HOW TO MAKE THE BEST OF WISH'S IFU AT LOW REDSHIFTS?

Hervé Wozniak

Observatoire astronomique de Strasbourg, France

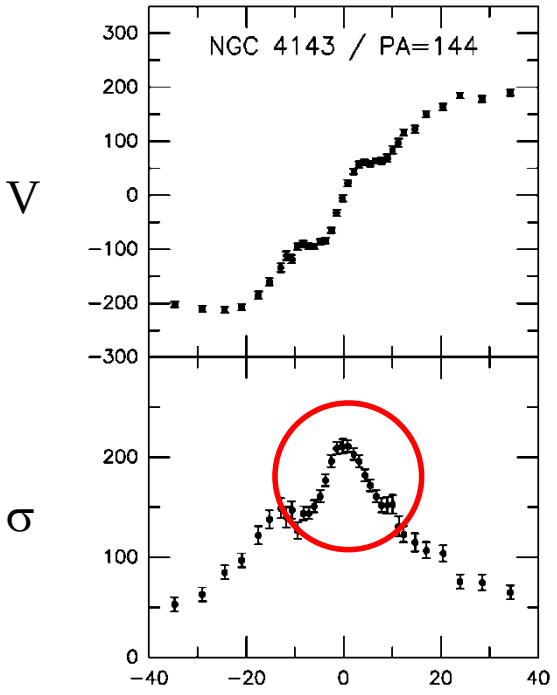
How to make the best of WISH's IFU at low redshifts?

- Nearby galaxies
  - "laboratories" for studying physical processes
    - gas/stellar dynamics − star formation − chemistry relationship
  - tracing both the kinematics and the stellar population of galactic components
  - optical spectroscopy less efficient in dusty regions (centers, shocks, etc.)
    - ^{12}CO absorption features at 2.3 microns very efficient tool for measuring stellar kinematics and the age of populations in dusty environments.

- A few examples of mock IFU observations
  - Even at moderate redshift (1.2)

What does 'normal' stellar kinematics mean in the central regions? (aka central kpc)

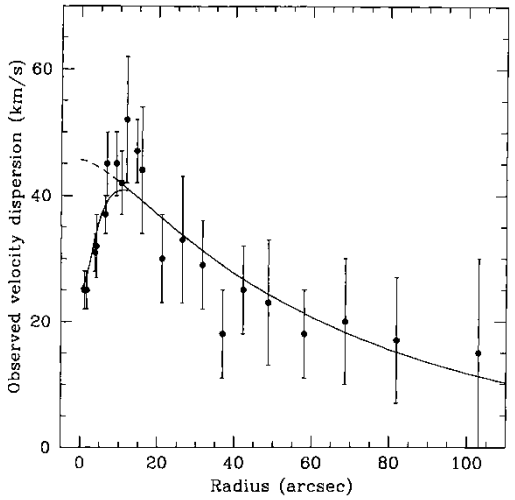
NGC 4143 (SAB)



