

# HII regions in the CALIFA survey

## Catalog presentation

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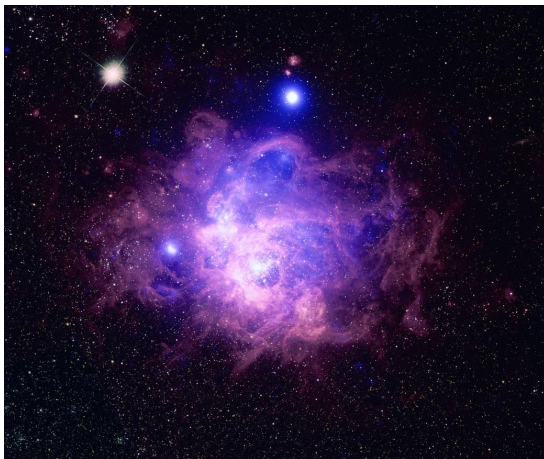
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### **Abstract**

We present a new catalogue of HII regions based on the integral field spectroscopy data of the extended CALIFA and PISCO sample. The catalogue provides the spectroscopic information of 26,408 individual regions corresponding to 924 galaxies, including the flux intensities and equivalent widths of 51 emission lines covering the wavelength range between 3745 and 7200 Å. We explore a new approach to decontaminate the emission lines from diffuse ionized gas contribution. With the catalogue of HII regions corrected, we proposed a new demarcation lines for the classical diagnostic diagrams and we study the physical properties of HII regions and the underlying stellar populations of the HII regions.

# HII regions

- Clouds of ionized gas surrounding young massive stars in which the star formation has recently taken place ( $<15$  Myr).
- The ultraviolet photons that ionized the surrounding medium are produced by OB stars that were formed in the HII regions.
- The HII regions trace recent star formations processes.
- The HII regions allow the present chemical composition of the interstellar medium to be determined.



