

**PhD student day  
November 30th, 2017**

**The impact of kinematics on the SFH of the  
Herschel Reference Survey (HRS)**

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# Overview of the Herschel Reference Survey

- Composed by 323 nearby objects (from which 261 are star-forming galaxies).
- K-band selected complete sample of both field and cluster galaxies.
- Spanning a wide morphological range: (E-S0-Sa-Im-BCD).
- Volume limited sample:  
 $15 < \text{distance} < 25 \text{ Mpc}$
- Spanning a wide stellar mass range  
 $10^8 < M_* / M_\odot < 10^{11}$

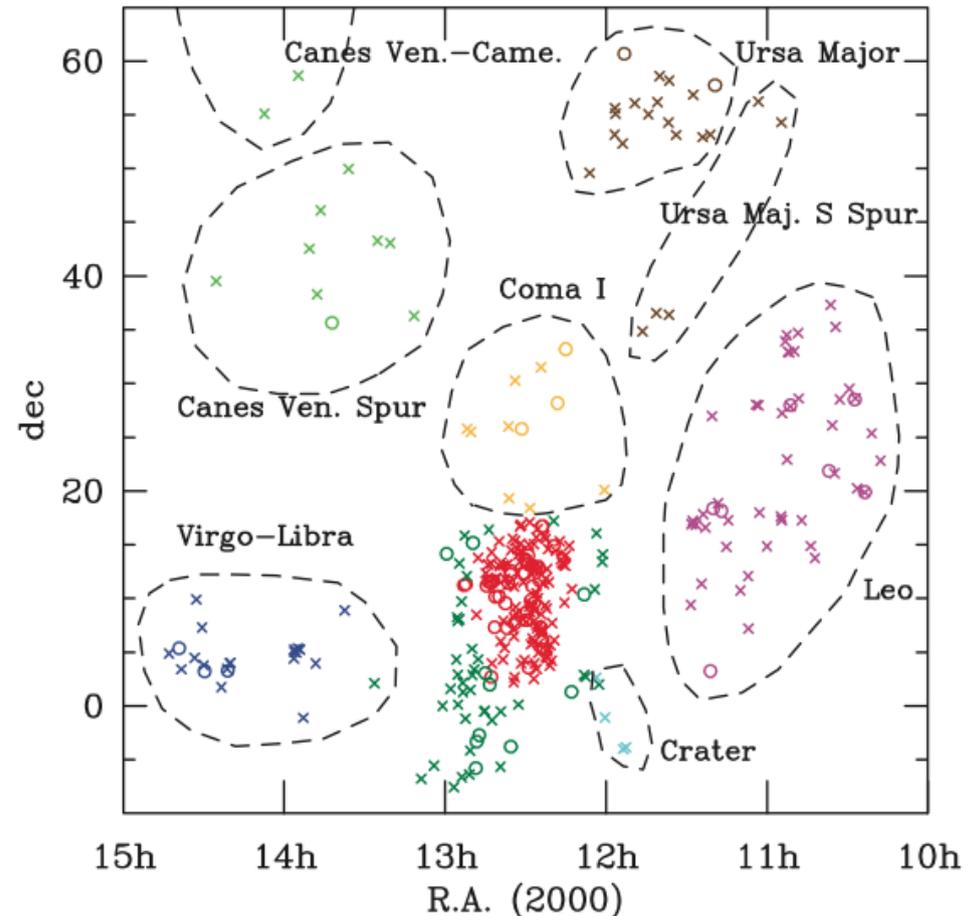


Fig. 1 Sky distribution of the HRS for early-type (E-S0-S0a; circles) and late-type (Sa-Sd-Im-BCD; crosses) galaxies. Dashed contours delimit the different clouds. The large concentration of galaxies in the center of the figure is the Virgo cluster (red) with its outskirts (dark green). Taken from Boselli et al. 2010.

# Goals of the project

- Characterizing, in spatially resolved star-forming galaxies (261 HRS objects) down to kpc scales, the relation between:
  - The star formation process.
  - The gas content.
  - The kinematics.
- Gathering high resolution spectroscopic H $\alpha$ -emission datacubes for the star-forming HRS sample, to derive the 2D kinematical properties down to a couple of km/s.

