# **Cosmological Parameters via HII galaxies**

Ricardo Chávez Murillo, IRyA, UNAM

CosmoVerse, Lisbon, May 2023



#### **Giant Extragalactic Hll Regions**



#### NGC 5455 @ M101

30 Dor @ LMC

#### The L-σ Relation of GEHR



From Chávez et al. 2012

#### HII Galaxies

1 J000657.01+005125.8	13 J022037.66-092907.2	14 J024052.18-082827.3	17 J030321.4-075923	18 J031023.94-083432.8
- 2" N -	- 2" N -	- 2" N -	- 2" N -	- 2" N -
- <del>E</del>	- <del>E</del>	- <del>E</del> - W -	- <del>E</del> ₩ -	- <del>E</del> ₩ -
 	 	 - 8 -	- s -	- s -
J040937.61-051805.7	J074946.99+154013.2	J083946.02+140033.1	J084000.36+180530.9	40 J084414.21+022621.1
- 2" N -	- 2" N -	– 2" N –	– 2" N –	– 2" N –
- H		_ <del></del>	_ H _	_ H-I _
- <del>E</del> ₩	– <del>E</del> ————————————————————————————————————	- <del>E</del> ₩	– <del>E</del> ₩ –	– <del>E</del> ——₩- –
		-		
- 9 -	- 9 -	- 9 -	- 9 -	- 9 -
45 J090506.85+223833.7	54 J093424.07+222522.5	61 J095023.31+004229.1	71 J101157.07+130822	72 J101430.97+004754.9
- <u>2"</u> N -	- 2" N -	- 2" N -	- 2" N -	- 2" N -
–		– <del>–</del> ₩ –	– • • – – <del>E</del> — ₩ –	- <del>-</del> - <del>-</del>
- s		- s		- s -

From Chávez et al. 2014

#### HII Galaxies: Optical Spectra



#### HII Galaxies Properties: BPP Diagram of L



#### The L-σ Relation: Local HIIG



From Chávez et al. 2014

#### The Hubble Constant Tension



#### **The Hubble Constant Tension**



From Di Valentino et al. 2021

#### HIIG as Cosmological Probes: The Hubble Constant



#### HIIG as Cosmological Probes: The Hubble Constant



#### **HIIG as Cosmological Probes: Systematics**

- Size of the starburst: 0.03 mag —> 0.97 km/s/Mpc
- Age of the starburst: 0.025 mag —> 0.8 km/s/Mpc
- Spectrophotometry: 0.015 mag —> 0.48 km/s/Mpc
- Chemical abundances: 0.02 mag —> 0.6 km/s/Mpc
- Internal extinction: 0.025 mag —> 0.8 km/s/Mpc
- Total: 0.053 mag —> 1.68 km/s/Mpc

#### A Picture of our Universe



### **Observations: High-z Sample**

#### VLT Telescope:

2 half nights in the period 95A with KMOS

16 hours in the period 97A with KMOS.Priority A, first Q

39 hours in the period 98A with KMOS.Priority A, first Q

**KECK Telescope:** 

1 night with MOSFIRE in January 27th, 2016.

 Visitor mode. Lost due to rain!!!!.

Service mode.

Observing period from 3/2016 to 9/2017(extended)

Service mode.

Observing period from 10/2016 to 3/2017

Visitor mode.





#### Monthly Notices of the ROYAL ASTRONOMICAL SOCIETY

MNRAS 505, 1441–1457 (2021) Advance Access publication 2021 May 17 https://doi.org/10.1093/mnras/stab1385

## Independent cosmological constraints from high-z H II galaxies: new results from VLT-KMOS data

Ana Luisa González-Morán,<sup>1</sup>\* Ricardo Chávez<sup>®</sup>,<sup>2</sup>\* Elena Terlevich,<sup>1</sup> Roberto Terlevich,<sup>1,3</sup> David Fernández-Arenas<sup>®</sup>,<sup>4</sup> Fabio Bresolin<sup>®</sup>,<sup>5</sup> Manolis Plionis,<sup>6,7</sup> Jorge Melnick,<sup>8,9</sup> Spyros Basilakos<sup>10</sup> and Eduardo Telles<sup>9</sup>

<sup>1</sup>Instituto Nacional de Astrofísica, Óptica y Electrónica, AP 51 y 216, 72000, Puebla, México

<sup>2</sup>CONACYT-Instituto de Radioastronomía y Astrofísica, UNAM, Campus Morelia, C.P. 58089, Morelia, México

