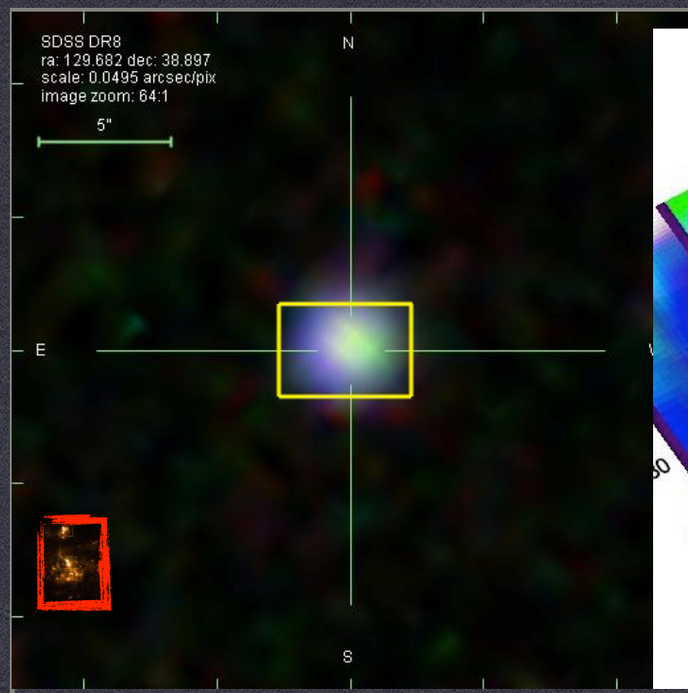
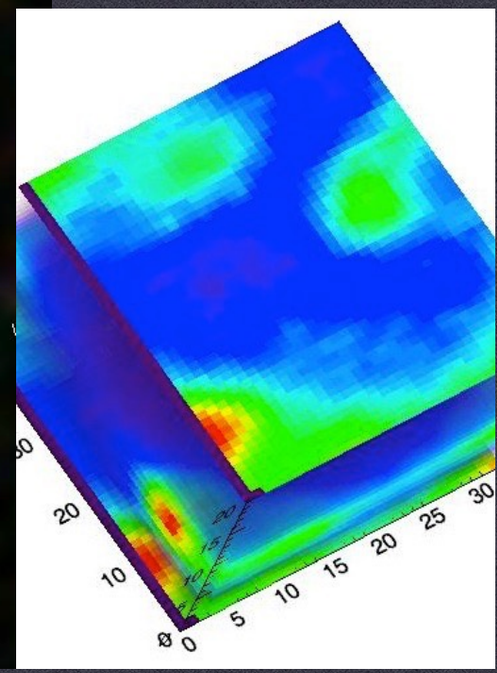
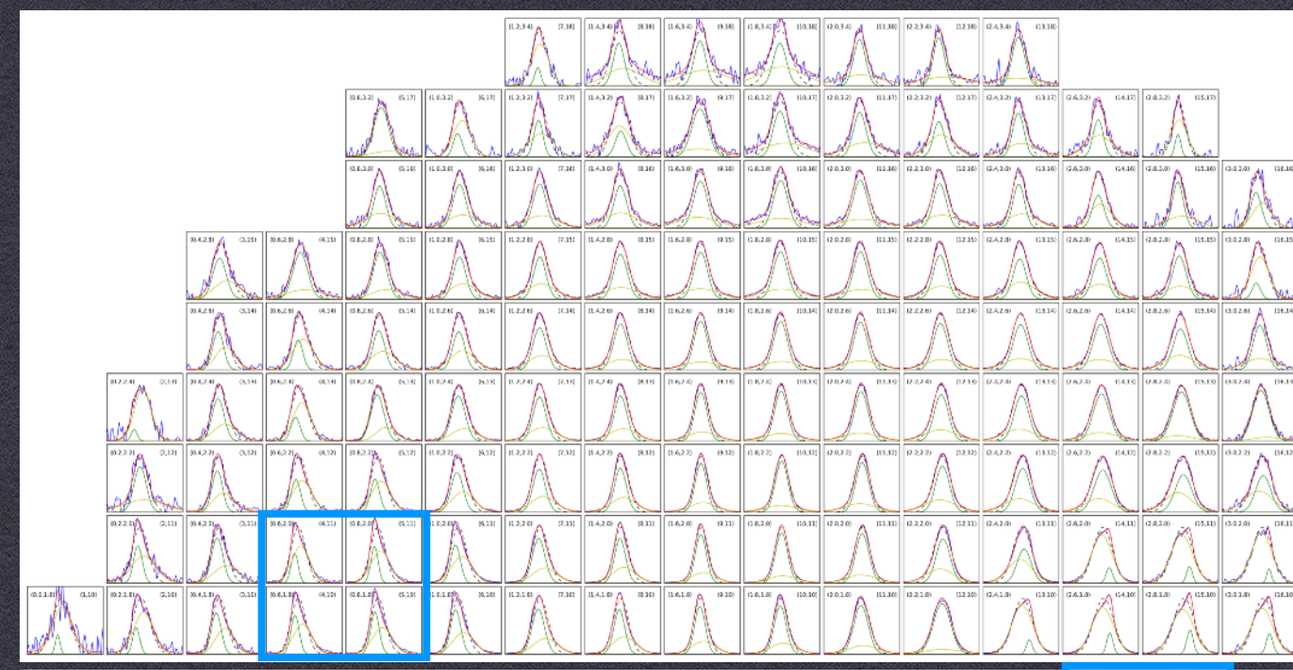
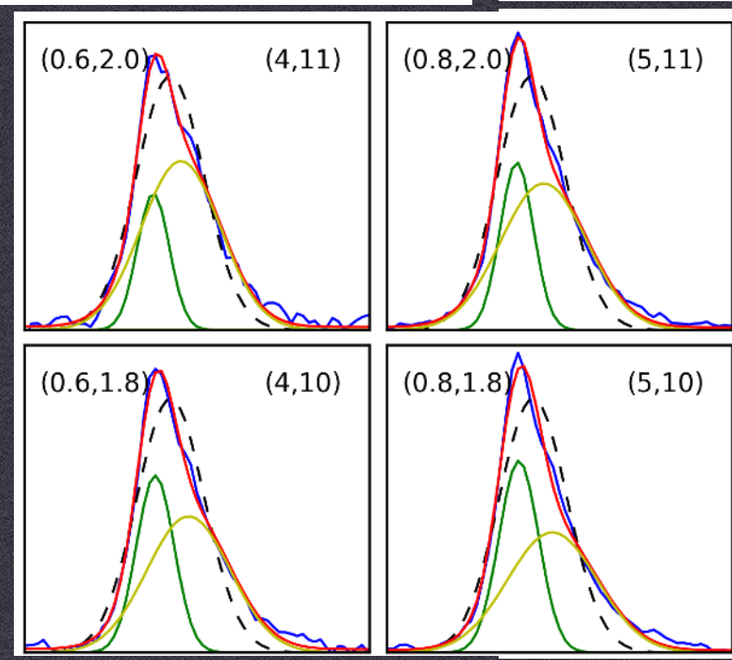
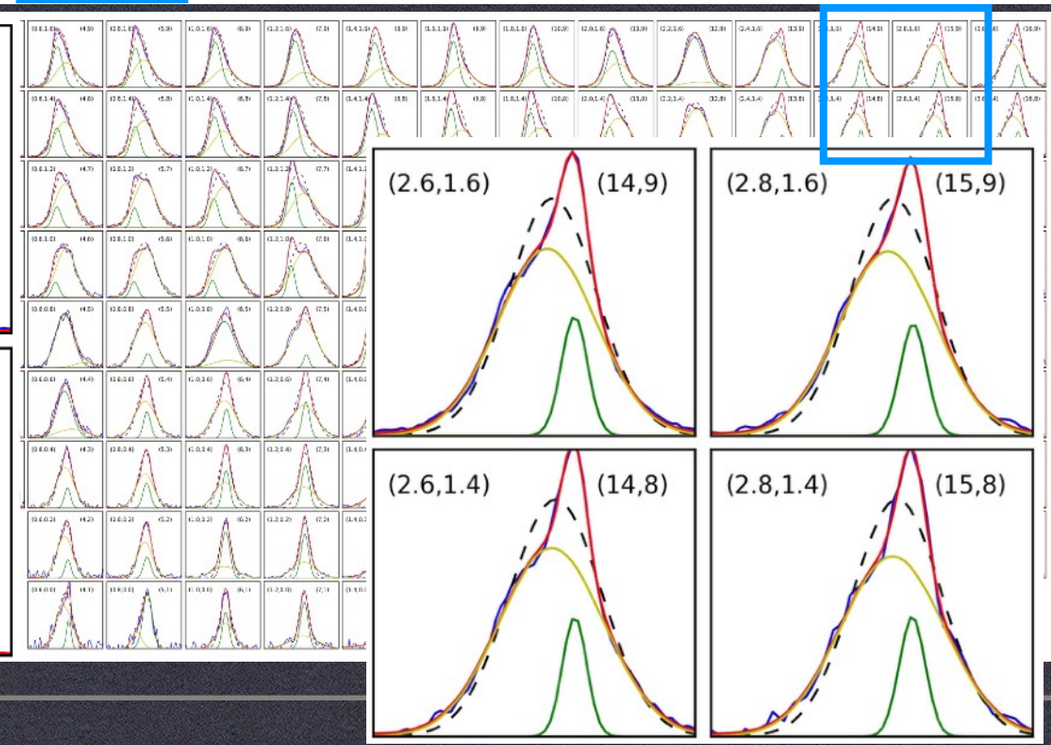










MULTIPLE COMPONENT KINEMATICAL ANALYSIS ON THE SDSSJ0838 'GREEN PEA' STARBURST GALAXY

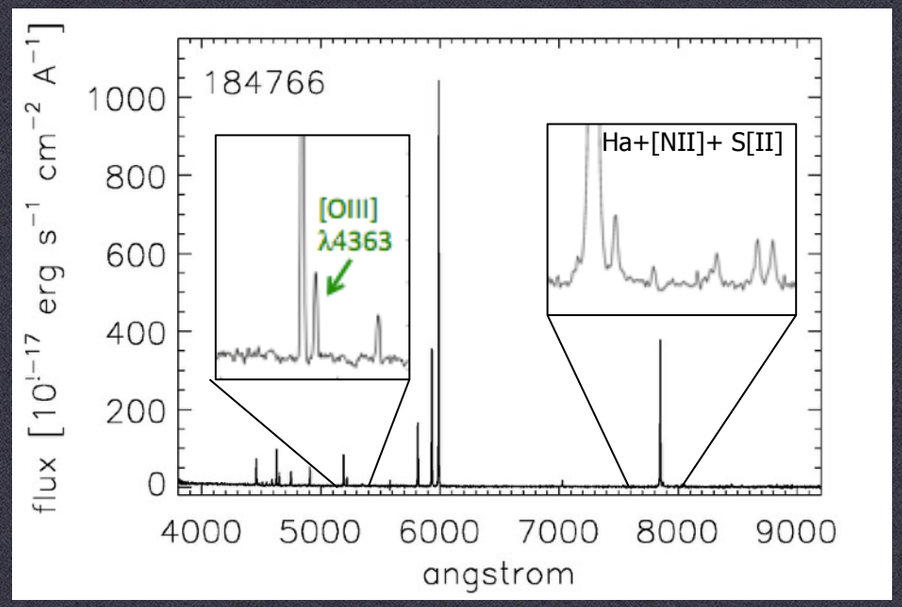
Guillermo Bosch (IALP)