# Estimating SFR

The CIGALE SED-fitting code (Noll et al. 2009) allows us to accurately estimate several properties for galaxies (SFR,  $M_*$ , ...) in a pixel-by-pixel basis.

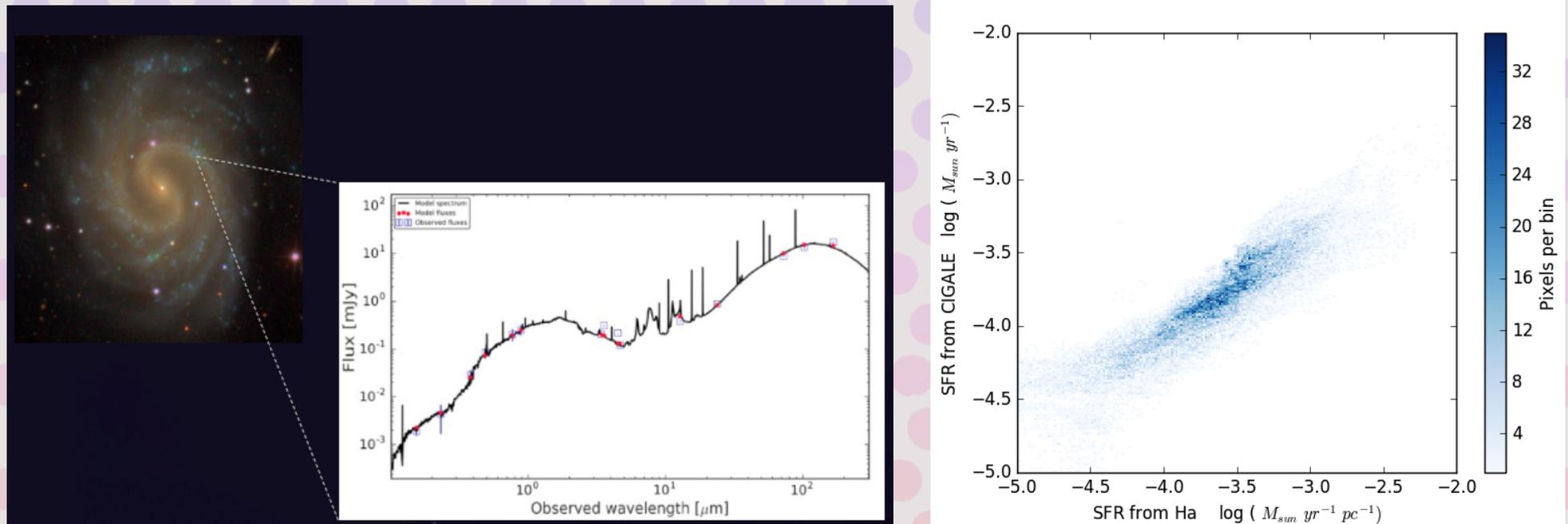


Fig. 4. *Left panel:* Typical best SED-fitting corresponding to one pixel of the galaxy NGC 4535 (Gómez-López et al. IN PREP.). *Rigth panel:* SFR estimated by CIGALE fittings (y-axis) plotted against the SFR estimated from H $\alpha$  imaging data (Boselli et al. 2015).

# Kennicutt-Schmidt Law

- Star formation is tightly correlated to the gas column density :

$$\Sigma_{\text{SFR}} = \alpha \Sigma_{\text{gas}}^n \quad (1 < n < 2) \quad (\text{Kennicutt 1998a}), (1)$$

- Star formation and gas column density are probably modulated at large scales by the differential rotation of the disc, while at smaller scales by non-circular motions:

$$\Sigma_{\text{SFR}} \propto \frac{\Sigma_{\text{gas}}}{T_{\text{dyn}}} \propto \Sigma_{\text{gas}} \Omega_{\text{gas}} \quad (\text{Silk 1997; Elmegreen 1997}), (2)$$

$$\Sigma_{\psi} \propto \frac{\Sigma_{\text{gas}}^2}{\sigma_{\text{gas}}} \quad (\text{Larson 1992}), (3)$$

$$\Sigma_{\psi} \propto \frac{\Sigma_{\text{gas}}^2}{\sigma_{\text{gas}}} \left( 1 + \frac{\Sigma_{*}}{\Sigma_{\text{gas}}} \frac{\sigma_{\text{gas}}}{\sigma_{*,z}} \right)^{0.5} \quad (\text{Corbelli 2003; Leroy 2008}), (4)$$

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## How to get spectroscopic H $\alpha$ datacubes?

