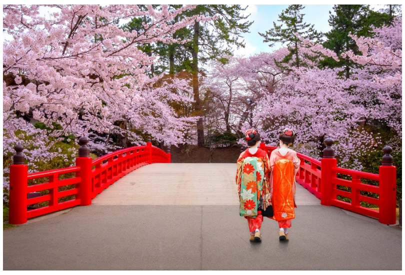

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On the Hubble constant tension in the Supernovae Ia Pantheon sample

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The long-standing Hubble constant (H0) tension is the discrepancy of more than 4σ between the local measurement of H0 through the Cepheids and Supernovae Ia (SNe Ia) and the cosmological value of H0 obtained with the Planck measurement of the Cosmic Microwave Background radiation. To investigate this tension, we performed an estimation of H0 in the standard ΛCDM and the w0waCDM models through a binned analysis of the Pantheon sample, a collection of more than 1000 SNe Ia (Scolnic et al. 2018). Dividing the Pantheon sample in 3, 4, 10, and 20 ordered in redshift bins, we found the value of H0 in each bin through a Monte Carlo Markov Chain approach where we left free to vary only the parameter H0 and fixing all the remaining cosmological parameters. Thus, the found H0 values were fitted with the following functional form: g(z)= H' 0/(1+z)^ α, where z is the redshift, H'0= H0(z=0), and α is the evolutionary coefficient. We found that α is in the order of 10^-2 and is compatible with zero in the range 1.2σ-2.0σ (Dainotti et al. 2021). With this information, we extrapolated the value of H0 at the redshift of the Last Scattering Surface, zLSS=1100, finding a value compatible in 1σ with the measured one from Planck. In a subsequent analysis, we investigated if this effect could be due to the mono-dimensionality of the parameters space and the use of SNe Ia as the only probe. Therefore we added the Baryon Acoustic Oscillations (BAOs) to the Pantheon sample and we performed a division in 3 bins with the variation of two parameters per time: H0 and the total matter density parameter (Ωm) in the ΛCDM model, and H0 together with wa, namely the slope of the equation of state parameter in the CPL parametrization w(z)=w0 + wa (z/1+z) (Chevallier & Polarski 2001). We found that the slow decreasing trend of H0 is still visible through the aforementioned g(z) form, with α again in the order of 10^-2 and the compatibility with zero in a range 2.0σ-5.8σ (Dainotti et al. 2022). This trend, if not due to statistical effects, could be explained through the presence of hidden astrophysical biases, such as the effect of stretch evolution (Nicolas et al. 2021). If this is not the case, these results may require new theoretical models, for example, the f(R) theories of gravity.

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