G. Hägele, M. Cardaci, F. Campuzano (IALP, Argentina) R. Amorín (Khavli, UK) V.Firpo (ULS, Chile)

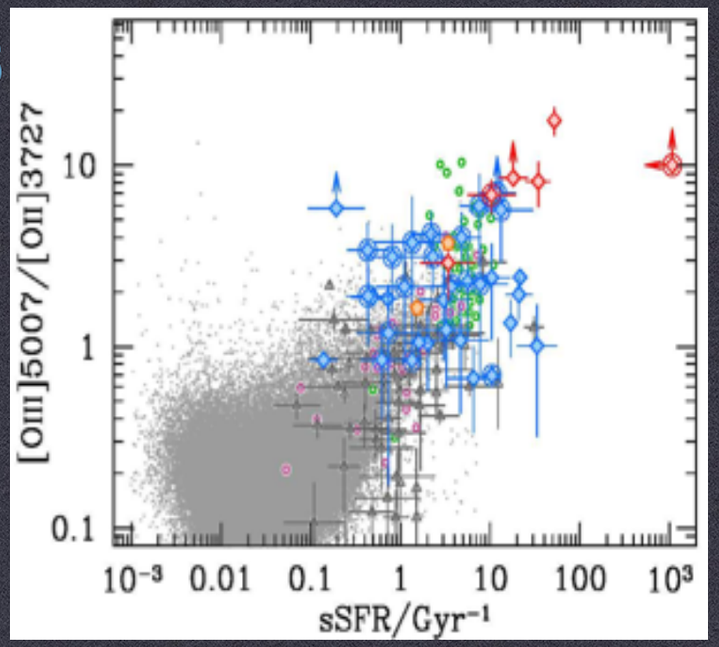
DATE	07-25-2018	PLACE	SAN FRANCISCO, USA

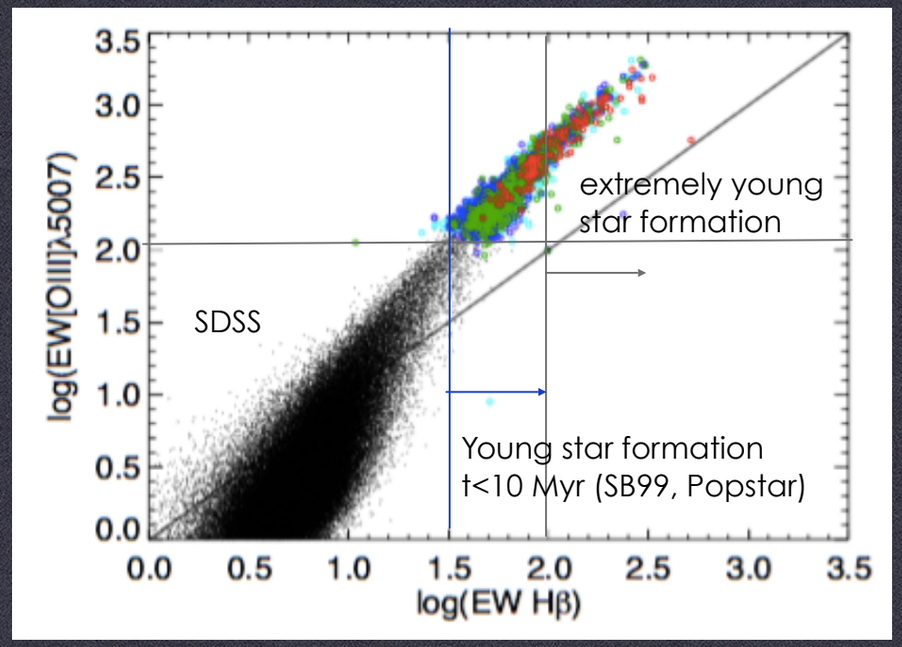
Green peas are extreme emission line galaxies

- Compact luminous starbursts in a low-mass galaxy. Green colour due to unusually strong [OIII]5007 redshifted to r' band.
- Spectra reflects the properties of a gas-rich, highly ionized, very young, metal-poor, galaxy-wide starburst.
- GPs are rare local galaxies with properties closely resembling those seen ubiquitous in high redshift galaxies.



LBGs
LAEs
GPs

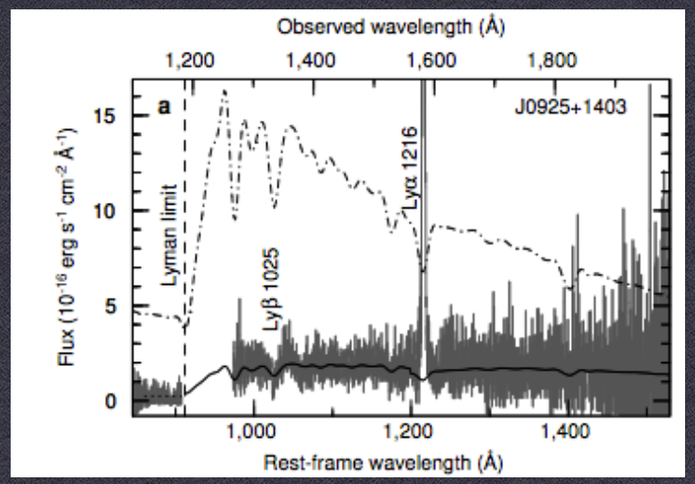


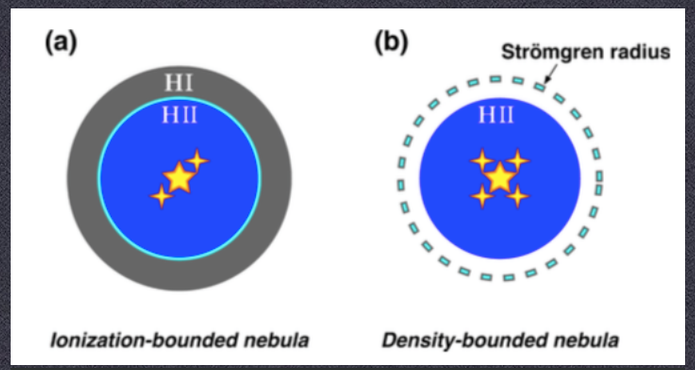


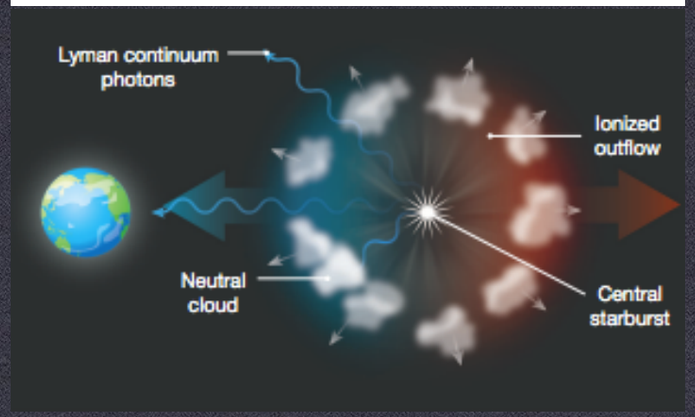
Green peas are LyC leakers

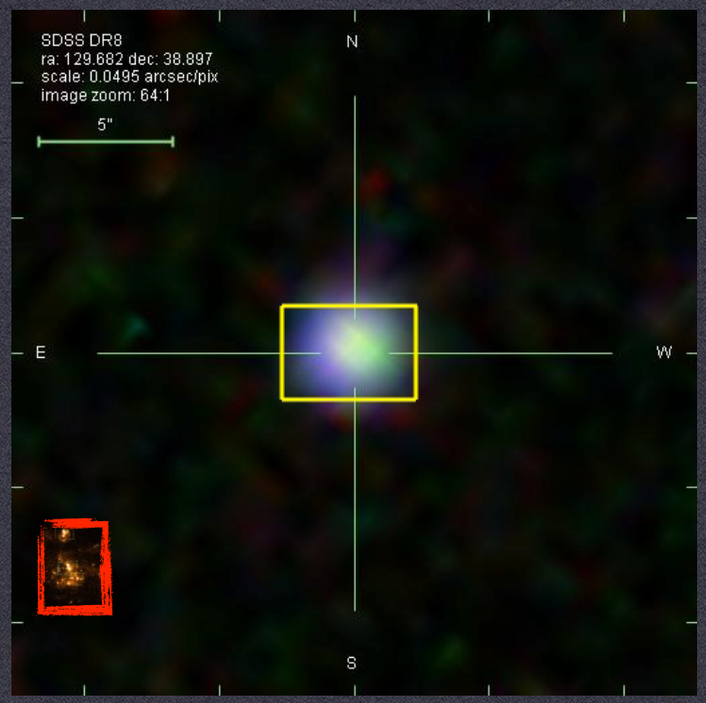
- 100% success rate in detecting Ly alpha or Ly continuum which indicate escape fractions ranging from 5 to 75%. Similar to those detected at z~3.

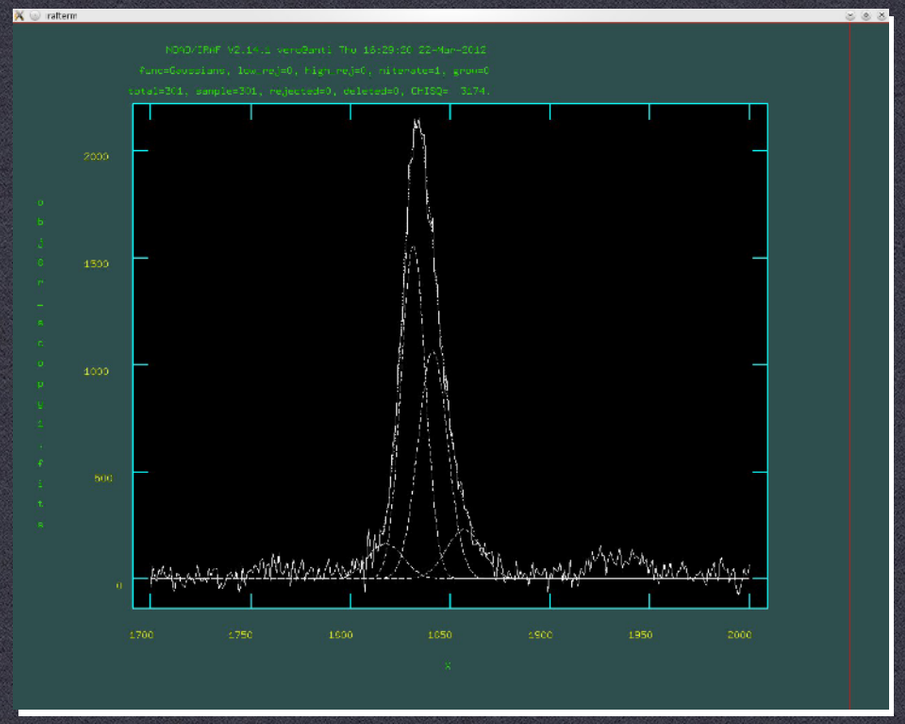
- Could be explained with massive HII regions reaching matter bounded conditions and/or shredding its parental cloud.