- Fabry-Perot observations, scanning the H $\alpha$  emission line:
  - Instrument GHASP at OHP Observatory (France).
  - Instrument PUMA at SPM Observatory (Mexico).
- Both instruments provide similar spectral ( $R \sim 13000$ ) and angular ( $\sim 2-3$  arcsec) resolution of the data.

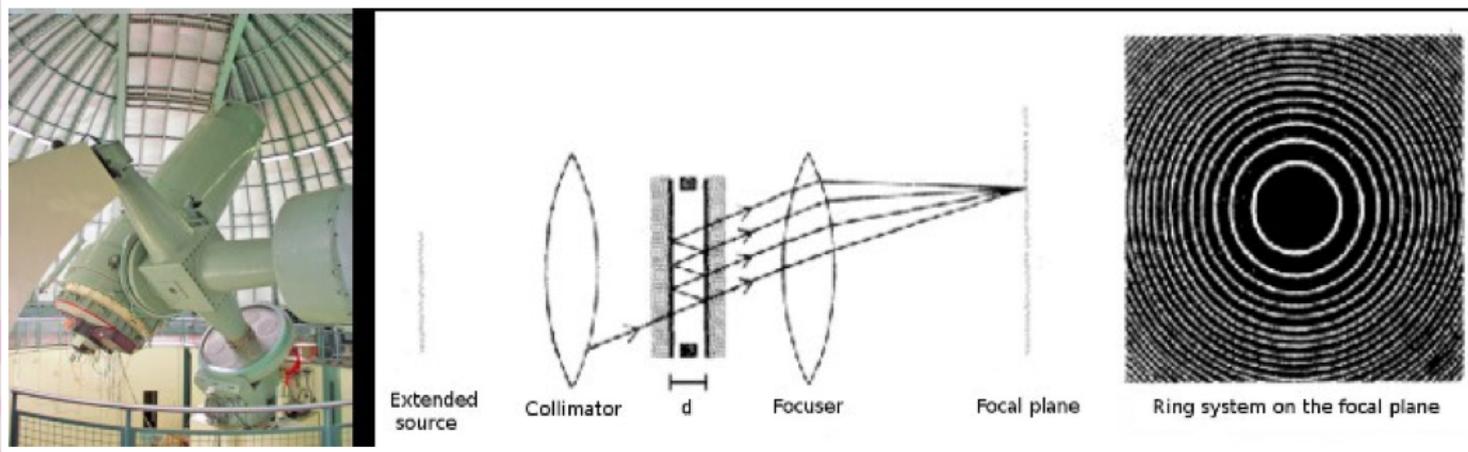


Fig. 2. 1.93m OHP Telescope and performance of Perot-Fabry Interferometer.

