Star Formation Rate at multiple physical scales using CALIFA and TYPHOON data

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CALIFA Survey

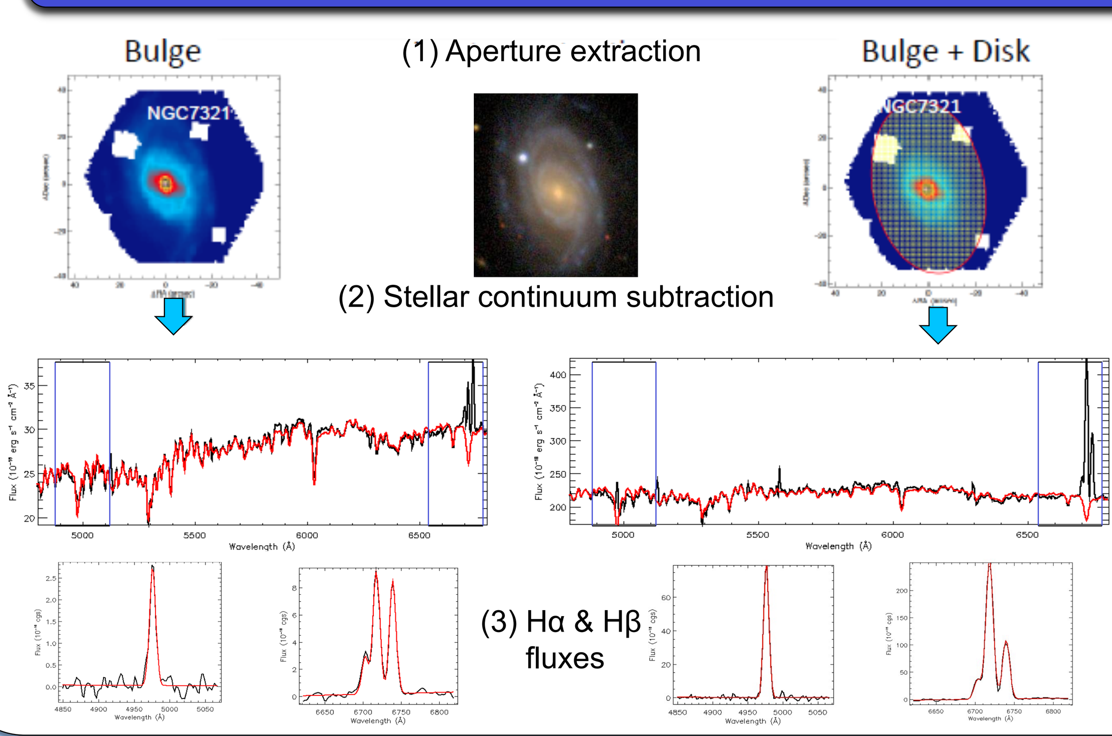
Abstract

- **The measurement of the star formation rate (SFR) is crucial for understanding the birth and evolution of the galaxies. It provides information on the amount of gas in galaxies and the efficiency in the formation of stars inside them. SFRs are key parameters that define galaxies and their evolution across cosmic times.**
- **In this work we derive integrated extinction-corrected Hα–based SFRs from the analysis of CALIFA IFS data. We use a representative sample of galaxies covering all types in the local Universe (~380 objects). We provide updated SFRs tracers using our integrated extinction-corrected Hα SFR as a reference, thanks to the quality of our correction via Balmer decrement paying special attention to the hybrids tracers (Catalan-Torrecilla et al. 2014, in prep.).**
- **Finally, we are going to study the distribution of the SFR inside galaxies with higher spatial resolution using TYPHOON data.**

Analysis: multi-wavelength range

GALEX + CALIFA + WISE + IRAS + AKARI

Analysis: spatially integrated measurements of galaxies



Step 1: For each galaxy we generate an integrated spectrum within the largest possible elliptical aperture in the field of view of our CALIFA datacubes.

Step 2: Subtract the stellar continuum underlying the Hα and Hβ spectral features.

Step 3: Compute the resulting Hα and Hβ emission line fluxes, by fitting gaussian functions to the residuals. Once the observed fluxes from both emission lines are computed we correct the Hα flux for dust-attenuation assuming an intrinsic Balmer ratio of 2.86.

