Article Title

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June 19, 2020

Abstract

*The recent tensions on the measured value of the Hubble constant between CMB and astrophisical observations, has triggered the need of new methods for its determination. In view of this, an effort has been done by H0LiCoW to use the gravitational lensing of quasars as a probe for H0. This type of measurement requires a long term monitoring of lensed quasars (of the order of years). Since big telescopes have to deal with many observational requests, it is difficult to have a constant monitoring over the years, therefore this task can be achieved more easily by small/medium size telescopes. However, the number of lensed quasars with multiple images that can be resolved by these telescopes drops drastically. Here we present a method to deal with **non resolved** lensed quasars. This method has also the advantage of being less dependent on the microlensing effect of the lens galaxy.*

I. Introduction

In the last years, the precision of the Planck experiment [cita], whose task was to analyse the Cosmic Microwave Background (CMB) anisotropies, has allowed to fully test our standard cosmological model (ΛCDM) which assumes the existence of Dark Energy (Λ) and Cold Dark Matter (CDM). In particular, in addition to the minimal 6 parameters describing ΛCDM, the CMB anisotropies allow to indirectly constrain other parameters, such as the current expansion rate of the Universe, H_0, whose inference strongly depends on the assumed cosmological model. For example, relaxing the spatial flatness hypothesis of our Universe or the constant equation of state for the dark energy, would impact the H_0 estimation.

In parallel, the are other independent methods to measure H_0, such as the distance ladder [cita], water masers [cita], the time delay between multiple images of gravitational lensed quasars [1] and, gravitational waves [cita].

The highest precision reached by Plank has however shown a tension in the value of H_0 with respect to the distance ladder measurements, which has been further enhanced by the recent gravitational lensing results from the H0LiCOW collaboration [2], whose measured value is $H_0 = 73.3^{+1.7}_{-1.8}$ km s^{-1} Mpc^{-1}, in agreement with the distance ladder results and, together with them, with a $5.3\,\sigma$ tension with the Planck analysis assuming flat ΛCDM.

In this paper we will focus on the gravitational lensing: firstly suggested by Refsdal [3], this method directly relates the time delays between multiple images of the same source produced by a lensing object with H_0 in the form $\Delta_T \propto 1/H_0$. This method depends on the matter distribution in the source light trajectory, namely the lensing object (such as a galaxy) and objects along the line of sight, and it has a weaker dependence on the cosmological parameters if compared to the CMB analyses. In particular, it depends on the matter density Ω_m, the dark energy density Ω_Λ, the curvature parameter Ω_k and the dark energy equation of state ω [cita].

This method requires a long photometric monitoring of the multiple images of the source, of the order of years, and a good temporal sampling, to be able to observe the photometric

*A thank you or further information

variations of the source. In this regard, the COSMOGRAIL collaboration has been monitoring 18 strongly lensed quasars since 2004 [4] with 1-2 m size telescopes. And the H0LiCOW collaboration has used part of these data to evaluate H_0 with a precision of 2.4% [2].
Improving the precision in the H_0 evaluation will help in finding the reason of this big discrepancy, and, it would also have a big impact in the results of the next cosmological surveys, up to a 40% improvement if H_0 is independently known with 1% precision [5].

II. Methods

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Table 1: *Example table*

Name		
First name	Last Name	Grade
John	Doe	7.5
Richard	Miles	2

Text requiring further explanation[1].

III. Results

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[1] Example footnote

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IV. Discussion

i. Subsection One

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ii. Subsection Two

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