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# CALIFA and PISCO sample

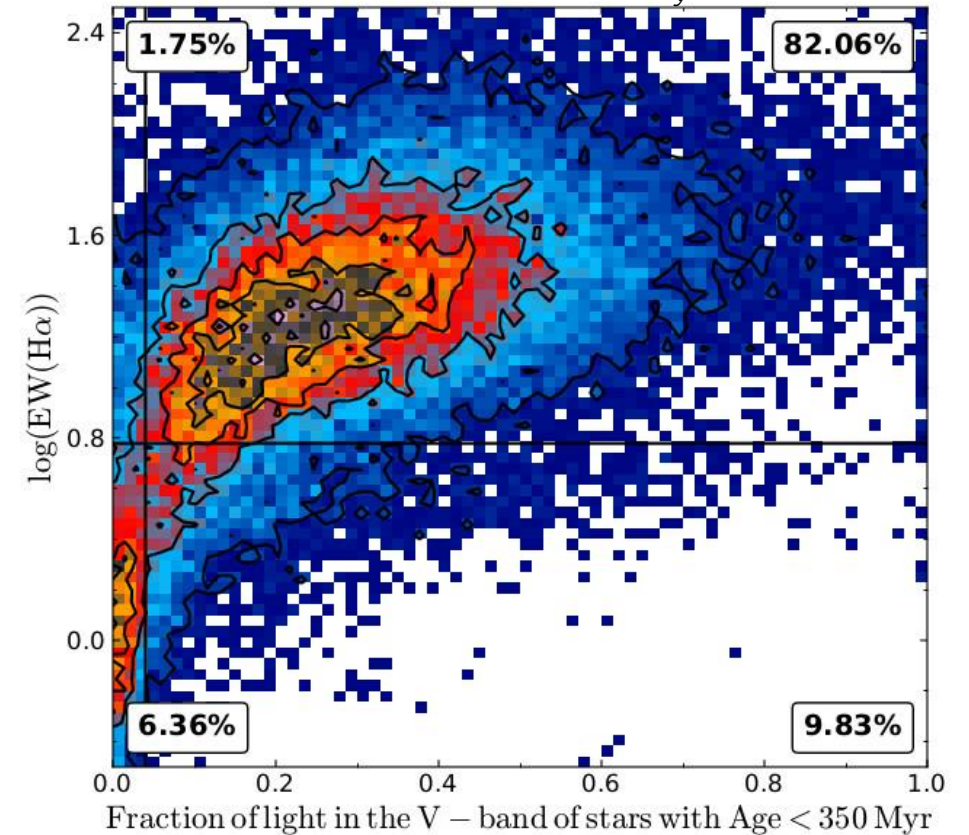
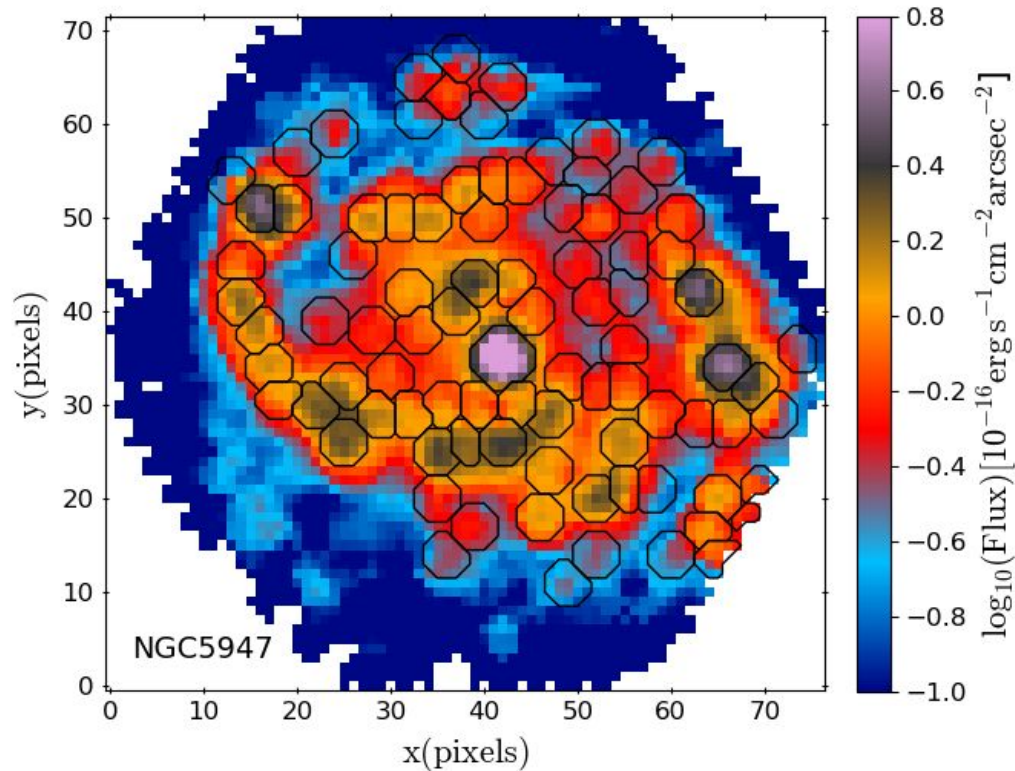
- The Calar Alto Legacy Integral Field Area survey (CALIFA) provides integral field spectroscopy data for a well defined and statistically significant sample of galaxies on the nearby Universe ( $z < 0.08$ ).
- The observation cover the full optical extent (up to  $3-4 R_e$ ) of the galaxies of any morphological type.
- The last public catalogue of HII regions based on the CALIFA survey was published by Sánchez et al. (2012)
- The PMAS/PPak Integral-field Supernova hosts COmpilation (PISCO) sample comprises IFS data of 232 supernova host galaxies.
- CALIFA + PISCO sample comprises the information of  $\sim 1000$  nearby galaxies.

# HII regions detection and extraction

The selection of HII regions was based on two assumptions: a clumpy structure with high contrast of H $\alpha$  emissions and an underlying stellar population comprising young stars.

