Is the IMF top-heavy in all metal-poor environments? A critical test in Sextans A

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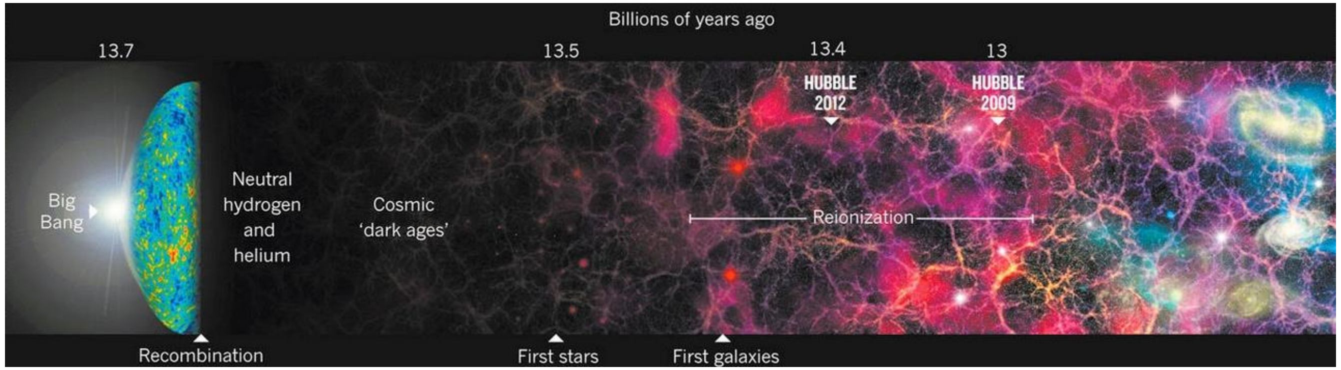
Massive star feedback plays an important role on the chemodynamical evolution of galaxies and the Universe. Exploring the physics of these stars in low-metallicity regimes is a necessary step to describe the first generation of stars. Our main purposes are to classify OB stars in Sextans A, potentially the Local Group iron-poorest galaxy (Z ~ 0.10 Zsun), to estimate their physical parameters, and to determine the IMF in this metal-poor galaxy. The data reduction process of faint, extragalactic OB stars with GTC-OSIRIS-MOS is improved as a by-product. We have achieved the largest OB star catalog in Sextans A. These stars have high initial masses, between 20 and 50 Msun, and are quite young, with ages around 1-7Myrs. In addition, we used bootstrap + Monte Carlo simulations to determine the IMF of Sextans A and its star forming regions. We find indications that the IMF of regions displaying H II bubbles (regions -B and -C) could be "top-heavy", similarly to other starburst star forming regions in the Local Group.

1. Context of the research:

- Massive stars are the main agents of the dynamic and chemical evolution of galaxies and the Universe itself.