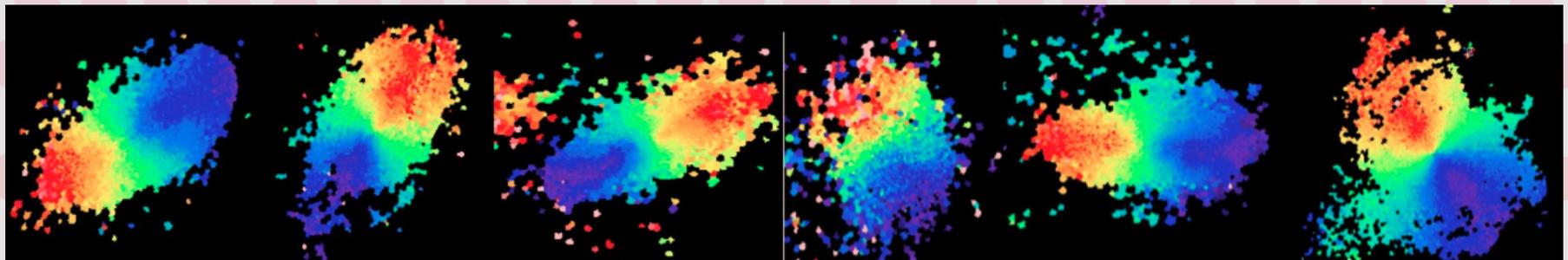


Fig. 3. Velocity maps obtained for six galaxies of the 200 galaxies observed in the past runs.

We already accomplished the FP observations for 200 of the 261 HRS star-forming objects, along these runs:

- 5 runs at OHP (France, 71 nights)
- 5 runs at SPM (Mexico, 27 nights)

# Preliminary results

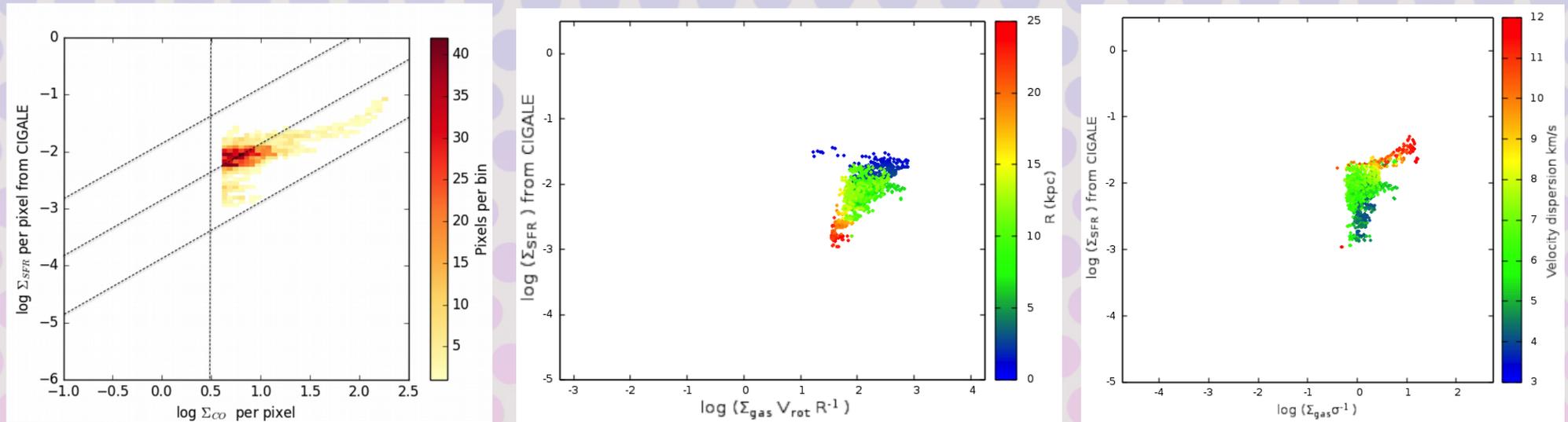


Fig. 5. SFR plotted against H<sub>2</sub> gas column density (left panel), gas modulated by velocity rotation (middle panel) and gas modulated by velocity dispersion (right panel) in a pixel-by-pixel basis for the galaxy NGC 4535 (preliminary results, Gómez-López et al. IN PREP.).

Main limit in our study: the resolution of the CO and FIR data...

Looking for CO data at high resolution (BIMA, ALMA, etc...)

# Future work

- We have 2 scheduled runs at SPM (December 2017, 7 nights) and OHP (February 2018, 8 nights), planning to ask for more observing time along 2018 to complete the star-forming sample.
- We plan to extend our study to the star-forming sample. We will also explore the systematic influence by the environment on the star formation and gas content ...
- Usually, HII individual regions in galaxies have size of  $\sim 50$ pc. Using the data from VESTIGE imaging survey (resolution  $\sim 0.5$  arcsec), we will explore the relation between HII individual regions and the velocity dispersion.

Thank you!