For the segregation of the clumpy structure from H $\alpha$  emission map, we use the semi-automatic program PYHIIEXPLORER.

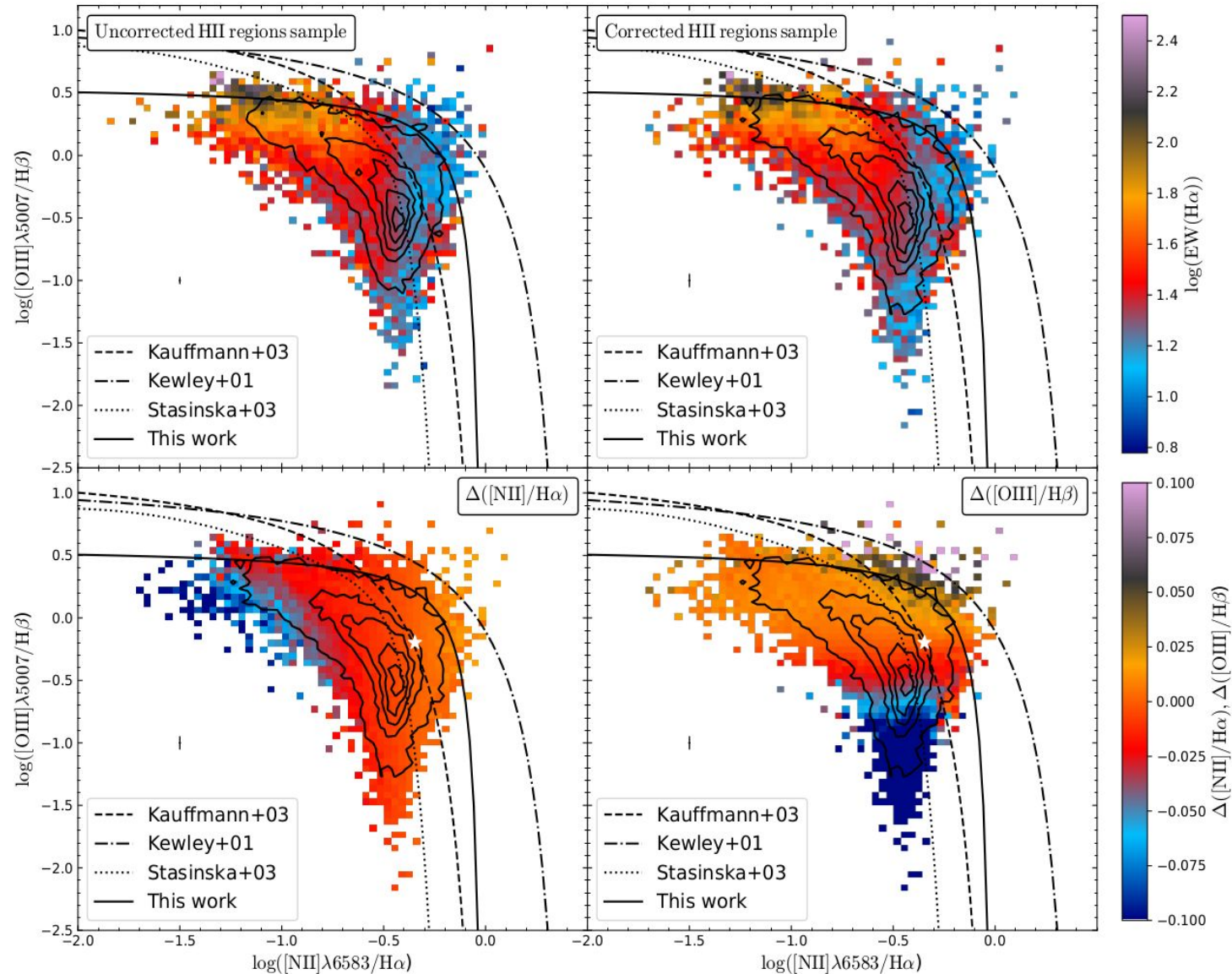
In order to select the clumpy structure with a underlying stellar population compatible with young stars, we select those one with a  $EW(H\alpha) > 6\text{\AA}$  and a fraction of young stars that contribute to the total luminosity ( $f_y$ ) above of 4%