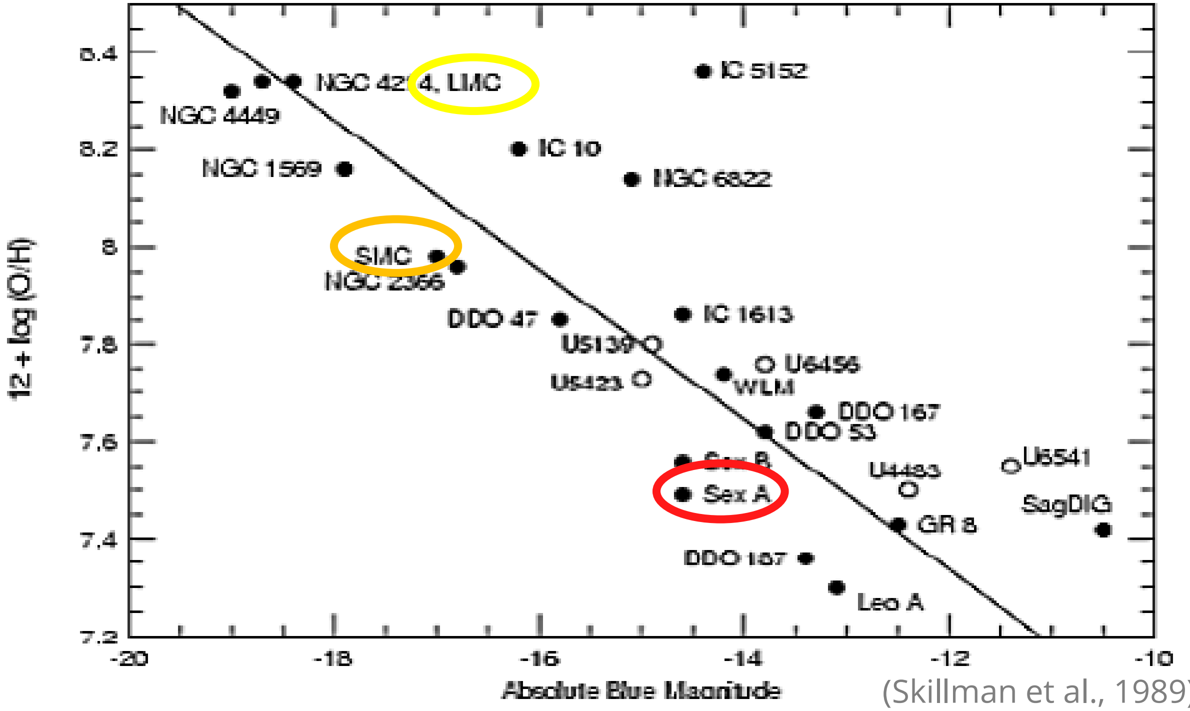
- Z ~ 0 massive stars may have started the first re-ionization of the Universe.



credit: https://astrobites.org/2015/05/22/cosmic-reionization-of-hydrogen-and-helium/

- The Small Magellanic Cloud (SMC) has been the main reference for metal-poor environments (Z = 1/5 Zsun) until now.

- Sextans A, whose stellar population is resolved by GTC, is potentially the