No-Go Guide for the Hubble Tension

Wang-Wei Yu
Institute of Theoretical Physics, Chinese Academy of Sciences
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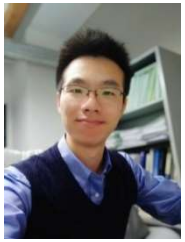
·2012.08292 Do the observational data favor a local void? PRD
·2102.02020 Chameleon dark energy can resolve the Hubble tension PRD Letter
·2107.13286 No-go guide for the Hubble tension: Late-time solutions PRD Letter
·2202.12214 No-go guide for the Hubble tension : matter perturbations under review

Rong-Gen Cai

Zong-Kuan Guo

Shao-Jiang Wang



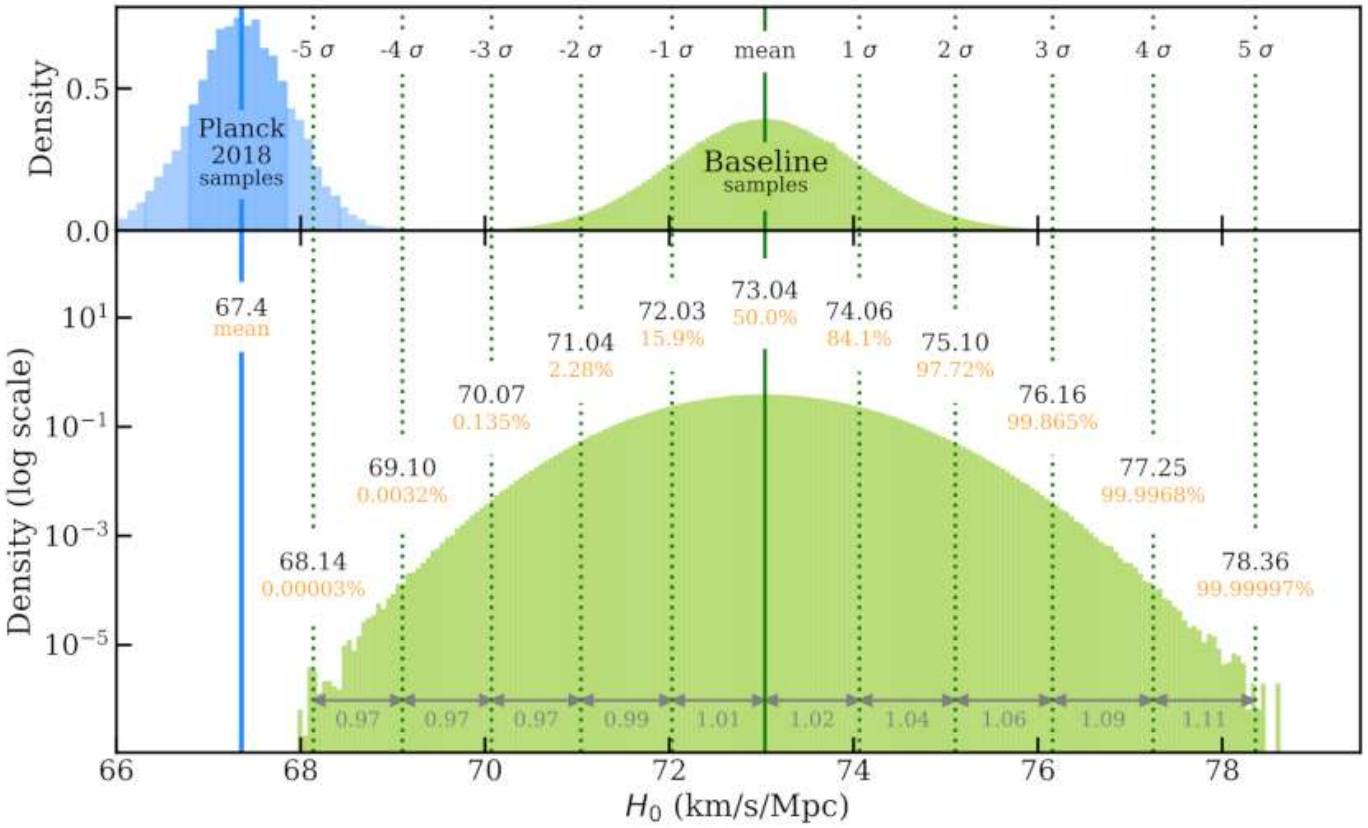
Li Li

Yong Zhou

Jia-Feng Ding

Hubble Tension

Hubble tension is becoming a Hubble crisis at 5-sigma C.L. !

