

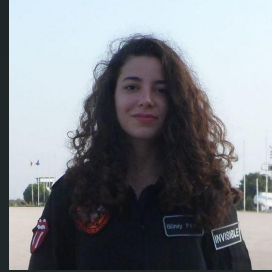
# Project 7: Cloudy Workshop, HII regions

# CADEAU

Cloudy + ALMA Diagnostics for the EARly Universe



Supervised by:  
Gary Ferland  
Patrice Theulé



Gelli Viola  
Paylı Günay  
Pramanick Suman  
Susmita Barman  
Saldana-Lopez Alberto  
Scheuermann Fabian  
Solimano Manuel  
Zamora Sandra

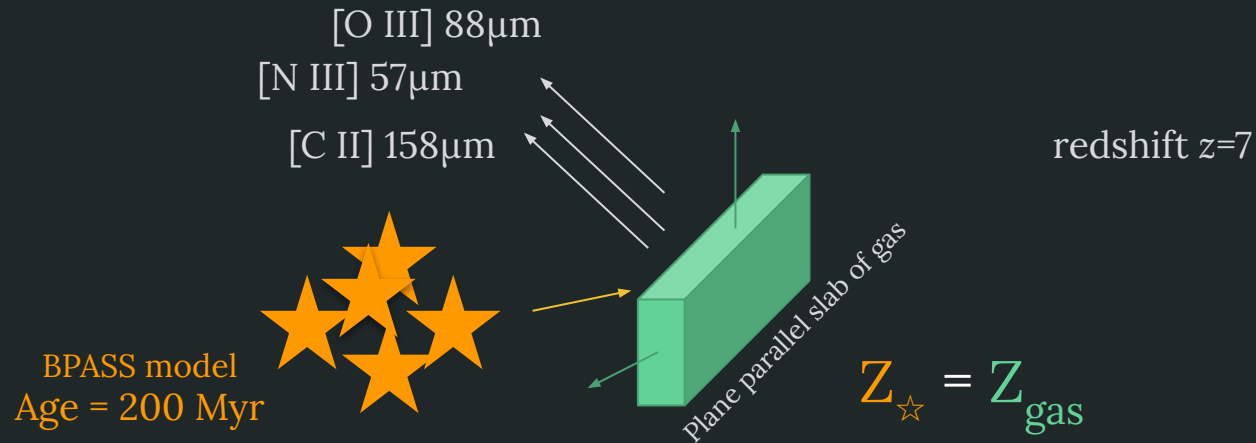
# Project 7: Cloudy Workshop, HII regions

## CADEAU

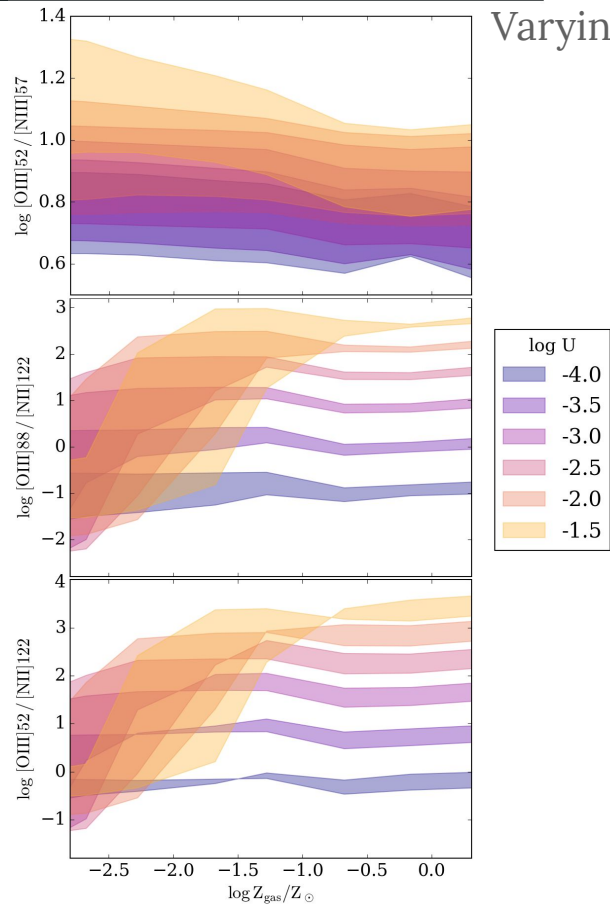
Cloudy + ALMA Diagnostics for the EARly Universe