Local Group (LG) iron-poorest galaxy, with Z = 1/10 Zsun, (Garcia et al., 2017).



(Skillman et al., 1989)

Our team is working to make Sextans A the new low-Z standard

2. Project Milestones:

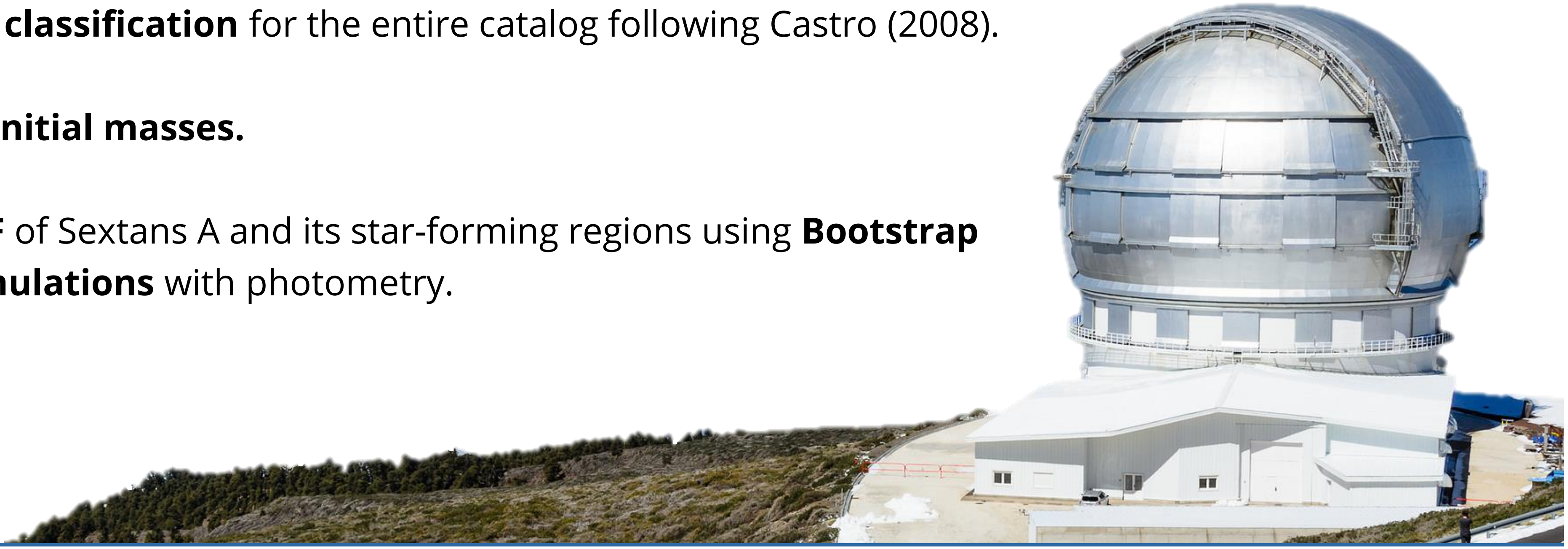
- Obtaining **2 data sets** with the multi-object spectroscopic mode (**MOS**) of OSIRIS at the 10.5m GTC. Effective resolution ~ 1000, 4000-5000 Å range, 1.2" wide-slits.