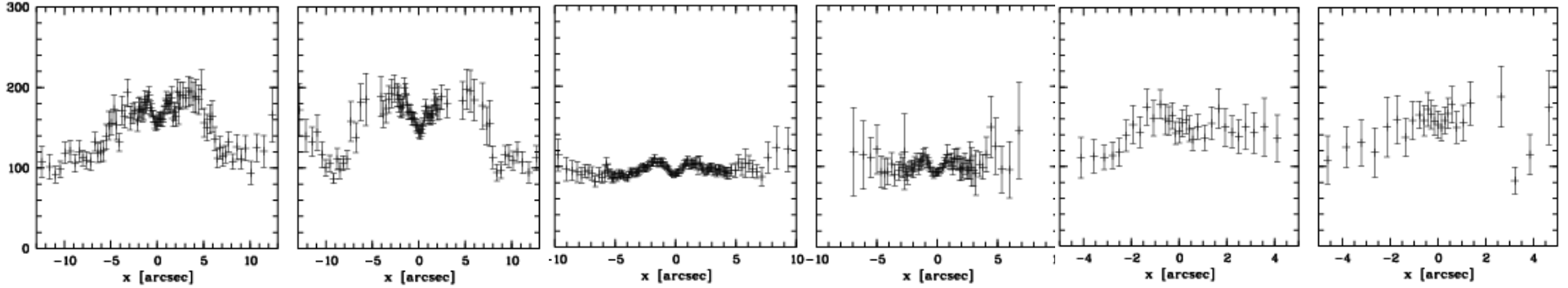
Simien & Prugniel 2002 A&A 384, 371

Unexpected: σ-drop

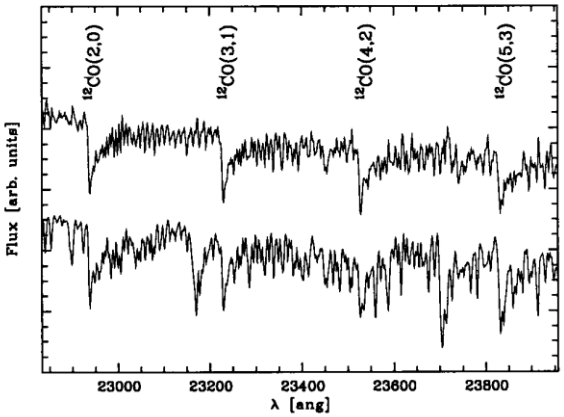
NGC 6503



Bottema 1993 A&A 275, 16
Bottema & Gerritsen 1997 MNRAS 290, 585



VLT/ISAAC CO 2.3μm absorption lines



ISAAC (aperture) spectrum of HD 16492, a K0 giant, before (bottom) and after (top) correction for the **telluric absorption**. The main ^{12}CO lines are identified.

⇒ **observations from space**

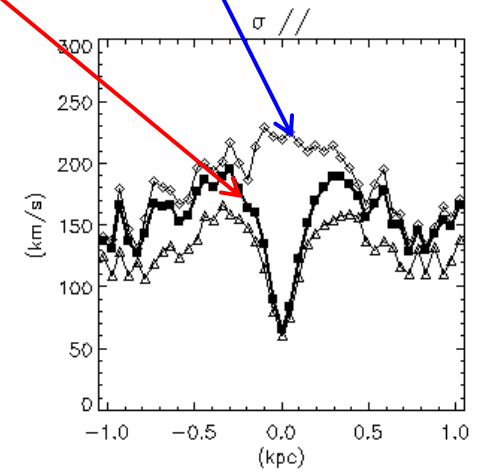
Emsellem et al. 2001 A&A 368, 52

Polar PM + SPH + SF instability criterion (Q < 1.4)
Cartesian PM + sticky particles + SF Schmidt law

Wozniak et al. 2003 A&A 409, 469

Two stellar populations:

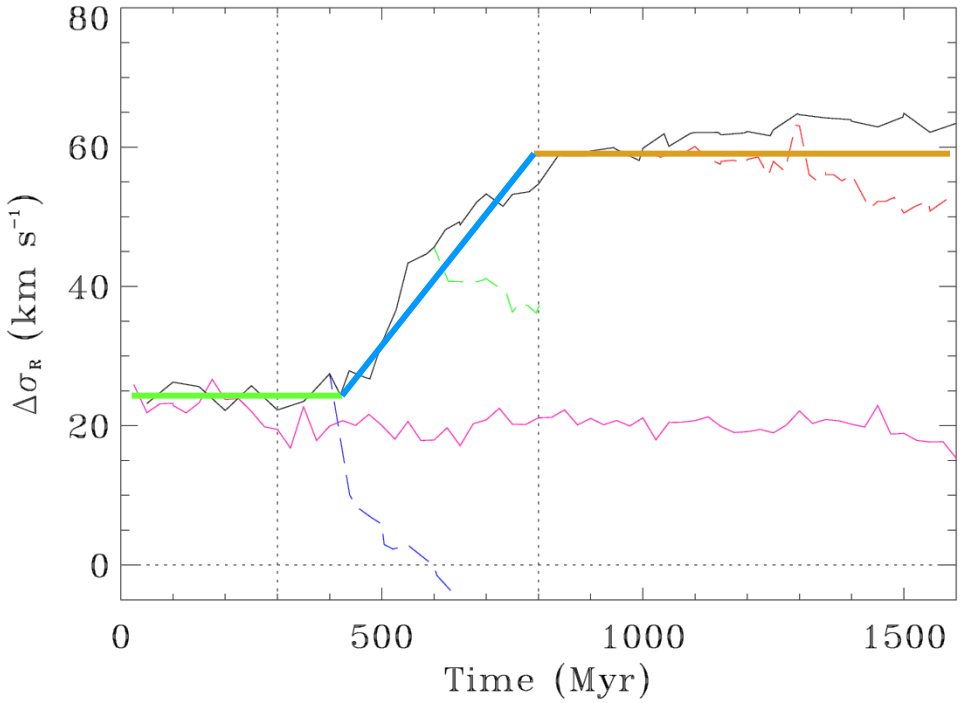
- 'old' population (normally hot)
- 'new' population created during the run (cold): inherits gas kinematical properties