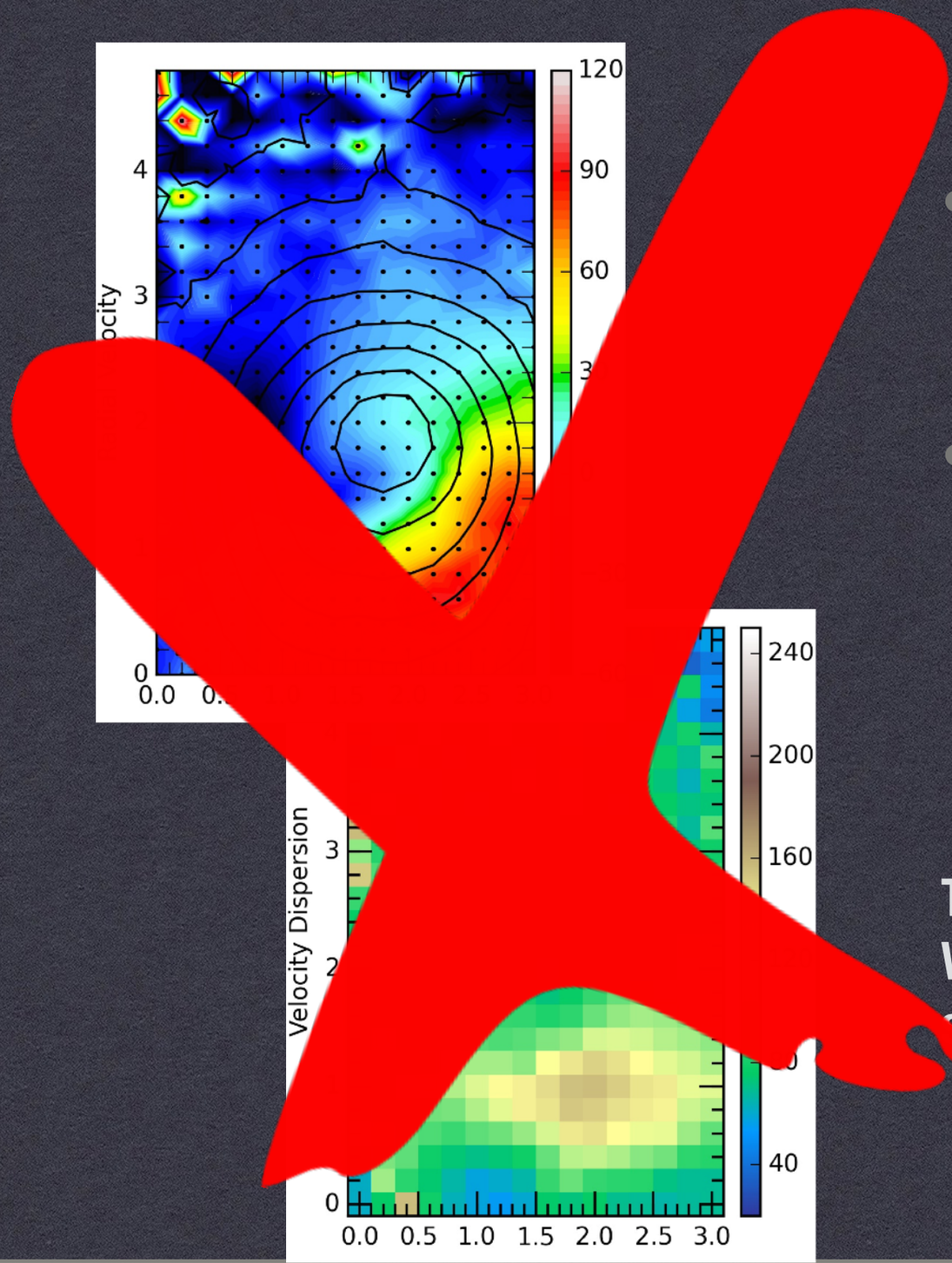






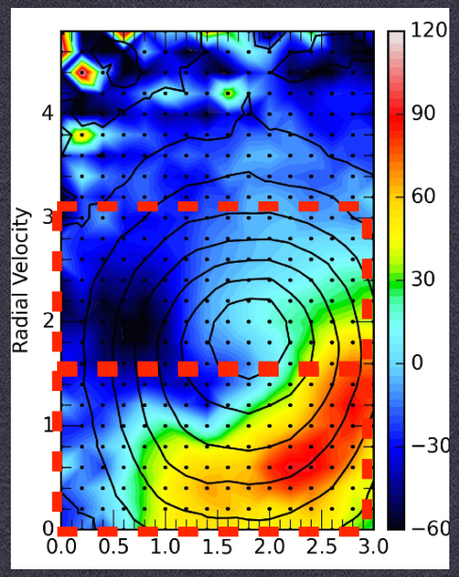
- SDSS J083843.6+385350: Strong starburst galaxy catalogued as “Green Pea”.
- ISIS spectra revealed the presence of multiple kinematic components in Green Pea galaxies (Amorín et al. 2012). At a redshift of z=0.147 (d=630 Mpc, 2.5 kpc/arcsec), the whole galaxy fits nicely in a GMOS IFU field
- Observations were taken at Gemini North with the R831 grating (R=4400) in 1-slit mode.

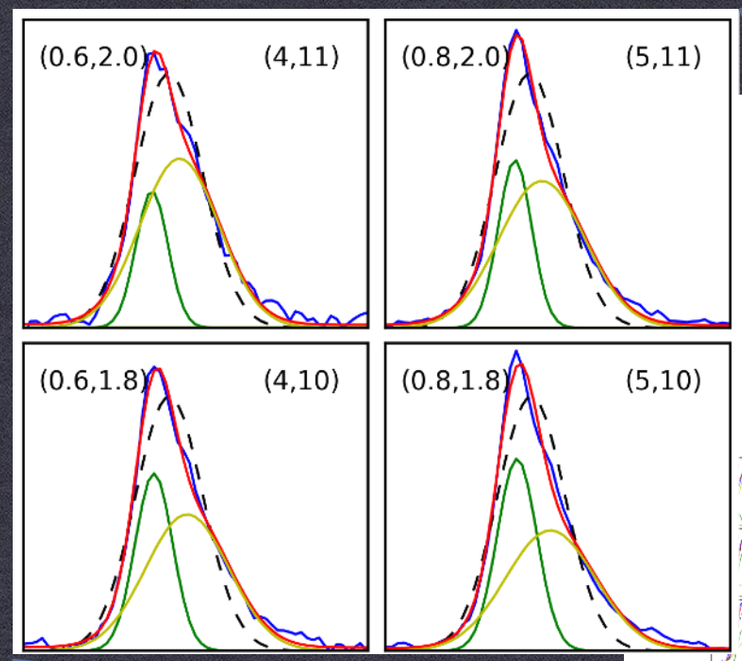
IFU in Green Pea Galaxies, the simple approach:

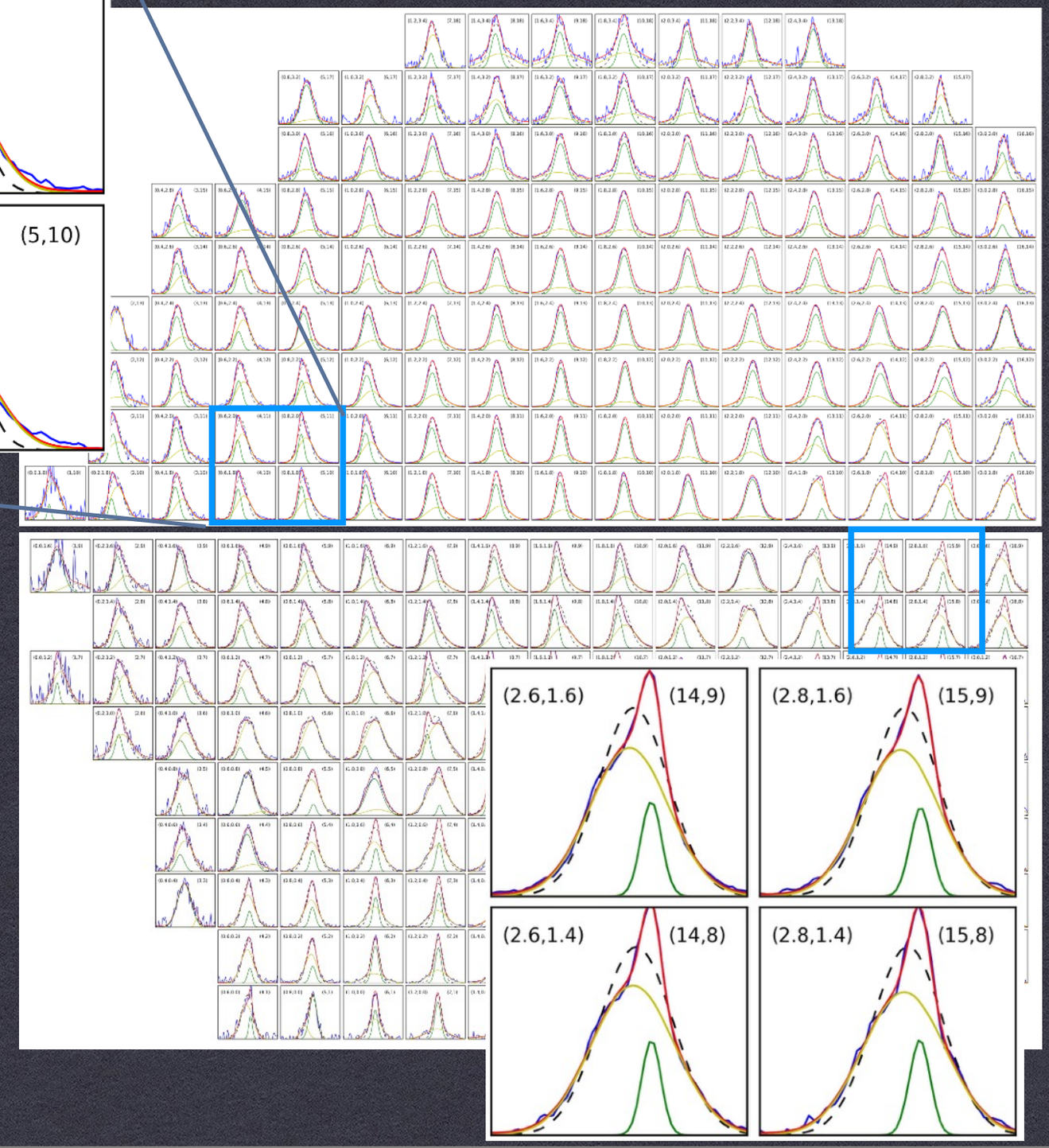


- Single Gaussian fit to IFU data on distant starbursts has already been performed (Green et al 2010, Wisniosky et al 2015, Lofthouse et al 2017)
- Single Gaussian fitting to the emission profile of the Halpha line:
  - SDSS J0838 shows a patterns that might resemble a perturbed rotational feature.
  - Velocity dispersion map does not show a peak in the flux maximum.

The galaxy does not fit the criteria established by Wisniosky et al (2015) to classify it as a rotating system.







