Studying nearby Galaxies with WISH

A. Boselli, LAM, France

Why Nearby Galaxies?

They are the ending point of galaxy evolution

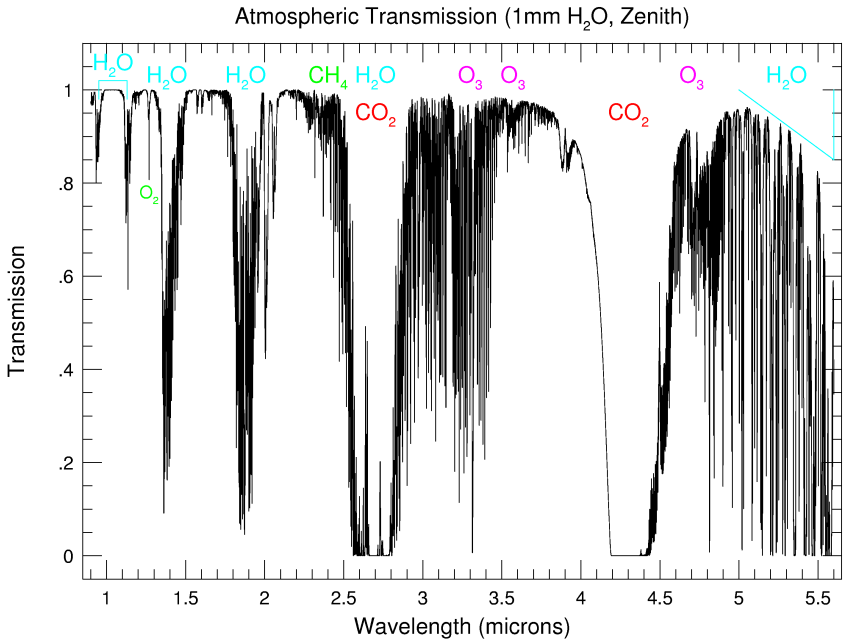
- To study the process of star formation
- To study the matter cycle in galaxies
  (gas -> star -> metals -> dust -> gas)
- To sample the full parameter space in stellar mass (from giant to dwarfs)
- To sample different environments (field vs. cluster)
- To resolve the different galaxy components (nucleus, disc, bulge, spiral arms…)
- Accessible at different λ

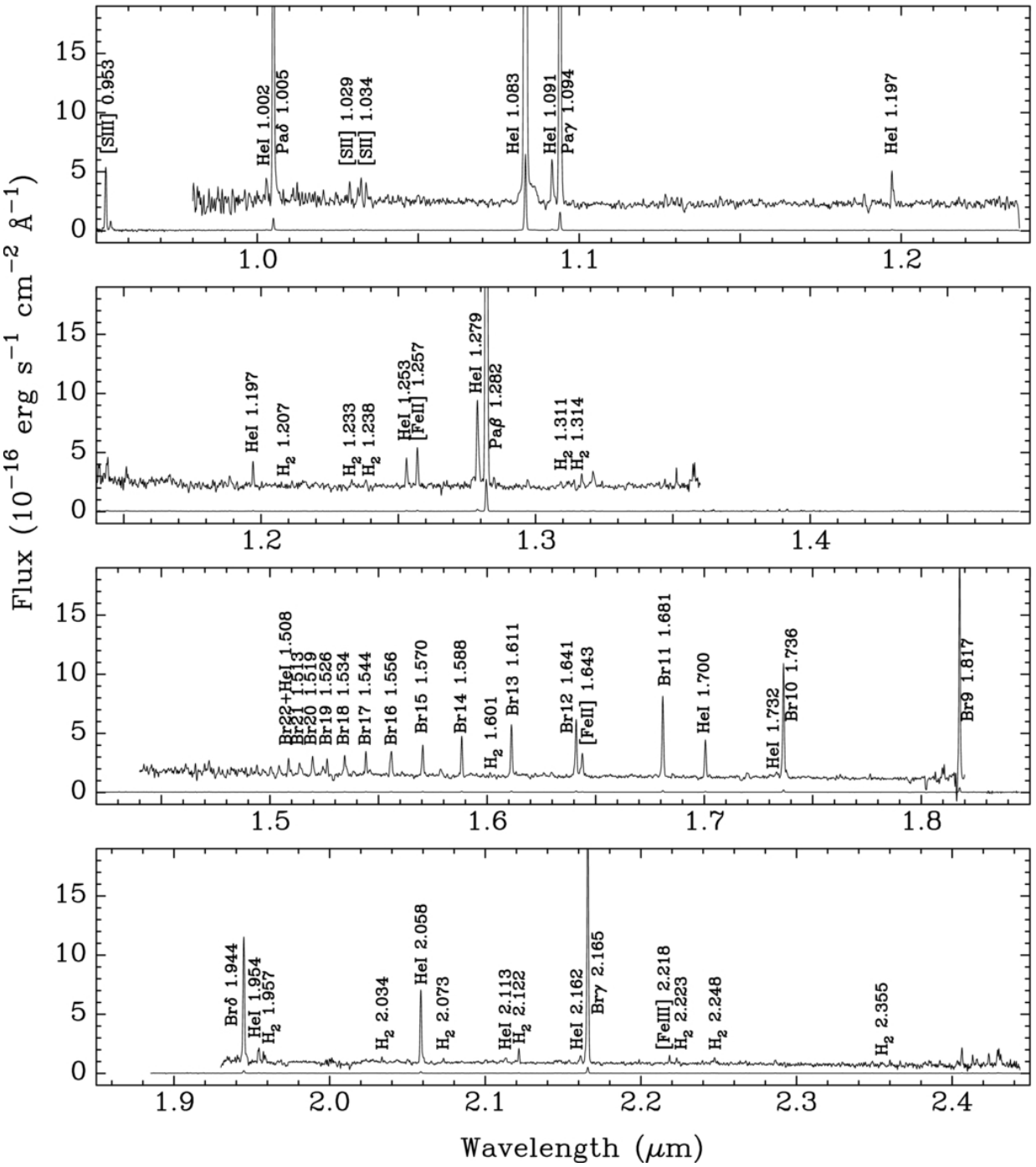
Why WISH?