σ-drop evolution

Wozniak & Champavert (2006 MNRAS)

Drop does not disappear as long as local SFR ≠ 0



Depth of a σ–drop:

$\langle\sigma_R\rangle$ (r < 100 pc) = σ_{min}

$\langle\sigma_R\rangle$ (r = 500 ± 50 pc) = $\sigma_{'max'}$

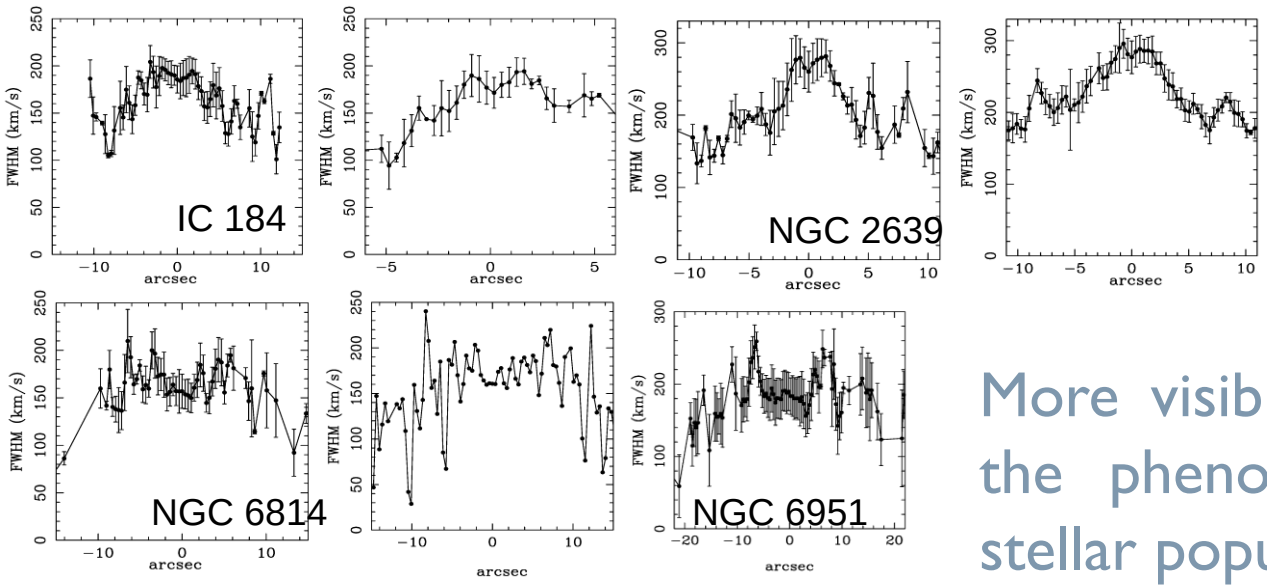
$\Delta\sigma = \sigma_{'max'} - \sigma_{min}$

- 0 < T < 475 Myr: bar formation phase, gas accretion, growing local SFR
- 475 < T < 800: growing phase; new population more massive than initial one in central region
- T > 800: nearly stable phase but slow heating at the same rate in both regions