Updated hybrid SFR tracers

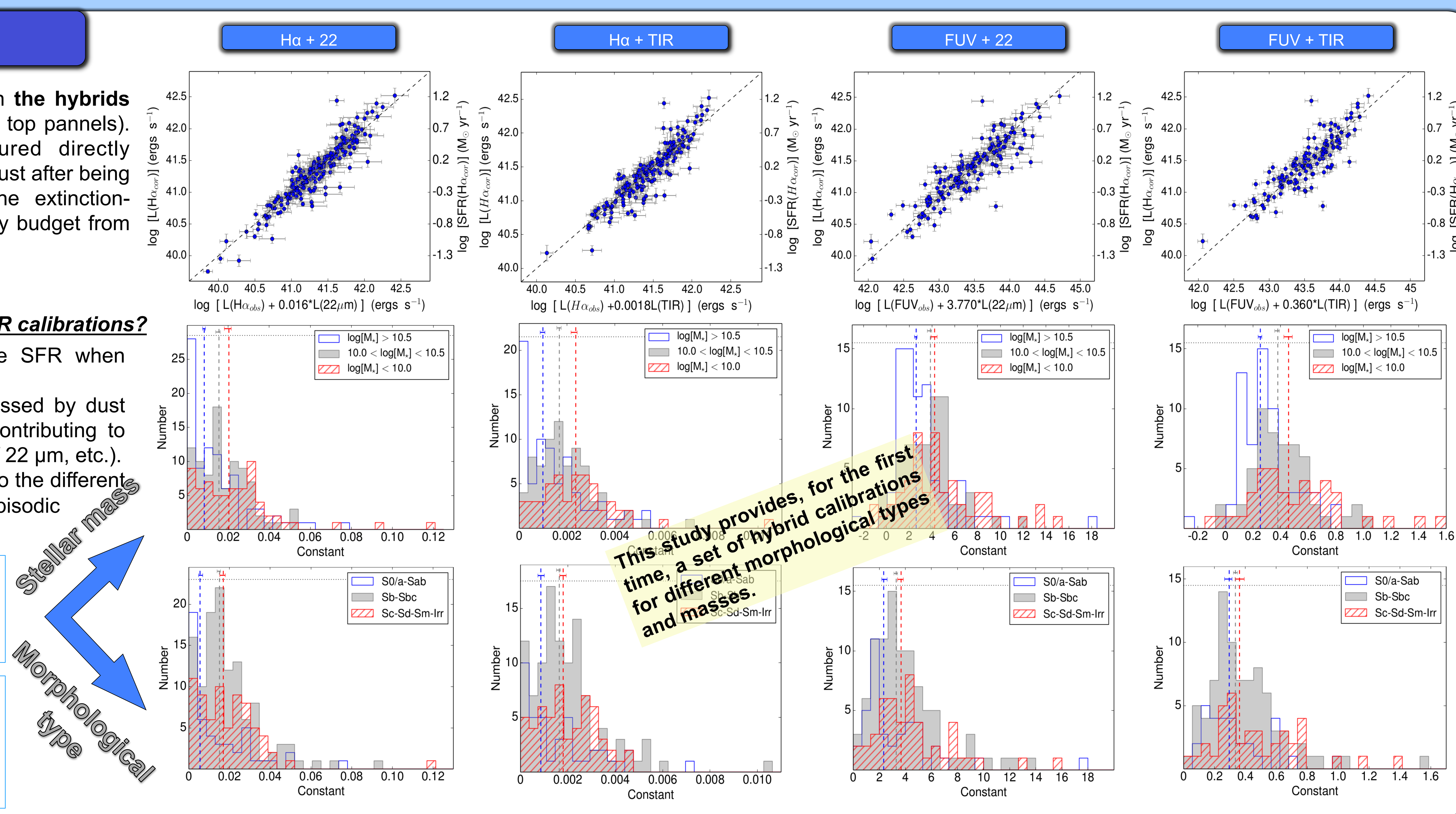
We obtain that there is a **strong correlation** between **the hybrids tracers** and the **extinction-corrected Hα tracer** (right top pannels). The hybrids tracers combine luminosities measured directly (observed UV and Hα) with that of the light emitted by dust after being heated by young massive stars. We show that the extinction-corrected Hα tracer is able to recover the entire energy budget from recently-formed stars.

What is the origin of the variance in these hybrid SFR calibrations?

- The L($H\alpha_{corr}$) might underestimate/overestimate the SFR when used as a reference to calibrate the hybrids tracers.
- The IR luminosity might not trace the SFR reprocessed by dust (examples: optical photons heating the dust and contributing to L(TIR) or variations in dust temperature in the case of 22 μm, etc.).
- Problems when comparing Hα and FUV tracers due to the different constants multiplying the corresponding luminosity (episodic SFH, IMF, …).