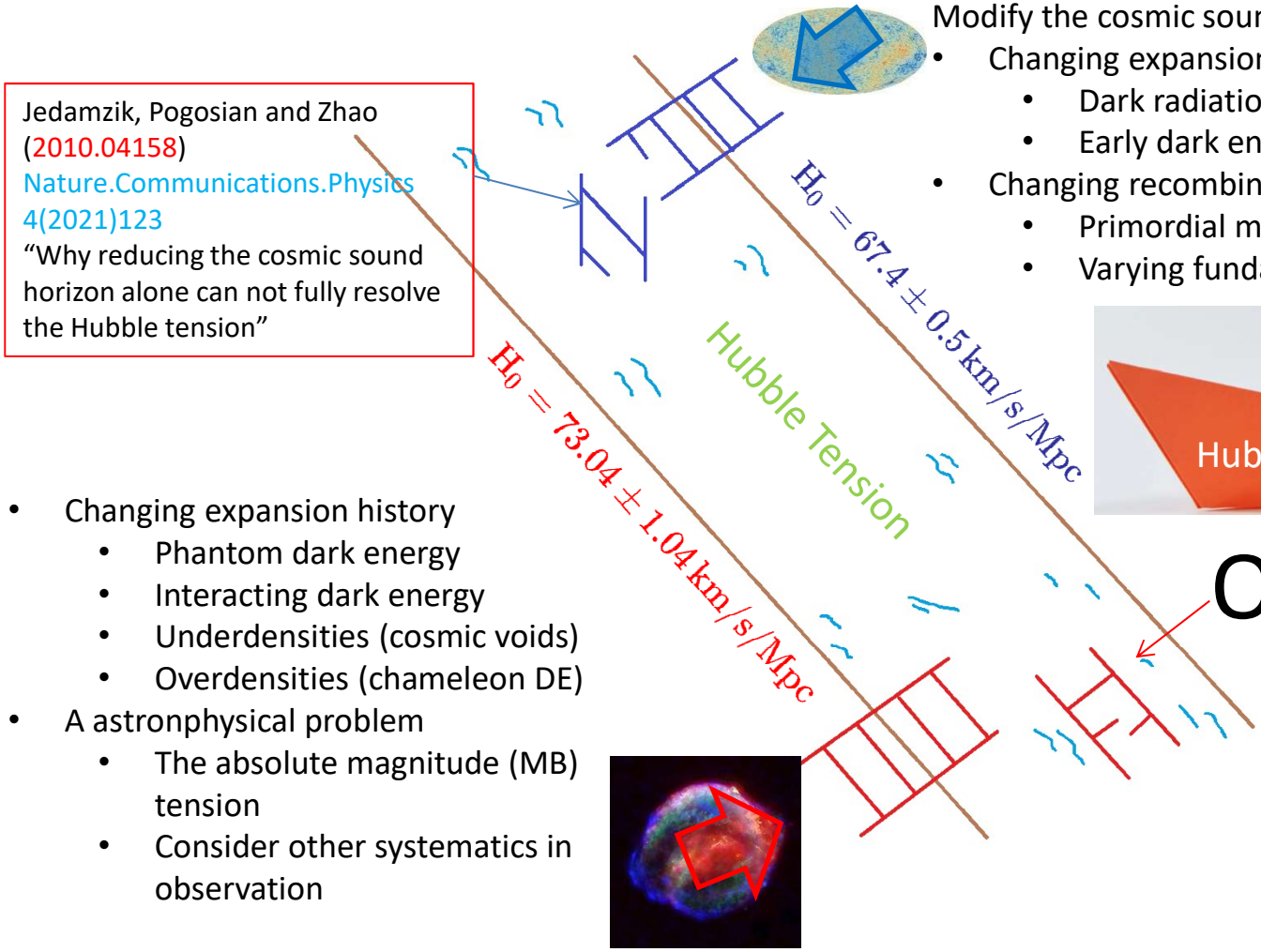


Credit: Riess et. al. 2112.04510

Hubble Solutions

Jedamzik, Pogosian and Zhao (2010.04158) Nature.Communications.Physics 4(2021)123
"Why reducing the cosmic sound horizon alone can not fully resolve the Hubble tension"