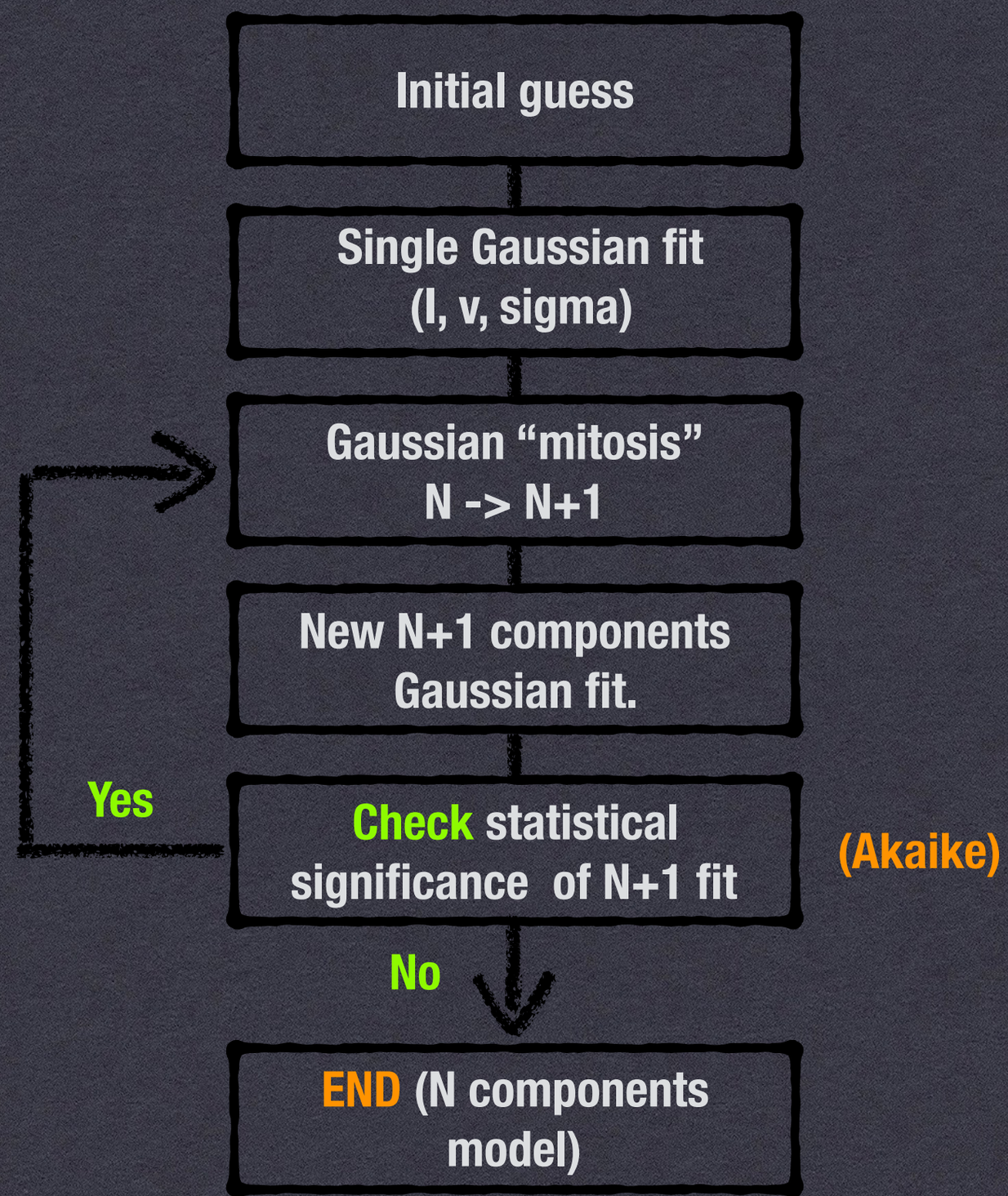
- Close inspection of individual profiles shows that they differ from a well behaved single Gaussian component. The shape changes dramatically throughout the galaxy field.
- It is NECESSARY to fit **multiple** components in each spaxel.

Conditions : Chi-squared minimization techniques always provide a solution but are strongly dependent on initial conditions.

Limitations: Such intial conditions vary throughout the field as intensity, velocity and dispersion are expected to change within the galaxy.

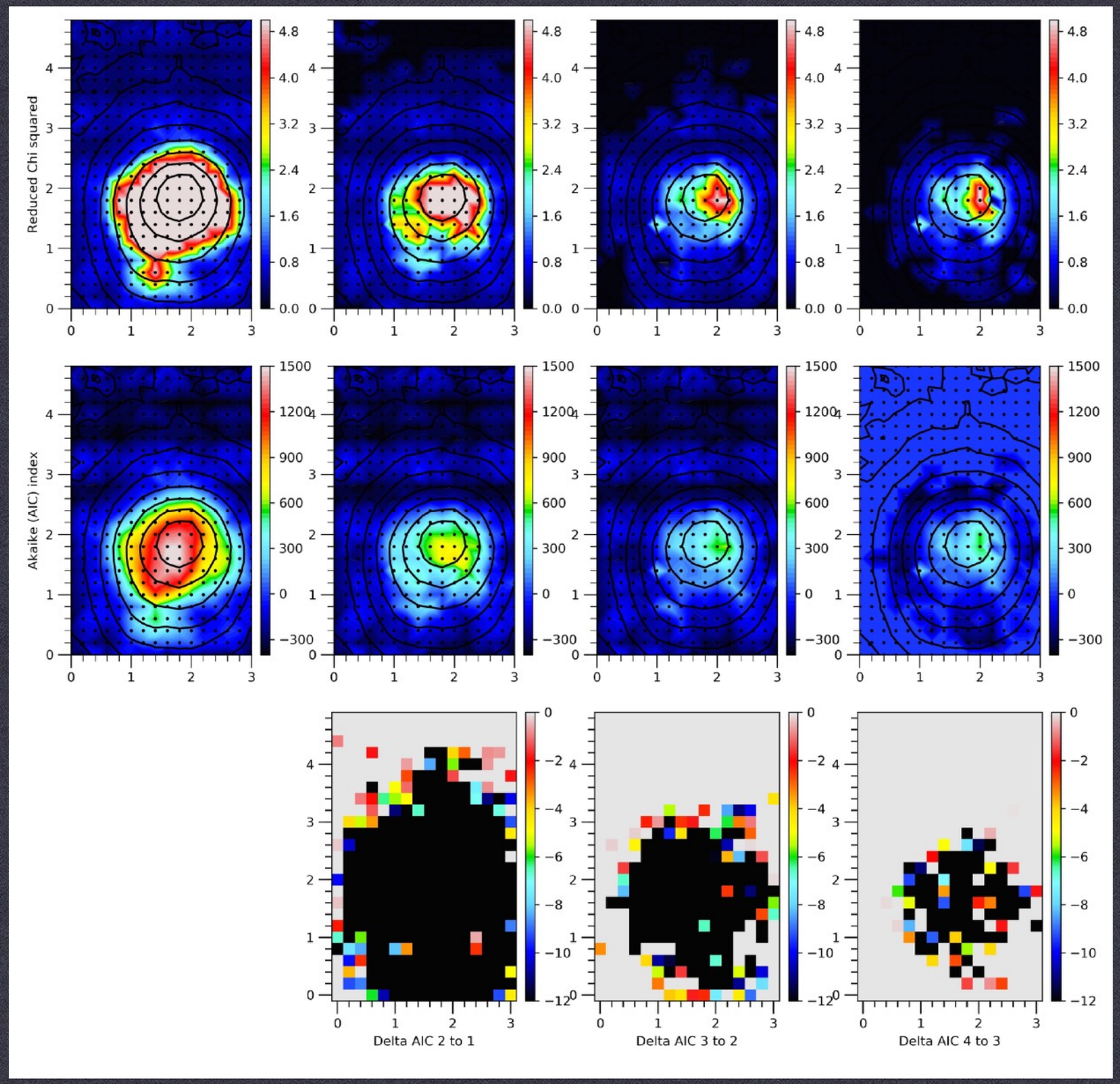
Answer: Build a code that performs an **iterative** Gaussian fit to each spectrum in order to confirm the presence of multiple components in the line profiles.

For each spaxel:



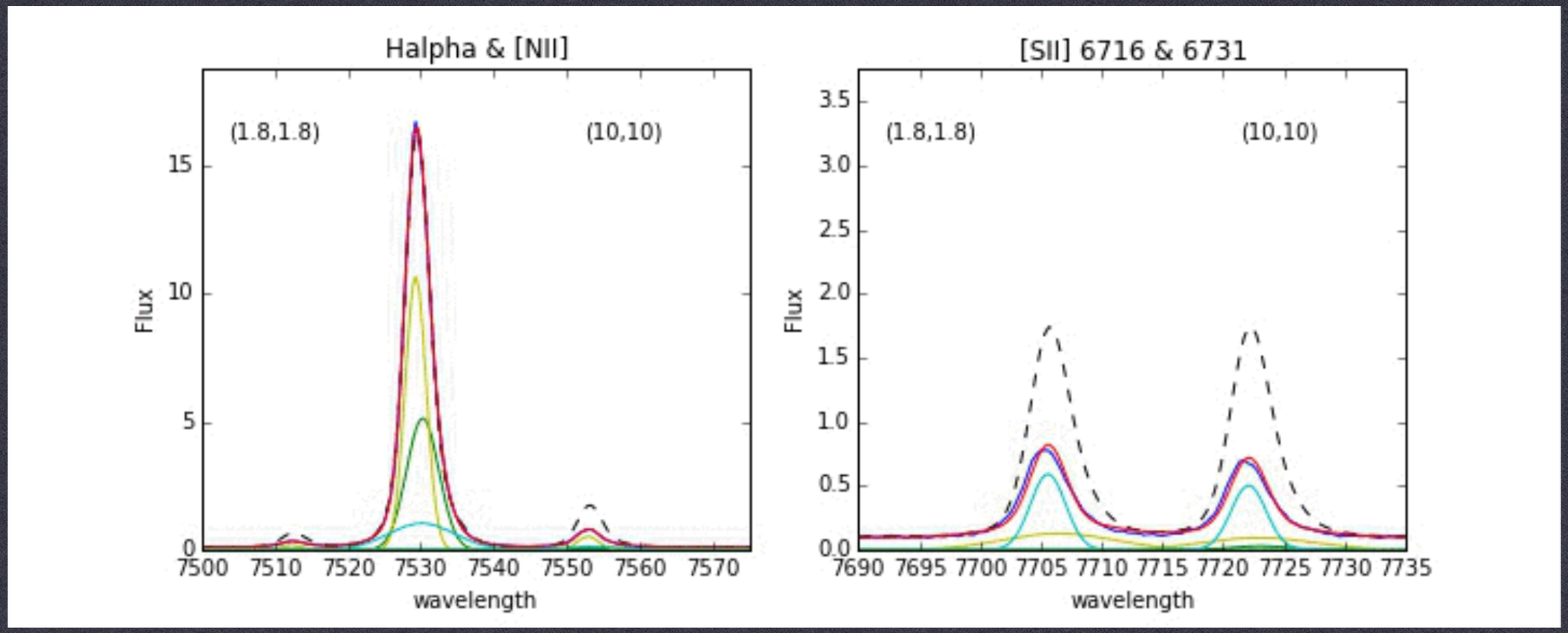
IFU Astrophysics:

On the number of significant components: Akaike Indicator (AIC) allows a direct comparison among different models for the same data sample. It penalizes increasing the number of parameters if these do not reduce the Chi^2 value significantly.
Although its absolute value provides little information, the change in AIC is strongly linked to an actual statistical improvement introduced by the new model.
As a rule of thumb, a reduction of AIC larger than 10 is considered as a very strong evidence that the model has improved after adding a new component.

