Title: Kinematical Properties of the Herschel Reference Survey.

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Abstract:

The Herschel Reference Survey (HRS) is a complete K-band-selected, volume-limited (15<d<25 Mpc) sample of 323 nearby galaxies spanning a wide range in morphological type (from E to Sd-Im-BCD) and stellar mass (10ˆ8< Mstar < 10ˆ11 M☉) (*Boselli et al. 2010*). Gathering and analyzing high-resolution two dimensional Perot-Fabry spectroscopic Hα data for the star forming objects of the sample (a subsample of 260 galaxies) will provide a complementary kinematical information to the sample. Combined with multifrequency data spanning the whole electromagnetic spectrum (from UV GALEX to far-IR Herschel, including HI, CO, and integrated long slit spectra), and multizone chemo-spectrophotometric models of galaxy evolution as well as with the CIGALE SED fitting code, these data are necessary to study the role played by velocity rotation, velocity dispersion and turbulence down to kpc scales in the process of star formation occurring in normal late-type galaxies.

Objectives:

Star formation is a key process in the study of galaxy evolution. Stars are formed within giant molecular clouds through the collapse of the gaseous component. A correlation between the average SFR per unit area and the mean surface density of the cold atomic and molecular is described by the Kennicutt-Schmidt Law *(Kennicutt, 1989)*.

A detailed study of the matter cycle in galaxies thus requires multifrequency observations. Multifrequency observations of the whole HRS have been carried out, and the different stellar components can be observed in the UV to the near-IR spectral domain. UV is a direct tracer of star formation because it is sensitive to the photospheric emission of massive stars. Unfortunately, the presence of dust affects its effectiveness by reddening and scattering out and into the line of sight.

The process of star formation is modulated at large scales by the differential rotation of the disc (spiral density waves), while at smaller scales by turbulences (*Kennicutt & Evans 2012*). These processes can favour cloud-cloud collisions and thus directly participate to the process of star formation. We will explore the possibility to relate the kinematical properties (rotation velocity, velocity dispersion) to physical properties, in particular to the SFR.

Methodology :

Kinematical Data

In order to get the velocity fields of the sample of galaxies, high spectral resolution 3D data cubes in the Hα line have to be obtained. This is achieved using GHASP, the focal reducer containing a scanning Fabry-Perot interferometer attached at the Casegrain focus on the 1.93m OHP telescope (Observatoire de Haute Provence). The pixel size is 0.68" (the angular resolution is limited by the seeing, about ~3"), the field of view is 5.8 square arcmin and the velocity sampling is ·~5km/s (for a resolution of ~10km/s).

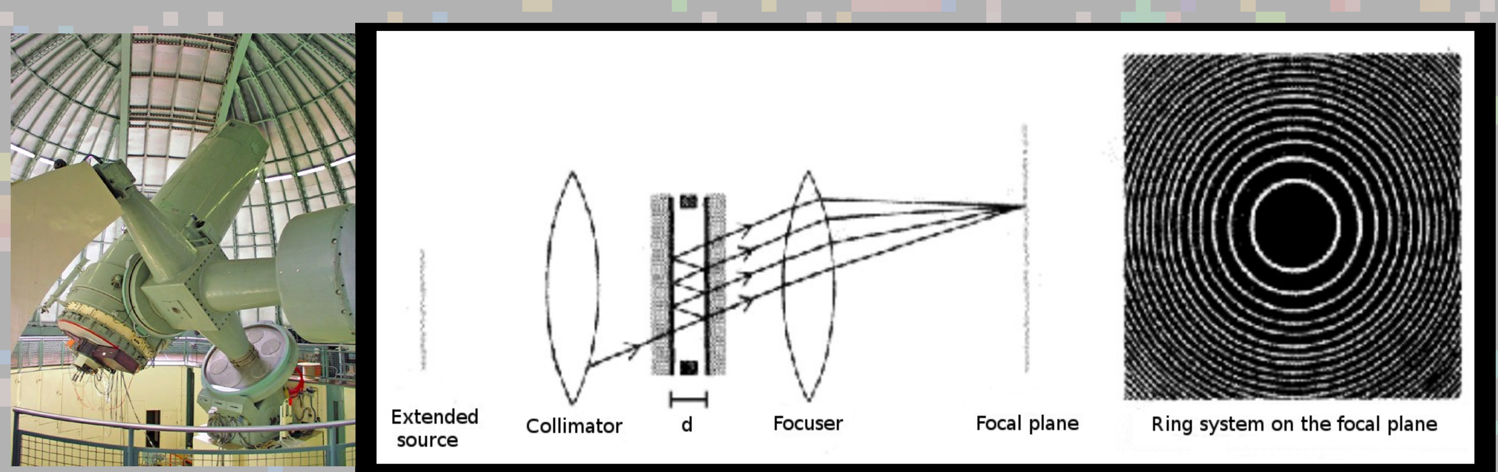

Fig. 1. 1.93m OHP Telescope and performance of Perot-Fabry Interferometer.

The result is a 3D datacube with two spatial coordinates of the extended source such a galaxy, and the *z* coordinate whichis related to the wavelength.

Observing the Doppler shift of spectral lines allow us to determine the velocity field of the galaxy, a fundamental tool for studying the dynamics in galaxies (Amram et al. 2002). We can obtain information of rotation velocity and velocity dispersion in each point of the galaxy (pixel by pixel).

We will cover a long-term observing campaign started in October 2015 and scheduled for the next years at the 1.93m telescope at Haute Provence Observatory with GHASP, and at the 2.1m telescope in San Pedro Mártir Observatory using the PUMA instrument.

