CSP Cosmology

Or: How I Learned to Relax and Love Dust

Where We Are

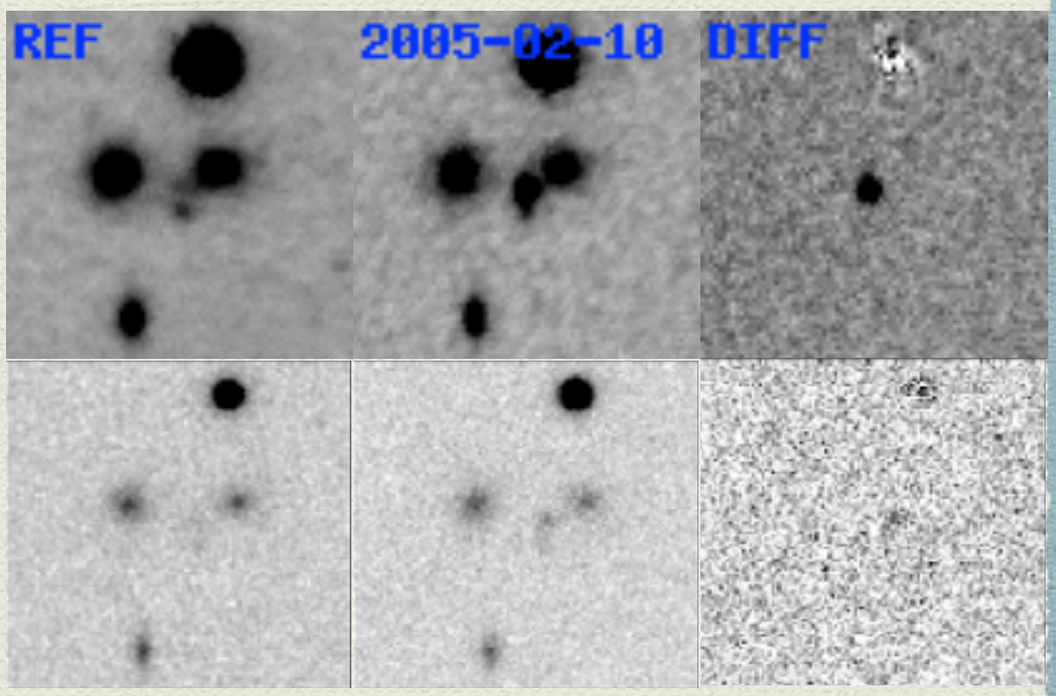
- Low-z CSPI photometry is nearly complete. Thanks to Carlos and the folks at A&M, we have the *best* low-z survey product:
  - Well-defined and publicly **available** filter functions.
  - Local sequence photometry, standards, etc.
  - Online quality control software.
  - Potential for a full covariance matrix.

CSPI High-z Project

Where We Are

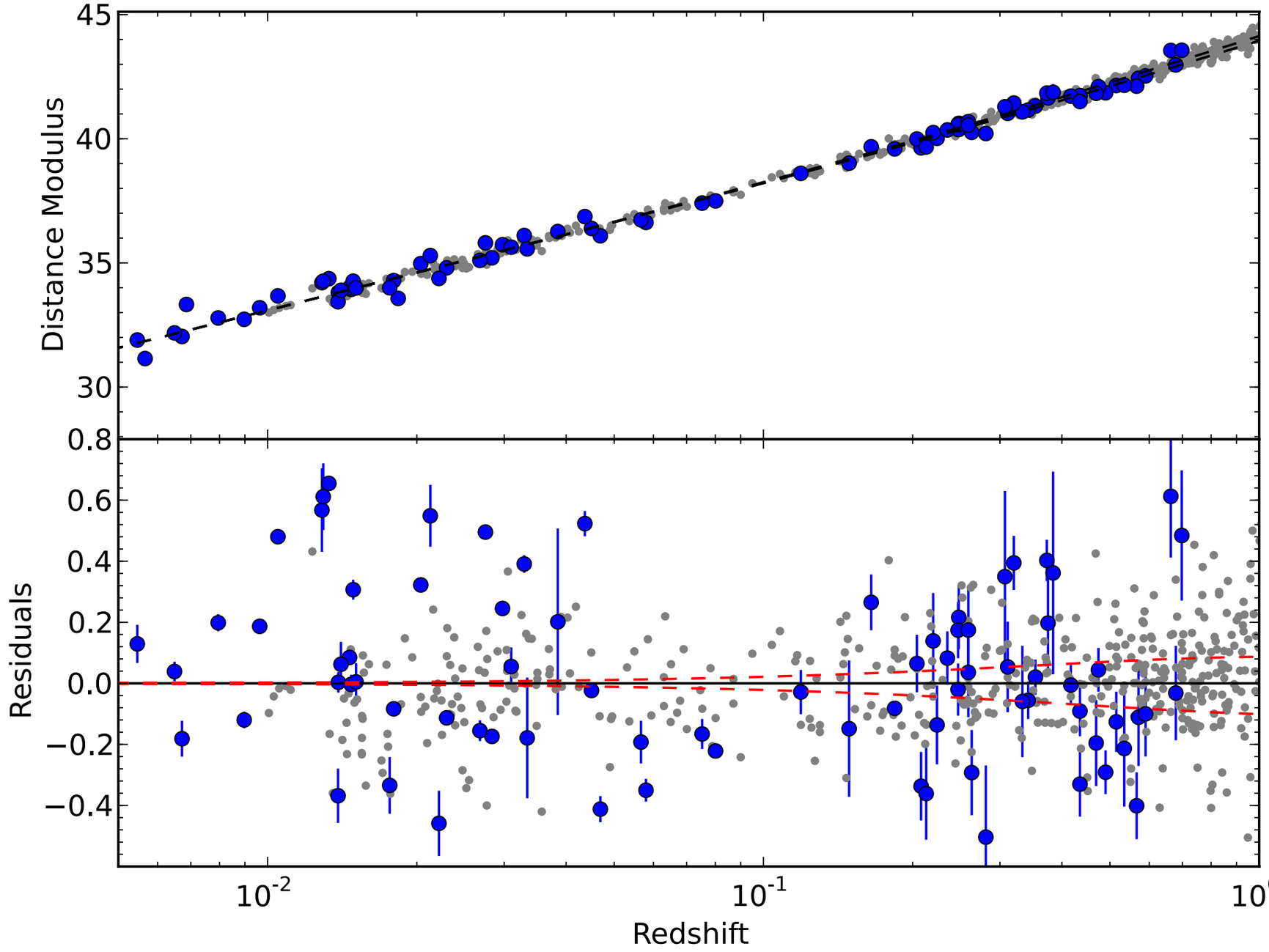
- High-z photometry is complete.
  - ~70 “good” objects (at least in the NIR).
- Auxiliary optical photometry is published (SNLS, SDSS, Essence).
- So what’s left to do?

i-band



J-band

SNLS 05D2bt, z = 0.67

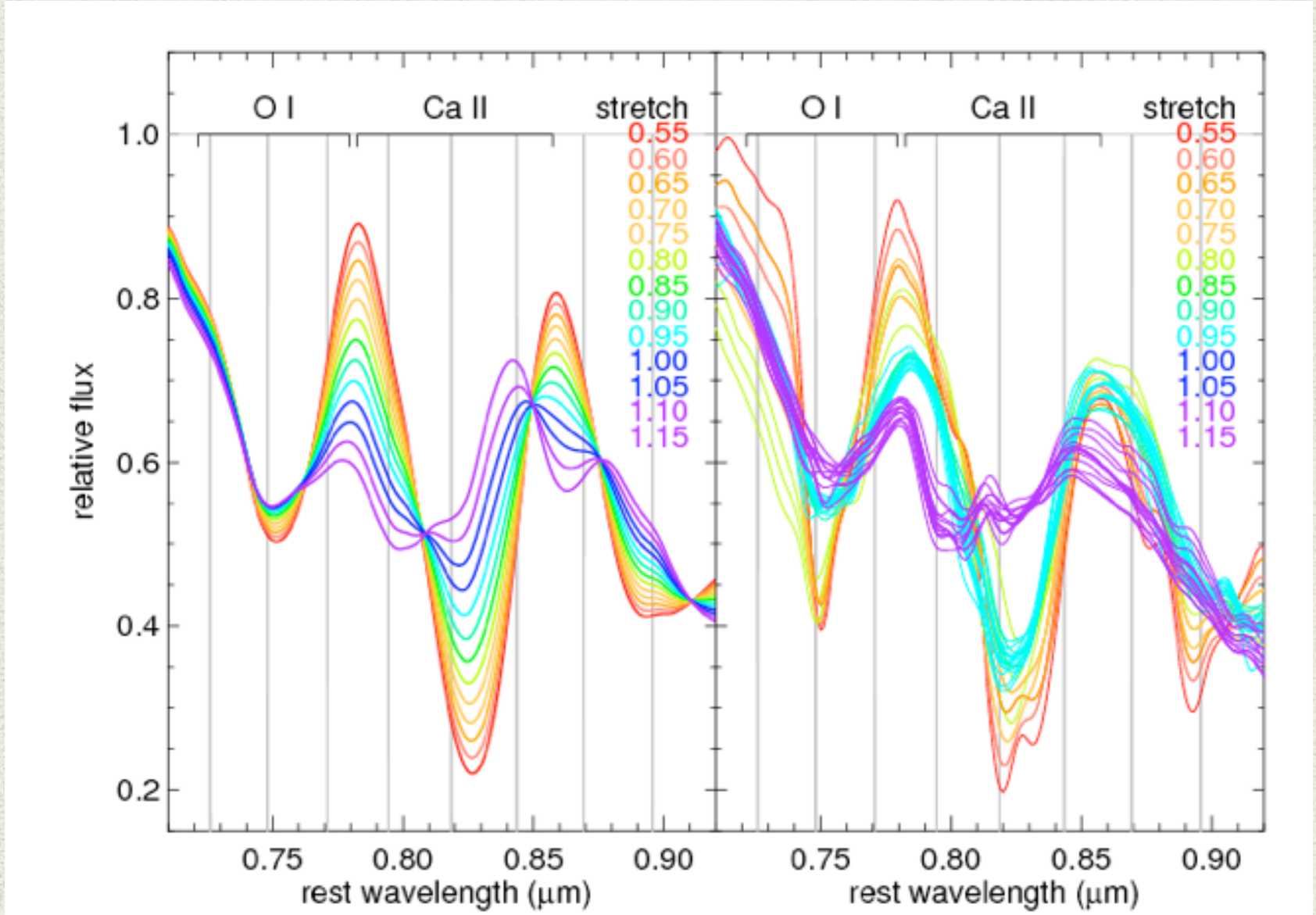

Distance Modulus
45
40
35
30
Residuals
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
10^{-2}
10^{-1}
10^{0}
Redshift

} $w \pm 10\%$

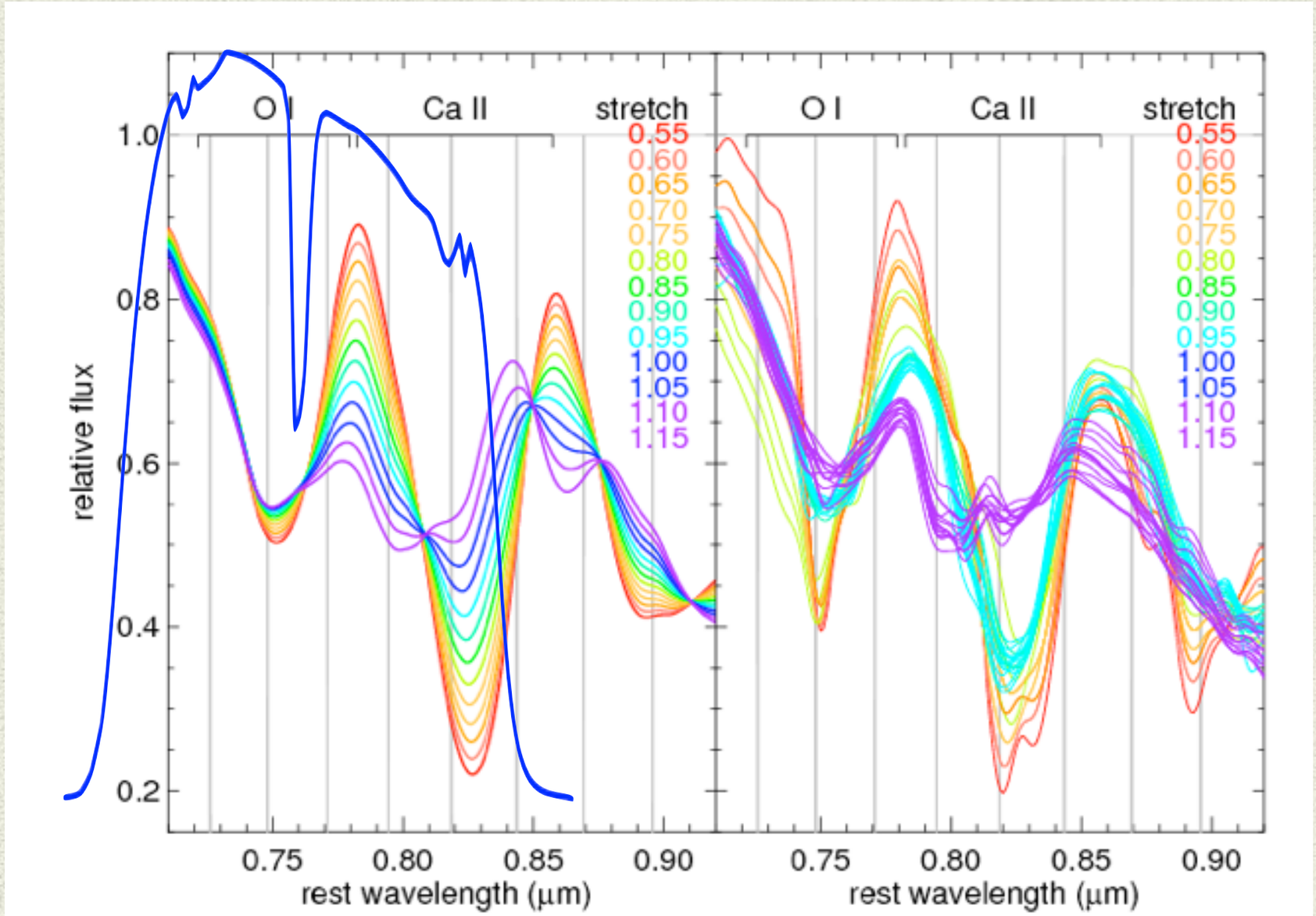
High-z Cosmology

- What needs to be done:
  - Re-do photometry using Carlos' package. Better to be consistent between low- and high-z samples. Get it installed on eero.
  - Better SNIa SED template near maximum light. Capture the CaII triplet variation with stretch.