- The NIR is not easily accessible from the ground
- It covers an interesting spectral domain (emission and absorption lines + continuum)
- It still lacks of a full

spectral 2D-coverage

in normal galaxies

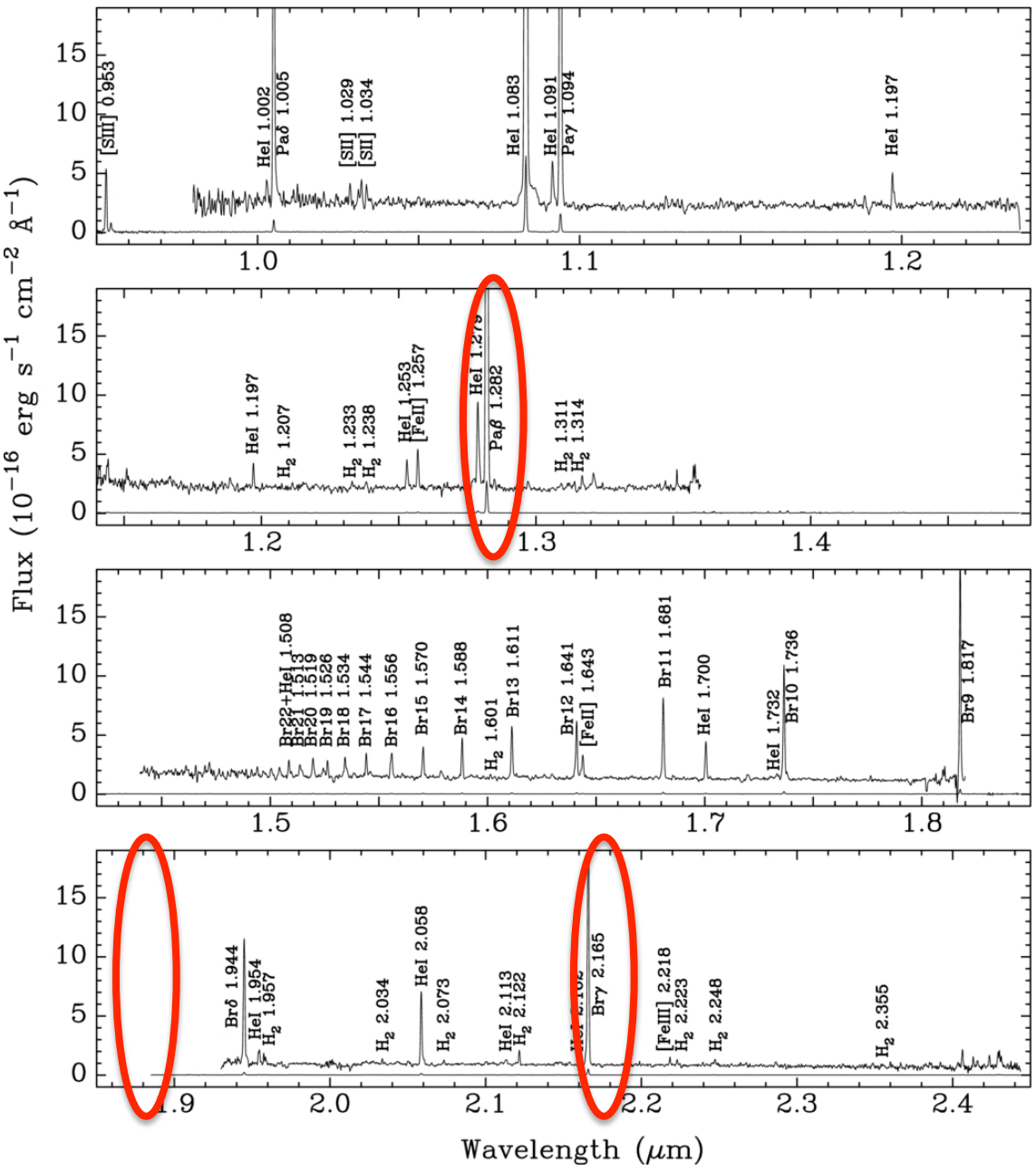




BCD galaxy IIZw40

20 min exposure with a 3.5m telescope

