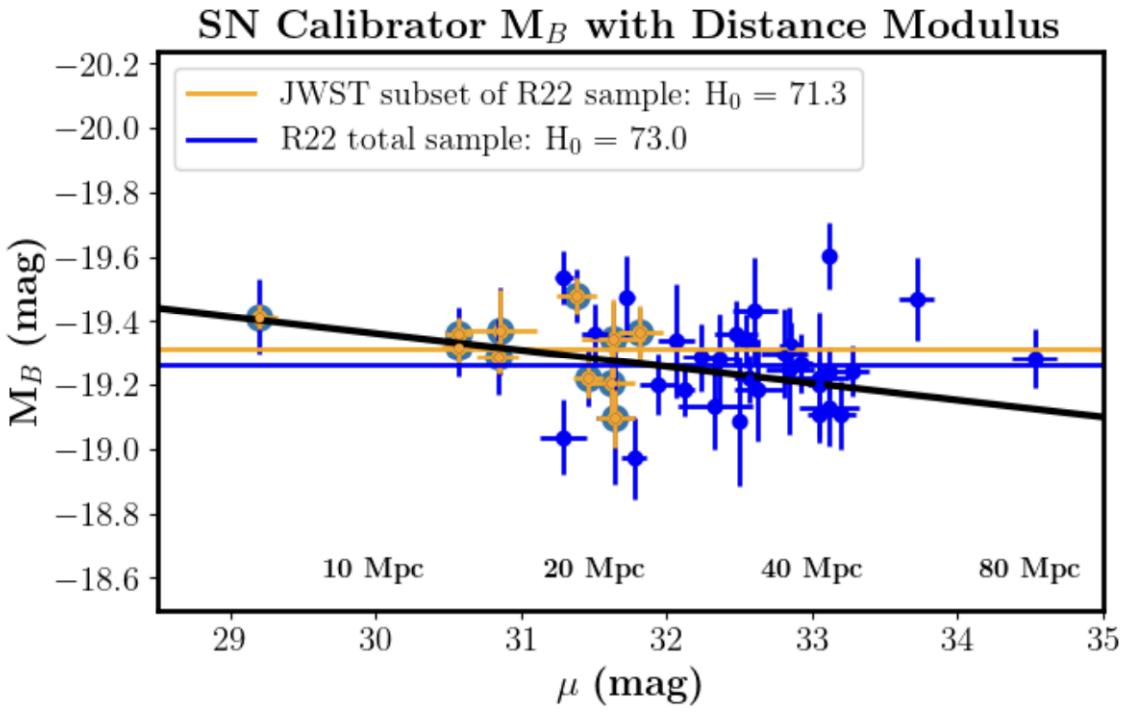

**Figure 11.** PDFs for the values of $H_0$ based on the three calibrations: JAGB (green), TRGB (red) and Cepheids (blue). The width of each individual Gaussian represents the statistical uncertainty. The error bars shown above, which use the same color-coding, represent the systematic uncertainties (see §5). The $1\sigma$ statistical uncertainties are determined from the 16th and 84th percentiles for the Frequentist sum of the distributions (shown in gray), and decreased by $\sqrt{N-1}$. The curve in black is the Bayesian product of the three PDFs.

(4) One main theme pushed in report is that Cepheids could be biased. However, when they compare the three probes, the errors include only scatter/root N_hosts, they leave out the systematic uncertainty–how well each method ties to the reference, NGC 4258, a ~ 0.05 mag term for each (see their Table 5), so it makes it look like JAGB and JWST Cepheids differ but when you include each method's error the most different is only ~1.3sigma, so nothing should be excluded. E.g., half the claimed difference with JAGB-Cepheids is the choice of mode vs mean/median for JAGB )

(5) So let's take their data table and then compare the distances from all methods/telescopes/groups to HST Cepheids.
The mean differences from each team/probe/telescope are on the 0.03 mag level, much smaller than the Hubble tension size (0.17 mag). Also because they are all <1 sigma of HST Cepheids, all the crosschecks pass so there's no reason to not use the much larger 42 SN Ia H0 which gives the most precise H0. This is awesome.

