What’s Next With Type Ia Supernovae

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Workshop on “The Future of H0: Crisis or Concordance?”
This is what real tension looks like.
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The Pantheon Sample - Scolnic et al. 2018 is out. Can find it online, in COSMOMC, COSMOSIS..

Analyzed 1,050 SNIa [PS1+Low-z +SNLS+SDSS +HST] from z=0.01 to z=2.3

Biggest SN sample to date and first homogeneously calibrated sample
Pantheon analysis placed tightest constraint on dark energy to date.

\[ w = -1.026 \pm 0.041 \]

PS1 Phot Sample [Jones, Scolnic et al. 17], DES Spec Sample [in prep.] get very similar results.
New analyses are combining Pantheon with BAO and other combinations, find low $H_0$.

Blue is with BAO+SNe+rd. Gray is Planck+LCDM.

Feeney et al. 2018

These SNe ~same as SNe used in R16 measurement!
The Pantheon Sample - Scolnic et al. 2018 is out. Can find it online, in COSMOMC, COSMOSIS.

For $w$: Care about 1% difference between $z=0.05$ and $z=0.5$

For $H_0$: Care about 4% difference between $z=0.005$ and $z=0.05$
When Pantheon is binned down, one is going to see ‘curiosities’, but a lot of these are systematics.
A correlation between Host Galaxy and Hubble Residuals is one of those systematics, but is better constrained with more data.

CSP - Burns et al. 2018

Pantheon

CSP - mass correction can be as large as 0.2 mag, Pantheon 0.03 on either side.
For $H_0$, we looked at different correlations of host properties and Hubble residuals, particularly focusing on ‘local’ properties of the host.

Table 4
Predicted Change in $H_0$ due to Mass and Color Steps

<table>
<thead>
<tr>
<th>Step Significance(^a)</th>
<th>% in Cepheid Calibrators</th>
<th>% in Hubble Flow</th>
<th>$\Delta H_0$ (km s(^{-1}) Mpc(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>local mass &gt; 8.9 dex</td>
<td>3.2$\sigma$</td>
<td>37.5</td>
<td>46.2</td>
</tr>
<tr>
<td>global mass &gt; 10 dex</td>
<td>0.5$\sigma$</td>
<td>50.0</td>
<td>72.2</td>
</tr>
<tr>
<td>local $u - g &gt; 1.6$</td>
<td>1.1$\sigma$</td>
<td>6.2</td>
<td>47.7</td>
</tr>
<tr>
<td>global $u - g &gt; 1.6$</td>
<td>1.5$\sigma$</td>
<td>12.5</td>
<td>48.0</td>
</tr>
</tbody>
</table>

Note. — We show the effect of applying a local step after correcting for a 0.06 mag mass step following [Riess et al. 2018](https://journals.aps.org/pra/abstract/10.1103/PhysRevA.98.032109). Note that the “global mass” correction increases $H_0$, as we measure a slightly smaller mass step of 0.05 mag in this work.

\(^a\) Significance of the step after 0.06 mag correction based on global mass.
The question is: How do we go from a 2.4% measurement to a 1% measurement?

First data release has more useful low-z SNIa than full previous sample. Just hit 300 SNIa!

Foley, Scolnic, Rest et al. 2018

Scolnic et al. 2018 in prep.
We don’t see evidence from SNe of a local void.

- We already correct for local (peculiar) flows derived from 2M++ density field
- Expect local-to-global $\Delta H_0$ N-body sims in Gpc$^3$ box, SN, $z \rightarrow \Delta H \sim 0.3\%$ Odderskov et al. (2016) and Wu & Huterer (2017)

![Graph showing supernovae per bin with intercepts and Planck data points. The graph includes various fit lines and designations.](image)
The next thing I’m most excited about is SHOES analysis with $n=19 \rightarrow n=32$ calibrators. Can push even further down on systematic insensitivity.

Real process solves all parameters simultaneously to propagate covariances.
In next month, new DES w result, new Foundation w result.

In next few months, new Foundation-intercept result.

Year-ish timescale, new SH0ES calibrators result.