- Building an **optimal reduction protocol** for GTC-OSIRIS-MOS observations of faint OB stars.

- Providing **spectral classification** for the entire catalog following Castro (2008).

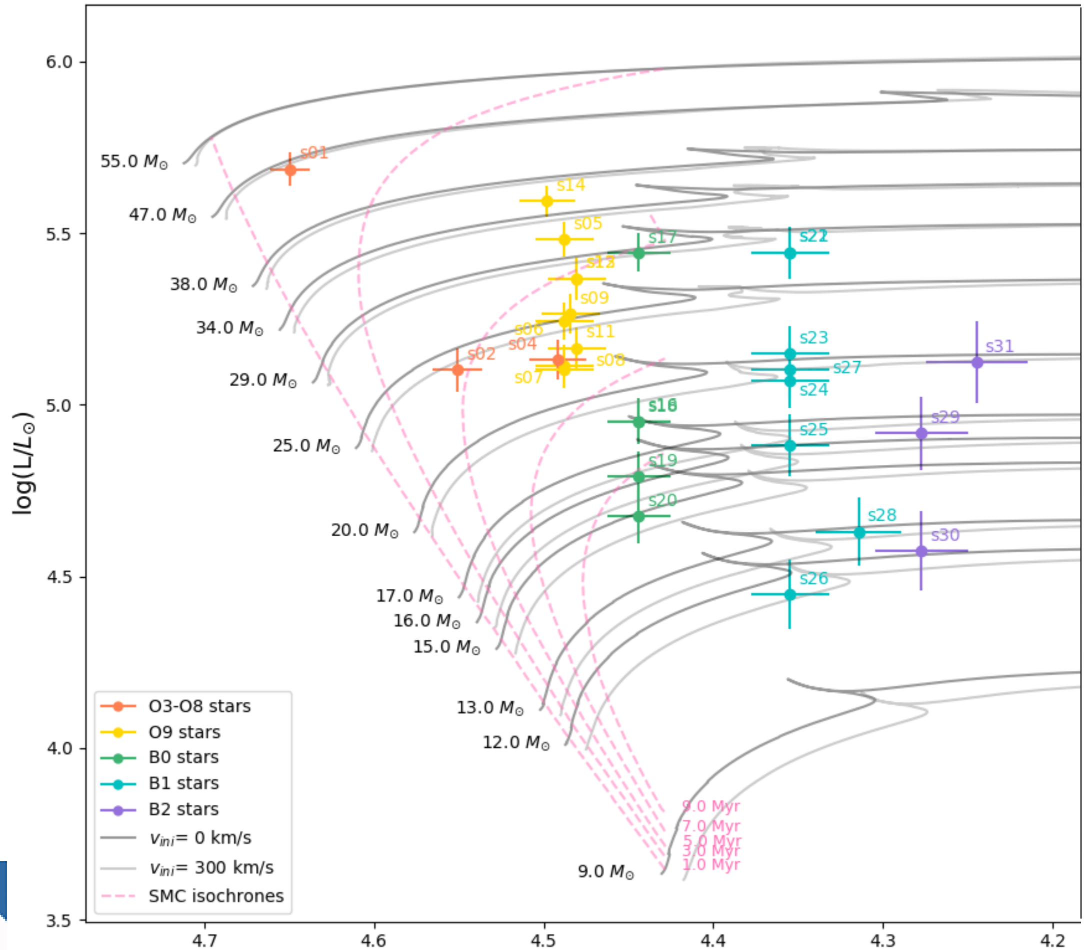
- Determining their **initial masses.**

- Calculating the **IMF** of Sextans A and its star-forming regions using **Bootstrap + Monte-Carlo simulations** with photometry.



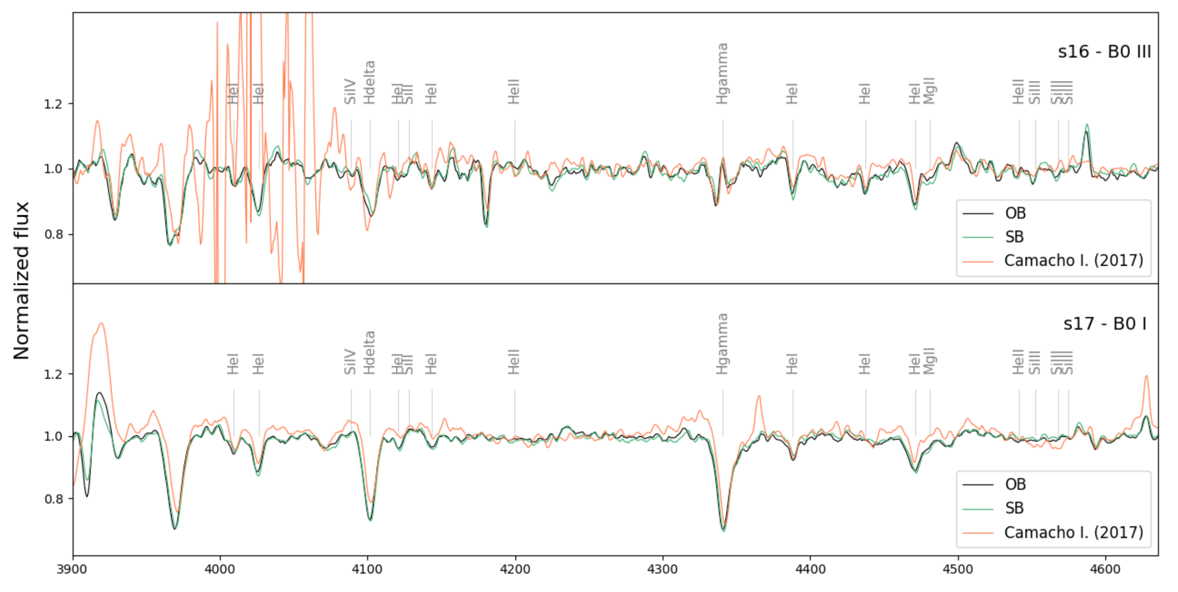
3. Results:

- A **catalog of 73 OB-type stars** which triplicates the number of massive stars known in Sextans A.