  Δσ reaches a plateau

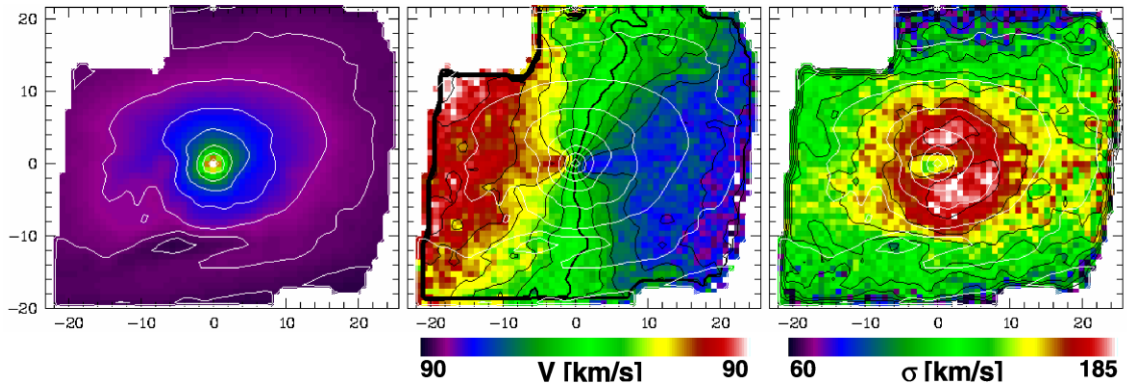
Other absorption lines

Marquez et al. 2003 A&A 409, 459 ; De Zeeuw et al. 2002 MNRAS 329, 513



WHT/ISIS CaIIT 8600Å

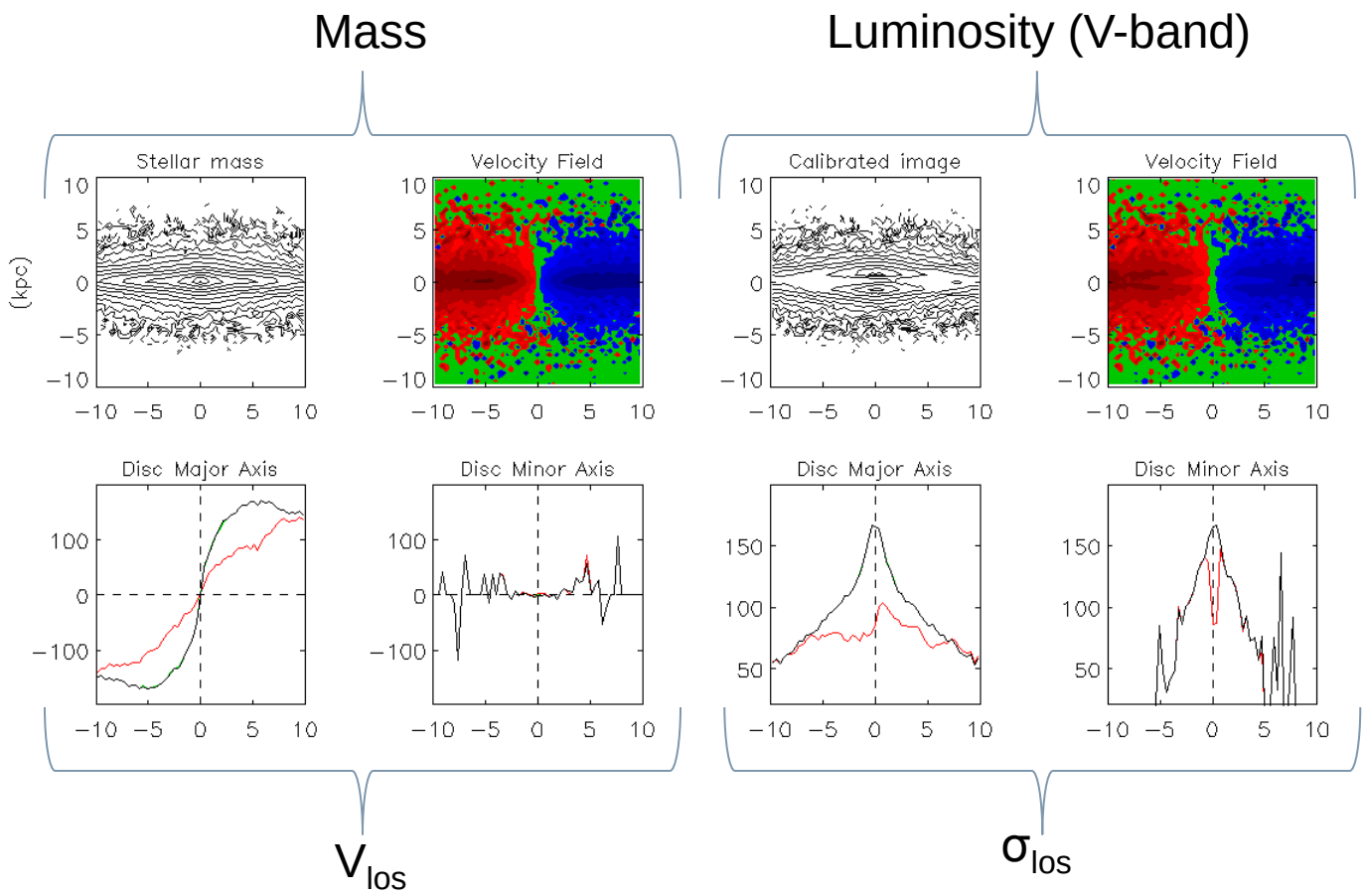
More visible in IR than optical as the phenomenon is sensitive to stellar population age



WHT/SAURON
Mg b 5175 Å lines
(NGC 3623)

Figure 8. SAURON measurements of NGC 3623 in the Leo triplet, based on two pointings overlapping by ≈ 15 arcsec, and exposed for 4 × 1800 s each. The field-of-view is 40 × 50 arcsec and the spatial sampling is 0.8 × 0.8 arcsec. From left to right: (a) reconstructed total intensity *I*, (b) stellar mean velocity *V*, and (c) velocity dispersion σ. Contours of the reconstructed total intensity are superimposed (steps of 0.25 mag arcsec^{-2}). They are significantly affected by a dust lane below the nucleus.