K-corrections



K-corrections



High-z Cosmology

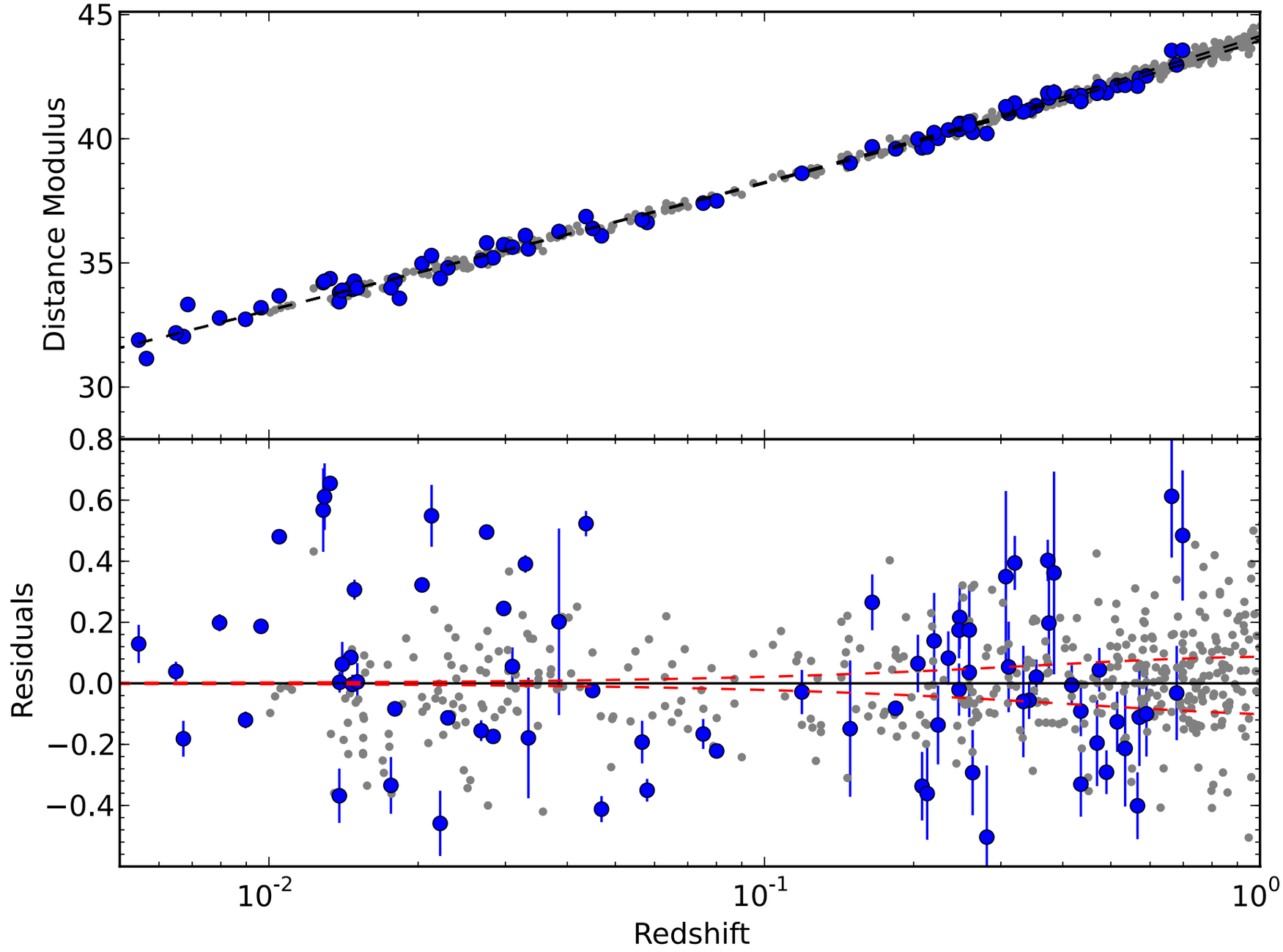
- What needs to be done:
  - Re-do photometry using Carlos' package. Better to be consistent between low- and high-z samples. Get it installed on eero.
  - Better SNIa SED template near maximum light. Capture the CaII triplet variation with stretch.
  - Host galaxy photometry. Measure stellar masses.

Remember this guy?

Remember this guy?

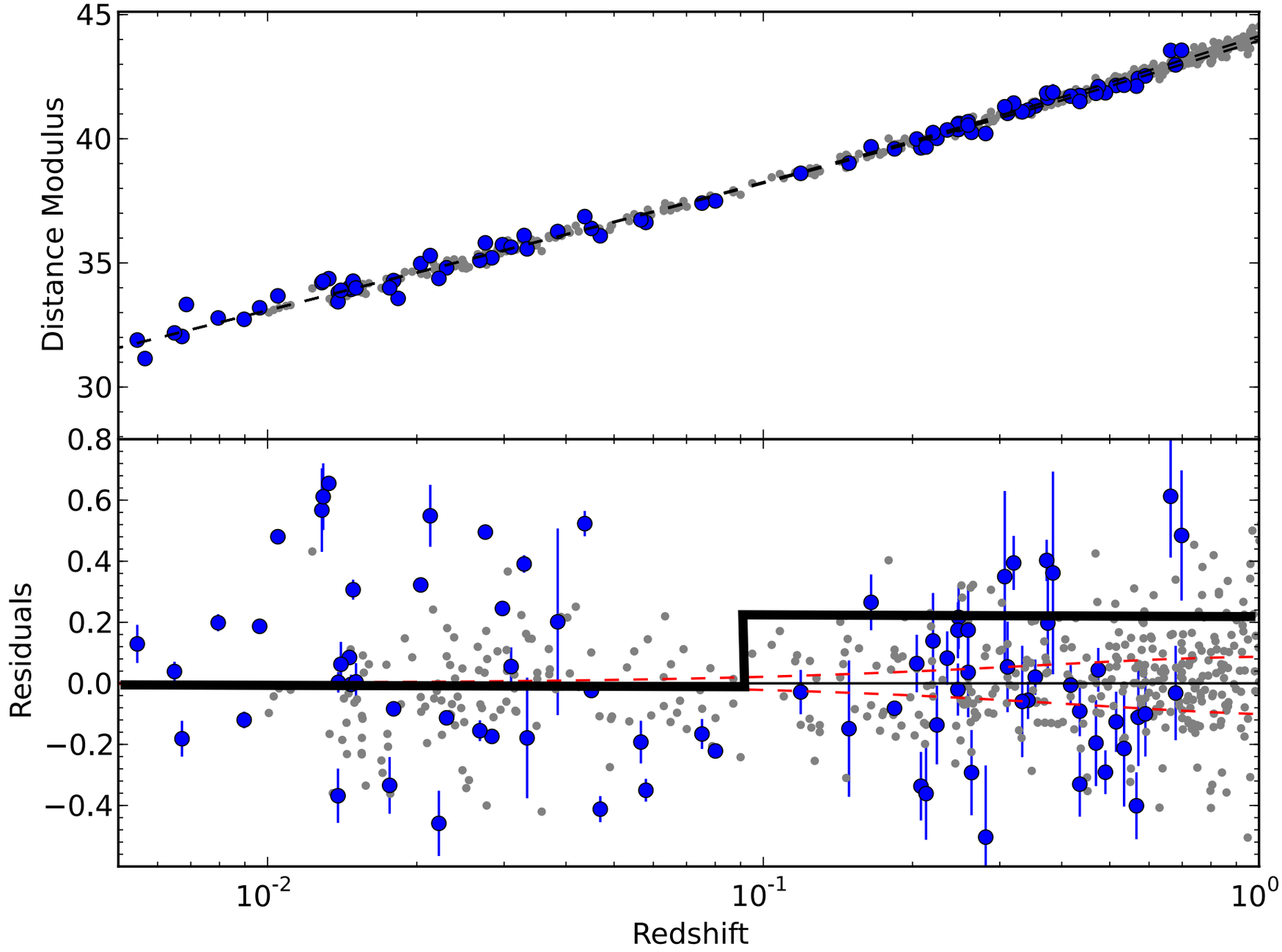
Remember this guy?

Calibration!!!



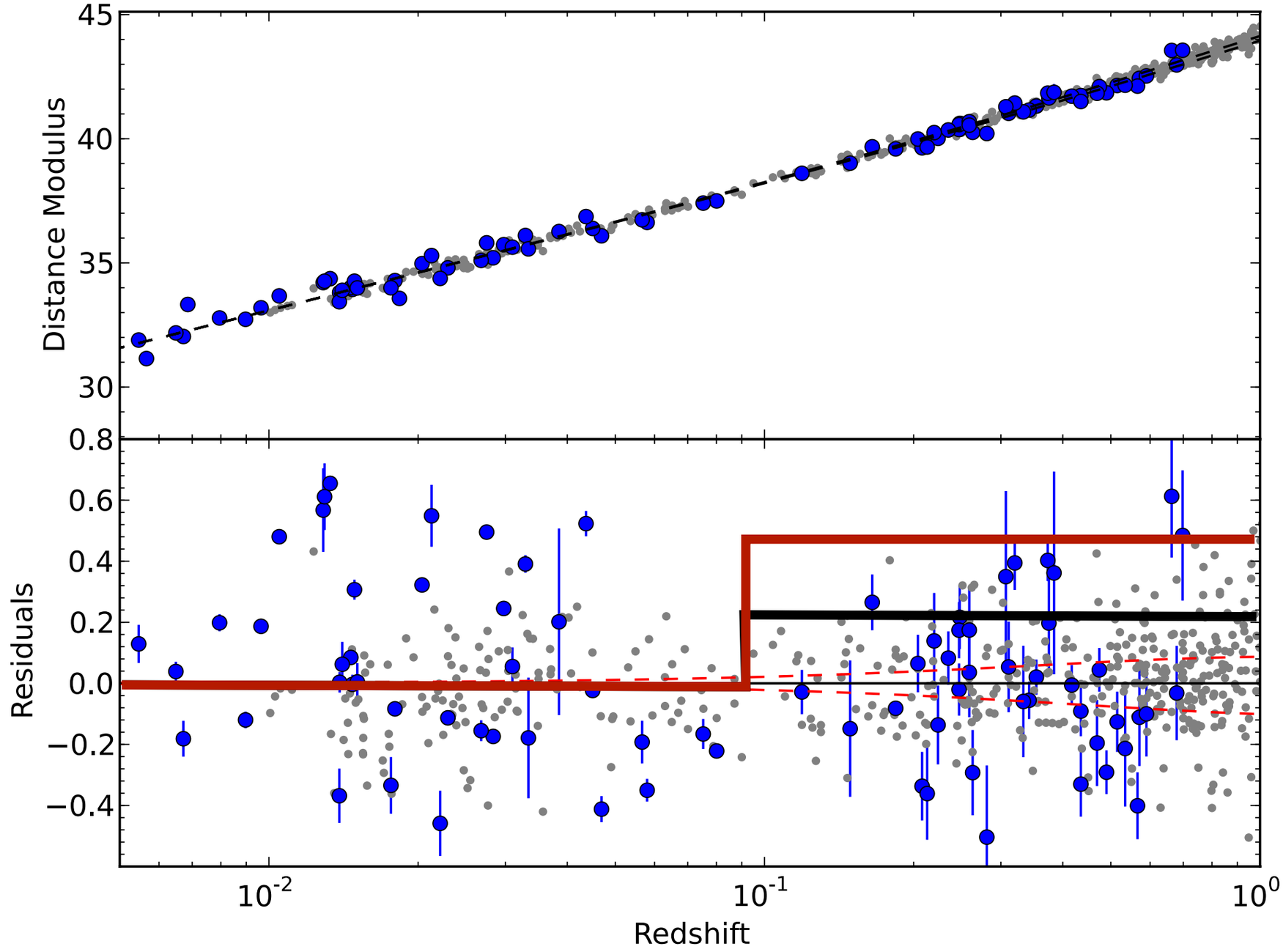
Δzp_λ

Calibration!!!



Δzp_λ

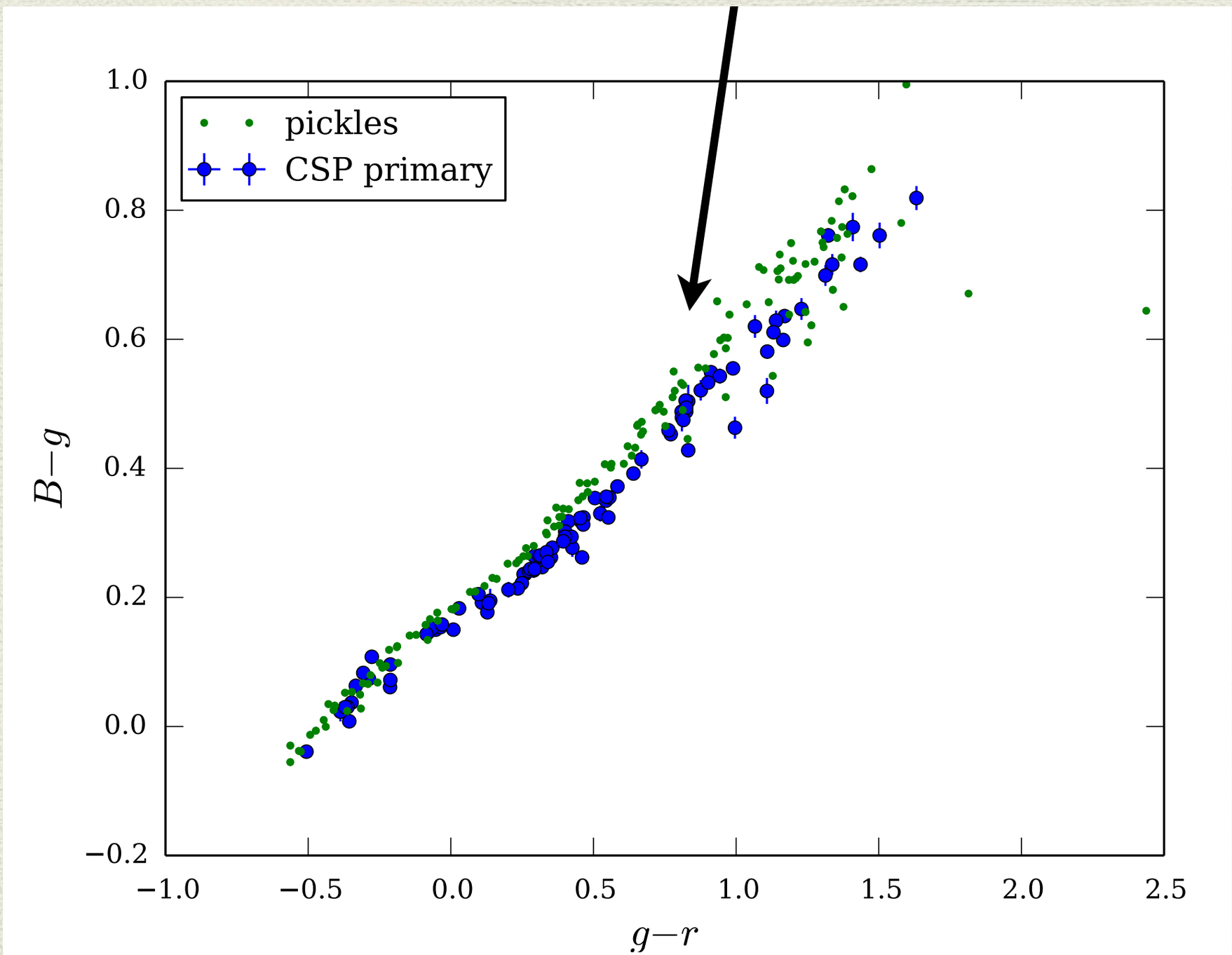
Calibration!!!