Lorenzo, MSc. Thesis (2019)

Optimal reduction protocol for GTC-OSIRIS-MOS observations of faint OB stars



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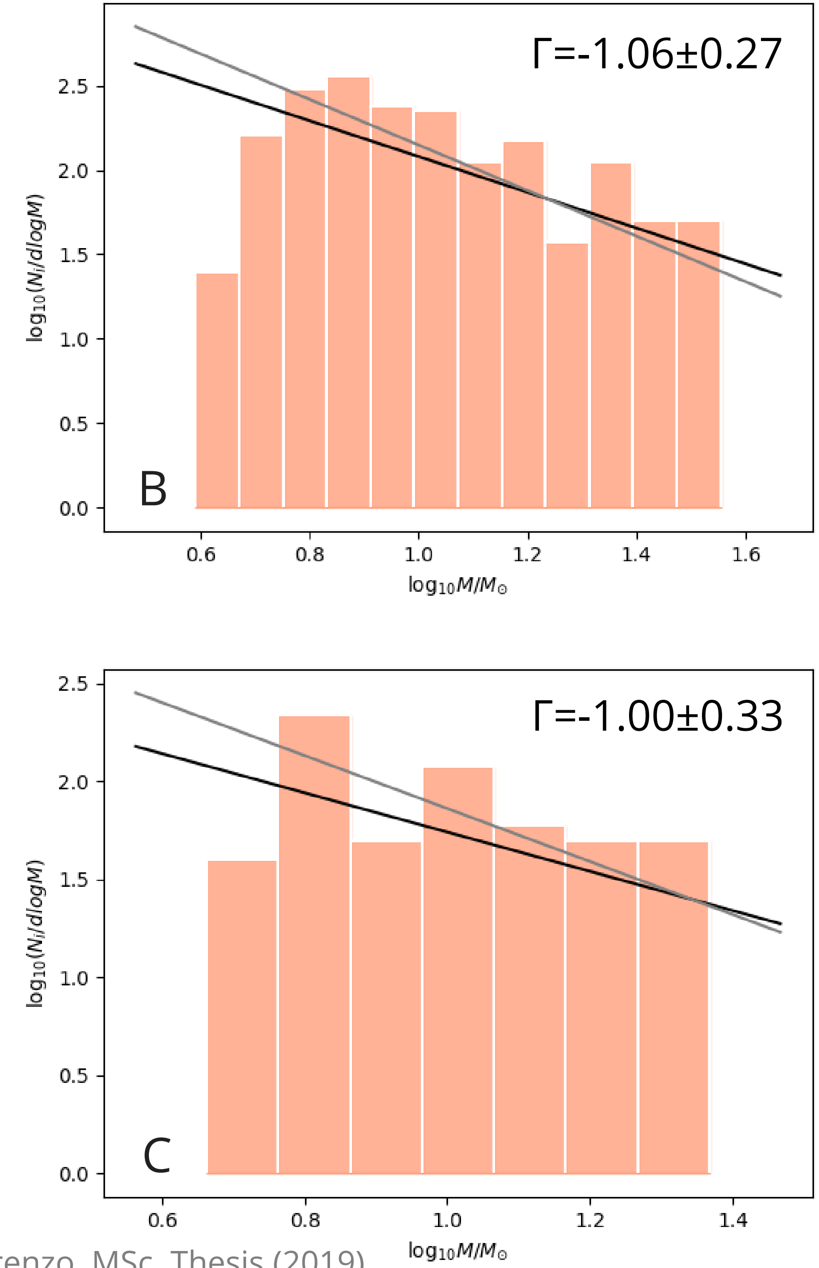
3. Results:

- **Flatter IMF-slopes**, in comparison with Salpeter's (Γ=-1.35), in regions with intense star formation.
- Schneider et al. (2018) also determined a top-heavy IMF in **30 Doradus** (LMC starburst), Γ=-0.90±0.37
- Intense star formation → flatter IMF slope → **more high-mass stars**. Why? 2 possibilities → 2 hypothesized mechanisms to increase fragmentation mass:
  - Their intense radiation fields and turbulence
  - ↓Z of the environment → inhibits gas cooling



