E. Bellocchi

Kinemetry of local (Ultra)luminous Infrared Galaxies

The kinematics of a sample of 42 (Ultra)Luminous Infrared Galaxies [(U)LIRGs] at low redshift (<z>=0.022) will be analysed thanks to Integral Field Spectroscopy (IFS) carried out with the VIMOS instrument on the VLT. Studying the characteristics of (U)LIRGs at low redshift allow us a better understanding the interrelated physical processes involved, and the implications for high-z since these galaxy populations more numerous at cosmological distances than locally. As preliminary steps, the data reduction and post-reduction have been performed using the EsoRex pipeline (by ESO) and IDL and IRAF scripts (creating the final data cube). Then, the line profiles of these spectra (e.g., H_alpha) will be studied in order to extract the relevant emission line information (central wavelength, FWHM and flux intensity). We are going to apply the kinematic criteria used by Shapiro et al. (2008) to the whole sample in order to distinguish galaxies dominated by ordered rotational motions (i.e.,disk) and those involved in major merger events (i.e., merger) considering the asymmetries in both the velocity field and velocity dispersion maps of the warm gas (as traced by Halpha). To this aim the "kinemetry" method, developed by Krajnoviƒá et al. (2006), will be considered. Here, the results of a sub-sample will be discussed.

"Kinematic study of local (U)LIRGs with VLT-VIMOS integral-field spectroscopy"

CSIC
Consejo Superior de Investigaciones Científicas

ELIXIR

Enrica Bellocchi

Departamento de Astrofisica, CAB (INTA-CSIC)
Madrid (Spain)
Supervisor Santiago Arribas
(Javier Rodriguez Zaurin, Luis Colina,
Almudena Alonso-Herrero, Ana Monreal-Ibero)

MARIE CURIE ACTIONS

SEVENTH FRAMEWORK PROGRAMME

-- Main goals:

Study the (ionized gas) kinematics of local (U)LIRGs and trying to answer basic questions:

1- Are the *kinematic properties* of these galaxies different from other local samples ?(e.g Characteristics of velocity fields, velocity dispersion maps, presence of outflows, etc)

2- Is the *dynamical status* (inferred from morphology) is "clearly" correlated with kinematics ?

3- Are *dynamical masses* inferred from kinematics consistent with stellar (and gas) masses ?

4- Are the kinematic properties of this local population similar to those of populations at *high -z* ?

The sample

❖ 38 local (<z> ~ 0.022) (U)LIRGs observed with **VIMOS** @ VLT (from **RBGS**, Sanders et al. 2003)

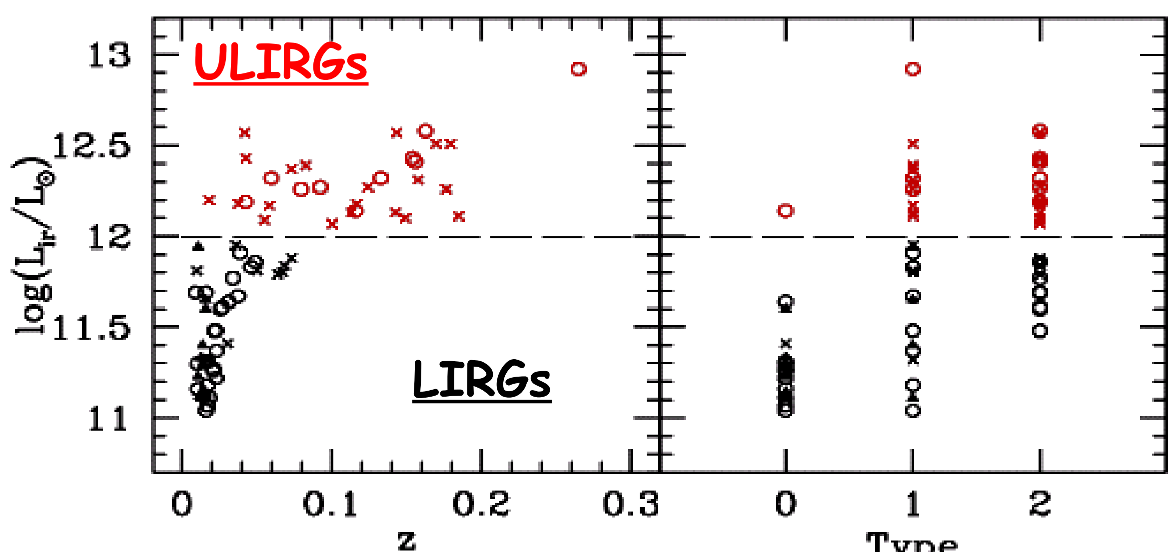
Our observing mode characterized by
- ✓ FOV = **27x27** arcsec² (@ **0.67"**/fiber)
- ✓ Wavelength range: **5250÷7400** Å
- ✓ **1936** spectra/object
- ✓ High resolution: **R ~ 2650**