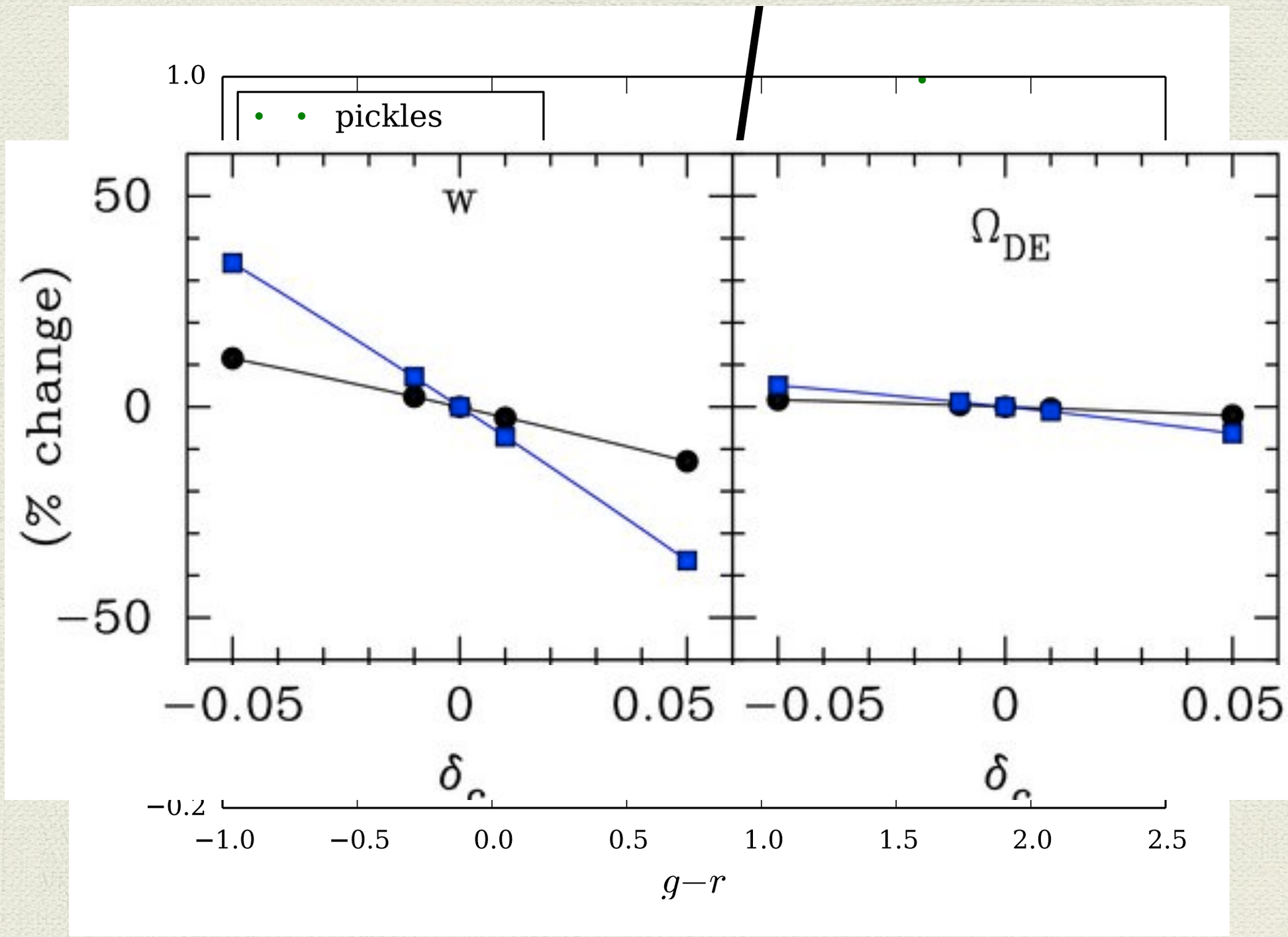
$R_\lambda \Delta zp_{B-V}$

Δzp_λ

Calibration!!!



Calibration!!!

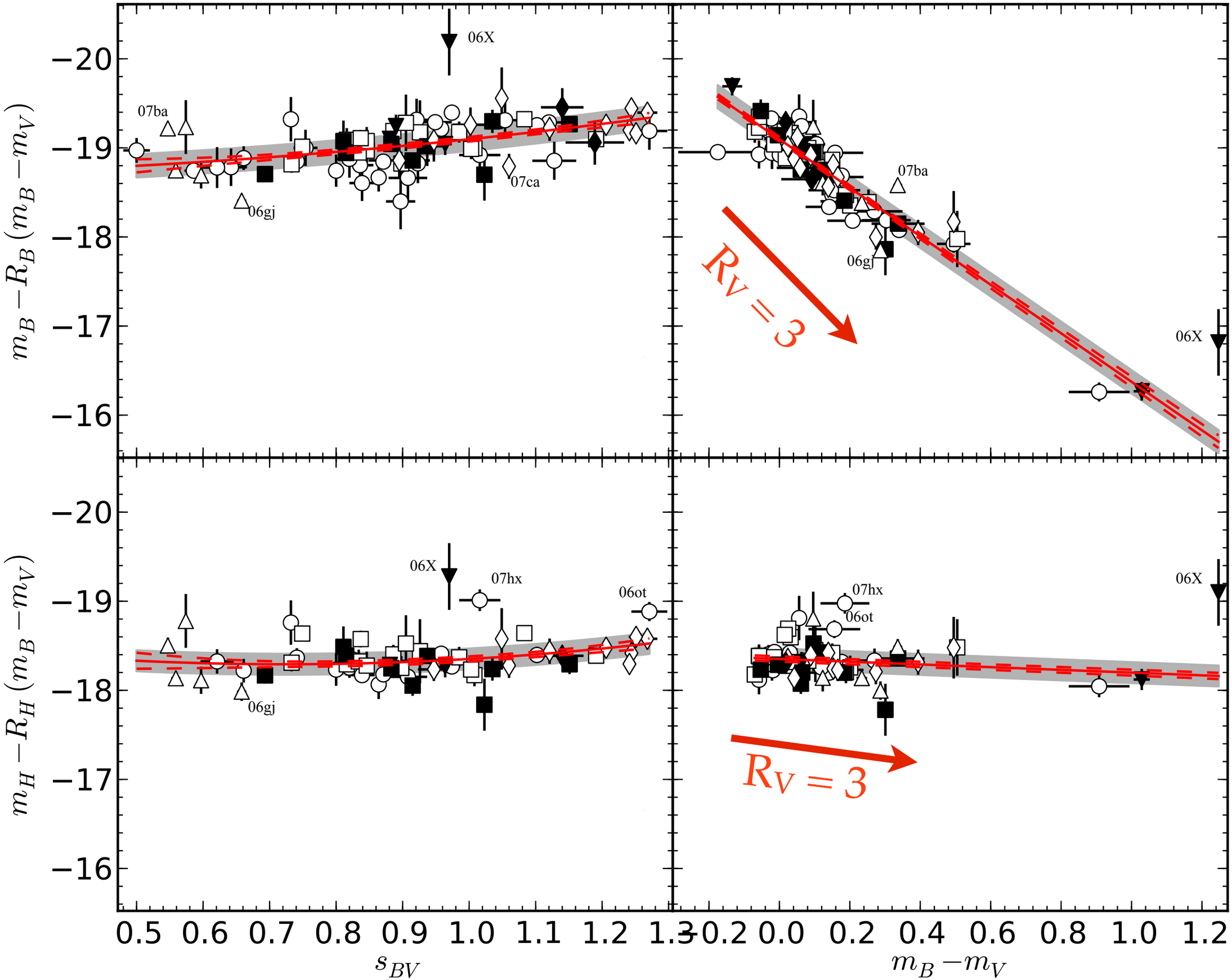


High-z Cosmology

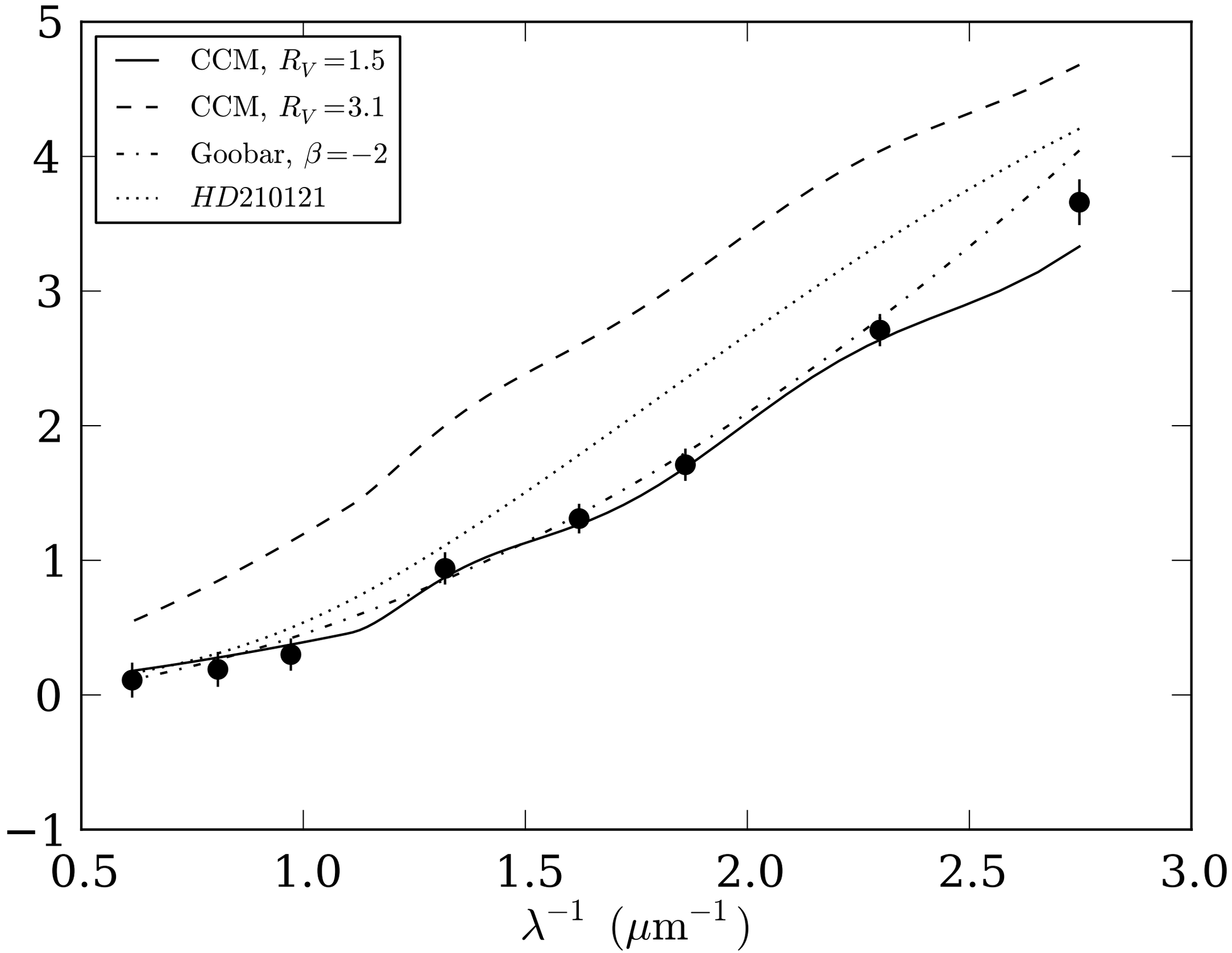
For discussion: what else can we do to make a NIR mark on cosmology?