Derivations of physical parameters

We will use CIGALE, code that fits the spectral energy distribution (SED) of galaxies simultaneously from the UV to the FIR (*Noll et al., 2009*). CIGALE models the SED of galaxies by combining several old and young stellar populations, including nebular emission. The UV-optical domain is reddened by an attenuation law, and the re-emission in MIR and FIR is also fitted. The code derives the properties of a galaxy such as stellar mass, SFR, epoch of the star forming episodes, etc.

Quantifying the role of velocity rotation and velocity dispersion in the process of star formation will be done by comparing the radial variations of the star formation activity of galaxies determined using the Hα and UV imaging data, corrected for dust attenuation using infrared data, and modulated by the variation of the rotational velocity, to the gas surface density of the galaxies. The multifrequency dataset in our hands will allow us to determine in a self consistent way, and with unprecedented precision, the 2D-distribution of the different galaxy components (stellar, atomic, molecular, dust masses), the dust attenuation, the typical age and metallicity of the different stellar populations and several other properties critical for the study of the radial variation of the star formation history of these galaxies

Present status:

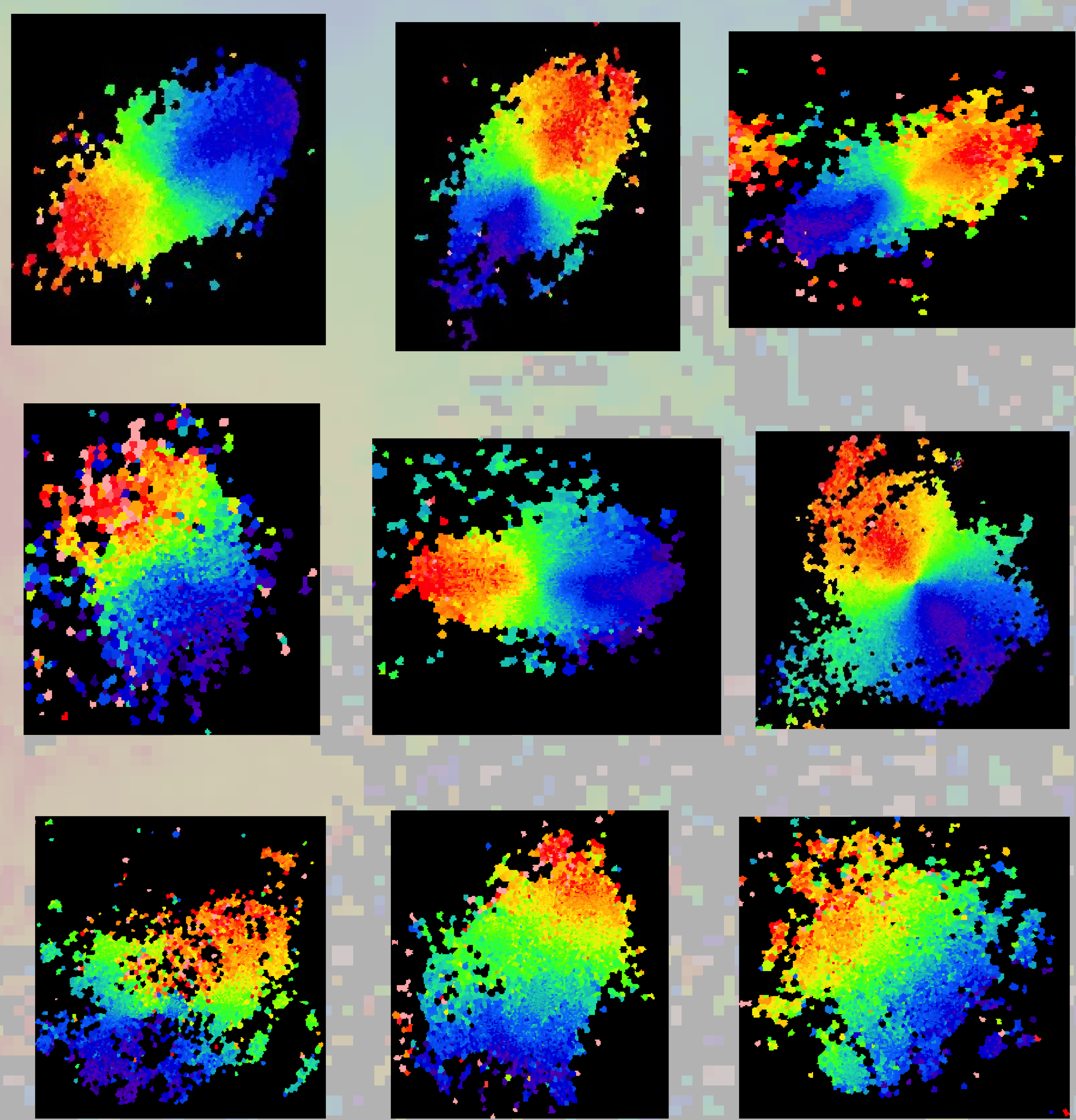

Fig. 2. Nine of the velocity maps obtained for the 57 galaxies observed in the past February and March runs.Top: galaxies HRS 13, 17, 25. Middle: galaxies HRS 47, 66, 77. Bottom: galaxies HRS 88, 86 and 187. Data reduction of the data is performed by adaptative spatial binning, based on the 2D Voronoi tessellations method, allowing to optimize the spatial resolution to the S/N ratio.

These first six months, we have observed 57 new HRS galaxies, and we already had 46 observed galaxies in the GHASP database, giving a total of 101 star forming galaxies observed at the moment... The goal is 260...

References

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(5) Noll, S., Burgarella, D., Giovannoli, E., et al. 2009, A&A,507,1793N