Izotov & Thuan 2011

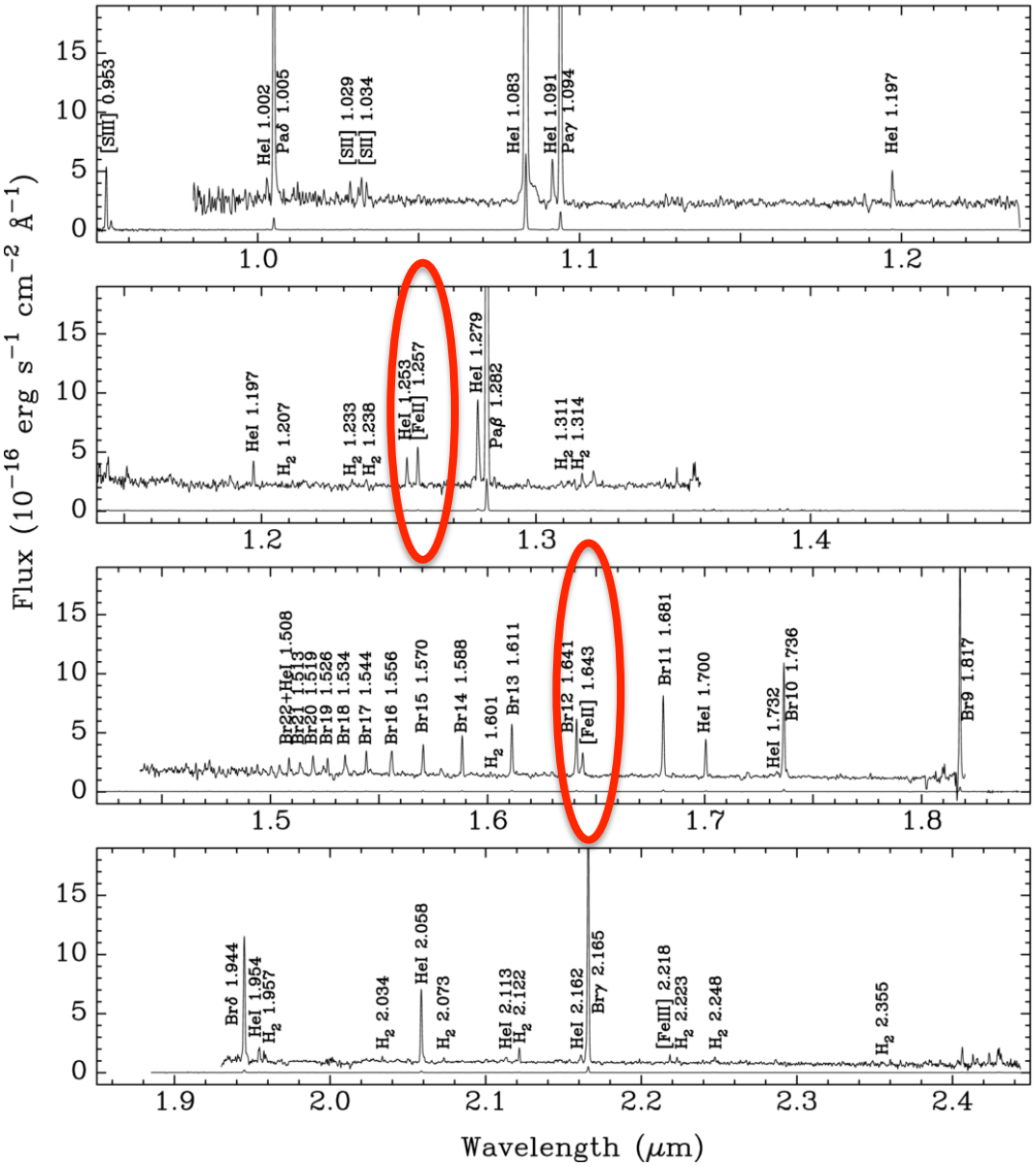


Hydrogen recombination lines

Paβ: 1.2818 µm
Paα: 1.8750 µm (~0.1 Hα)
Brγ: 2.1655 µm
Brβ: 2.6252 µm
Brα: 4.0512 µm
Pfβ: 4.6525 µm

Important for measuring dust attenuation and star formation in highly attenuated regions