Embrace the Dust

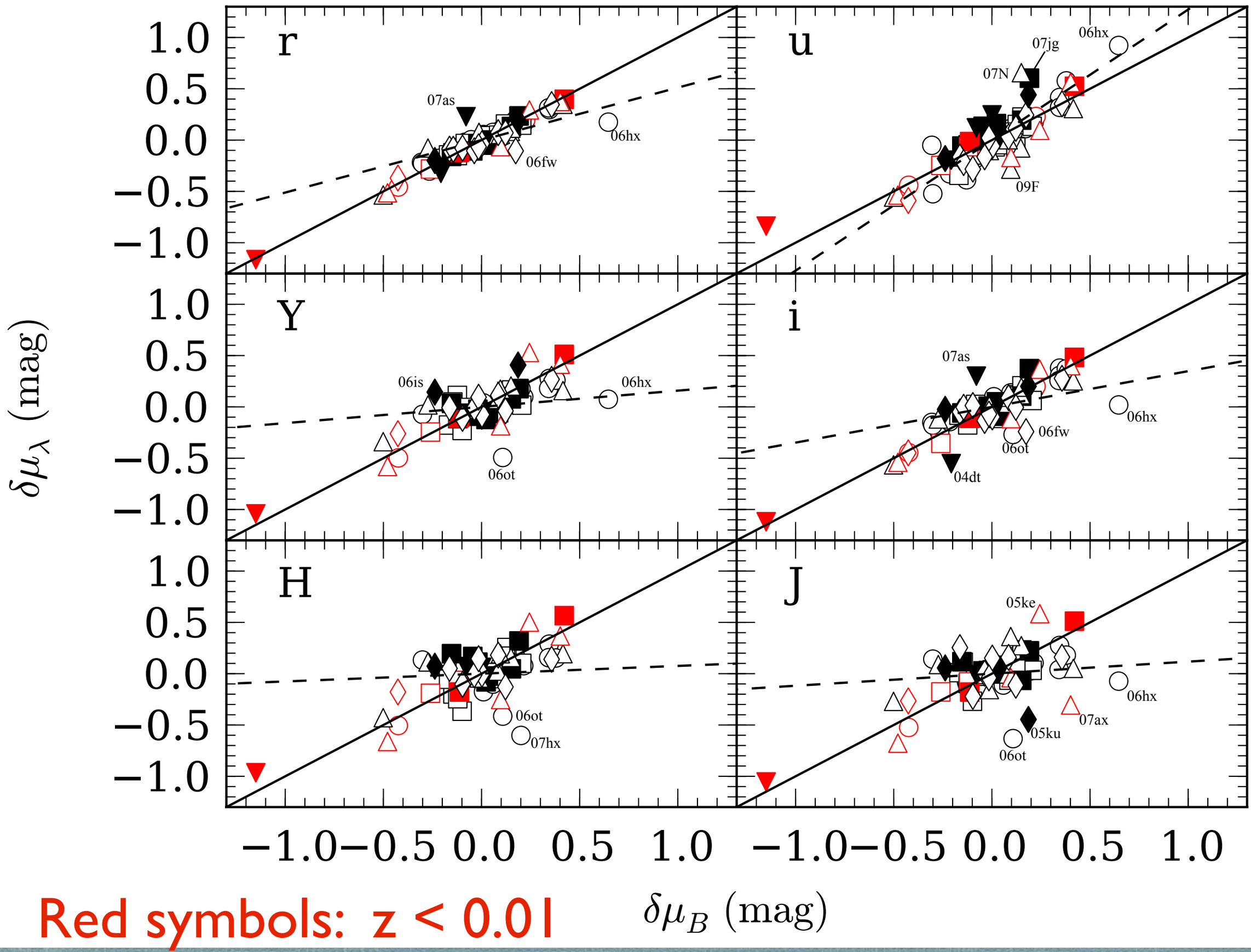
Tripp fits in B and H



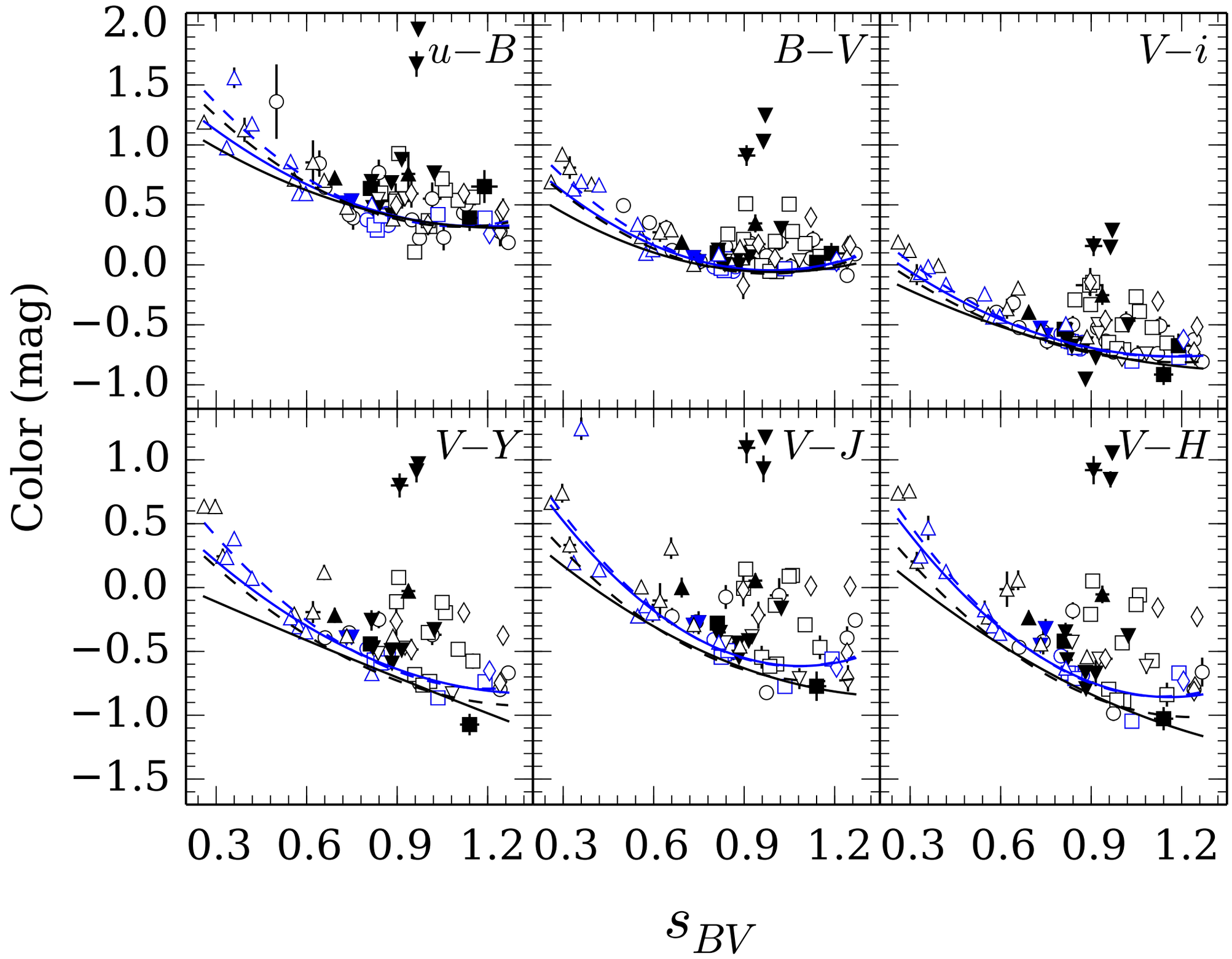
Tripp color coefficients vs. wavelenth

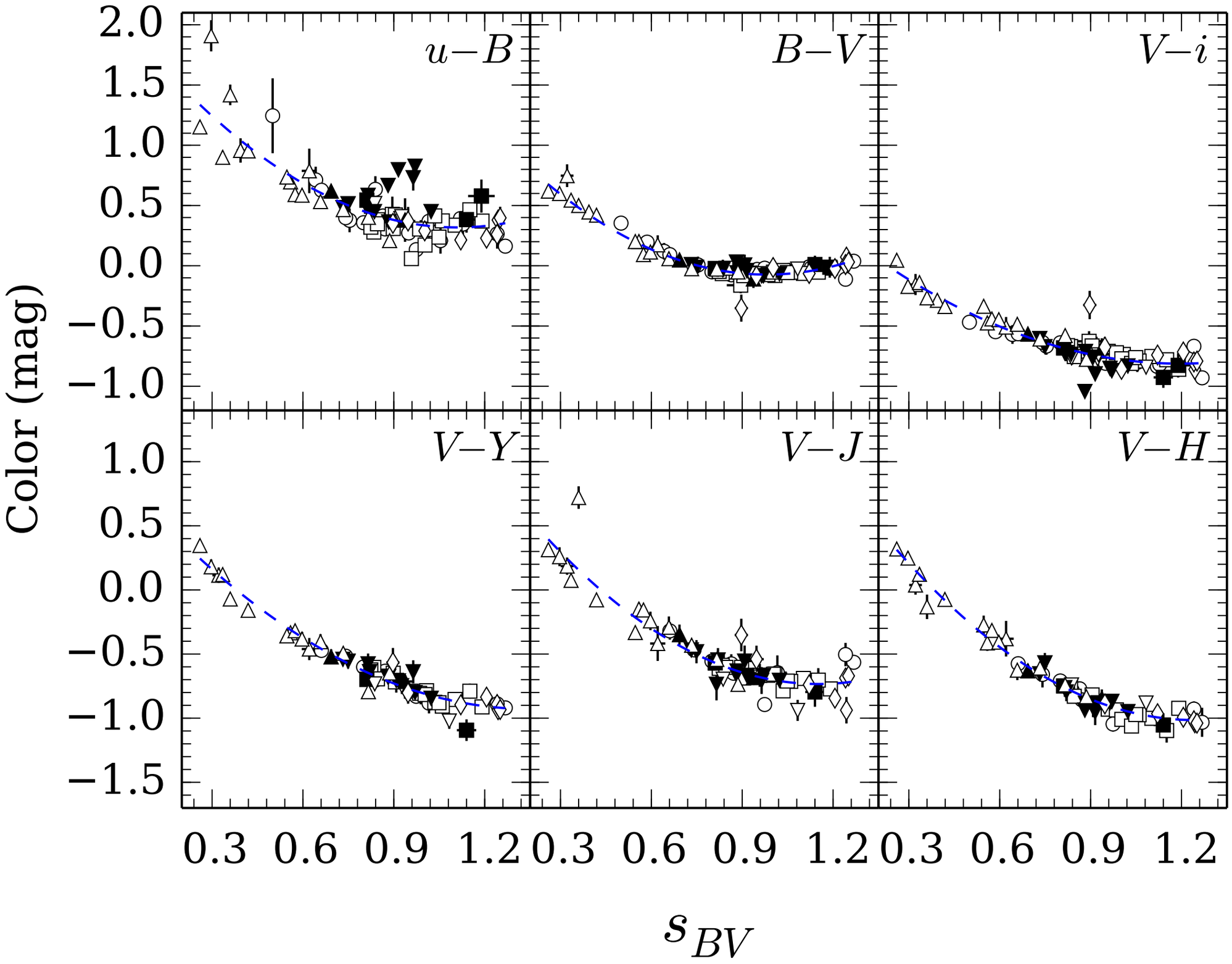


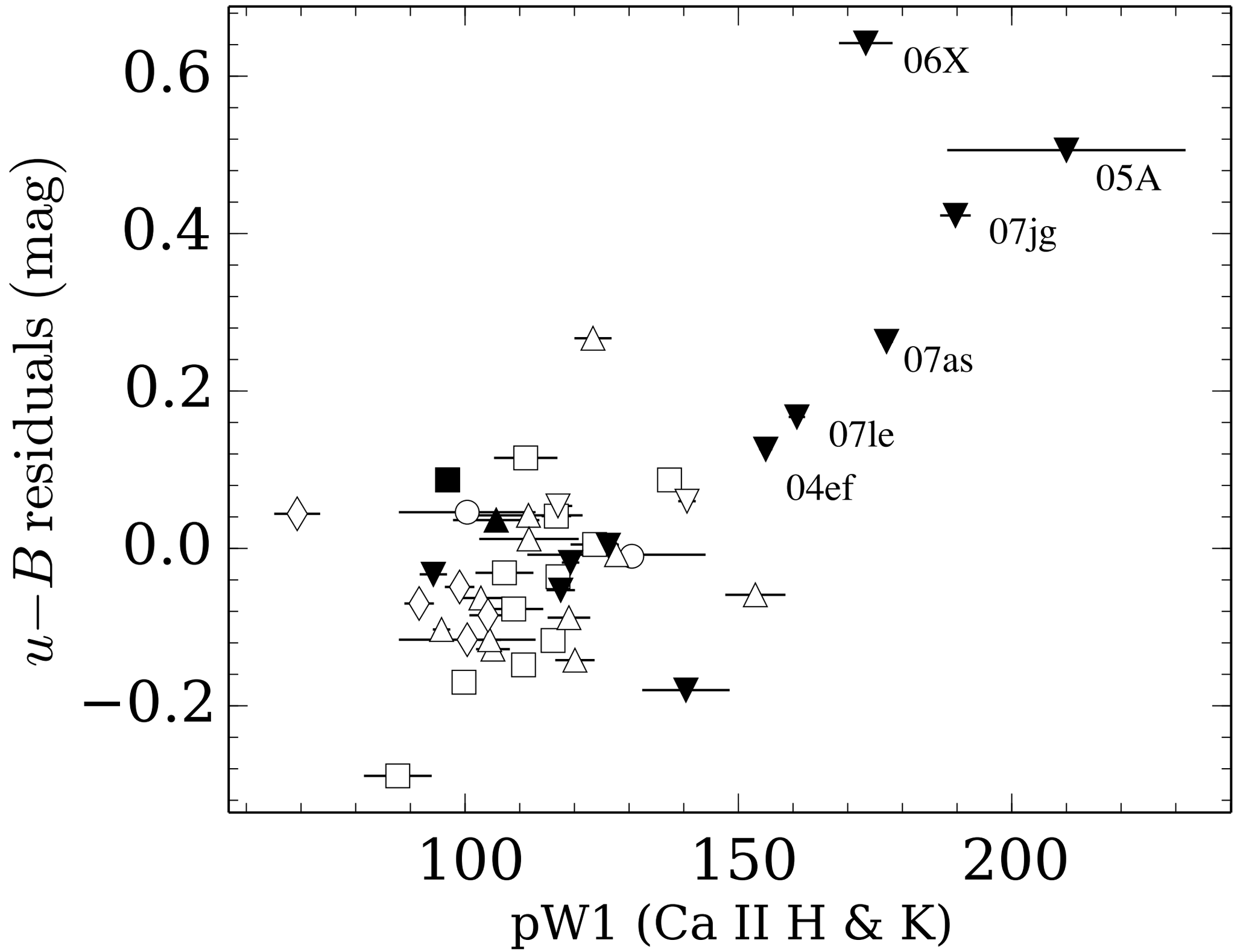
Tripp Residuals vs. Tripp Residuals

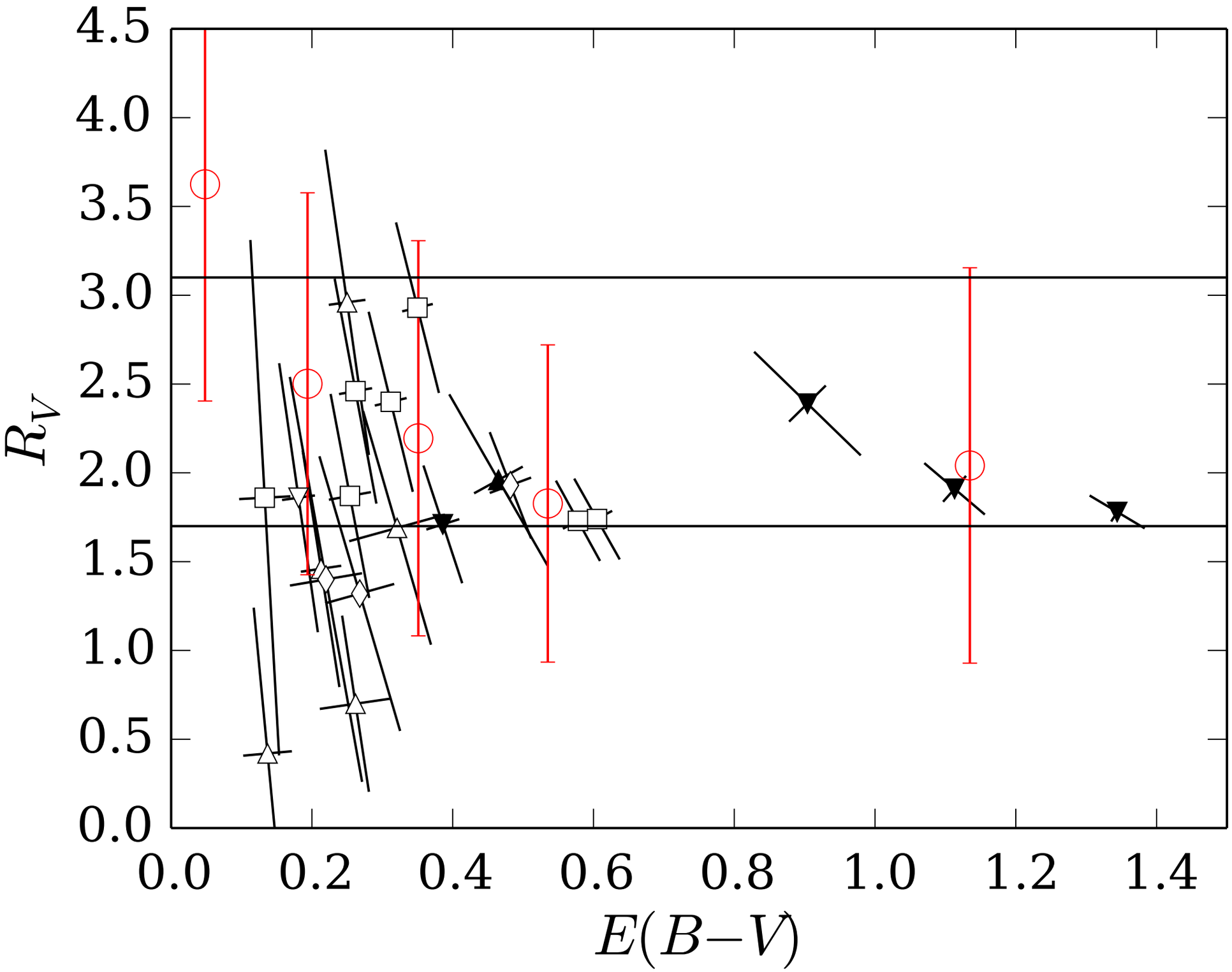


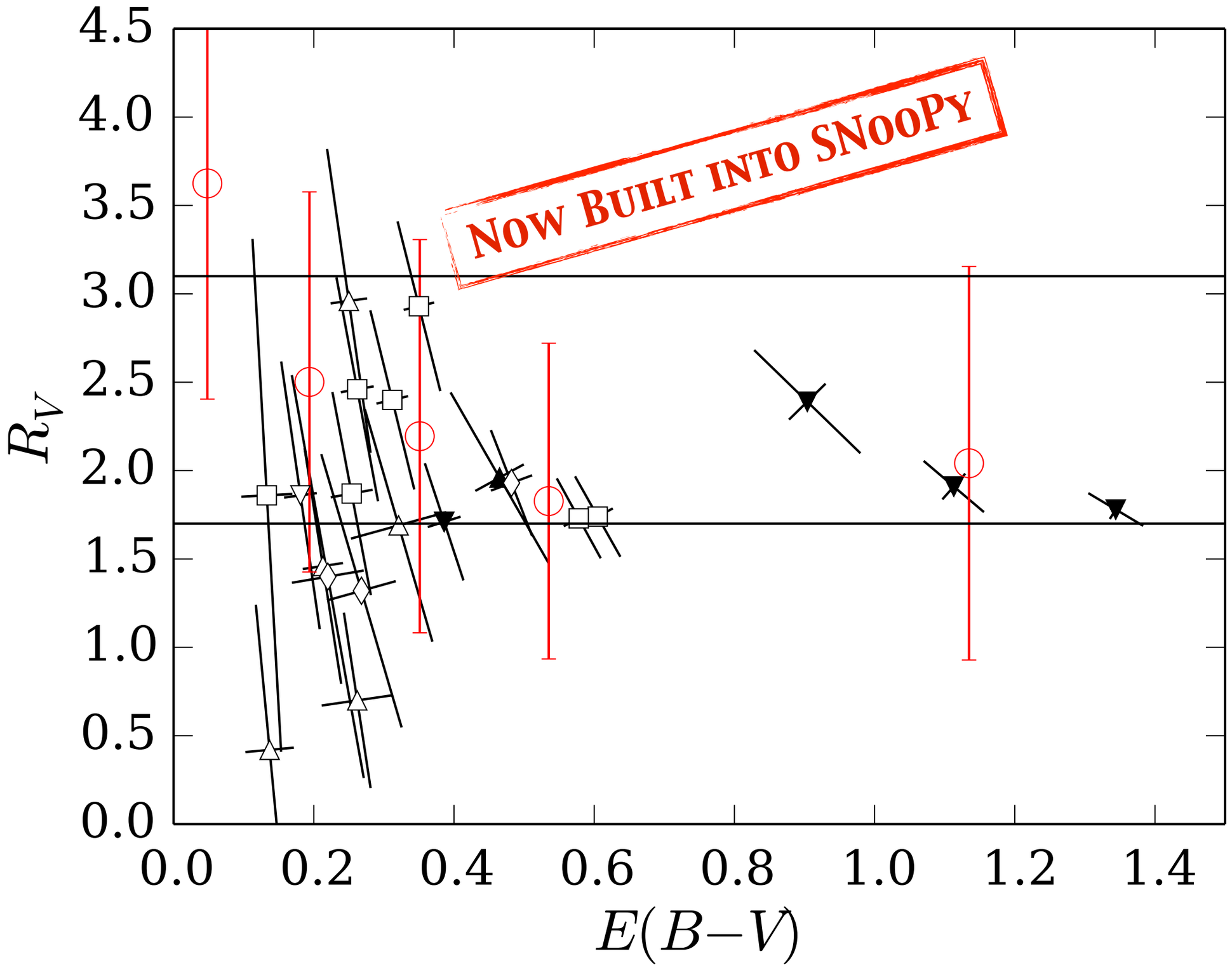
Red symbols: z < 0.01

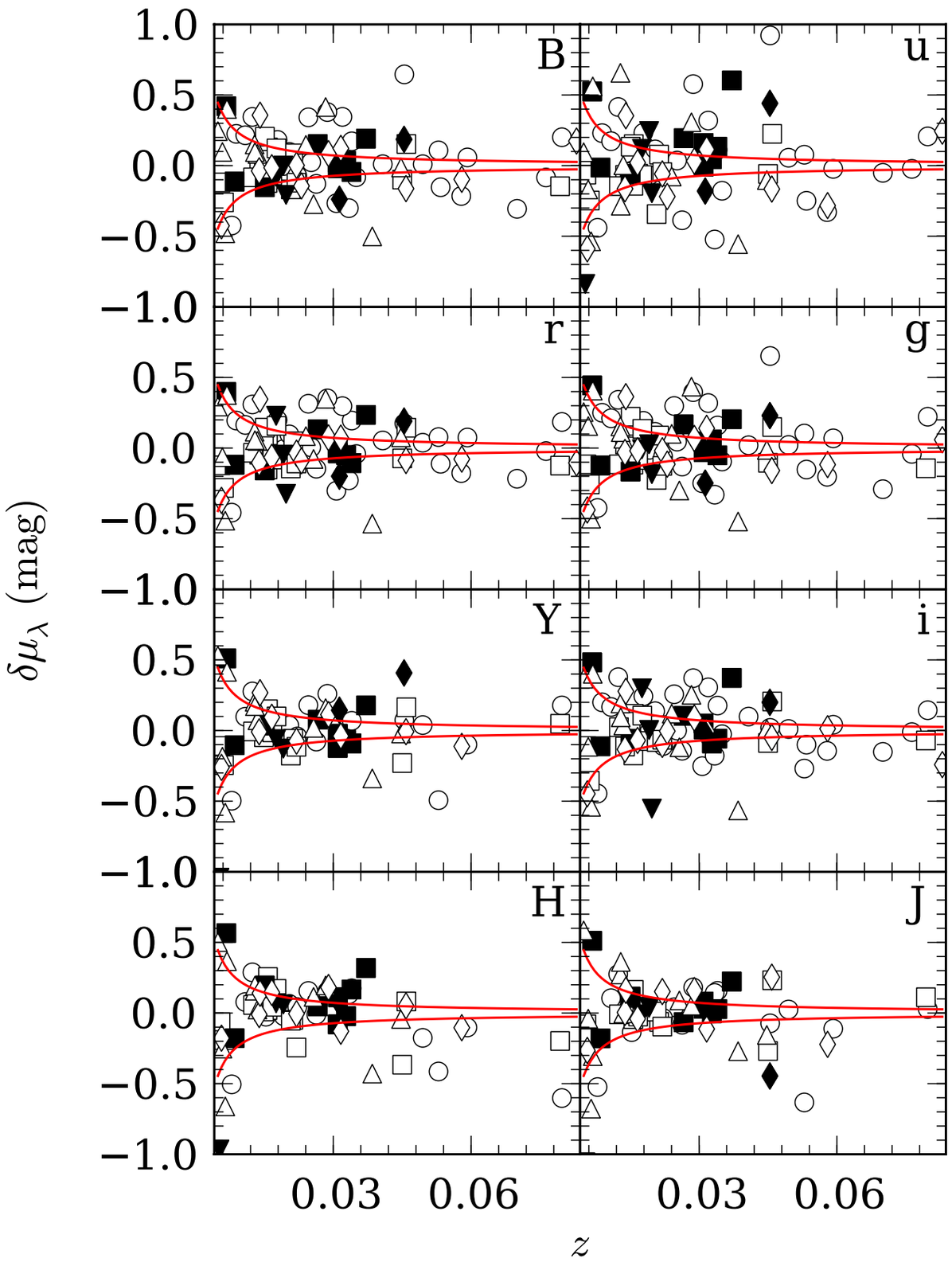

u−B
B−V
V−i
V−Y
V−J