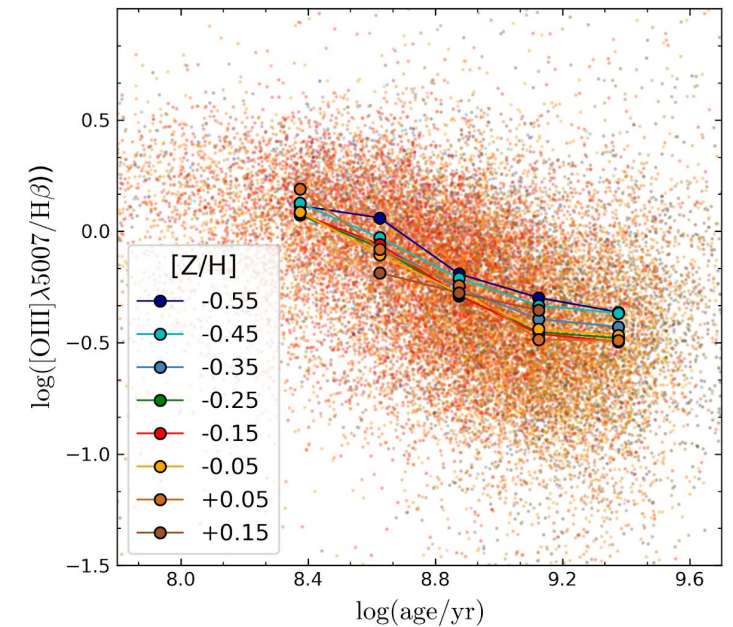
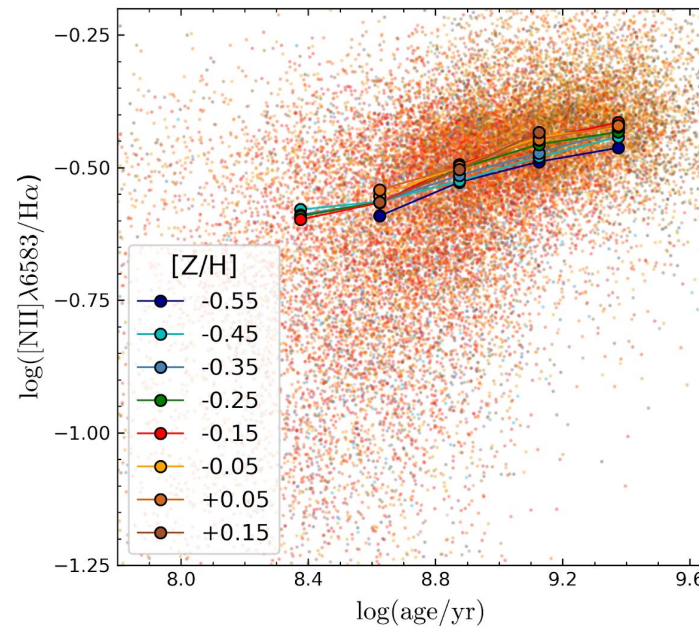
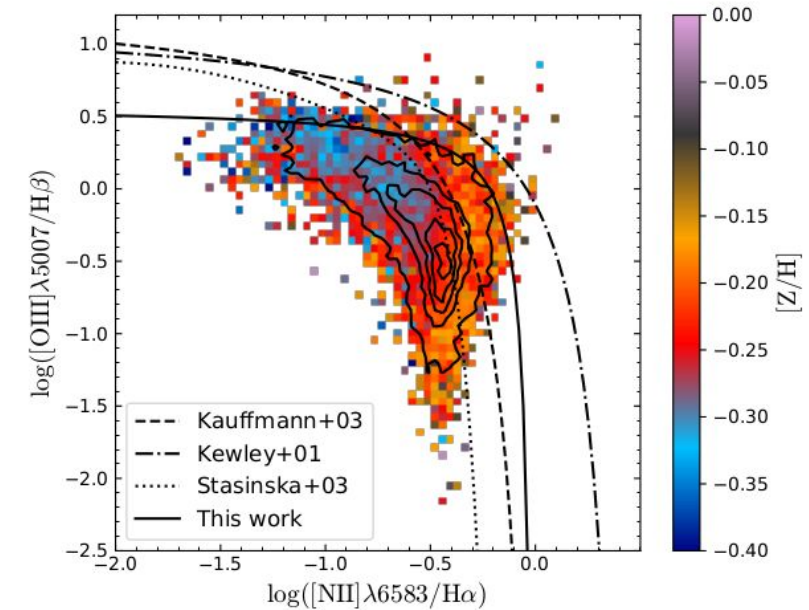
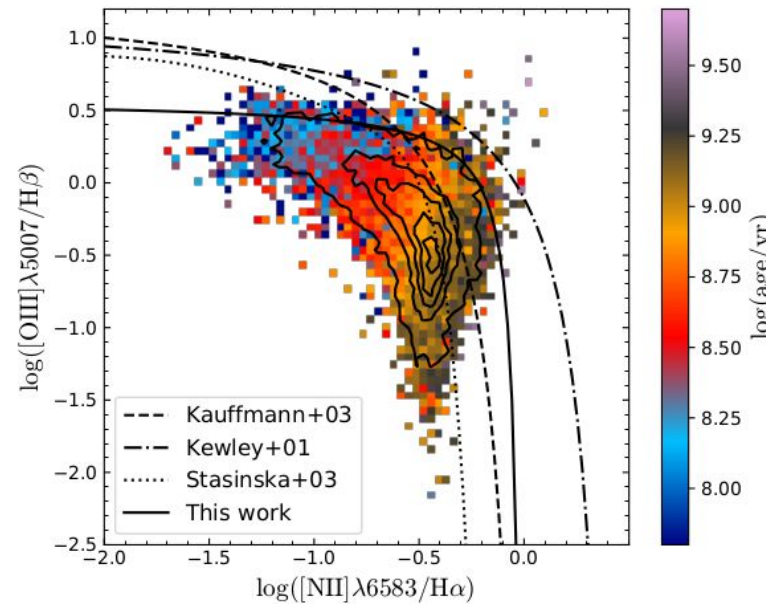
# Results