Dust absorption effects on kinematics

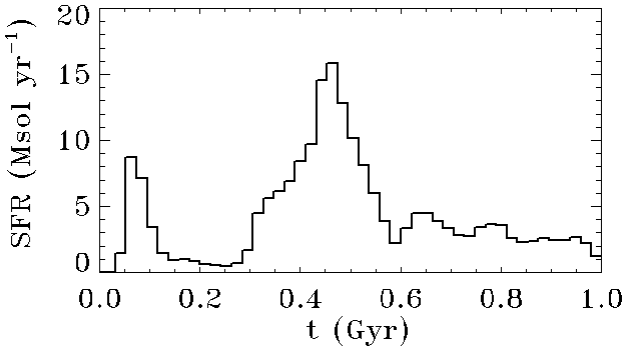


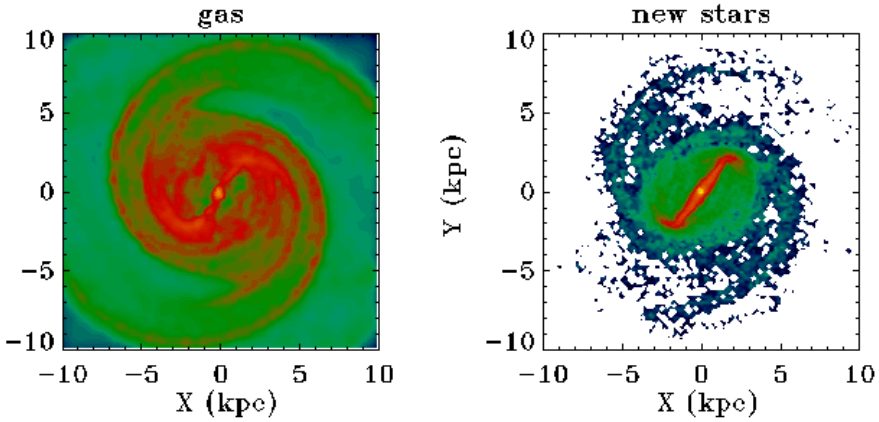
Wozniak & Michel-Dansac 2003 Ap&SS 284, 707

(simple) Chemodynamical simulations→WISH mock cube

(Michel-Dansac & W 2004, 2006 ; W & Michel-Dansac 2009)

- Stellar dynamical evolution = N-body = PM scheme
- ISM Hydrodynamics = SPH





- star formation (instantaneous):
  - λ=1.4 (Kennicutt 1990)

$$Q_i^g = \frac{s_i \kappa_i}{\pi G \Sigma_i^g} \leq \lambda$$

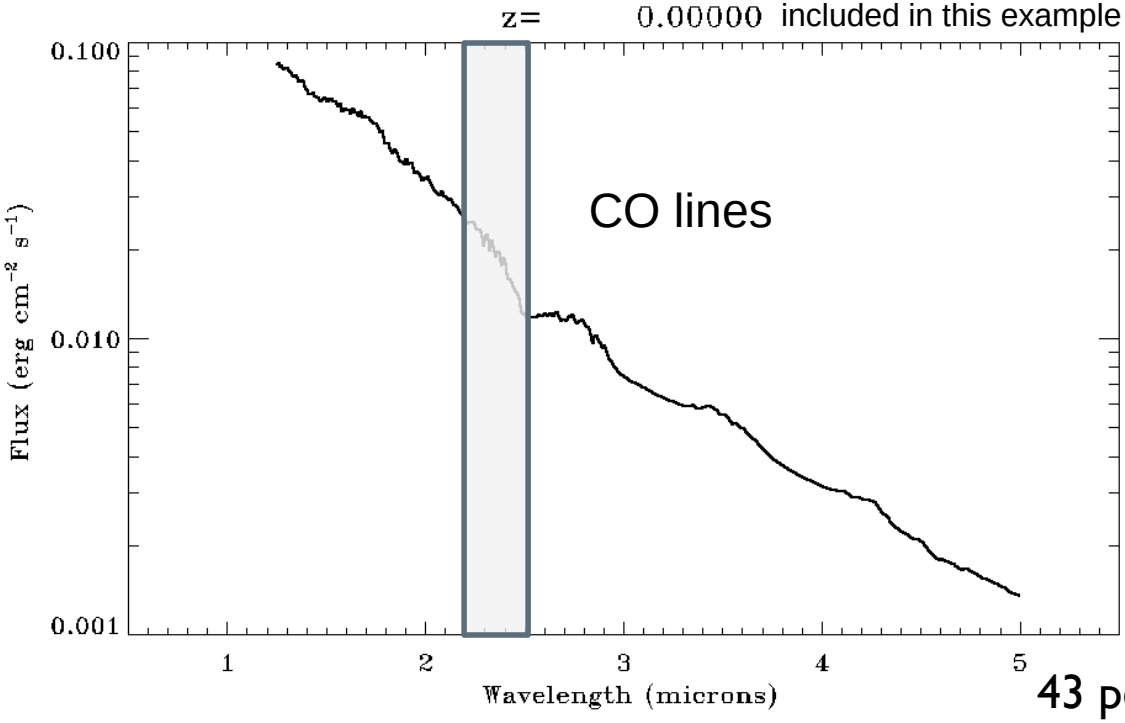
  - SFE = 0.1
  - creation of new stellar particles (stellar remnants)
- SNII feedback (instantaneous recycling)
- Population yields → metallicities (Z and O)
- Cooling for solar abundances
- **New population: age, Z, position at birth**