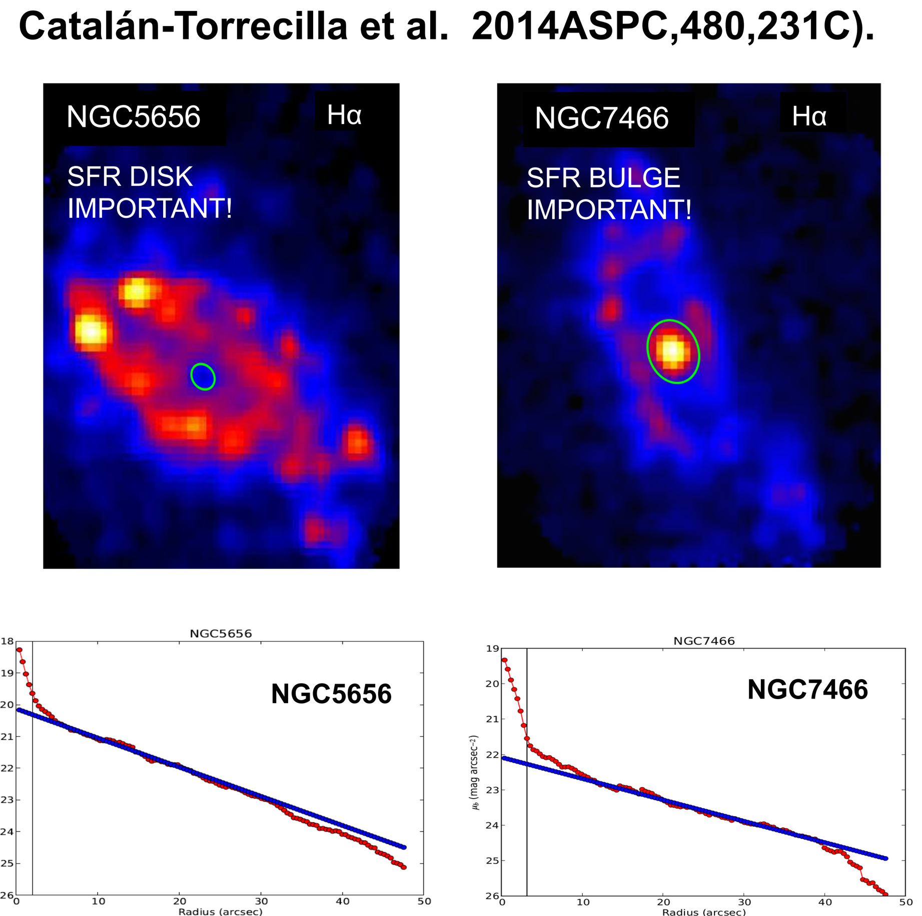
In the plots at right we analyze the behavior of the '*constant*' (scaling factor of the IR luminosity) as a function of **STELLAR MASS** (top) and **MORPHOLOGICAL TYPE** (bottom).

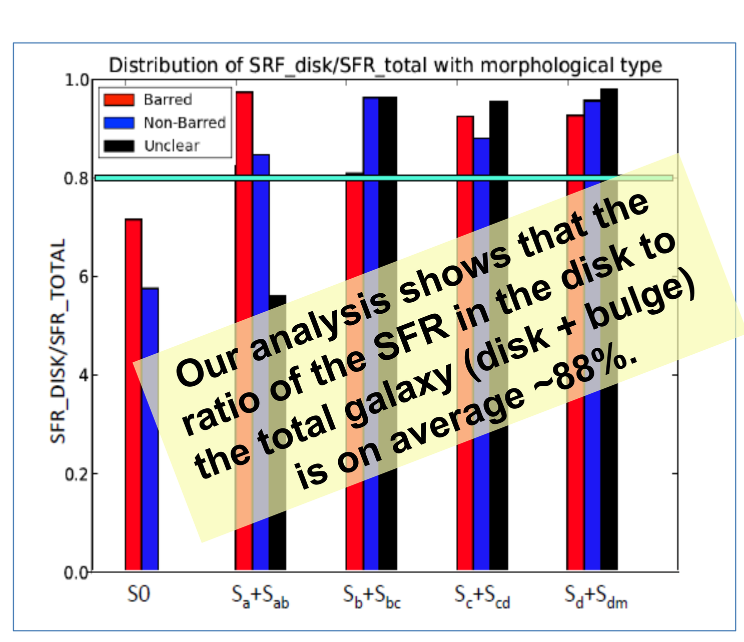
This set of hybrid calibrations for different morphological types and masses are particularly useful in case that the sample to be analyzed shows a different bias in terms of morphology or, more commonly, luminosity or stellar mass.