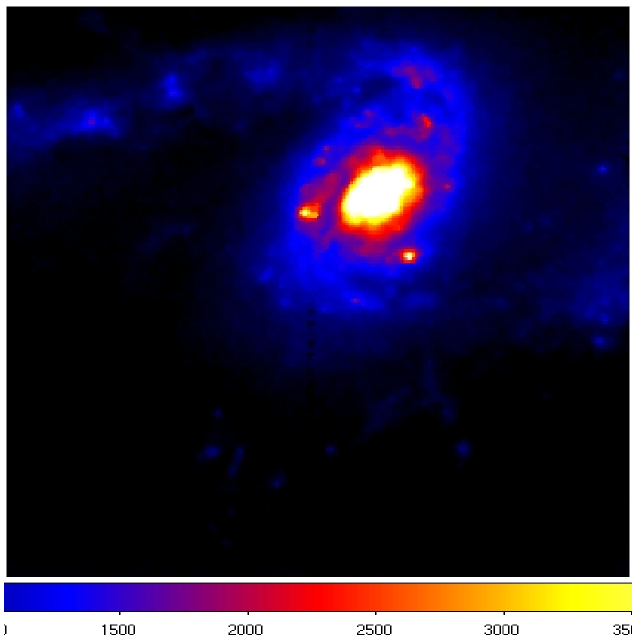
❖ Different ionization types: LINERs, Seyfert, HII…

❖ $L_{IR} = L_{[8-1000\ \mu m]} = 10^{11}$-$10^{12.6}\ L_{\odot}$

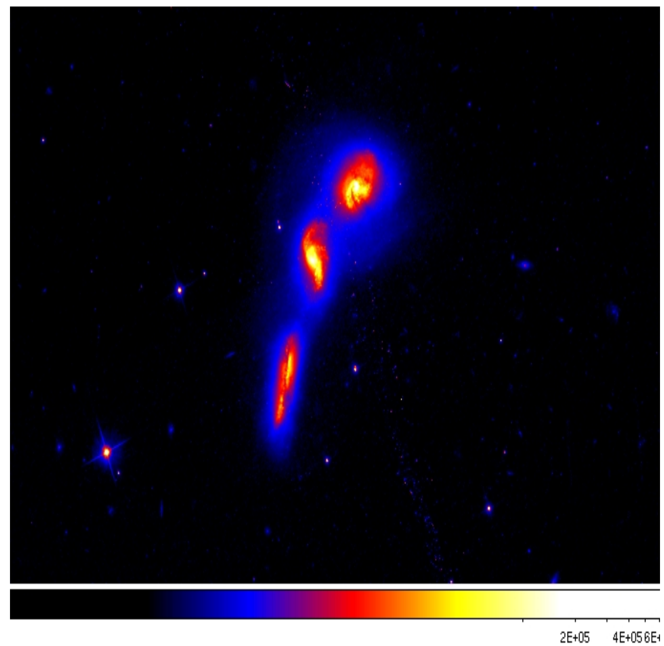
❖ Different dynamical phases (morphological types)

(Arribas et al. 2008)