V−H
Color
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
0.3
0.6
0.9
1.2
s_{BV}

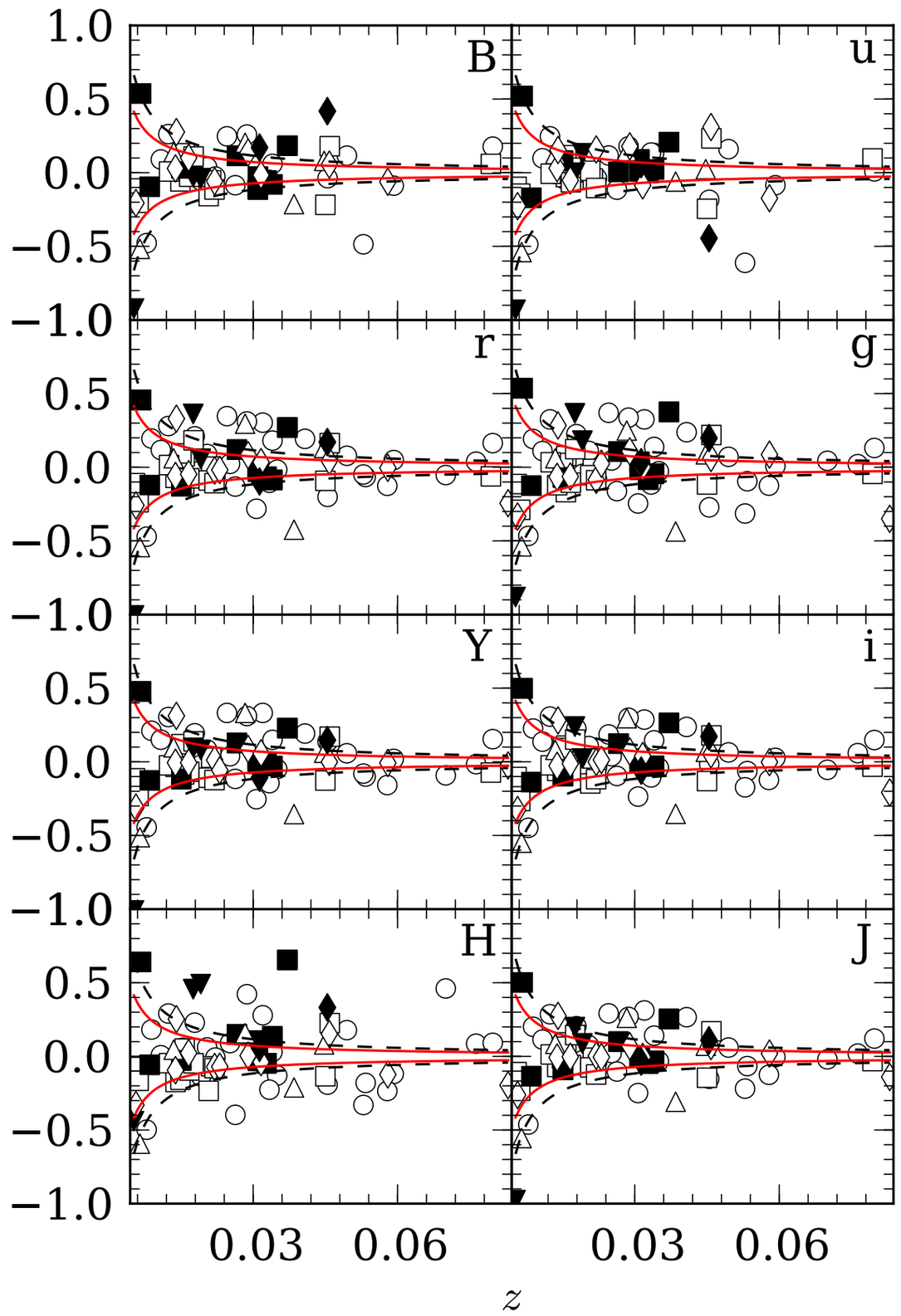

$u-B$
$B-V$
$V-i$
$V-Y$
$V-J$
$V-H$
Color (mag)
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
1.0
0.5
0.0
−0.5
−1.0
−1.5
0.3 0.6 0.9 1.2
0.3 0.6 0.9 1.2
0.3 0.6 0.9 1.2
s_{BV}

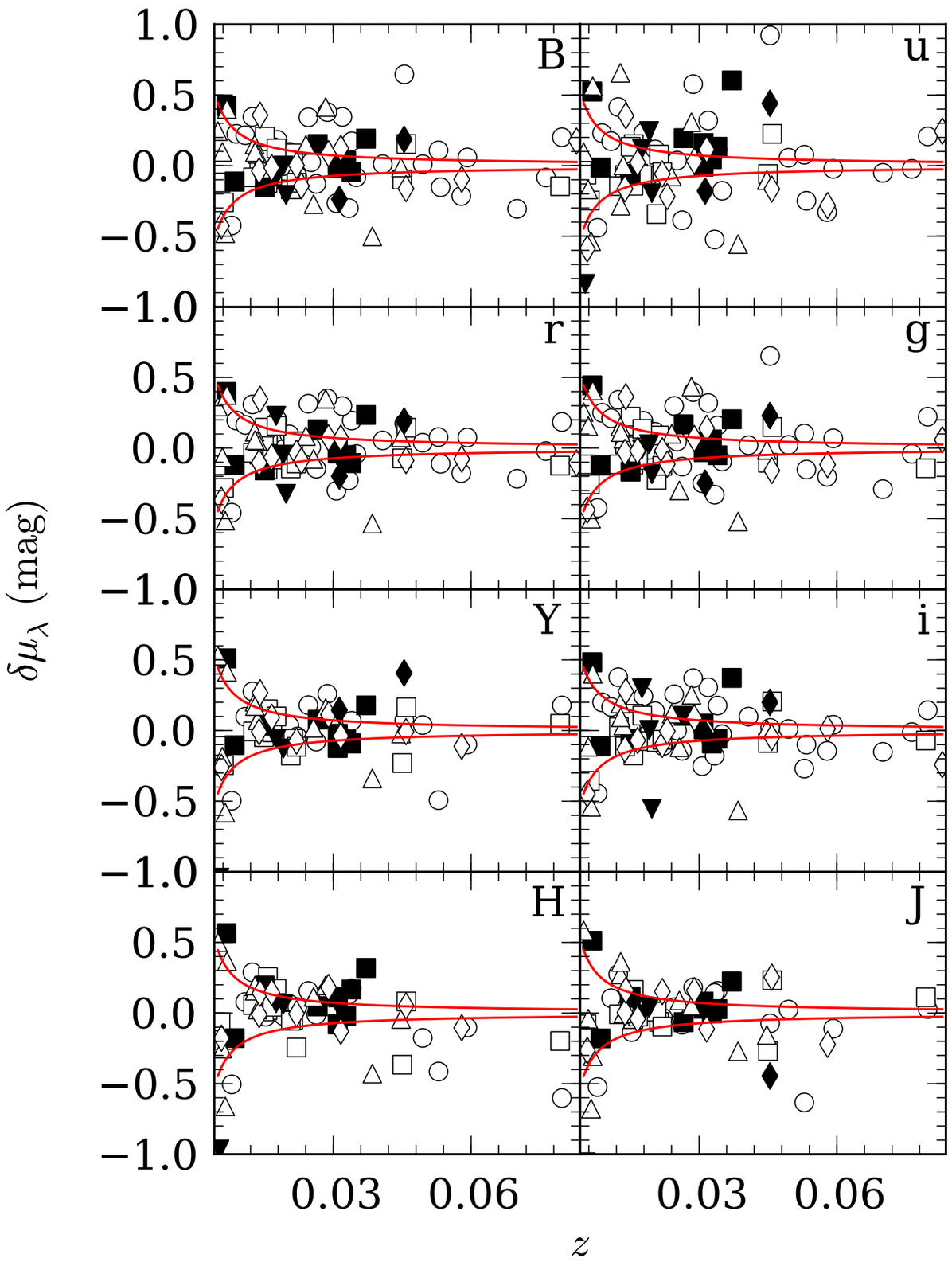

0.6
0.4
0.2
0.0
−0.2
$u-B$ residuals (mag)
100
150
200
pW1 (Ca II H & K)
06X
05A
07jg
07as
07le
04ef