- We classify all the emissions of spaxels excluded from the clumpy regions as emission produced by diffuse ionized gas (DIG). Unfortunately, the segregation between DIG powered by old stellar population and leaking of photons from HII regions is not possible due to the features of the data. Hence, we have corrected only the DIG powered by old, hot stars. Being aware of possible improvements in the decontamination procedure, we provide an uncorrected and a corrected version of the HII regions catalogue.
- We compare the uncorrected and corrected HII regions samples.
- With the corrected HII sample, we proposed a new purely empirical demarcations line for the classic diagnostic diagrams. It is important to note that these new demarcation lines are based on a sample of HII regions that were selected based on the definition of HII region.



# Results

- We study the relations between the locations within the BPT diagrams and the properties of the underlying stellar populations.
- We demonstrate that the line ratios  $[\text{NII}]\lambda 6583/\text{H}\alpha$  and  $[\text{OIII}]\lambda 5007/\text{H}\beta$  present a clear correlations with both the ages and metallicities of the underlying stellar populations.
- The relation is stronger for the  $[\text{NII}]\lambda 6583/\text{H}\alpha$  since this line ratio is more sensitive to oxygen abundance than  $[\text{OIII}]\lambda 5007/\text{H}\beta$ .





# Conclusions

- We present the new HII regions catalog based on CALIFA and PISCO surveys. To our knowledge, this is the largest catalogue of HII regions properties, derived from the broadest range of galaxies of different morphologies and masses.
- This HII regions sample is suitable to perform further exploration of the physical properties of these nebulae.
- In forthcoming studies, we will present the main patterns of physical properties for these HII regions

For further information, see [Espinosa-Ponce et al. \(2020\)](#).