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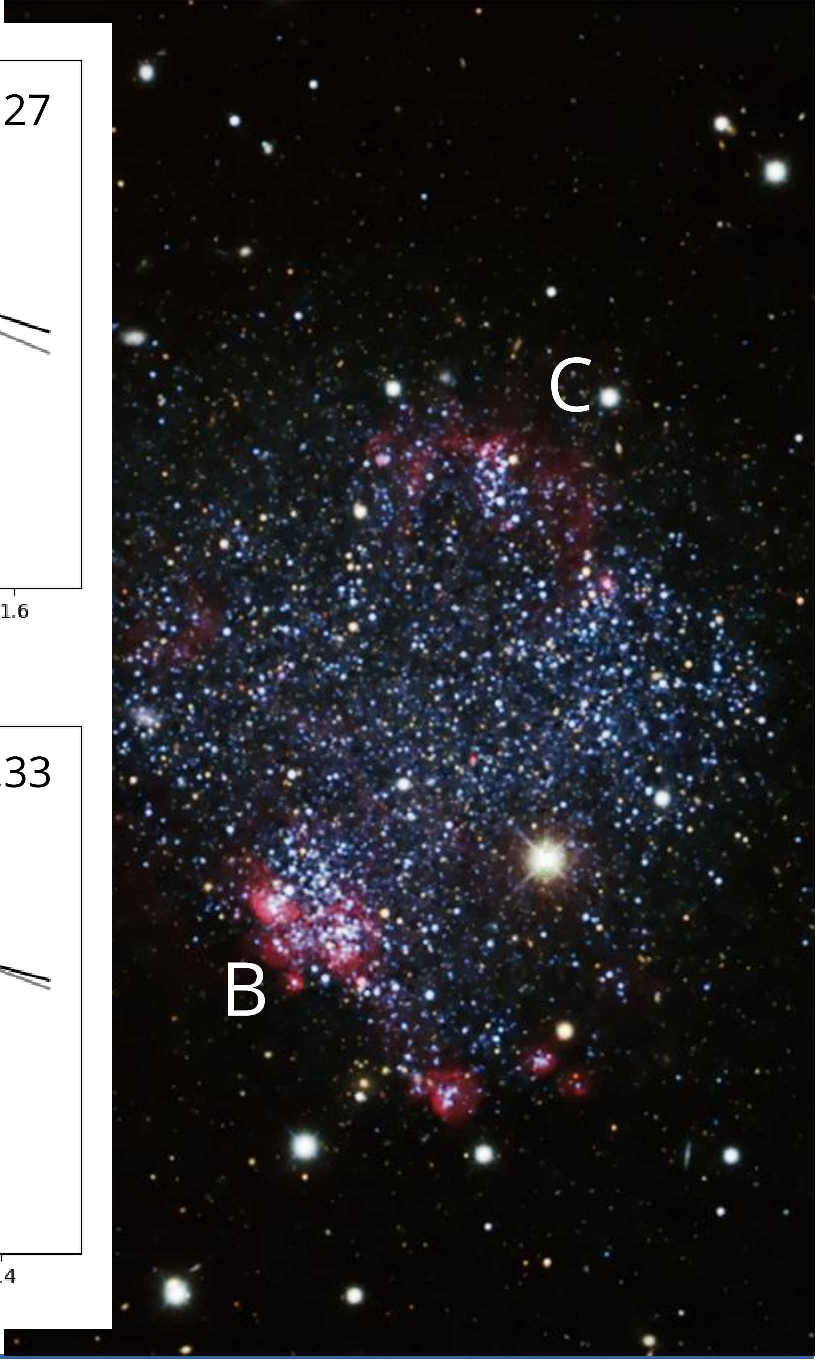

4. Impact and prospects for the future:

Impact:

- The improved reduction protocol will be used by our team's program to explore low-Z Local Group galaxies with GTC-OSIRIS-MOS.
- Largest sample of sub-SMC metallicity OB stars known to date.
- Evidence of a IMF-slope flatter than Salpeter's in metal-poor environments that display signatures of star formation.

Future plans:

- To extend the OB stars catalog in Sextans A with GTC (pending execution) and MEGARA.
- To achieve more solid results for the IMF in the star forming regions of Sextans A with long-slit spectrocopy (pending approval).