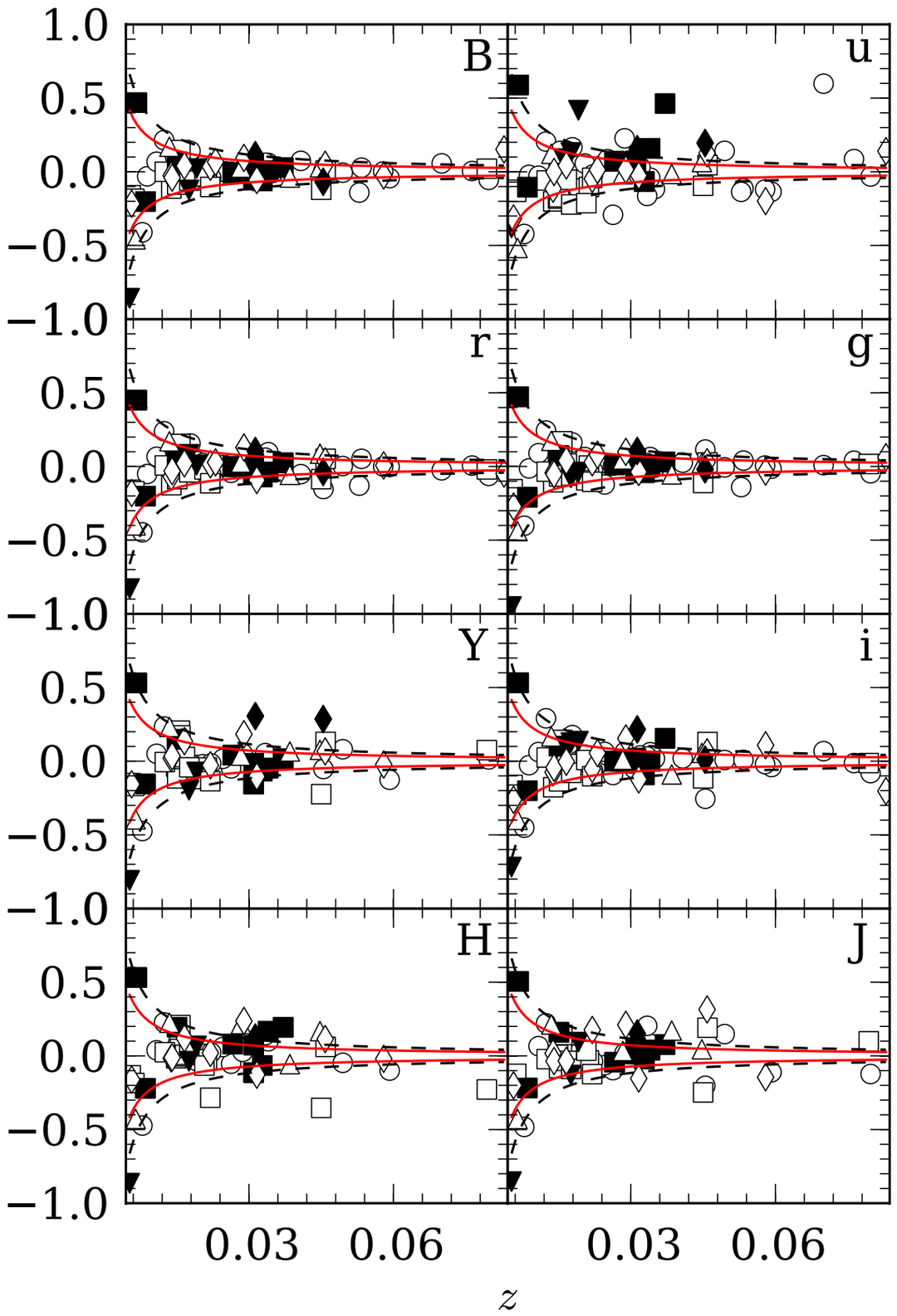

4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
R_V
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
$E(B-V)$


NOW BUILT INTO SNOOPY
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
R_V
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
$E(B-V)$