Izotov & Thuan 2011

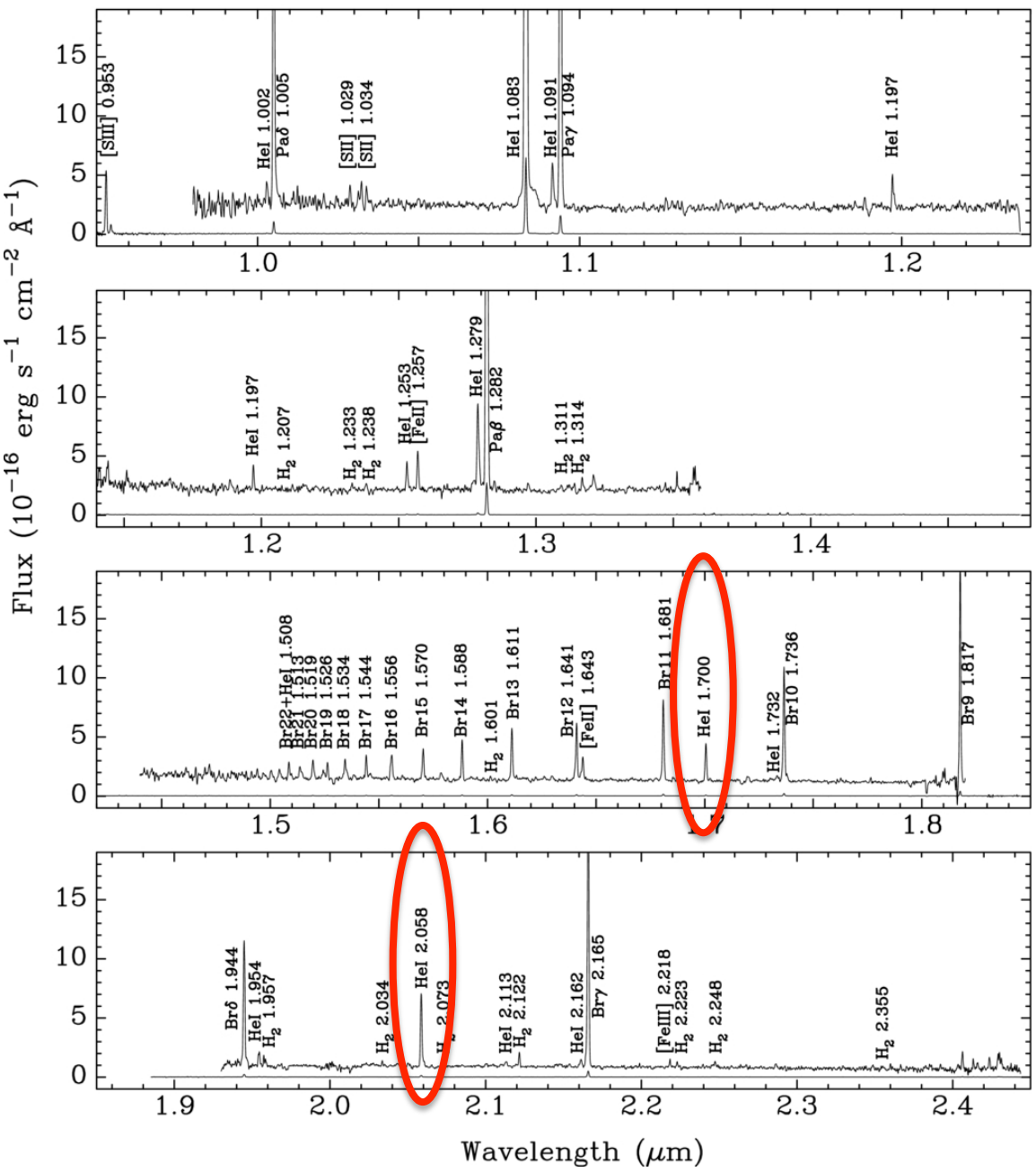


Fe emission lines

[FeII]: 1.257 μm
[FeII]: 1.643 μm

Typical of iron enriched shocked material such as SN remnants in star forming galaxies or X-ray heating in the nucleus of Seyferts (similar to [OI]6300A (Edge et al. 2002)