Modify the cosmic sound horizon
- Changing expansion history
  - Dark radiation(s)
  - Early dark energy
- Changing recombination history
  - Primordial magnetic fields
  - Varying fundamental constants



- Changing expansion history
  - Phantom dark energy
  - Interacting dark energy
  - Underdensities (cosmic voids)
  - Overdensities (chameleon DE)
- A astronphysical problem
  - The absolute magnitude (MB) tension
  - Consider other systematics in observation

Our Works!

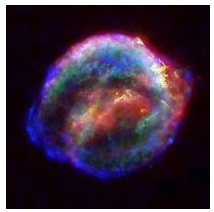
Distance Ladder

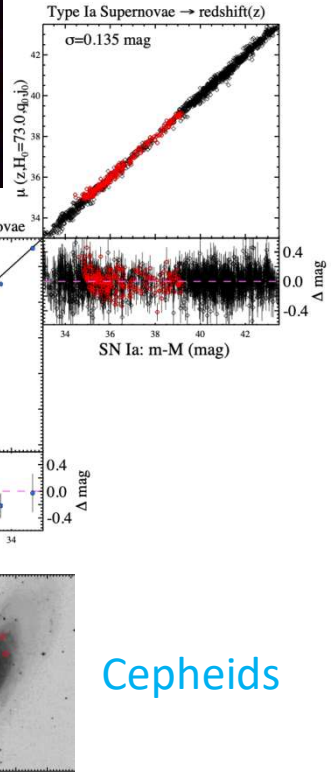
$$\mu = m_B - M_B = 5\lg\frac{D_L}{10\mathrm{pc}} = 5\lg\frac{c}{H_0} + 5\lg\frac{d_L}{10\mathrm{pc}}$$