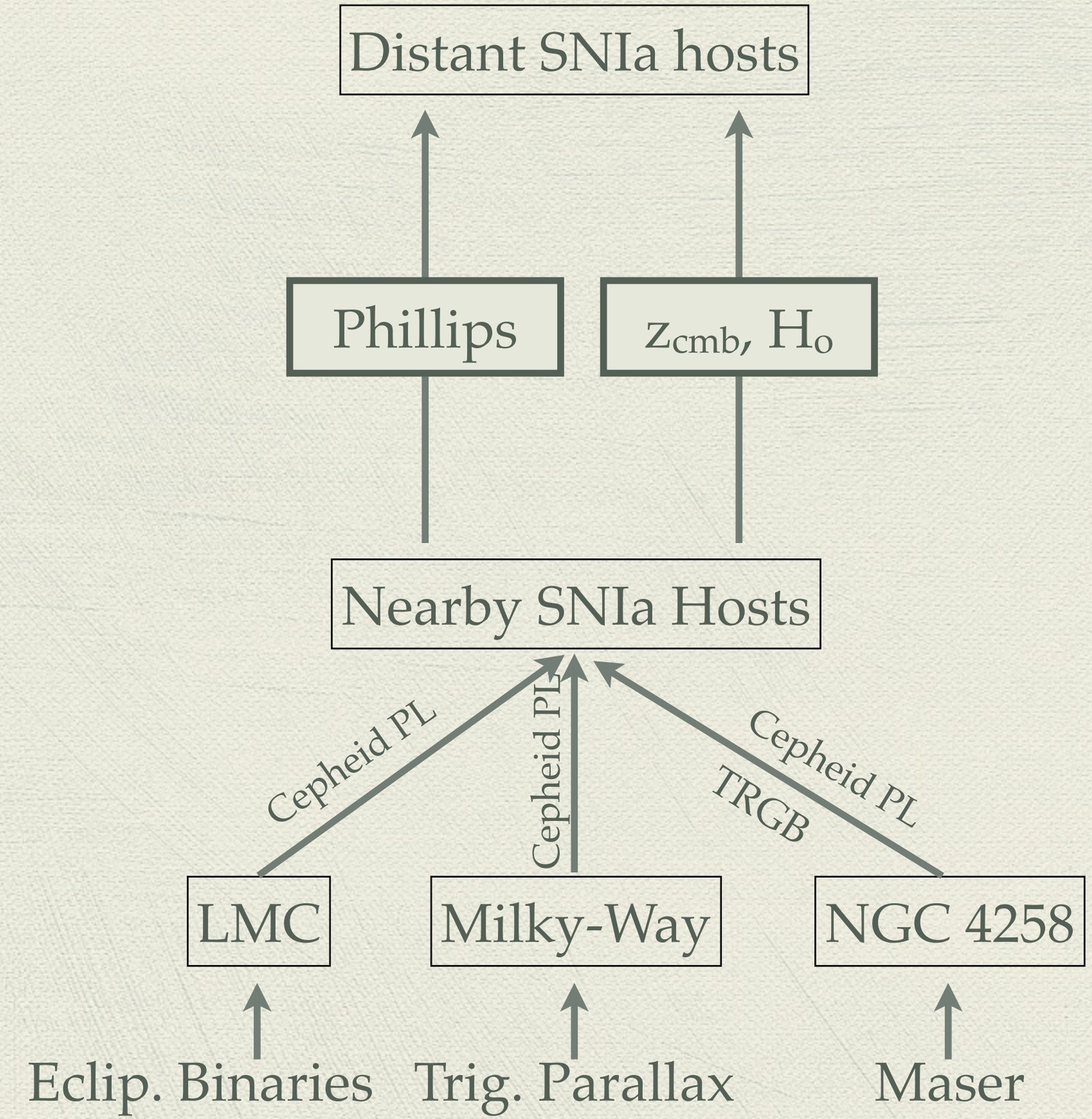

B
u
r
g
Y
i
H
J
1.0
0.5
0.0
−0.5
−1.0
0.03
0.06
$\delta\mu_\lambda$ (mag)
z

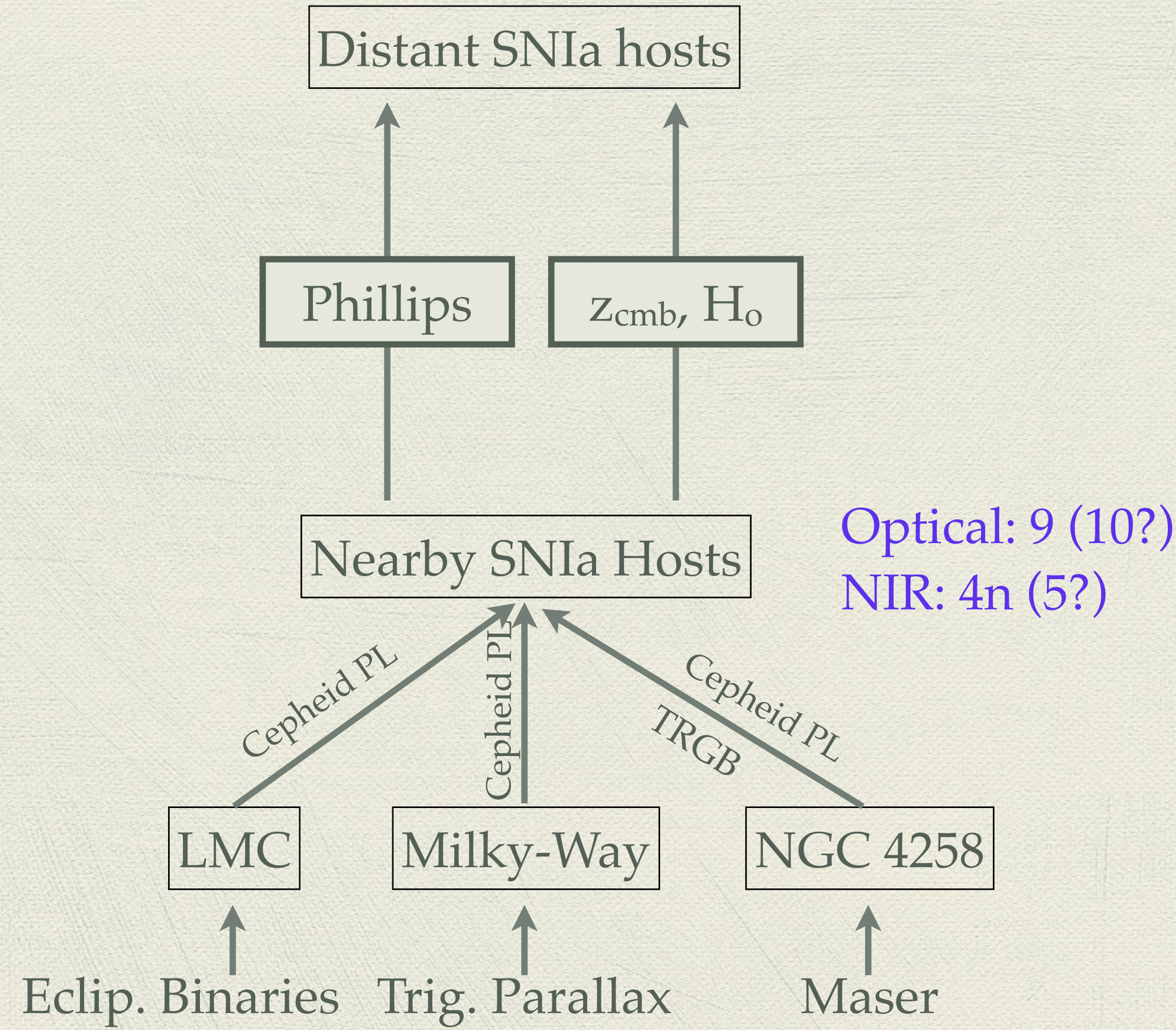

B
u
r
g
Y
i
H
J
1.0
0.5
0.0
−0.5
−1.0
0.03
0.06
z


B
u
r
g
Y
i
H
J
1.0
0.5
0.0
−0.5
−1.0
0.03
0.06
$\delta\mu_\lambda$ (mag)
z

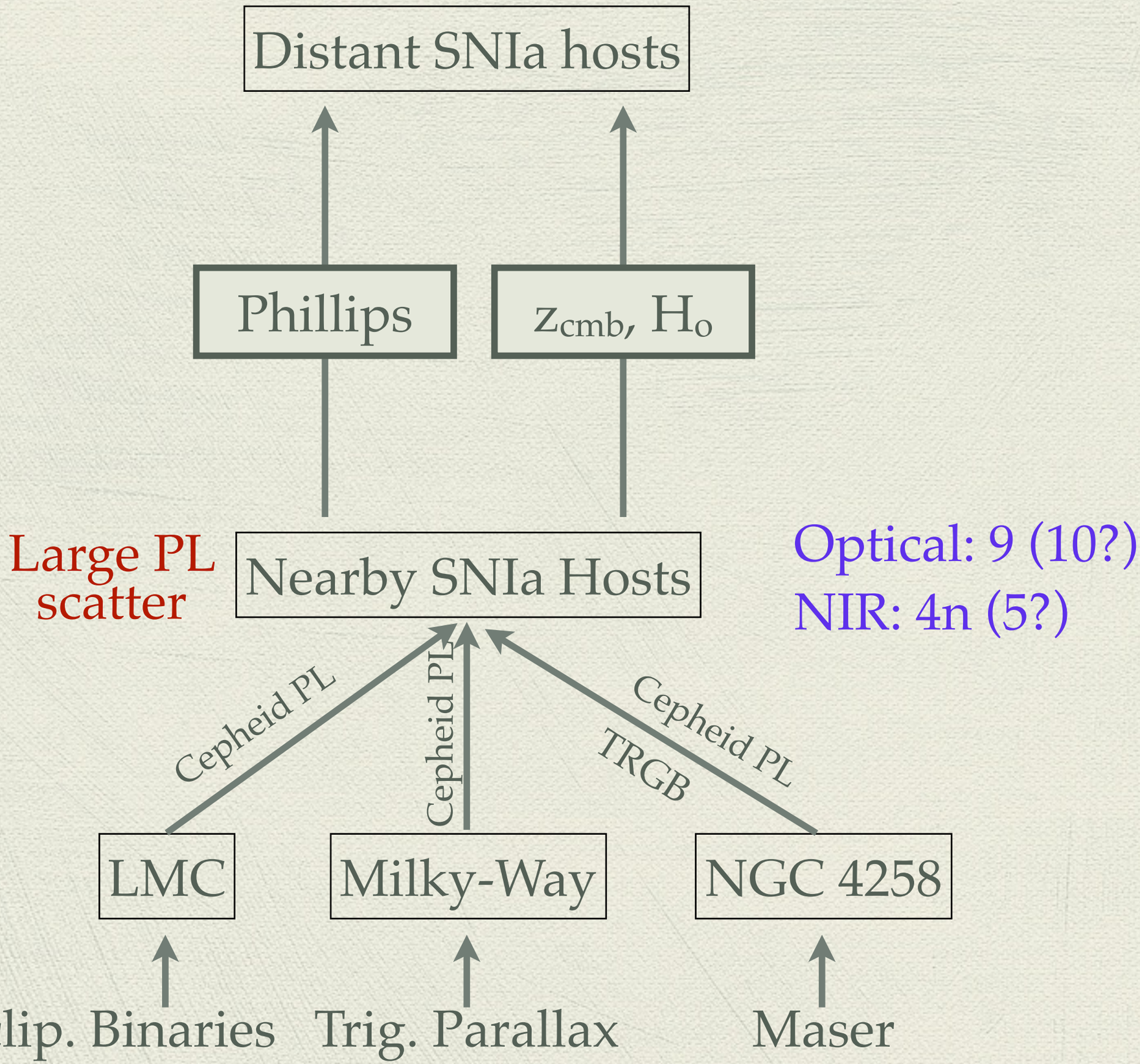

B
u
r
g
Y
i
H
J
1.0
0.5
0.0
−0.5
−1.0
0.03
0.06
z

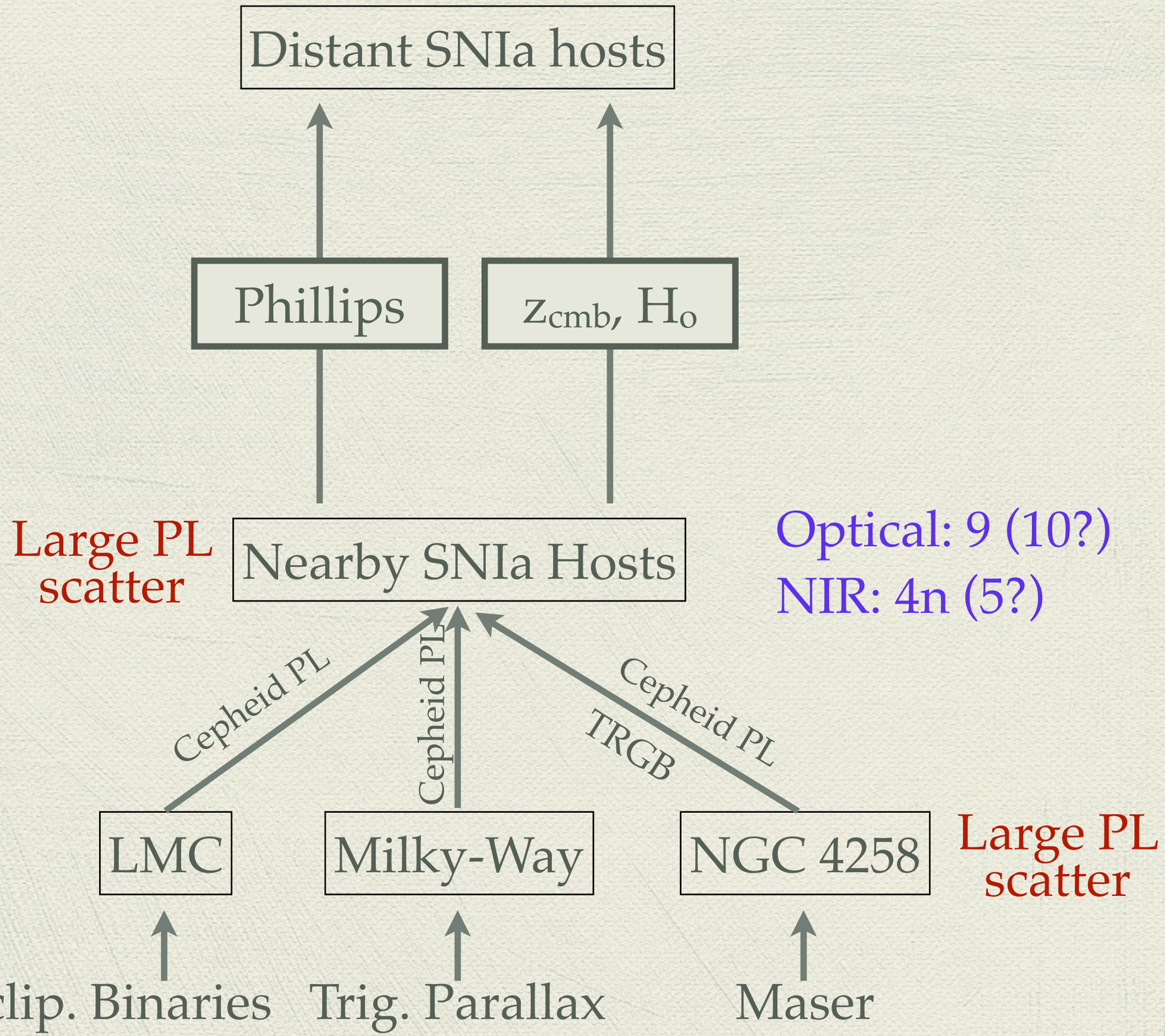
Near-field Cosmology: The Hubble constant.

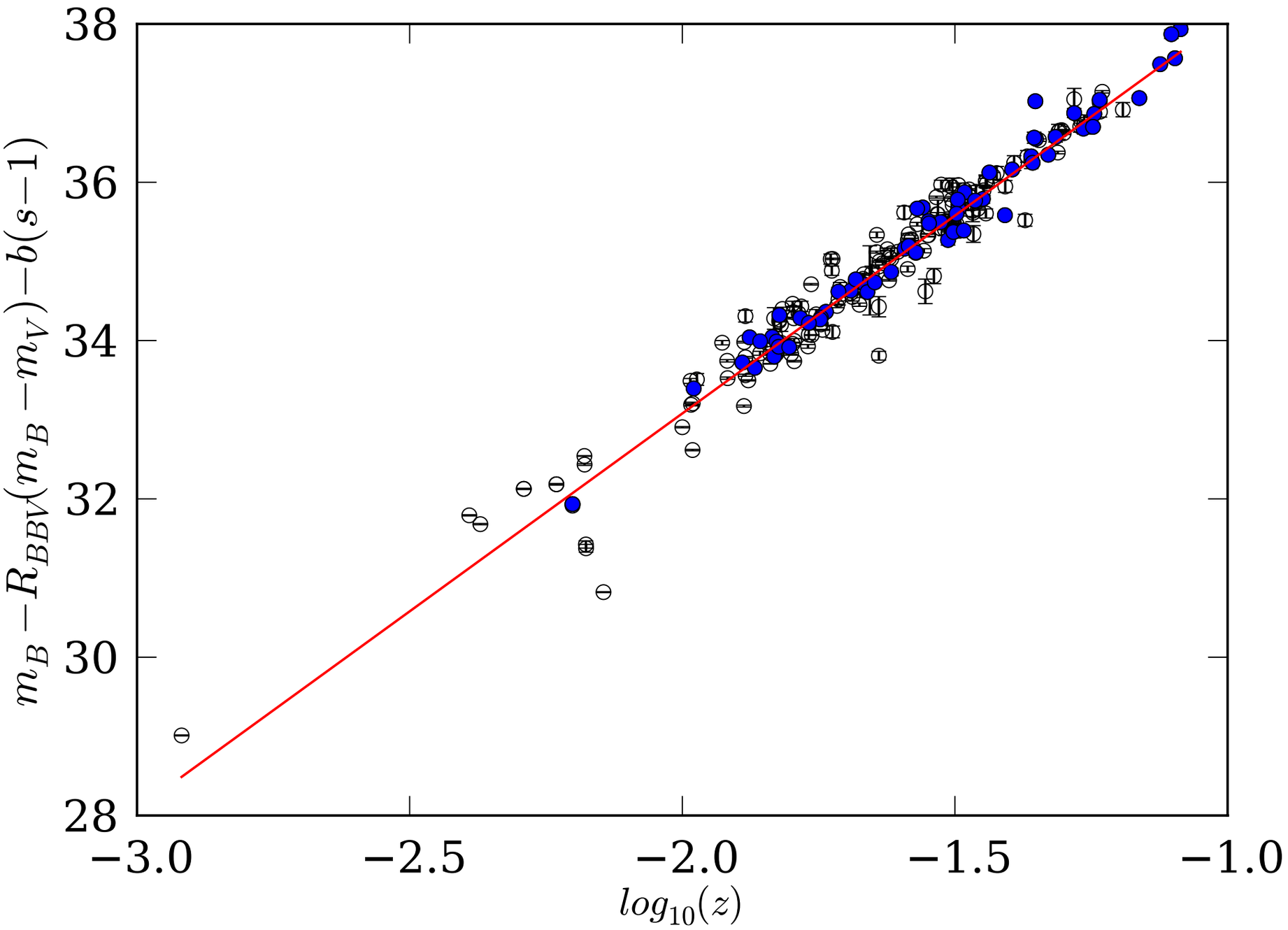

Distant SNIa hosts
Phillips
z_{cmb}, H_o
Nearby SNIa Hosts
Cepheid PL
Cepheid PL
Cepheid PL
TRGB
LMC
Milky-Way
NGC 4258
Eclip. Binaries
Trig. Parallax
Maser

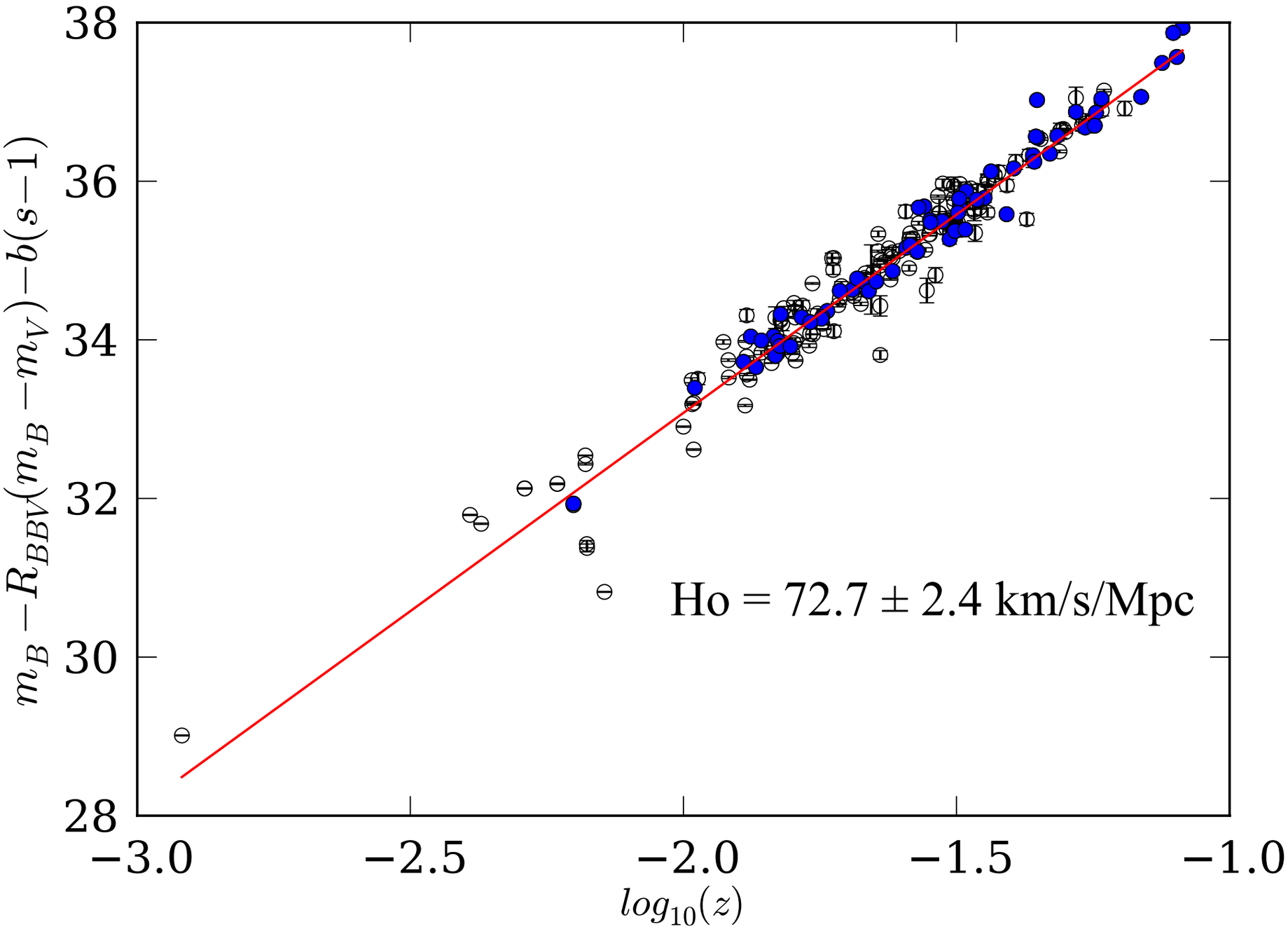


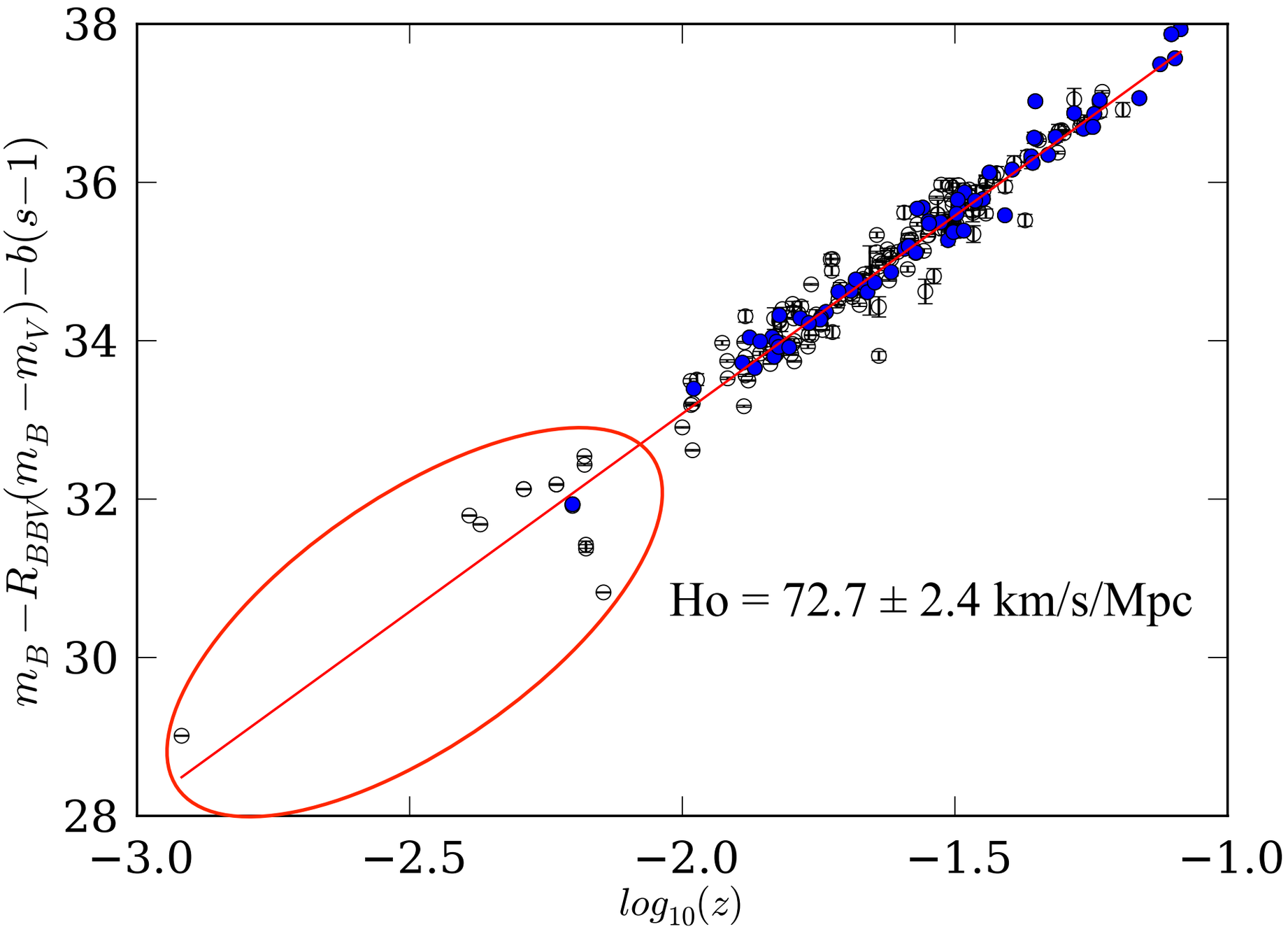
Optical: 9 (10?)
NIR: 4n (5?)