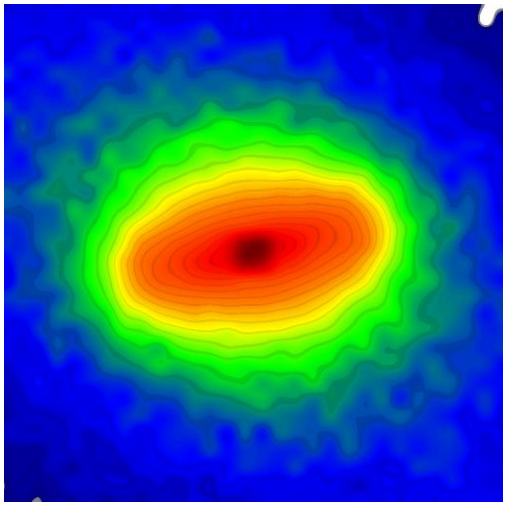
- **Calibration:**
  - **Bruzual & Charlot SSP**
  - **Mappings III for typical HII regions**
- **No AGN**

- **WISHspectro parameters (D. Burgarella)**

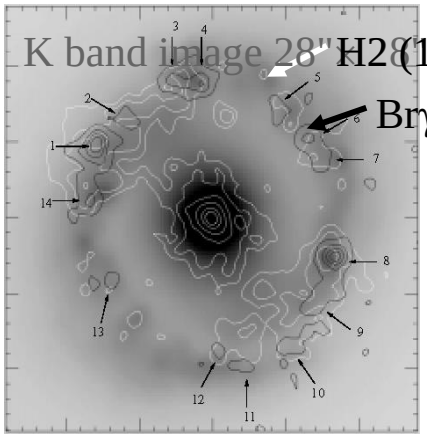
WISH cube @ z=0

No emission lines (HII or AGN) included in this example





43 pc/pxl (dist. of NGC 1097)