Distance Ladder

=

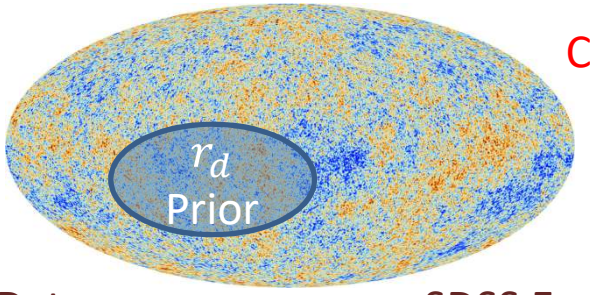
Cepheids + SNe





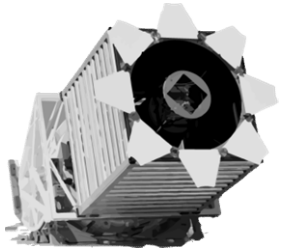
Cepheids

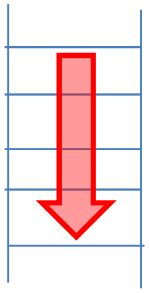
Credit: Riess et. al. 2112.04510



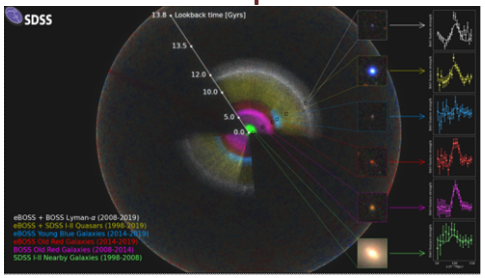
CMB prior

BAO Data





SDSS Experiments



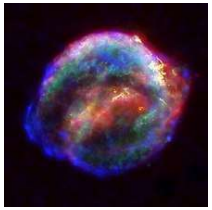
SNe + CMB prior

=

Inverse Distance Ladder

Our Late-time No-Go

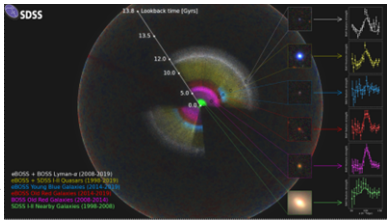
No Priors



Pantheon

H_0
M_B
Ω_m

H_0
r_d
Ω_m



BAO

Break Degeneracy

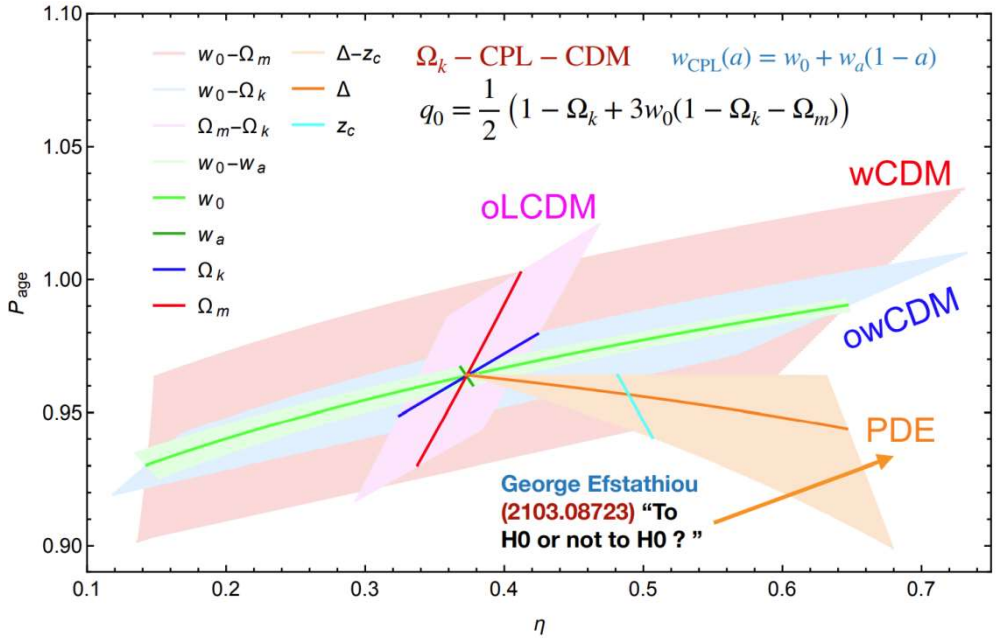
$Hz(z)$

Cosmic chronometers (CC)