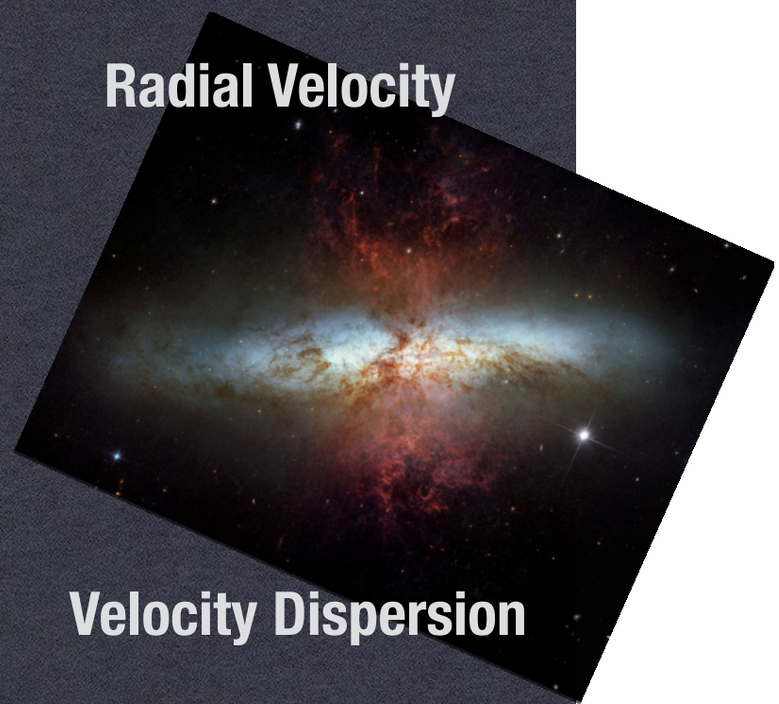


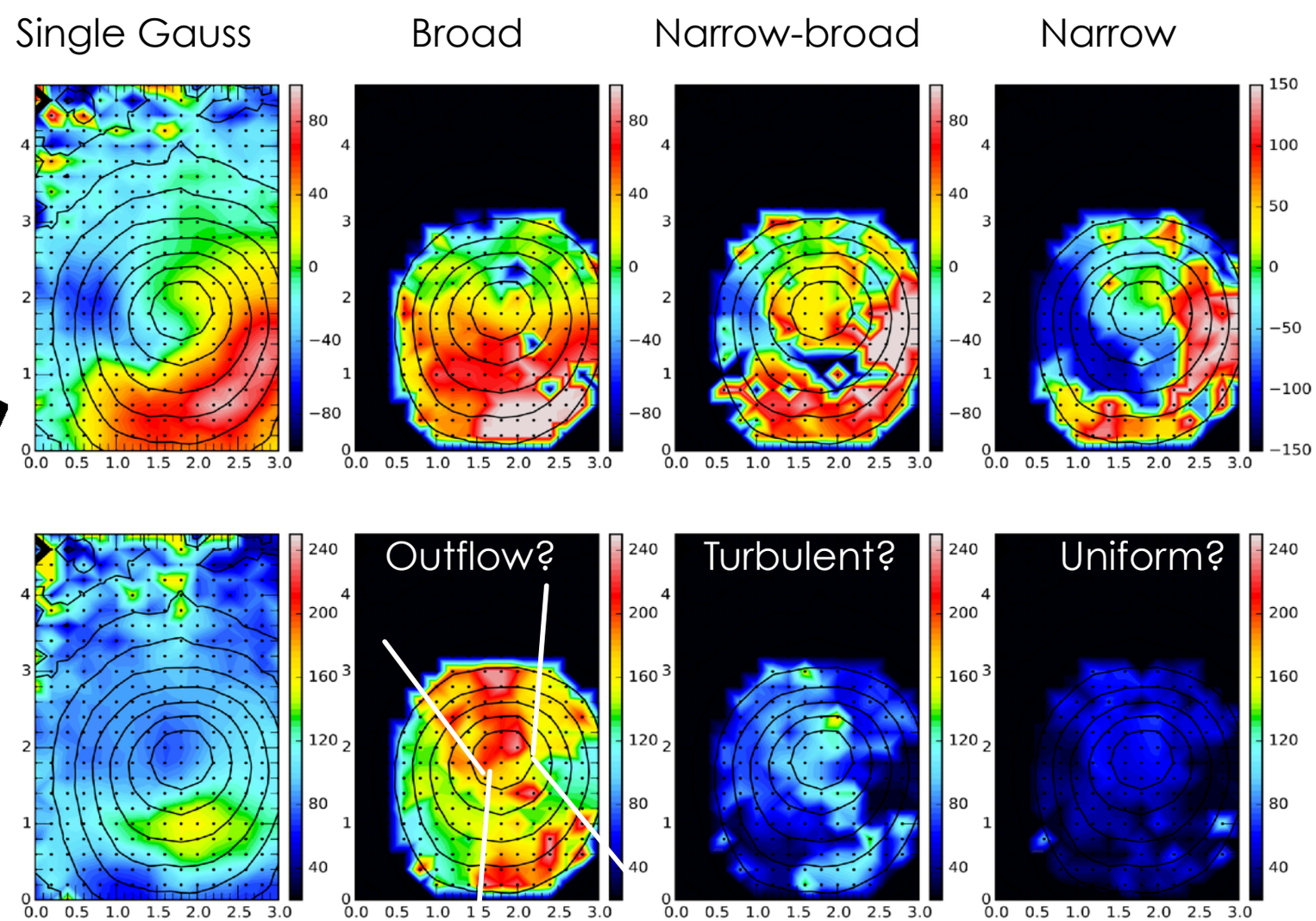
R~4000: Resolution and coverage

- Besides Halpha, Our spectra also include [NII] 6548 & 6583, [SII] 6717 & 6731, [OI] 6300 emission lines.
  - The HI and [NII] lines fit must be performed simultaneously as broad components overlap.
  - Kinematical solution found for these lines is applied to other ions, and chi squared minimization only fits the component amplitudes.



Compared kinematics: one and three components:



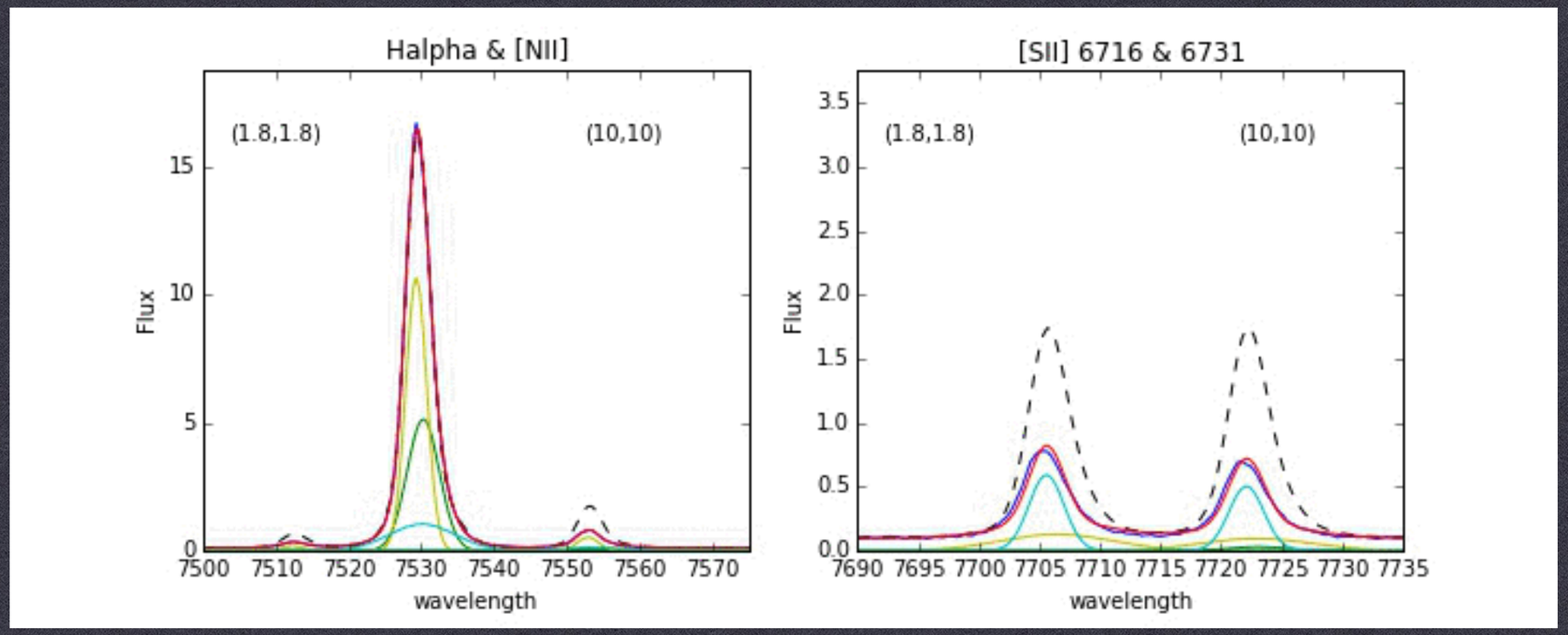


MULTIPLE COMPONENT KINEMATICAL ANALYSIS ON THE SDSSJ0838 'GREEN PEA' STARBURST GALAXY

SCIENCE & EVOLUTION OF GEMINI OBSERVATORY - JULY 2018

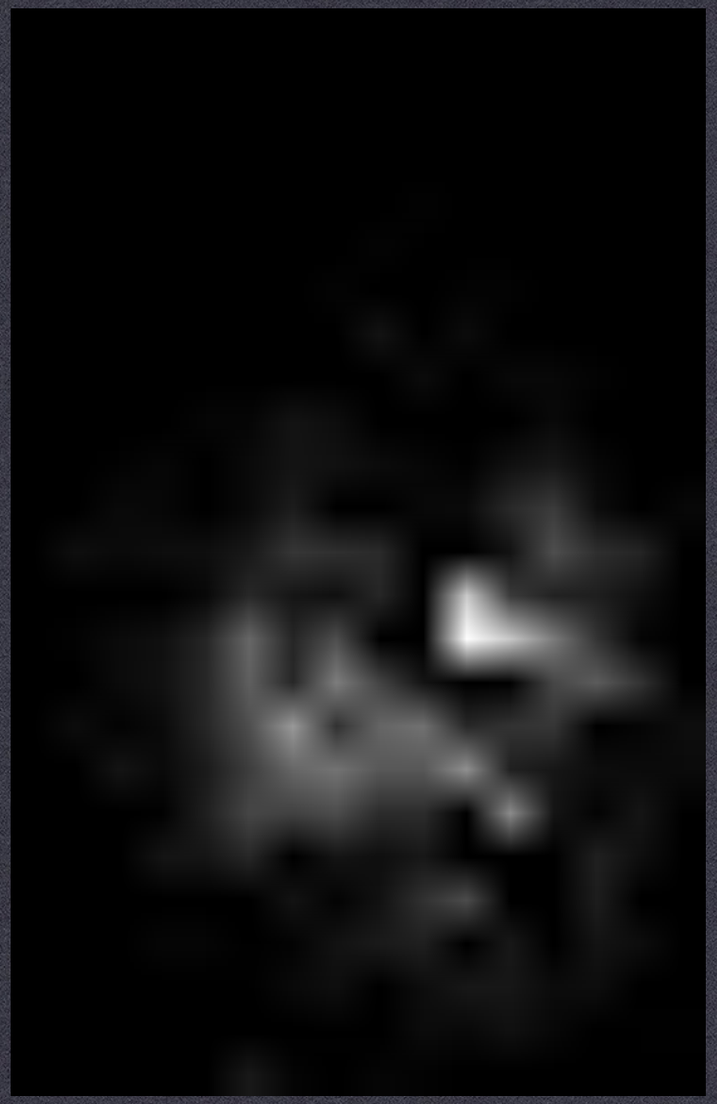
Summary and future improvements:

- Single Gaussian fitting to emission line profiles in IFU data provides first order information about internal kinematics but **might miss what is really happening.**
- Multiple component fit to the SDSSJ0838 GP shows that a lot can still be learned about these galaxies using GMOS with seeing limited conditions.
- We are exploring the possibility of using R831 grating in its second order to obtain 40% better resolution in the blue band (12km/s resolution instead of 20 km/s provided by B1200). Test runs with arc lamps look promising.