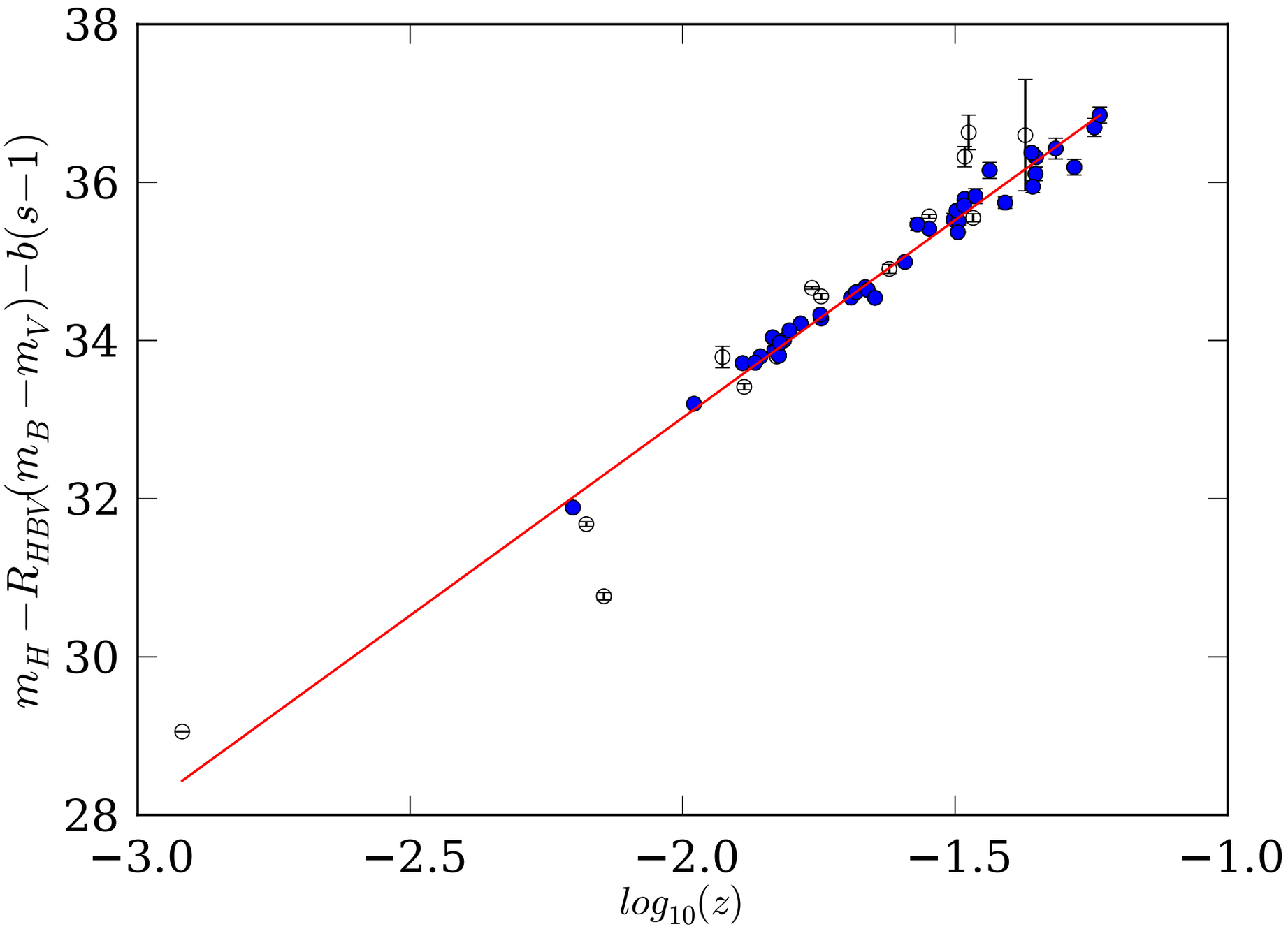

Distant SNIa hosts
Phillips
z_{cmb}, H_o
Large PL scatter
Nearby SNIa Hosts
Optical: 9 (10?)
NIR: 4n (5?)
Cepheid PL
Cepheid PL
Cepheid PL
TRGB
LMC
Milky-Way
NGC 4258
Eclip. Binaries
Trig. Parallax
Maser

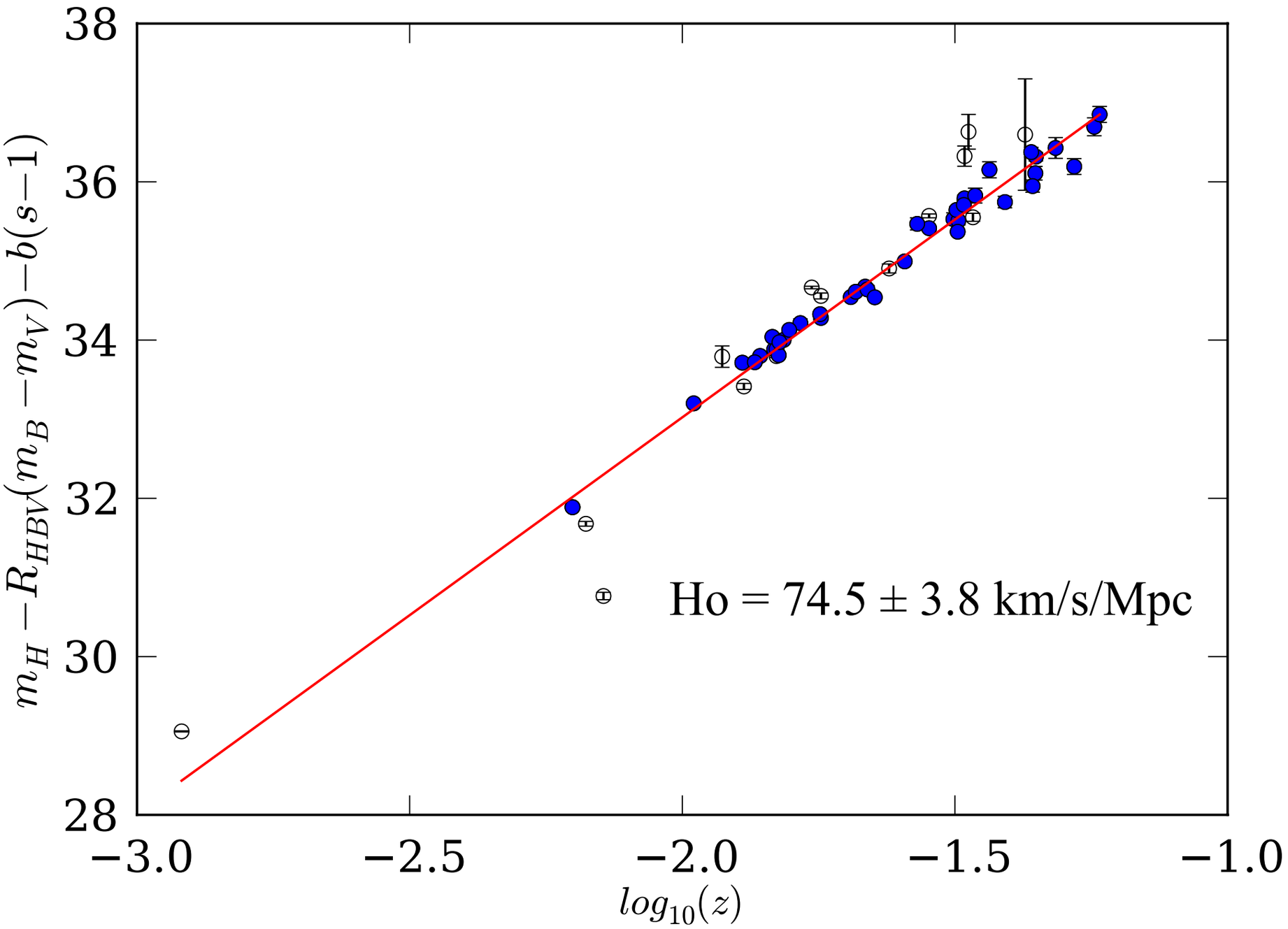

Distant SNIa hosts
Phillips
z_{cmb}, H_o
Large PL scatter
Nearby SNIa Hosts
Optical: 9 (10?)
NIR: 4n (5?)
Cepheid PL
Cepheid PL
Cepheid PL
TRGB
LMC
Milky-Way
NGC 4258
Large PL scatter
Eclip. Binaries
Trig. Parallax
Maser

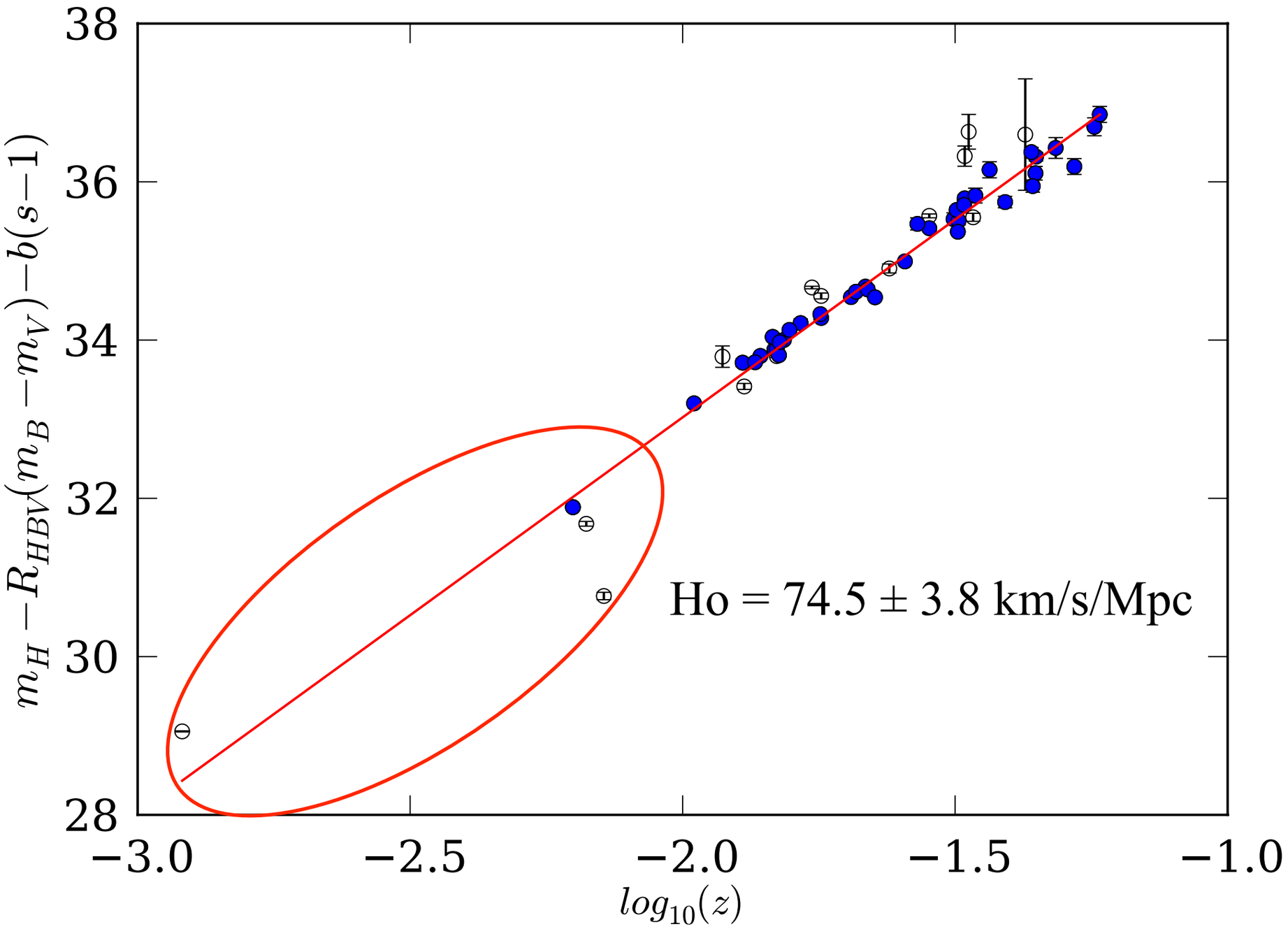

38
36
34
32
30
28
−3.0
−2.5
−2.0
−1.5
−1.0
$log_{10}(z)$
$m_B - R_{BBV}(m_B - m_V) - b(s-1)$


38
36
34
32
30
28
−3.0
−2.5
−2.0
−1.5
−1.0
$log_{10}(z)$
$m_B - R_{BBV}(m_B - m_V) - b(s-1)$
Ho = 72.7 ± 2.4 km/s/Mpc


38
36
34
32
30
28
−3.0
−2.5
−2.0
−1.5
−1.0
$m_B - R_{BBV}(m_B - m_V) - b(s-1)$
$log_{10}(z)$
Ho = 72.7 ± 2.4 km/s/Mpc


38
36
34
32
30
28
−3.0
−2.5
−2.0
−1.5
−1.0
$m_H - R_{HBV}(m_B - m_V) - b(s-1)$
$log_{10}(z)$


38
36
34
32
30
28
−3.0
−2.5
−2.0
−1.5
−1.0
$m_H - R_{HBV}(m_B - m_V) - b(s-1)$
$log_{10}(z)$
Ho = 74.5 ± 3.8 km/s/Mpc


38
36
34
32
30
28
−3.0
−2.5
−2.0
−1.5
−1.0
$log_{10}(z)$
$m_H - R_{HBV}(m_B - m_V) - b(s-1)$
Ho = 74.5 ± 3.8 km/s/Mpc

What CSP Brings

- Largest systematic for H_o: small number of SNIa hosts with independent distances. CSP adds 4 (07sr, 06X, 12fr, 06mr)
- High quality set of distant SNeIa. Significantly lower disp.
- Improved treatment of reddening (allowing nearby objects like 06X to be used to calibrate Phillips relation).
- Synergy with CHP.
- TRGB calibration instead of/in addition to Cepheid calibration.

JOBS TO DO

- Finalize the CSPI photometry, optical and NIR. Do we want to create “pickled” photometry? Tie Landolt and Smith?
- Get host galaxy properties for CSPI. Is there a NIR stellar mass-Luminosity correlation?
- Re-do high-z photometry using Carlos’ photometry package (it really needs a name).
- Work on SED templates and K-corrections. Another K-correction paper, but done the right way.

Intersection Sample?

- Combine (or not) the CfA3-4 and CSPI samples. Re-analyze the Union2 sample with added low-z objects.
- Impact of adding 30% more low-z objects. Need a fresh angle.
- Do proper reddening treatment instead of Tripp correction.
- Another idea: proper treatment of statistical and systematic errors in K-corrections. Do we have the data to do this? The stomach?

CSP: A River to Cosmology