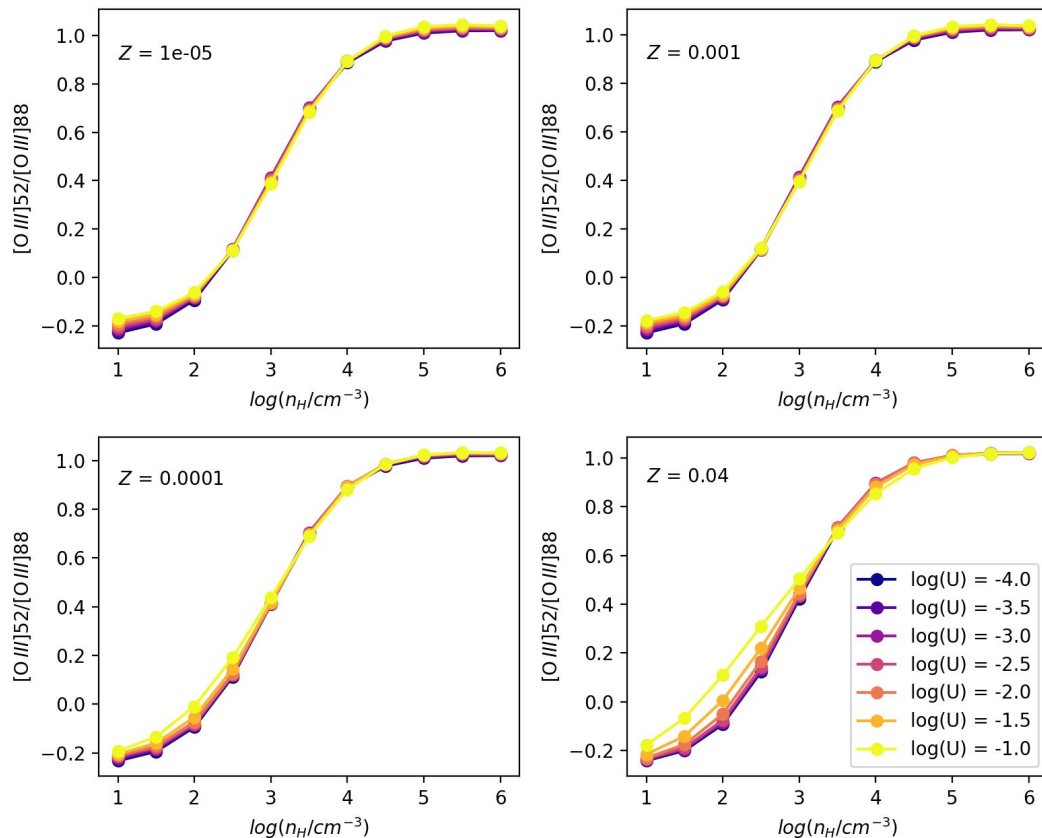
Supervised by:  
Gary Ferland  
Patrice Theulé



# CADEAU: Cloudy + ALMA Diagnostics for the EARLY Universe

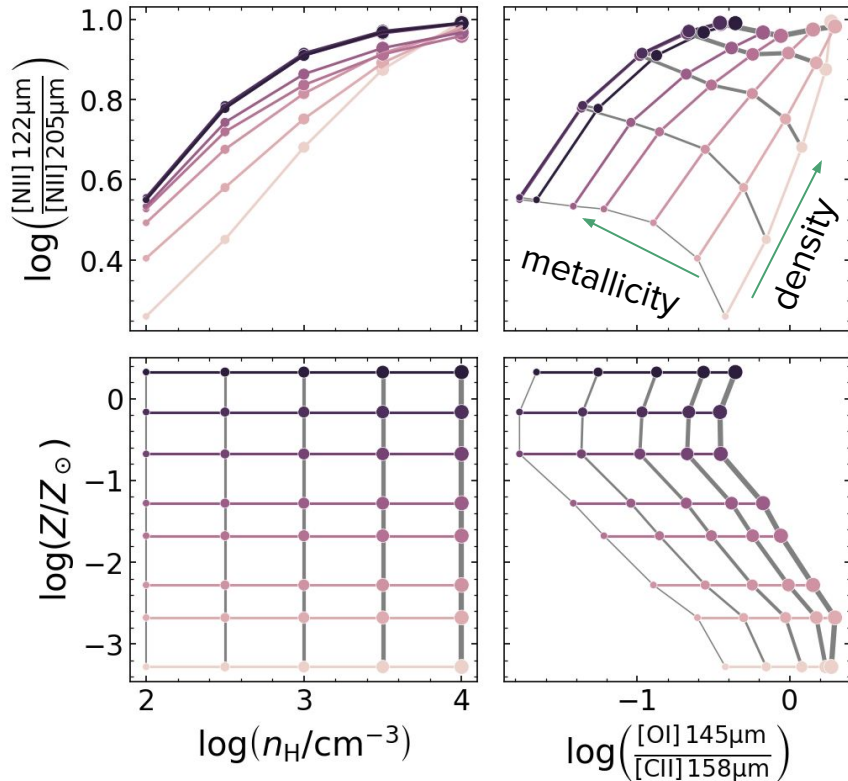


Varying: density  $n$ , ionization parameter  $U$ , metallicity  $Z_{\text{gas}}$  and  $Z_{\star}$



# CADEAU: Cloudy + ALMA Diagnostics for the EARly Universe

$\log U = -3$



## References & Acknowledgements

- Eldridge, J. J., et al. "Binary population and spectral synthesis version 2.1: construction, observational verification, and new results." *Publications of the Astronomical Society of Australia* 34 (2017).
- Ferland, G. J., et al. "The 2017 Release of cloudy." *Revista Mexicana de Astronomia y Astrofisica* 53.2 (2017).
- Kewley, Lisa J., et al. "Theoretical modeling of starburst galaxies." *The Astrophysical Journal* 556.1 (2001): 121.
- Lee, Minju M., et al. "Dense and Warm Neutral Gas in BR 1202-0725 at  $z = 4.7$  as Traced by the [OI] 145  $\mu\text{m}$  Line." *The Astrophysical Journal* 913.1 (2021): 41.
- Osterbrock, Donald E., and Gary J. Ferland. *Astrophysics Of Gas Nebulae and Active Galactic Nuclei*. University science books, 2006.
- Pereira-Santaella, M., et al. "Far-infrared metallicity diagnostics: application to local ultraluminous infrared galaxies." *Monthly Notices of the Royal Astronomical Society* 470.1 (2017): 1218-1232.

**We're thankful to Prof. Gary Ferland who taught us how to use CLOUDY and for valuable guidance. We would also like to thank Dr. Patrice Theulé for all his help and all the organizers who organized this wonderful summer school.**