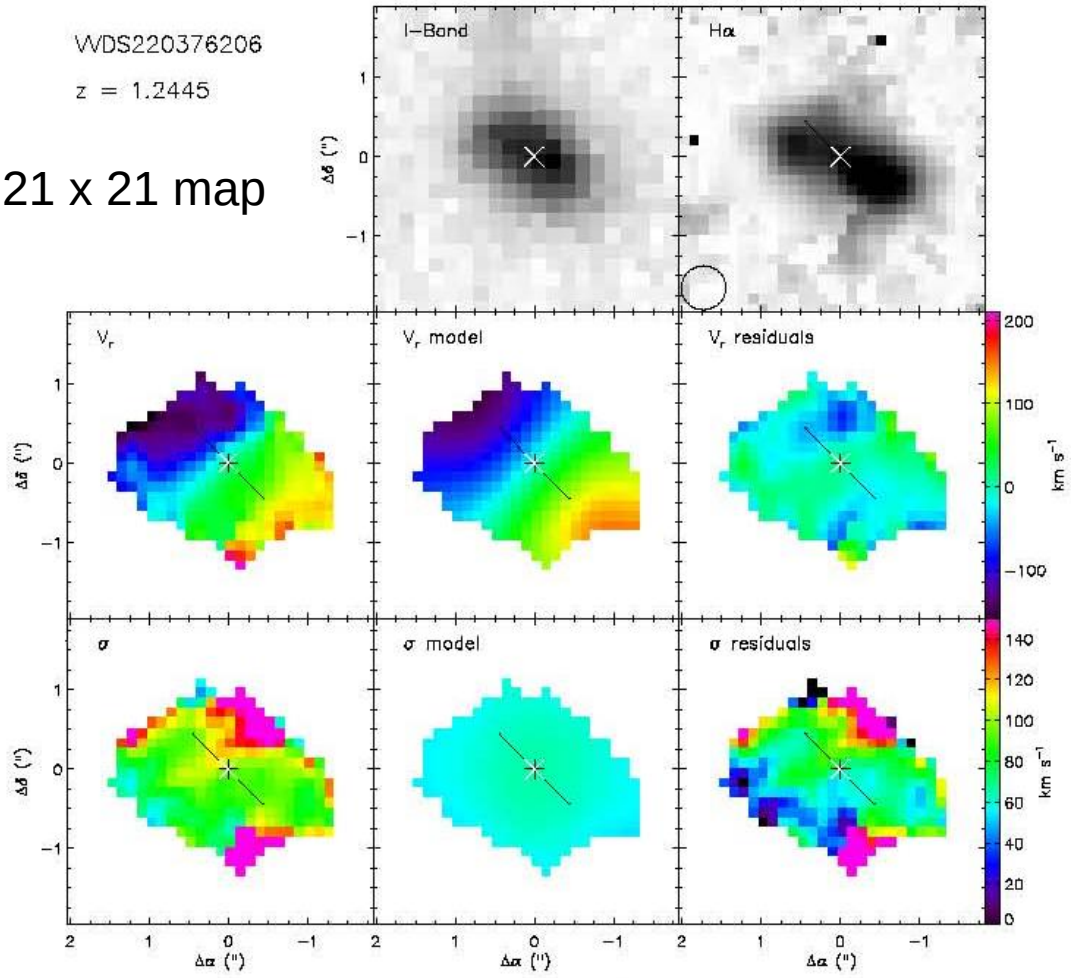
NGC 1097

1/10th of the full FOV (2.5 arcmin) ⇒ 30x30 pixels ~ 1.29 × 1.29 kpc

Only the central region in this example

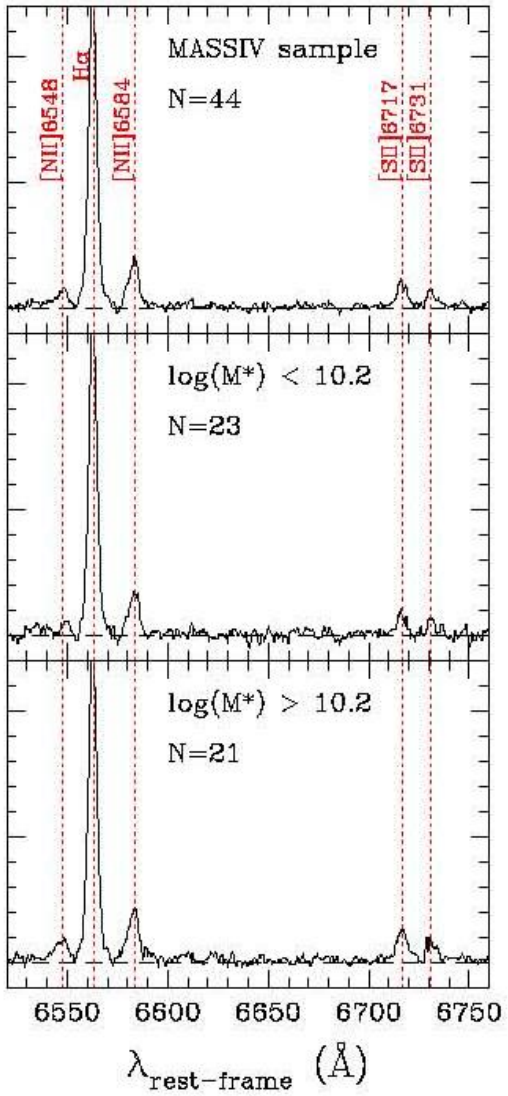
WISH cameras → disc ⇒ photometric calibration