<sup>3</sup>Institute of Astronomy, University of Cambridge, Cambridge CB3 0HA, UK

<sup>4</sup>Kavli Institute for Astronomy and Astrophysics, Peking University, Beijing 100871, China

<sup>5</sup>Institute for Astronomy, University of Hawaii, 2680 Woodlawn Drive, Honolulu, HI 96822, USA

<sup>6</sup>National Observatory of Athens, P. Pendeli, 15236 Athens, Greece

<sup>7</sup>Physics Department, Aristotle University of Thessaloniki, Thessaloniki 54124, Greece

<sup>8</sup>European Southern Observatory, Av. Alonso de Cordova 3107, Santiago de Chile, Chile

<sup>9</sup>Observatorio Nacional, Rua José Cristino 77, 20921-400 Rio de Janeiro, Brasil

<sup>10</sup>Academy of Athens Research Center for Astronomy & Applied Mathematics, Soranou Efessiou 4, 11-527 Athens, Greece

Accepted 2021 May 7. Received 2021 April 7; in original form 2020 November 24

## The VLT-KMOS sample

UDS10	UDS11	UDS15	UDS20	UD\$23	BM133	BM181	BX182	BX236	BX336
1000	1000	1.1	1.1.1	RINGS		1000	100	100	1000
<u>1"</u>	1"	<u>1"</u>	1"	1"	1"	<u>1</u>	1"	<u>1"</u>	<u>1"</u>
UD\$24	UDS25	UDS26	UDS35	UDS36	BX341	BX389	BX390	BX391	BX418
0.000	1.000	1000	1003.14	6.825		1000	1.000	1.00	1.000
1"	1"	1"	1	1	<u>1"</u>	1"	<u>1'</u>	<u>1"</u>	1"
UDS38	UDS40	UDS3646	UDS3760	UDS4501	BX429	BX435	BX436	BX442	BX461
5. au	10000	1.000	1.000	2.00	1000	Sec. 1	1.00	1.000	1000
<u>1"</u>	1"	1"	<u>1"</u>	1"	<u>1'</u>	1"	<u>1'</u>	<u>1"</u>	<u>1"</u>
UD\$7444	UDS11484	UDS14655	GSD2	GSD3	BX480	BX493	BX513	BX529	BX537
1000			1000	10000	1.1	1000	10000	1.000	0000
1"	1"	1"	1"	<u>1"</u>	<u>1"</u>	<u>1"</u>	1.	<u>1"</u>	<u>1"</u>
GSD5	GSD6	GSD9	GSD14	GSD23	BX599	BX601	BX660	COS-8991	COS-11212
140.00	1000	1000	1966	00000	1200	1000	100	Sec. S.	1000
1"	<u>1"</u>	.1"	1	1	1"	1"	1"	<u>1"</u>	<u>1</u>
PEARS103	GM-2113W	GM-2438A	GM-2438B	GM-2438C	COS-12102	COS-16566	COS-18358	zCOS-410041	zCOS-411737
Case of Co	1.000	1000	1000	1000	3963	100	CORA LA	100	1000
1"	1"	1"	1"	<u> </u>	<u>Ľ</u>	<u>1</u>	1	1"	<u>1"</u>
GM-2550	GS-17892	GS-26816							
STATES -	Contraction of the	1000 CC							
1"	1"	1							
(a) UDS and GOODS-S fields					(b) Q2343 and COSMOS fields				

#### The data





#### The L-σ Relation



#### The Hubble diagram



















#### **Cosmography with HII Galaxies**



28

#### J084220 with Megara



From Fernández-Arenas et al. 2022, submitted

## **Future Work**



# **Concluding Remarks**

- GEHR and HIIG are ideal laboratories to understand the feedback of star formation (SF) on the dynamics and energetics of the interstellar medium (ISM).
- We present constraints to H0 form a local sample of HII Galaxies.
- We present constraints to the parameter of the DE EoS from a sample of HII galaxies from the local Universe and up to redshift 2.5. Our constraints agree well with the results form other well developed methodologies.

## References

- González-Morán A.L., et al., 2019, MNRAS, 487, 4669
- Fernández-Arenas D., et al., 2018, MNRAS, 474, 1250
- Chávez R., et al., 2016, MNRAS, 462, 2431
- Terlevich R., et al., 2015, MNRAS, 451, 3001
- Chávez R., et al., 2014, MNRAS, 442, 3565
- Chávez R., et al., 2012, MNRAS, 425, L56
- Plionis M., et al., 2011, MNRAS, 416, 298