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CONSTRAINING THE DARK ENERGY EQUATION OF STATE USING ALTERNATIVE COSMIC TRACERS

R. Chávez,[1] R. Terlevich,[1] E. Terlevich,[1] F. Bresolin,[2] J. Melnick,[3] M. Plionis,[1,4] and S. Basilakos[5]

RESUMEN

Proponemos el uso de la relación corrimiento al rojo – distancia de las galaxias H II, medida mediante su correlación $L(\mathrm{H}\beta) - \sigma$, con el fin de determinar la función de Hubble a corrimientos al rojo intermedios y altos, con la intención de restringir el espacio de soluciones de los parámetros de la ecuación de estado de la energía oscura, esto como una alternativa al empleo cosmológico de supernovas de tipo Ia.

ABSTRACT

We propose to use the H II galaxies redshift – distance relation, measured by means of their $L(\mathrm{H}\beta) - \sigma$ correlation, in order to determine the Hubble function to intermediate and high redshifts, in an attempt to constrain the dark energy equation of state parameters solution space, as an alternative to the cosmological use of type Ia supernovae.

Key Words: dark energy — galaxies: starburst

1. INTRODUCTION

H II galaxies present a strong burst of star formation and consequently a large luminosity per unit mass. Inside these systems, as the mass of the young stellar component increases, both the number of ionizing photons and the turbulent velocity of the gas, which is dominated by the stellar gravitational potential, also increase. This fact induces a correlation between the luminosity of recombination lines, e.g. $L(\mathrm{H}\beta)$, which is proportional to the number of ionizing photons, and the ionized gas velocity dispersion, which can be measured using the emission lines width (σ) as indicator (Terlevich & Melnick 1981; Melnick et al. 1988, 2000). The strong emission lines characteristic of their optical spectrum, make H II galaxies readily observable up to $z \geq 3$ (Siegel et al. 2005).

On the other hand, our current understanding of the cosmological evidence shows that our Universe is undergoing an accelerated expansion driven by a component which acts as having a negative pressure, generaly labeled as dark energy (Riess et al. 1998; Perlmutter et al. 1999). Due to the lack of a fundamental physical theory, there have been many theoretical speculations about the nature of dark energy (Frieman et al. 2008; Caldwell & Kamionkowski 2009); furthermore and most importantly, the current observational data are not adequate to distinguish between the many competitor theoretical models.

Plionis et al. (2010) have shown the potential of H II galaxies as cosmological probes, provided that the zero-point of their $L(\mathrm{H}\beta) - \sigma$ correlation is well determined and the uncertainties in their distance modulus, also derived from the mentioned correlation, could be reduced.

The objective of this work is to reassess the H II galaxies $L(\mathrm{H}\beta) - \sigma$ correlation using modern instrumentation in an attempt to reduce the impact of observational errors onto the H II galaxies Hubble diagram.

2. OBSERVATIONS AND DATA REDUCTION

We have selected a sample of 128 local universe ($0.01 < z < 0.2$) young H II galaxies (with $W(\mathrm{H}\beta) > 25$ Å) and obtained high dispersion spectroscopy to measure the ionized gas velocity dispersion. Integrated Hβ fluxes were obtained from the SDSS spectroscopic survey.

High resolution spectroscopy has been performed using echelle grating spectroscopy at 8 meter class telescopes. The telescopes and instruments used are the Ultraviolet and Visual Echelle Spectrograph (UVES) at the European Southern Observatory (ESO) Very Large Telescope (VLT) in Chile and

[1]Instituto Nacional de Astrofísica, Óptica y y Electrónica, A. P. 51 y 216, 72000, Puebla, Mexico (ricardoc@inaoep.mx).
[2]Institute for Astronomy of the University of Hawaii, 2680 Woodlawn Drive, 96822 Honolulu, HI, USA.
[3]European Southern Observatory, Alonso de Cordova 3107, Santiago, Chile.
[4]Institute of Astronomy & Astrophysics, National Observatory of Athens, Palaia Penteli 15236, Athens, Greece.
[5]Academy of Athens, Research Center for Astronomy and Applied Mathematics, Soranou Efesiou 4, 11527, Athens, Greece.