Spatially-resolved analysis of galaxies: bulge – disk decomposition

In order to obtain the SFR in the spheroidal component and in the disk separately, we perform one-dimensional photometric bulge-disk decomposition. We fit the light profile of each galaxy using SDSS r-band data available for the whole sample. The aperture for the bulge is defined as that one at which bulge and disk show similar optical surface brightness (green ellipse in bottom images). Once the decomposition is done, we do the analysis of the integrated spectrum obtained for each component. (More details in Catalán-Torrecilla et al. 2014ASPC,480,231C).

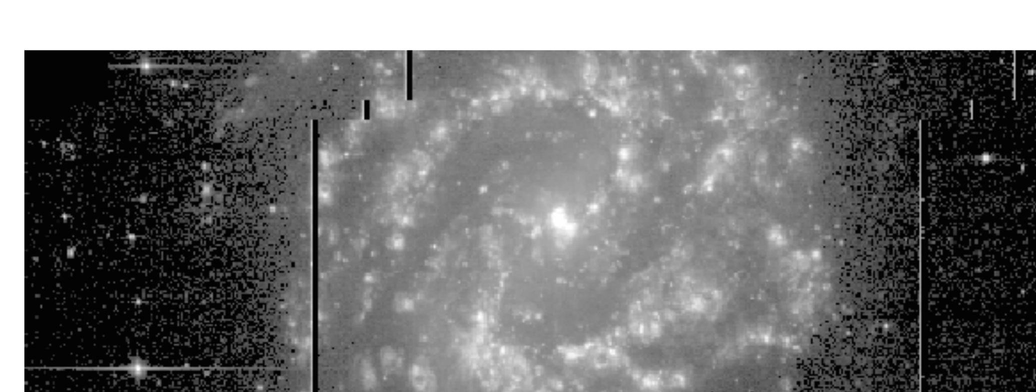




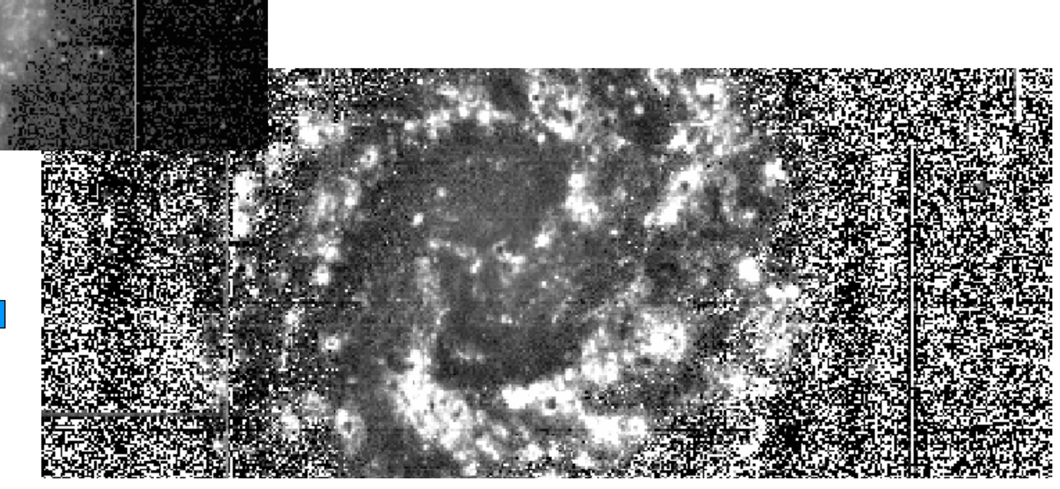
Frecuency histogram with the distribution of the SFR(disk)/ SFR(total) as a function of morphological type. Red, blue and black columns represent barred, unbarred galaxies and galaxies in which the presence of the bar is not clear, respectively.

Using TYPHOON data to study the distribution of the SFR

- Once we have studied the behavior of the SF using a large sample of galaxies, we are going to extend our analysis in order to resolve other structures such as nuclear rings, resonances,…
- This analysis requires of a higher spatial resolution. For that purpose, we are going to use **TYPHOON** data from the du Pont 100-inch telescope at Las Campanas Observatory.
- Our detailed analysis will include the study of the different components (nucleus, bar, bulge, disk…) of the well-known nearby face-on spiral galaxy M83 with spatial resolution.



Hα + continuum image of M83 using TYPHOON data (a FOV of 15 × 5 arcmin^2 is shown).



Hβ continuum-subtracted image of M83 (FOV of 15 × 5 arcmin^2).