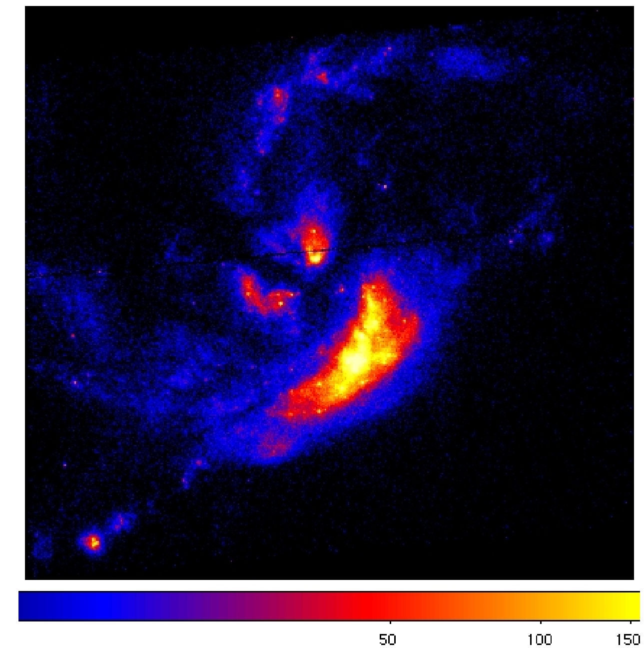




Isolated (0)



Interacting (1)



Merger (2)

-- First steps:

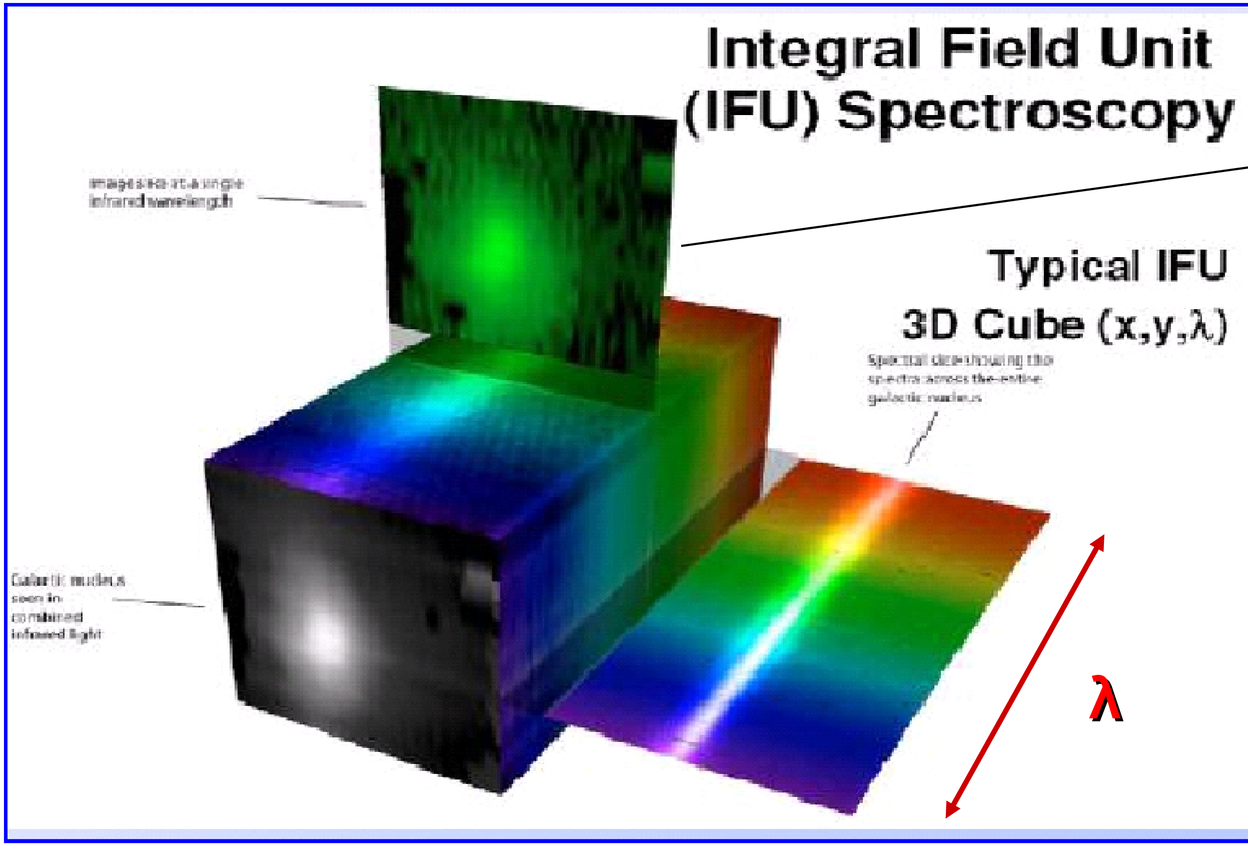
i. Data reduction *

ii. Data analysis:

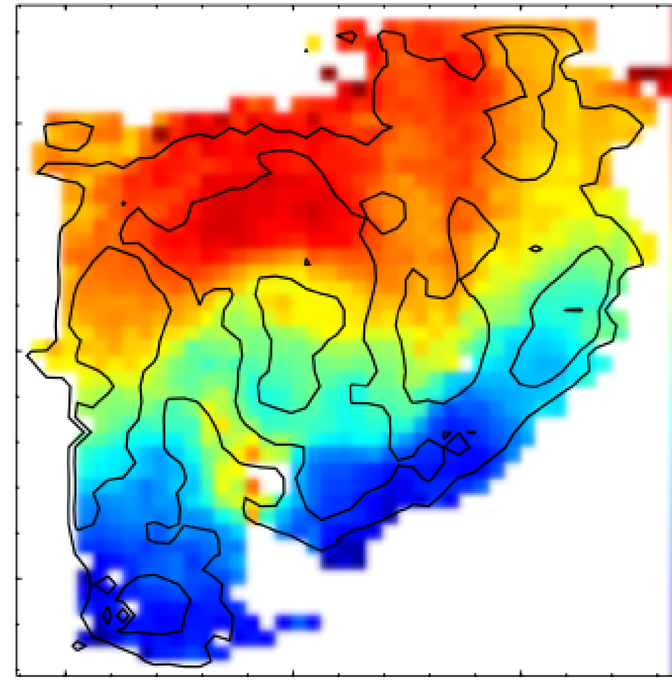
1) Line fitting & Creating maps

2) Kinemetry method (Krajnović et al. 2006)

i. Data reduction:



Ha wavelength



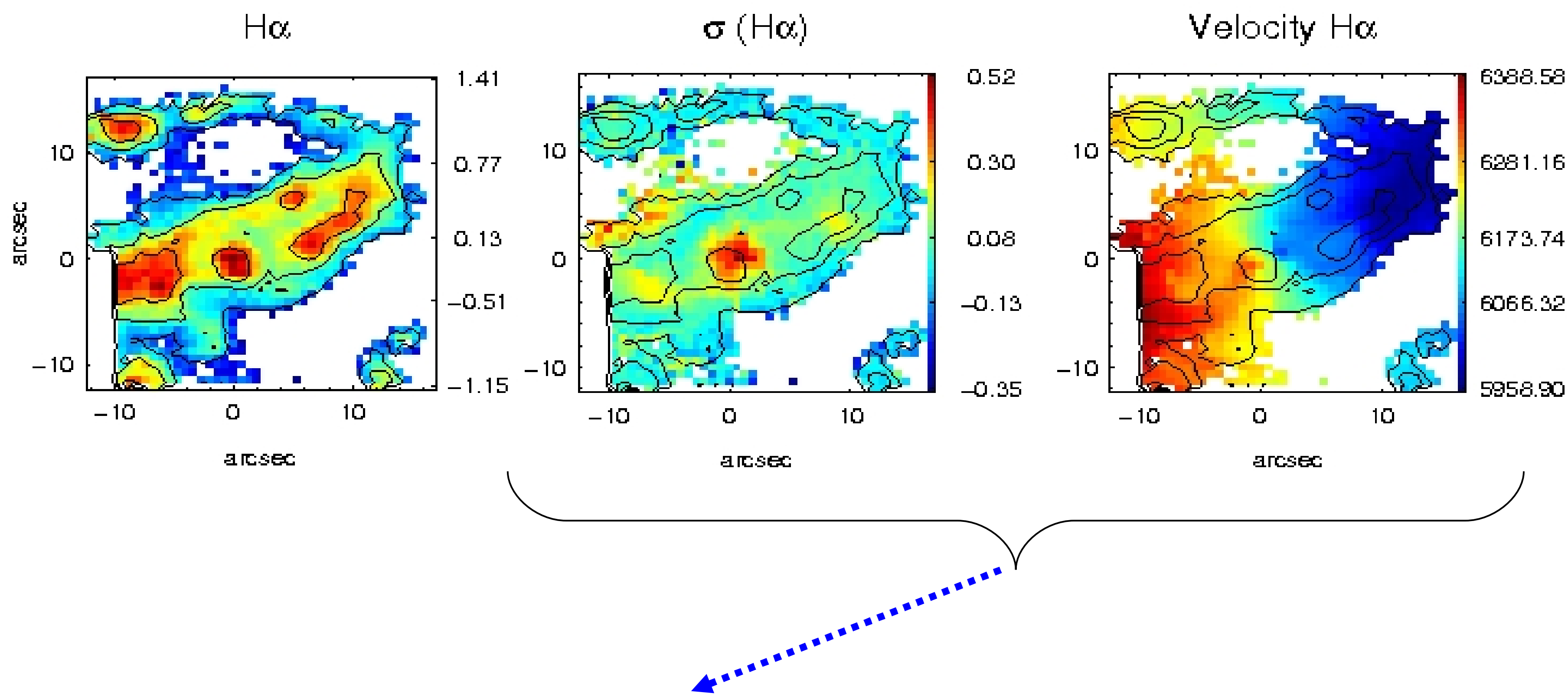
Finally a **3D cube containing SPATIAL (x, y) & SPECTRAL information is produced!**

ii. Data analysis

1) Line fitting and relative maps

Line profiles fitted with GAUSSIAN model obtaining

FLUX INTENSITY, FWHM & CENTRAL WAVELENGTH (λc)



2) "Kinemetry" analysis …

2) Kinemetry (I): quantifying the kinematic maps

- Harmonic expansion of 2D maps of observed moment along the best fitting ellipses: along each ellipse the moment as a function of angle is extracted and decomposed into the Fourier series

$$K(\psi, r) = A_0(r) + \Sigma\, A_i(r) \sin(i \cdot \psi) + B_i(r) \cos(i \cdot \psi)$$

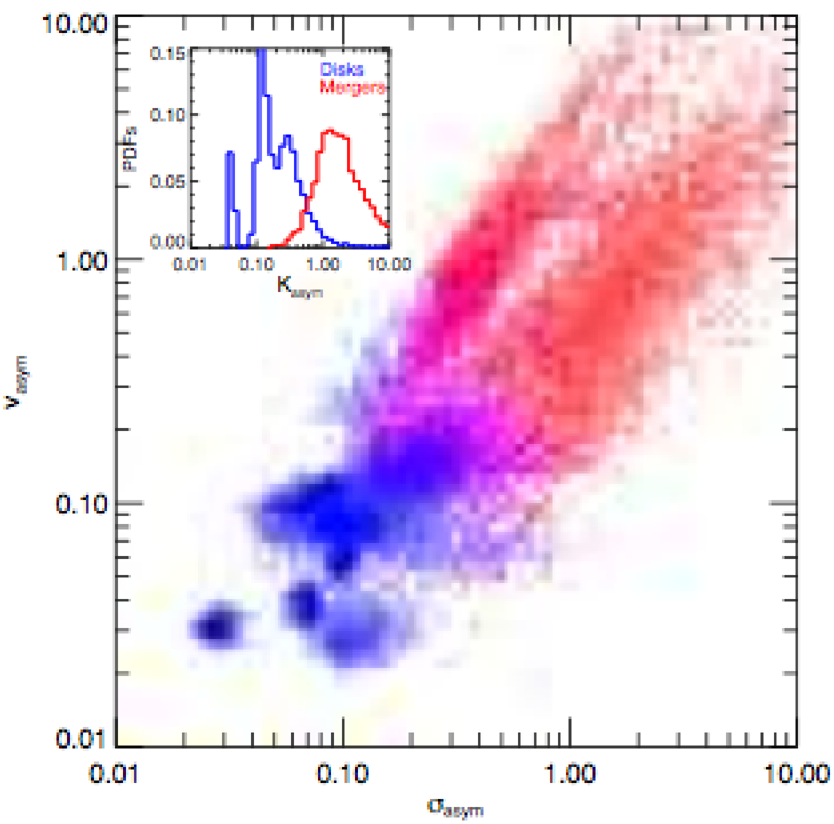
where Ψ is the azimuthal angle in the plane of the galaxy