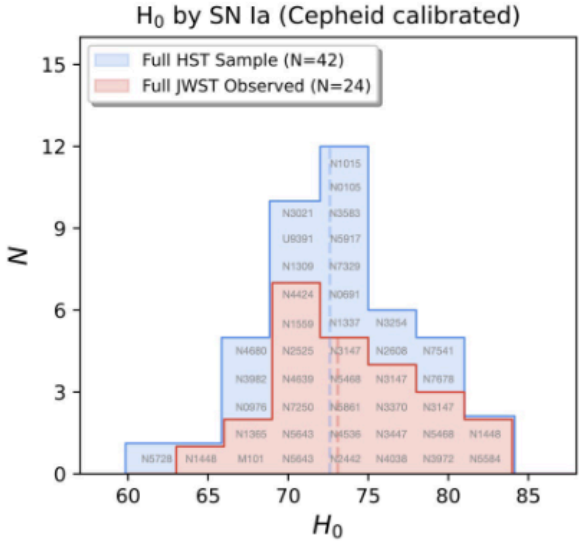

Distances by each method vs. R22 HST Cepheid distance
All data anchored to NGC4258
Cepheids
CCHP JWST
SH0ES JWST
TRGB +0.5
CCHP JWST
SH0ES JWST
CCHP HST
JAGB +1.0
CCHP JWST
SH0ES JWST
Miras +1.5
HST Miras
Weighted Mean of residual
Cepheids
TRGB
JAGB
Miras
CCHP JWST
SH0ES JWST
CCHP JWST
SH0ES JWST
CCHP HST
CCHP JWST
SH0ES JWST
HST Miras
Anchor:
NGC4258
small offsets in NGC4258 are added for view
μ
μ − μR22
μR22

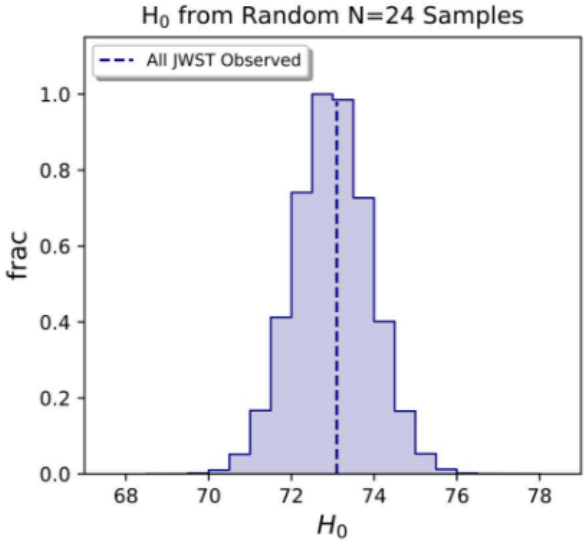
(6) They also claim there may be a distance bias in the SN magnitudes calibrated by HST Cepheids (the black line), but that seems …not in data. We checked this multiple times and get 1.4 sigma.. Also note no such trend against other indicators in the residuals (flipped) in the tweet above. Even better we used JWST to rule out a distance-dependent bias between HST and JWST at 8 sigma - bigger than tension!




(7) Anyway, I totally get if there is a feeling like the easiest way out of the Hubble tension is to hope there is a problem with the HST distance ladder, discard it, and start over with JWST. But the agreement of JWST and HST measures across methods and teams is a really powerful crosscheck and there is fantastic agreement!

(8) We are writing up a paper to explore this in more detail and we will combine all SN-hosts observed by JWST (24 so far!) and as you can see a larger JWST sample reverts back to HST mean (the dashed line). In summary, best I can say is that even though CCHP final result seems to land in middle, I actually think this new data shows there is much less way out for the enduring Hubble tension.


H0 by SN Ia (Cepheid calibrated)
Full HST Sample (N=42)
Full JWST Observed (N=24)
N
H0


H0 from Random N=24 Samples
All JWST Observed
frac
H0