Line Ratios

Maps

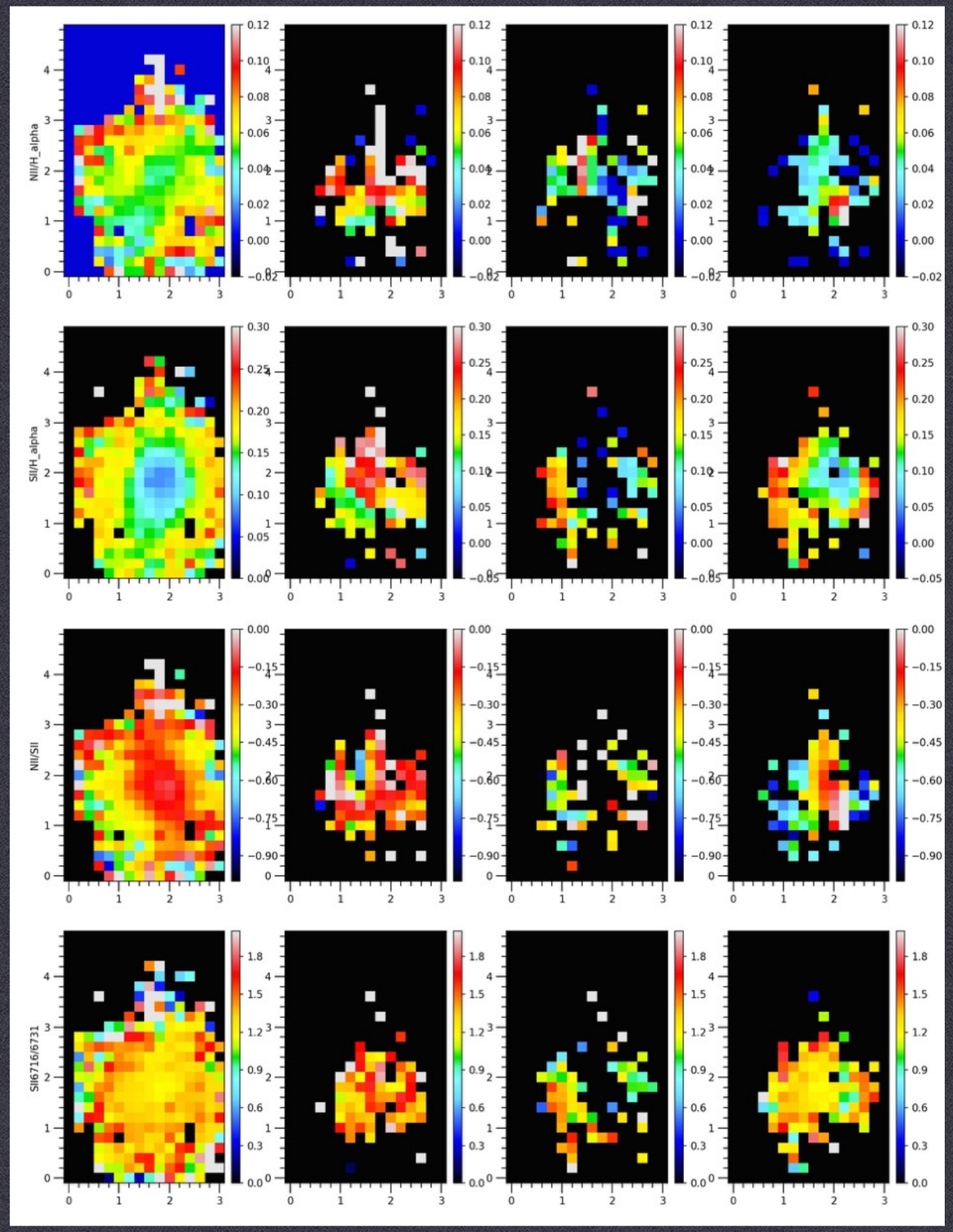


[NII]/Ha

[SII]/Ha

[NII]/S[II]

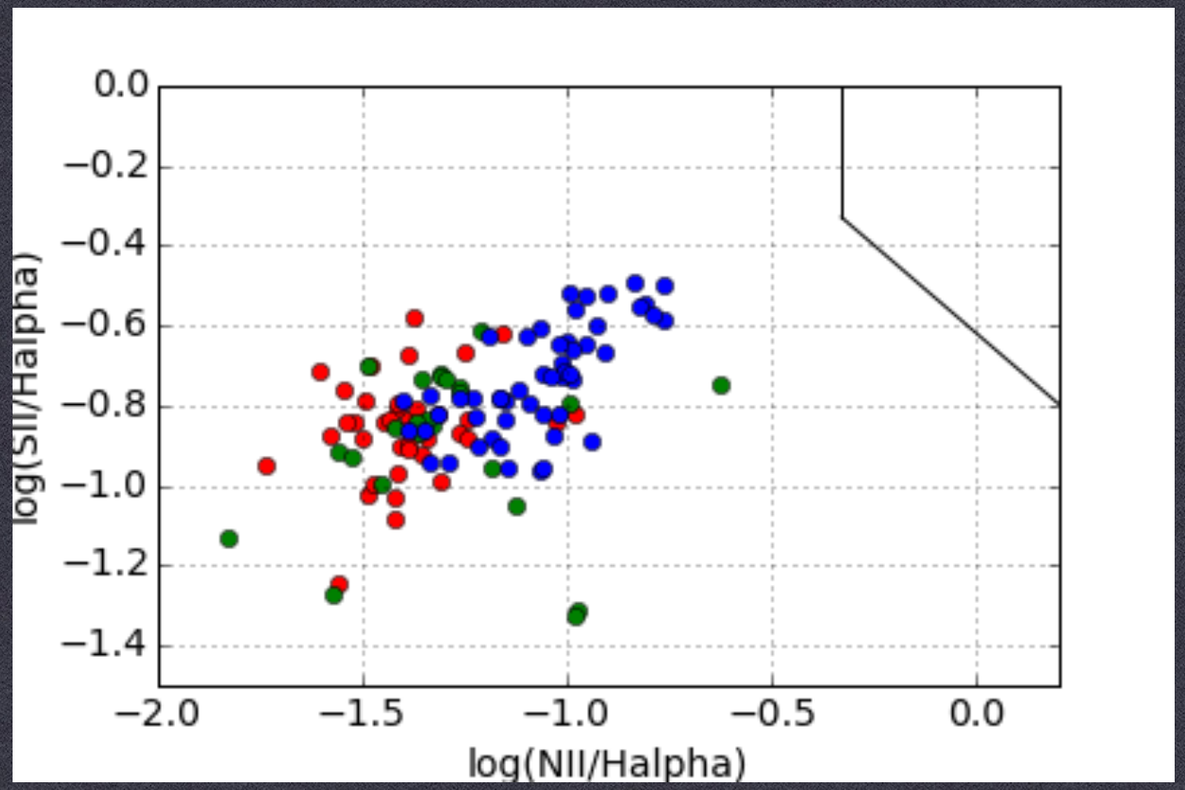
[SII]6716
/6731



Line Ratios:

Diagnostic Diagrams

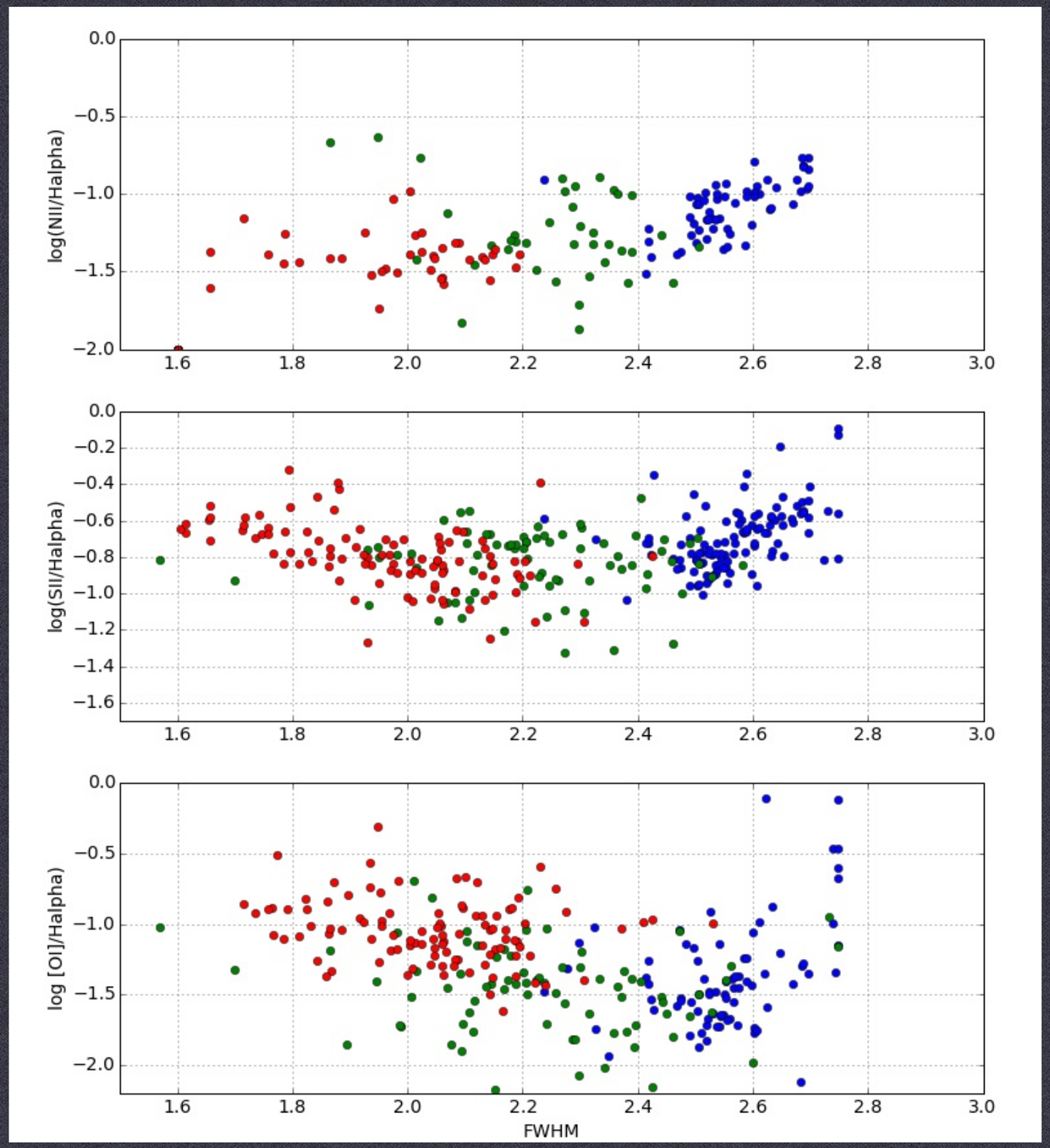
Alternative diagnostic diagram proposed by Lamareille (2010) where wavelength coverage is too narrow to derive canonical BPT diagrams.