→ The results are the **Fourier coefficients** (A_i, B_i) and **reconstructed kinematic moment maps** !

Kinemetry (II):

Starting applying kinemetry to the whole sample (isolated, interacting, merger) to *quantify asymmetries* (e.g., v_{asym}, σ_{asym}) of a system and to differenciate it between "disk" or "merger" (Shapiro et al. 2008)

$$\begin{cases} V_{asym} = \langle k_{avg,v} / B_{1,v} \rangle_R \\ \sigma_{asym} = \langle k_{avg,\sigma} / B_{1,v} \rangle_R \end{cases}$$



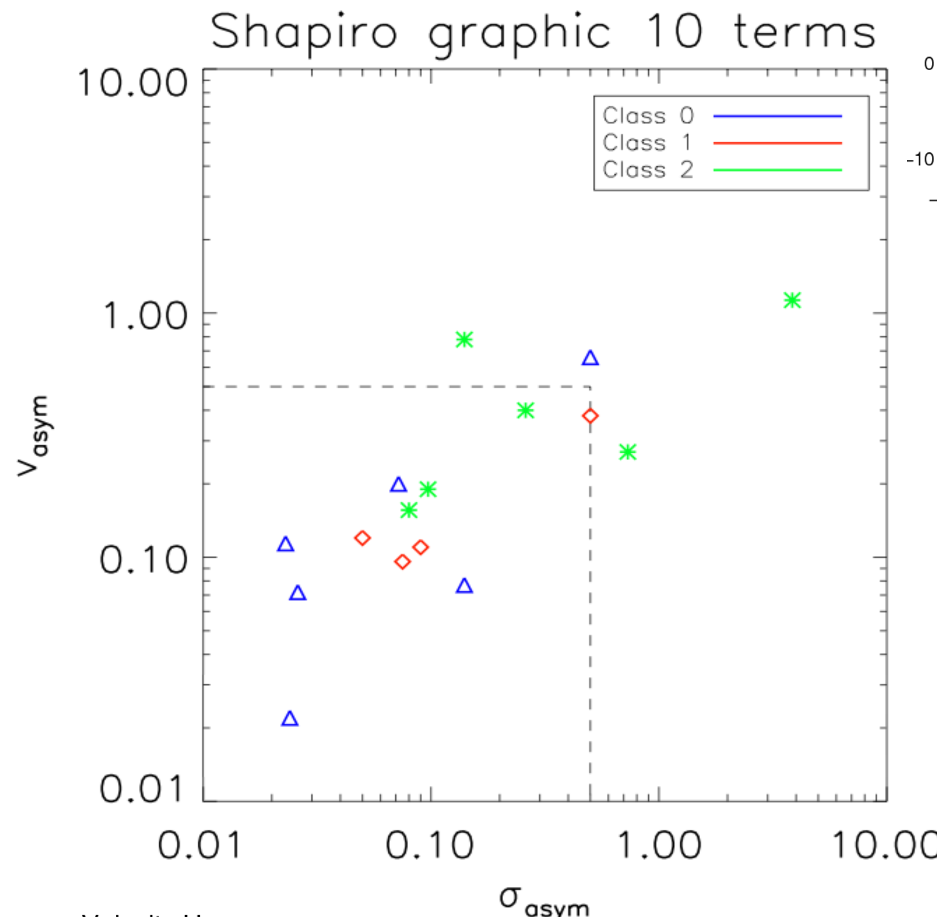
- $B_{1,v}$ is the *rotational curve* !