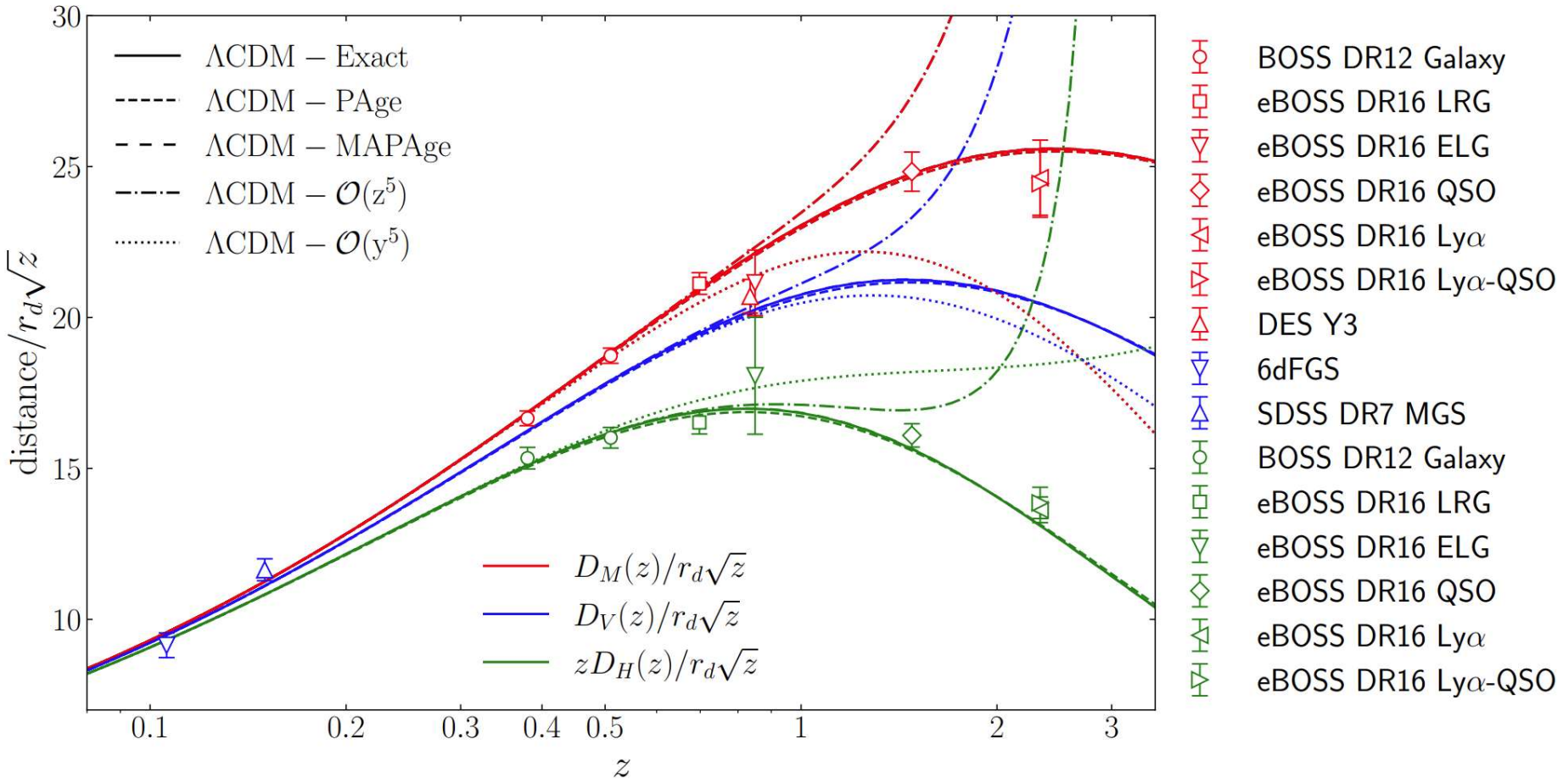
More General

$$\frac{H}{H_0} = 1 + \frac{2}{3}\left(1 - \eta\frac{H_0 t}{P_{\rm age}}\right)\left(\frac{1}{H_0 t} - \frac{1}{P_{\rm age}}\right) \qquad P_{\rm age} \equiv H_0 t_0$$