Line ratios

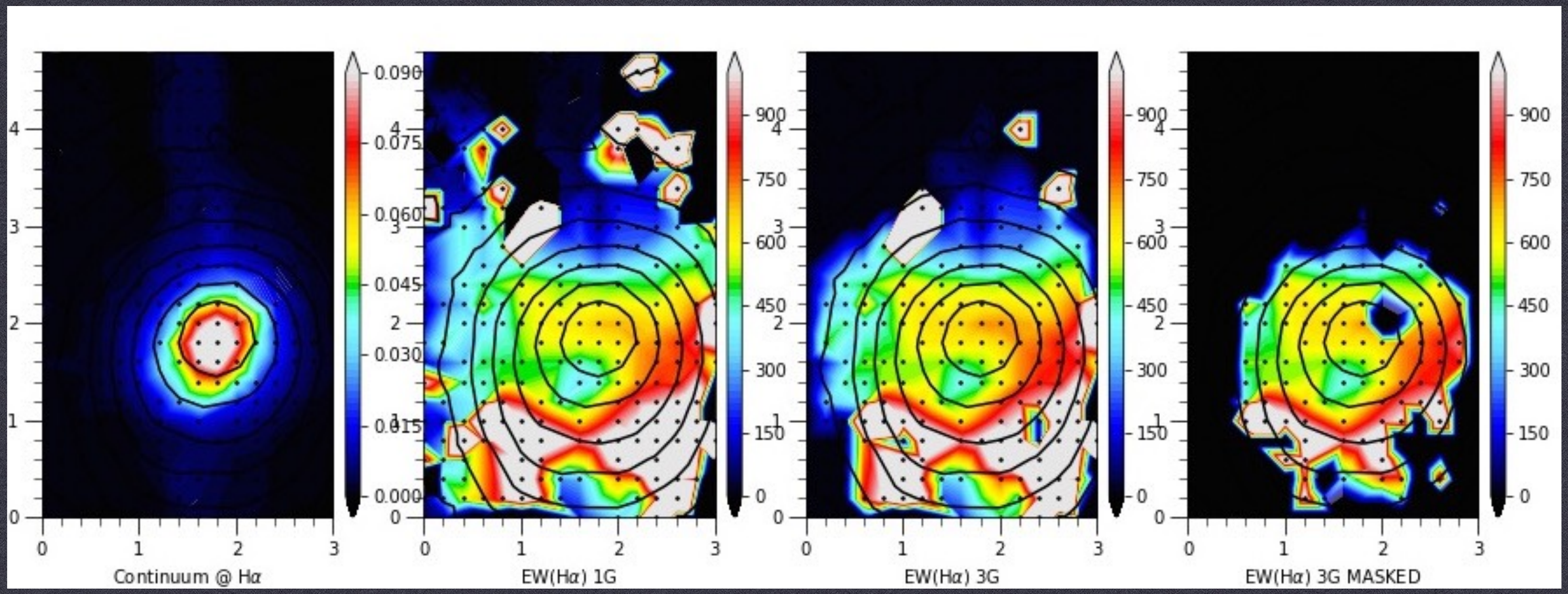
Kinematics

Arribas el al (2014) stated that, even if diagnostic diagrams show that photoionization is the dominant energy source for forbidden lines, a correlation between shock sensitive line ratios and FWHM might provide evidence of such shocks taking place.

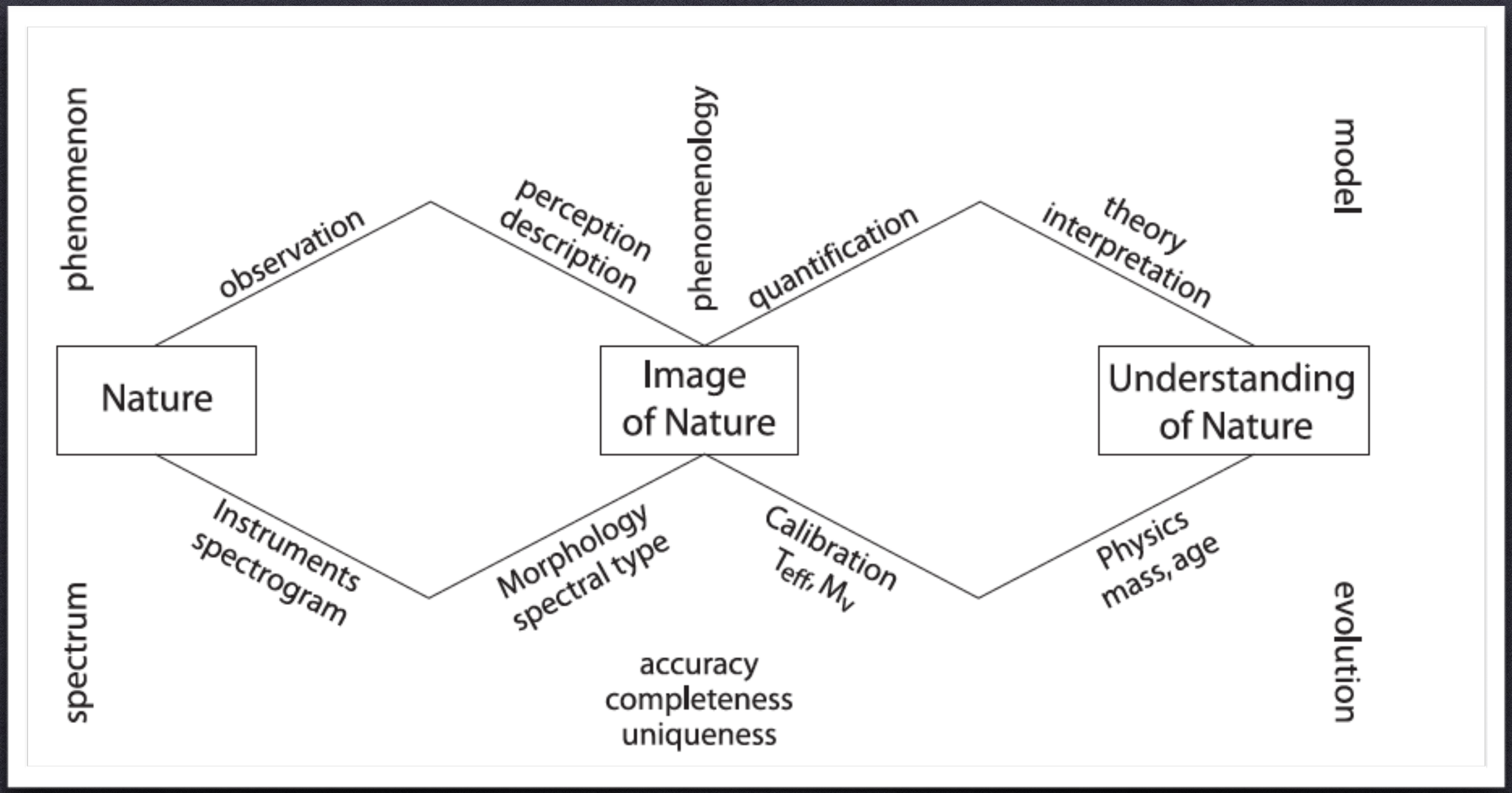


Line Ratios:

Equivalent widths



The profile fitting process yields a reliable value for the (very!) weak continuum contribution. This allows us to trace the spatial distribution of the stellar component and build a map of the equivalent width.


phenomenon
observation
perception
description
phenomenology
quantification
theory
interpretation
model
Nature
Image
of Nature
Understanding
of Nature
Instruments
spectrogram
Morphology
spectral type
Calibration
Teff, Mv
Physics
mass, age
spectrum
accuracy
completeness
uniqueness
evolution

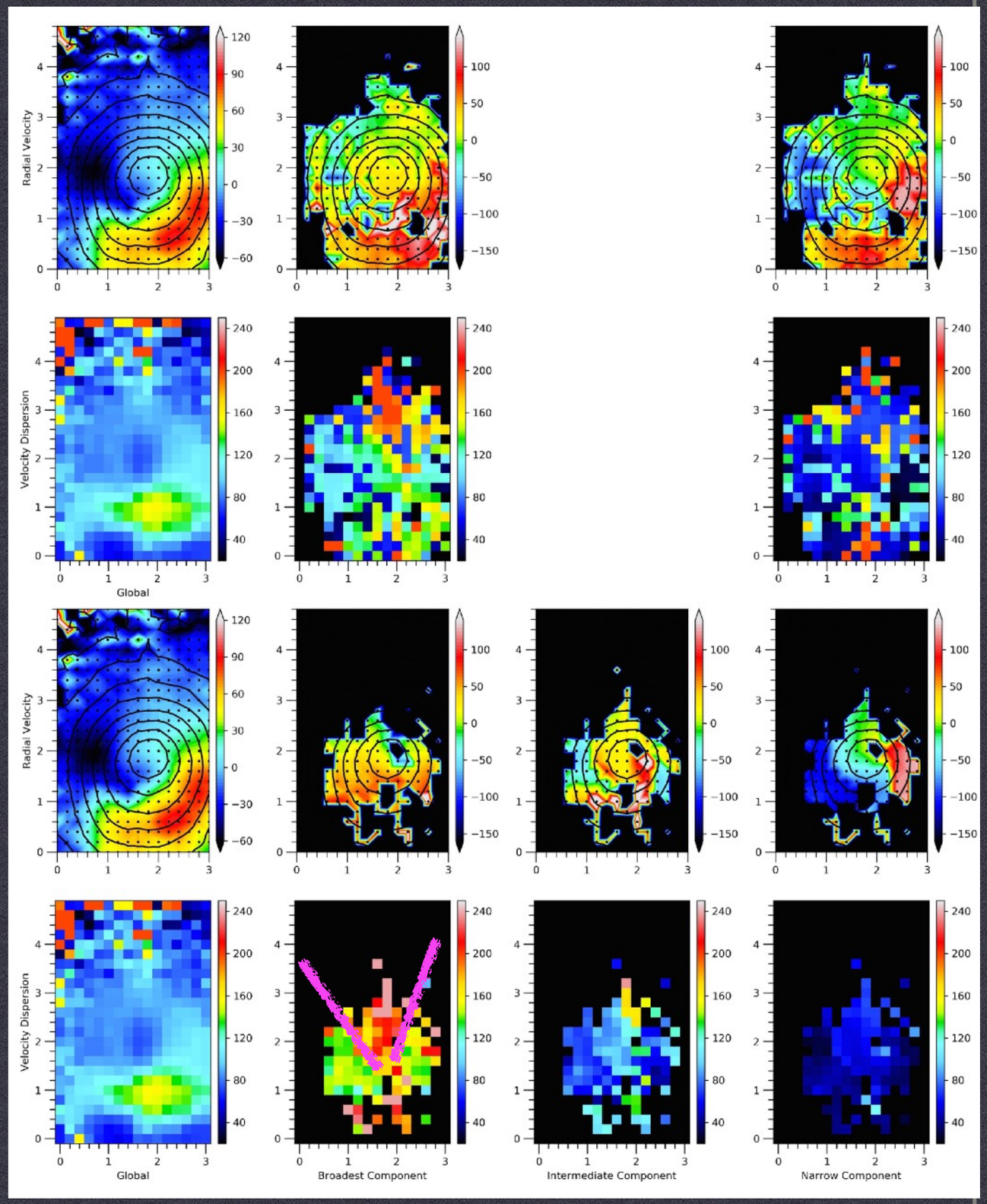
Compared kinematics: two and three components:

Radial Velocity
2 components

Velocity Dispersion
2 components

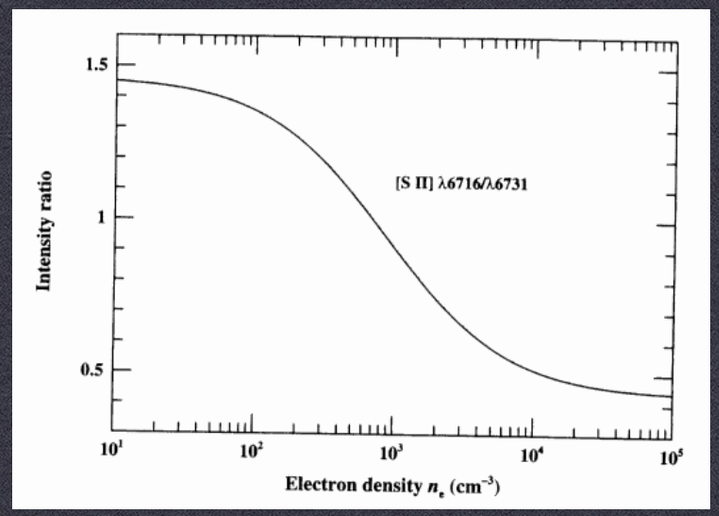
Radial Velocity
3 components

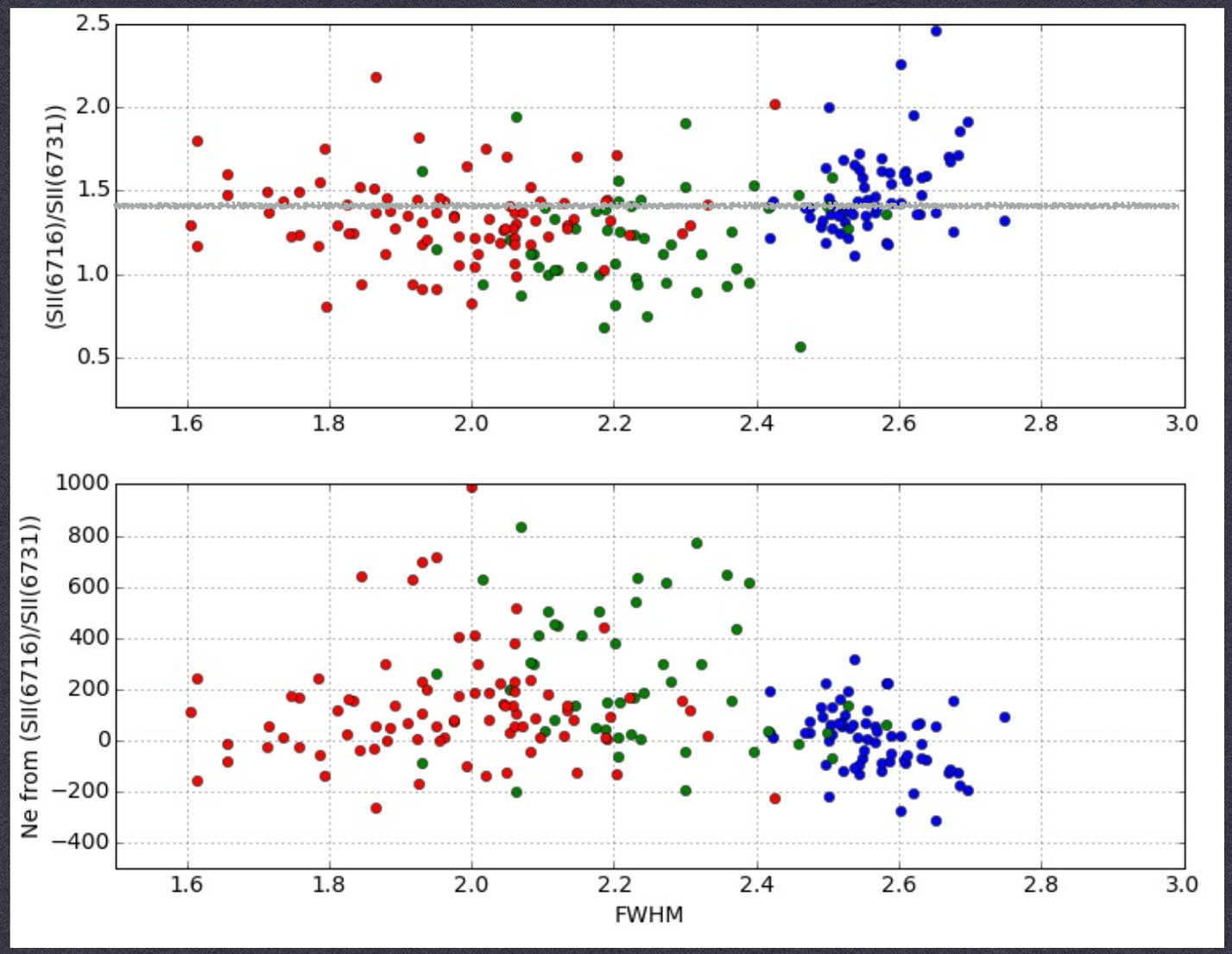
Velocity Dispersion
3 components



Cocientes de líneas:

Diagramas cinemáticos

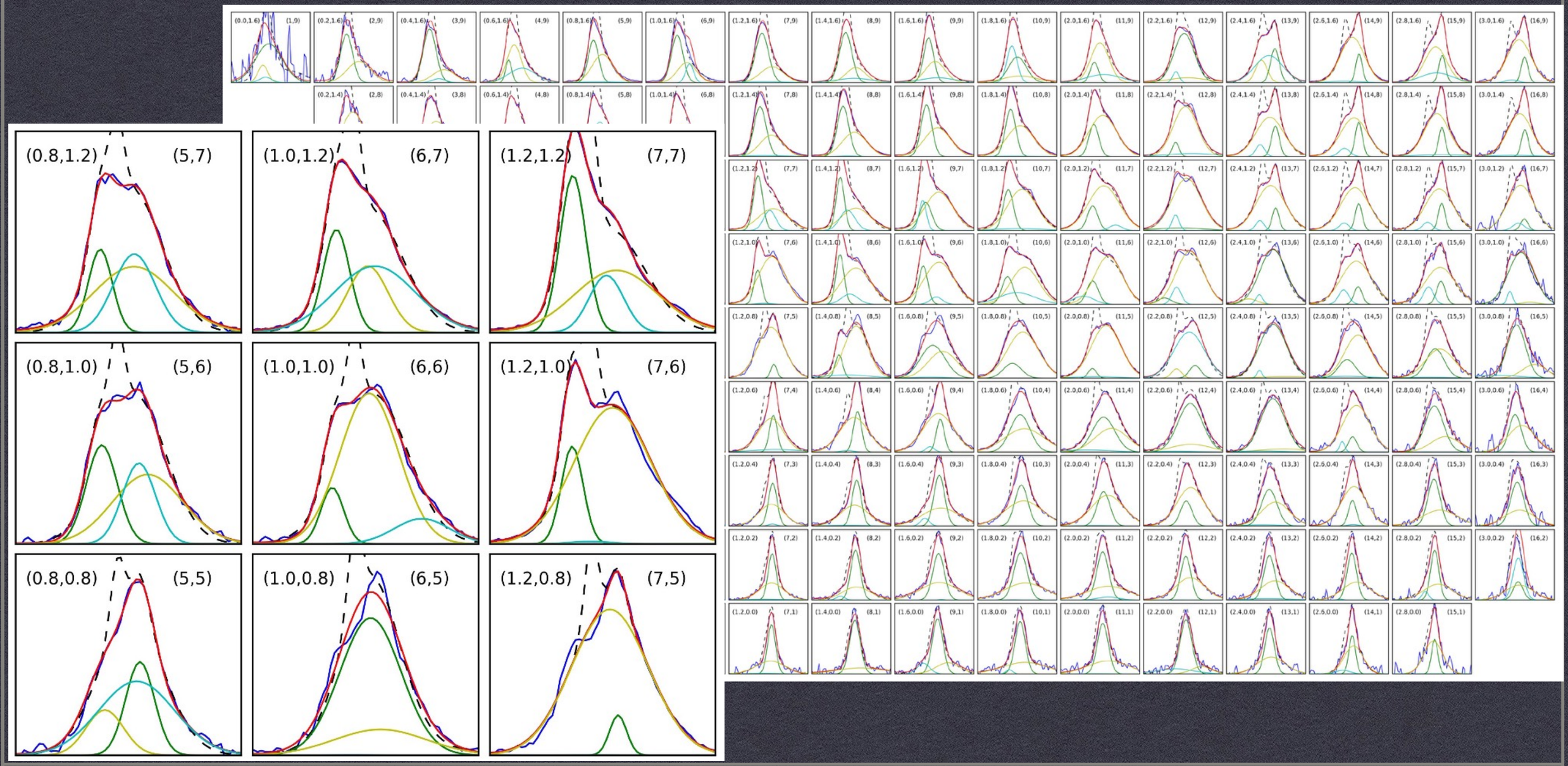




Del cociente [SII] 6716/6731 podemos estimar la densidad electrónica y verificar su dependencia entre fases de dispersión de velocidades distintas.

Un número considerable de spaxels presentan cocientes mayores a los esperados para densidades bajas, algo encontrado también por otros investigadores.

IFU Astrophysics:

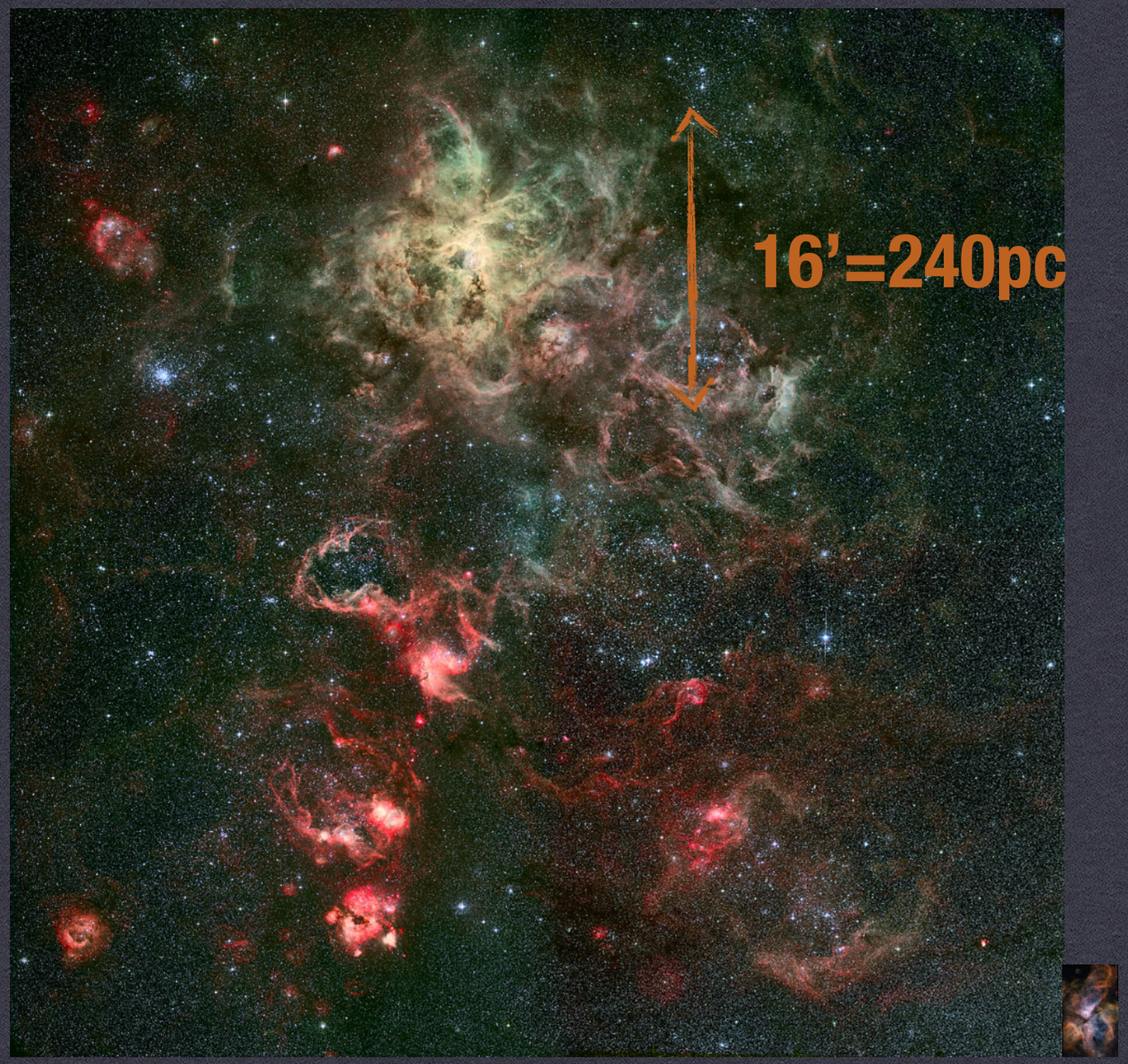


KINEMATICAL ANALYSIS WITH GMOS IFU IN “GREEN PEA” STARBURST GALAXIES

60 AAA - MALARGÜE - SEPTIEMBRE 2017

IFU Astrophysics

- 30 Doradus in the LMC (still in the Local Group is our best shot at this kind of starbursts.



Integral Field Unit Spectrographs:

- **The main goal is to expand the observed field without losing spectral resolution**
  (and wavelength coverage, throughput, and acquisition time, all these while keeping data reduction easy)