VLT/SINFONI survey @ z = 1.25



21 x 21 map

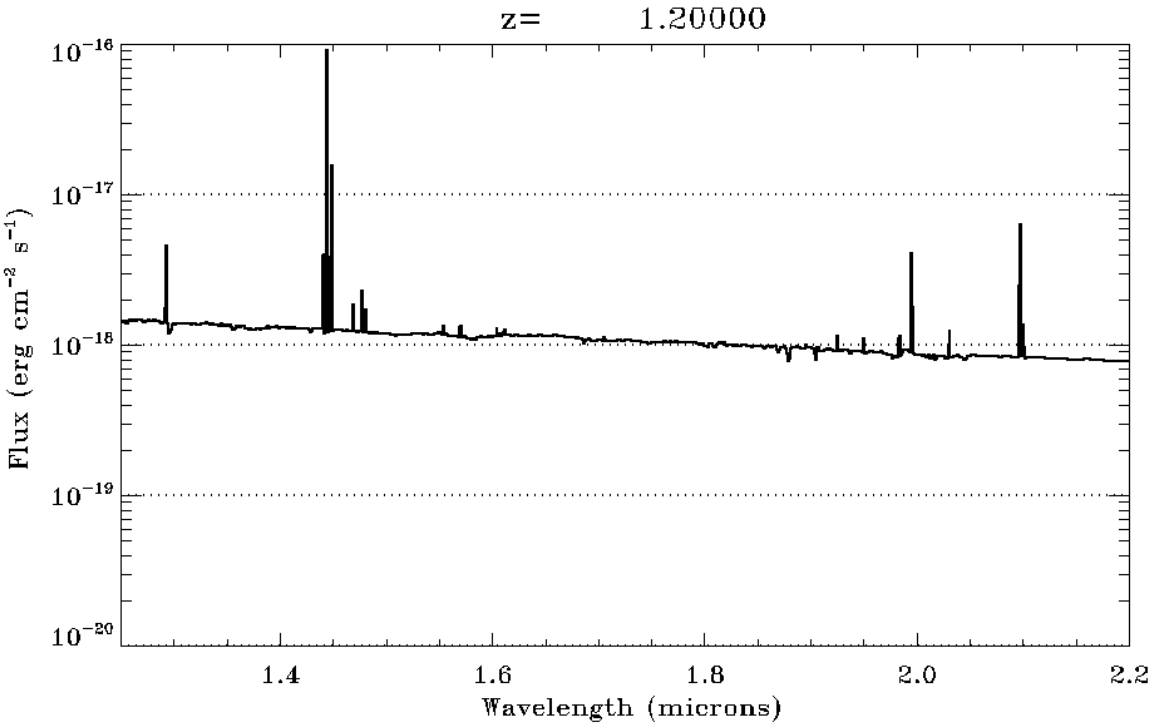
Epinat et al. 2012, A&A 539, A92
(MASSIV II.)

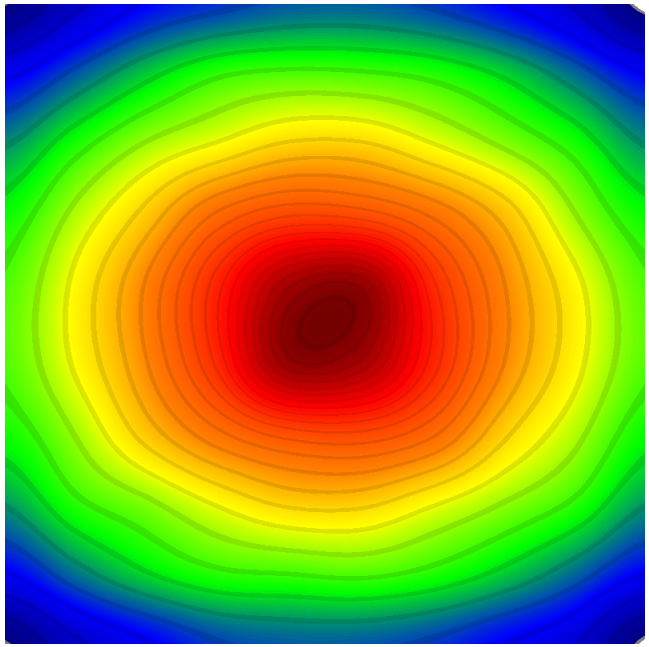


Composite spectra in rest-frame

Contini et al. 2012, A&A 539, A91
(MASSIV I.)

WISH cube @ z =1.20 10x10





Focus on SW range

HII regions included
No AGN

10x10 pixels ~ 41.3 × 41.3 kpc

4.13 kpc/pxl

The full disc

Conclusions and open questions

- Strong interest in WISH imagery capabilities BUT also in any spectroscopic extension (integral field)
- The low-z science case includes:
  - z ~ 0 objects for stellar kinematics and stellar populations in the NIR
  - Intermediate z for studying 'normal' galaxies (Milky-Way like)

- Denis's question on λ-range:
  - Must include 2.3 – 3.3 μm features (but certainly should start @ ~2 μm)

- Pointed observations?
  - Difficult in parallel mode of deep surveys