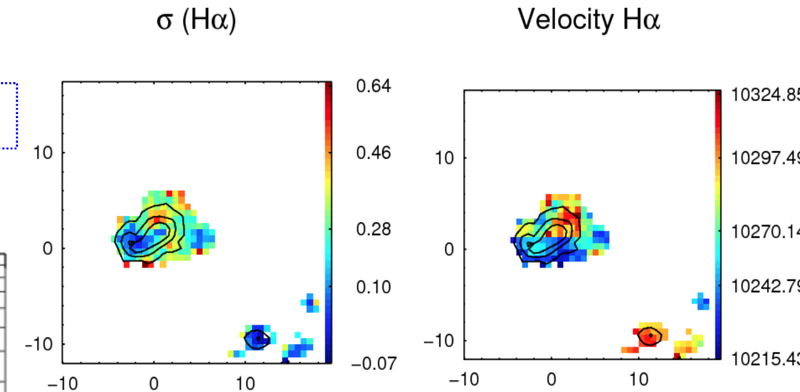
  (The only term for an ideal rotating disk...)

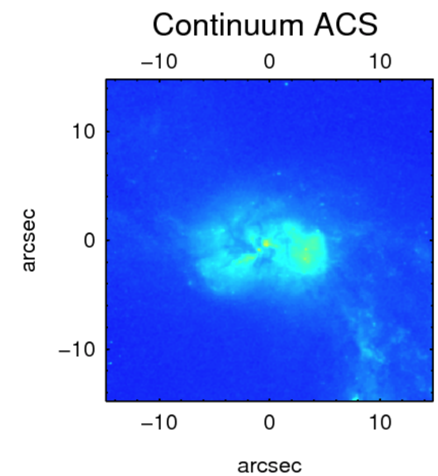
- "*disks*" → **low** values of v_{asym} & σ_{asym}
- "*mergers*" → **high** values of v_{asym} & σ_{asym}