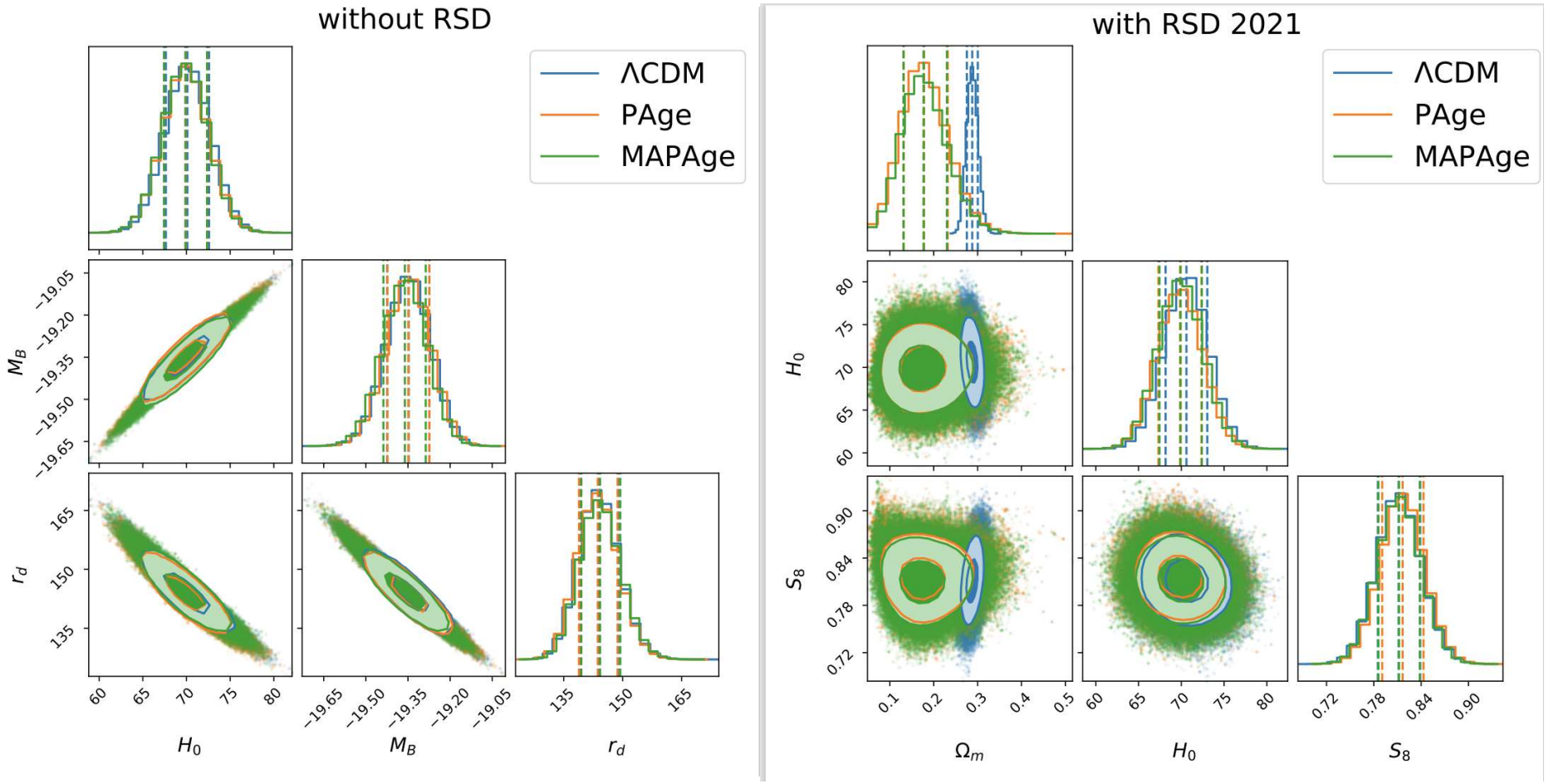
Zhiqi Huang 2020 ApJL 892:L28

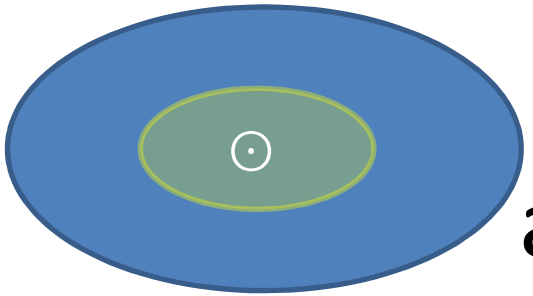


Better late-time model parametrization



No Evidence Beyond LCDM at Late-time

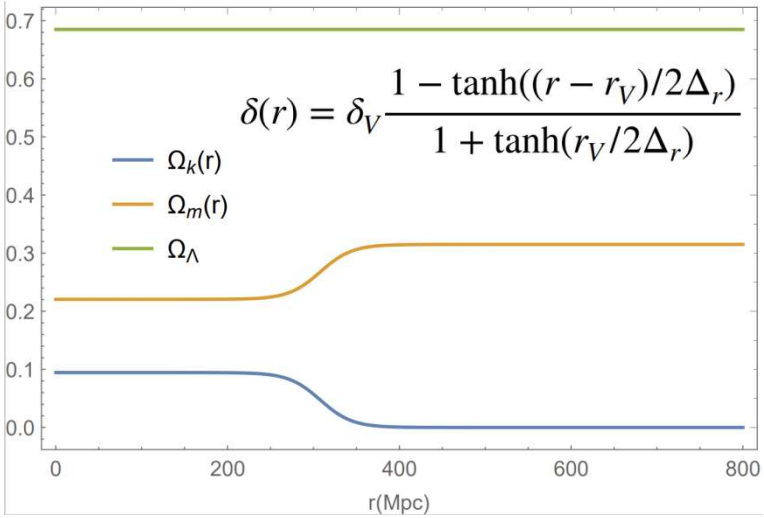


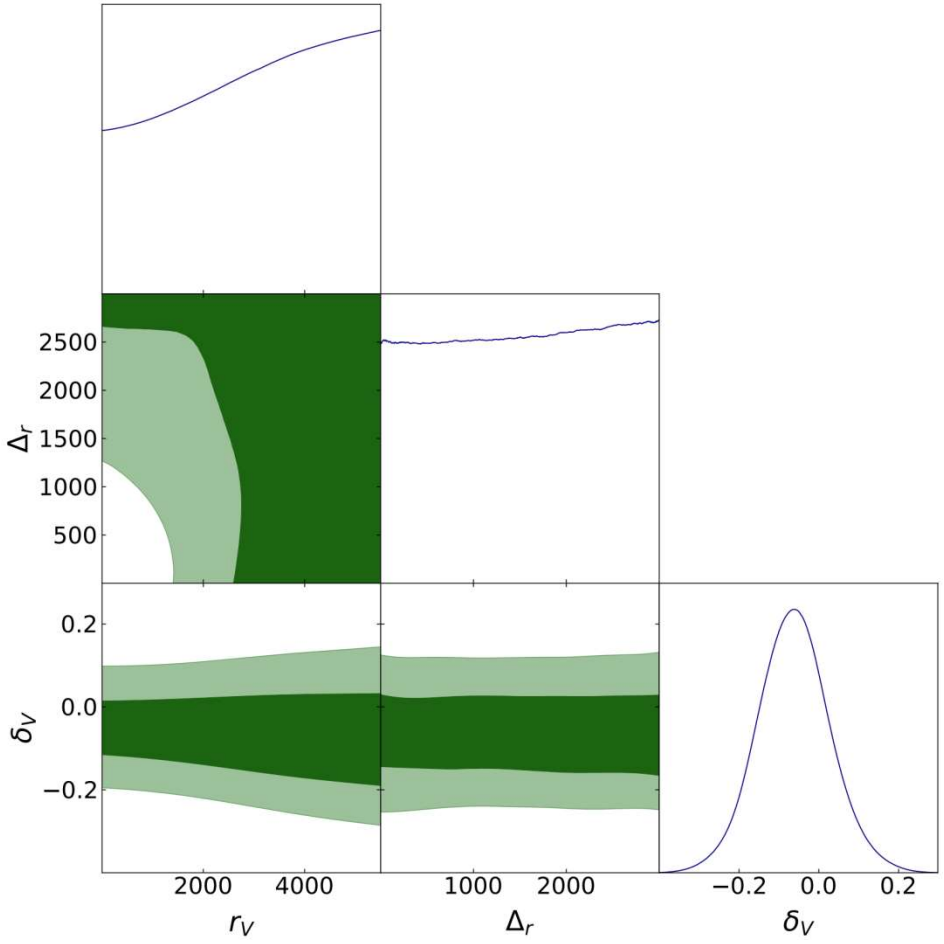


No Evidence for a Large Local Void

Pantheon SNe data with GBH profile in ΛLTB model

$$H^2(r,t) = H_0^2(r)\left[\Omega_M(r)\left(\frac{R_0(r)}{R(r,t)}\right)^3 + \Omega_k(r)\left(\frac{R_0(r)}{R(r,t)}\right)^2 + \Omega_\Lambda(r)\right]$$





Conclusion

- Hubble tension might be a smoking gun for new physics but we don't find it up to now;
- Local homogeneous solutions might not the key for resolving the Hubble tension;
- Local inhomogeneous solution with GBH profile in ΛLTB model might not resolve the Hubble Tension;
- Chameleon dark energy with Hubble Diversity scenario? ----- maybe.

Thanks for your listening!