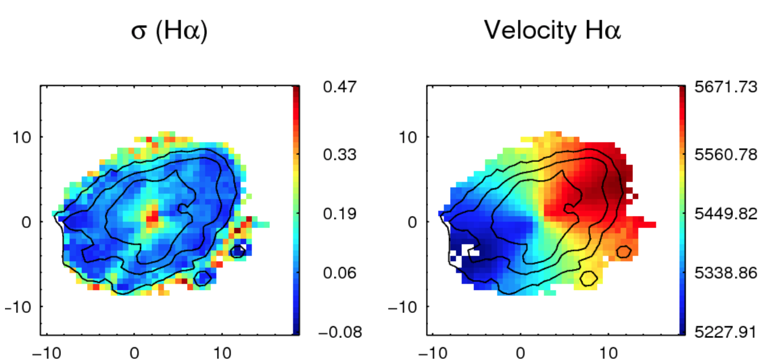
Kinemetry (II,cont):first results

- IRASF10038-3338









- IRASF12115-4656: almost "ideal" rotating disk

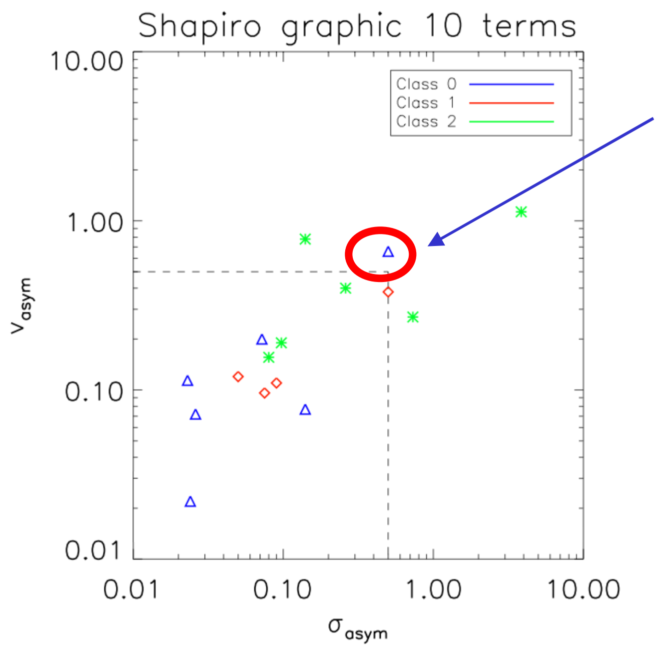
Our results support a *correlation between the kinematic and morphological classifications:* objects morphologically classified as isolated "disk" galaxies trend to have **low** kinematic asymmetries while objects morphologically classified as "mergers" have relatively **high** asymmetry in the kinematics.

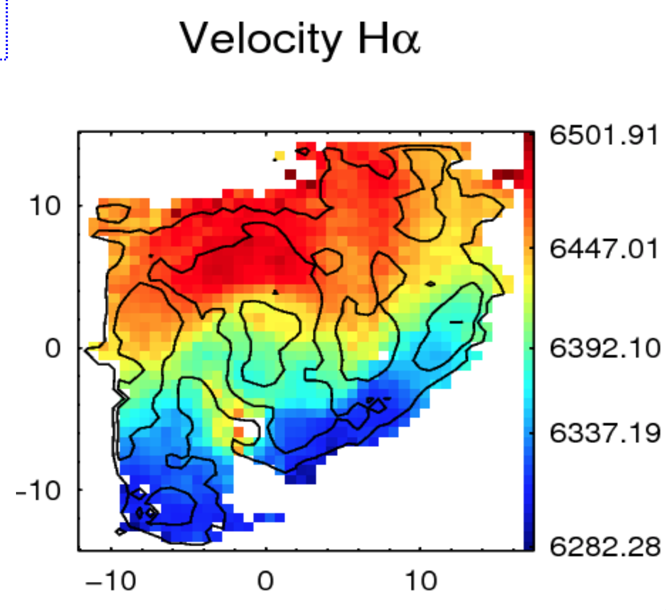
However

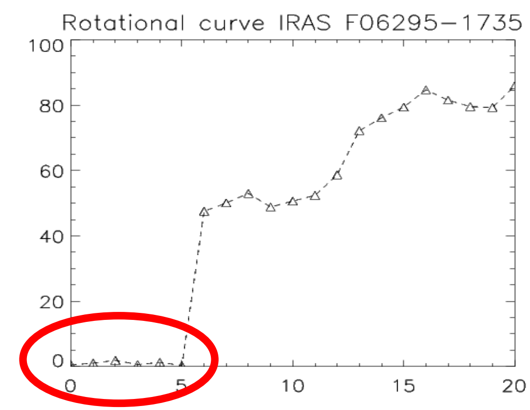
1)there are some exception (IRASF06295-1735)

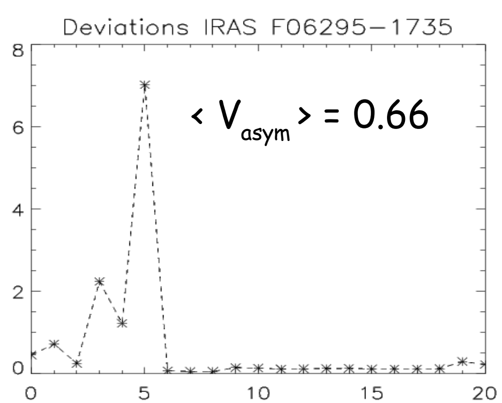
2)the limit distinghuishing between disks and mergers may need revision...

- IRAS F06295-1735









-- Future work

- ✓ Infer kinematic properties for the sample
- ✓ Extend kinemetry to the whole sample
- ✓ Explore *alternative methods* to separate kinematically disks and mergers
- ✓ Derive dynamical (and stellar) masses and discuss its consistency
- ✓ Implications @ high redshifts (simulated observations)