Izotov & Thuan 2011

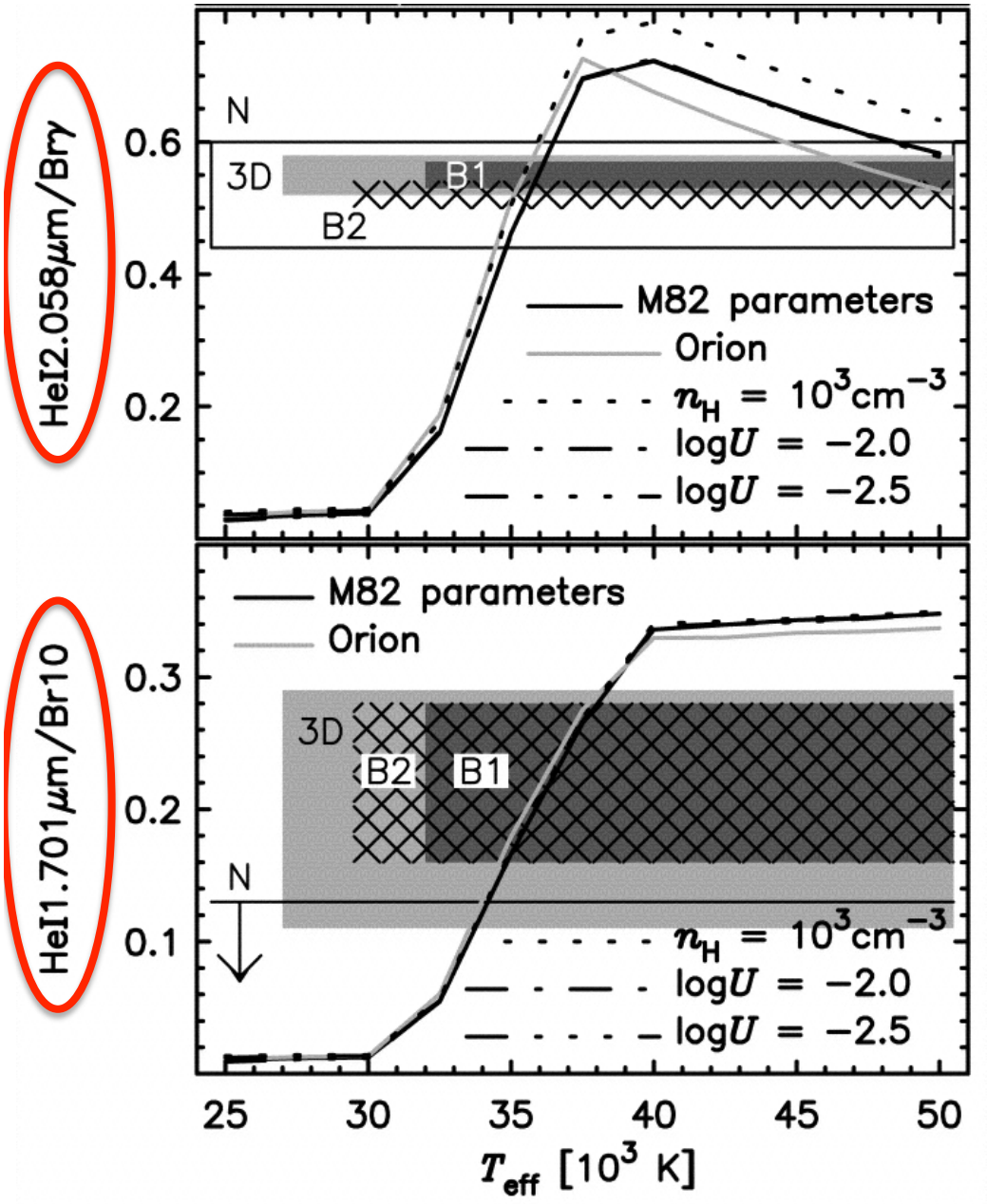


He emission lines

[HeI]: 1.701 µm
[HeI]: 2.058 µm
[HeII]: 2.189 µm

Combined with hydrogen lines to constrain photoionisation models (Teff, presence of WR stars..)

Izotov & Thuan 2011

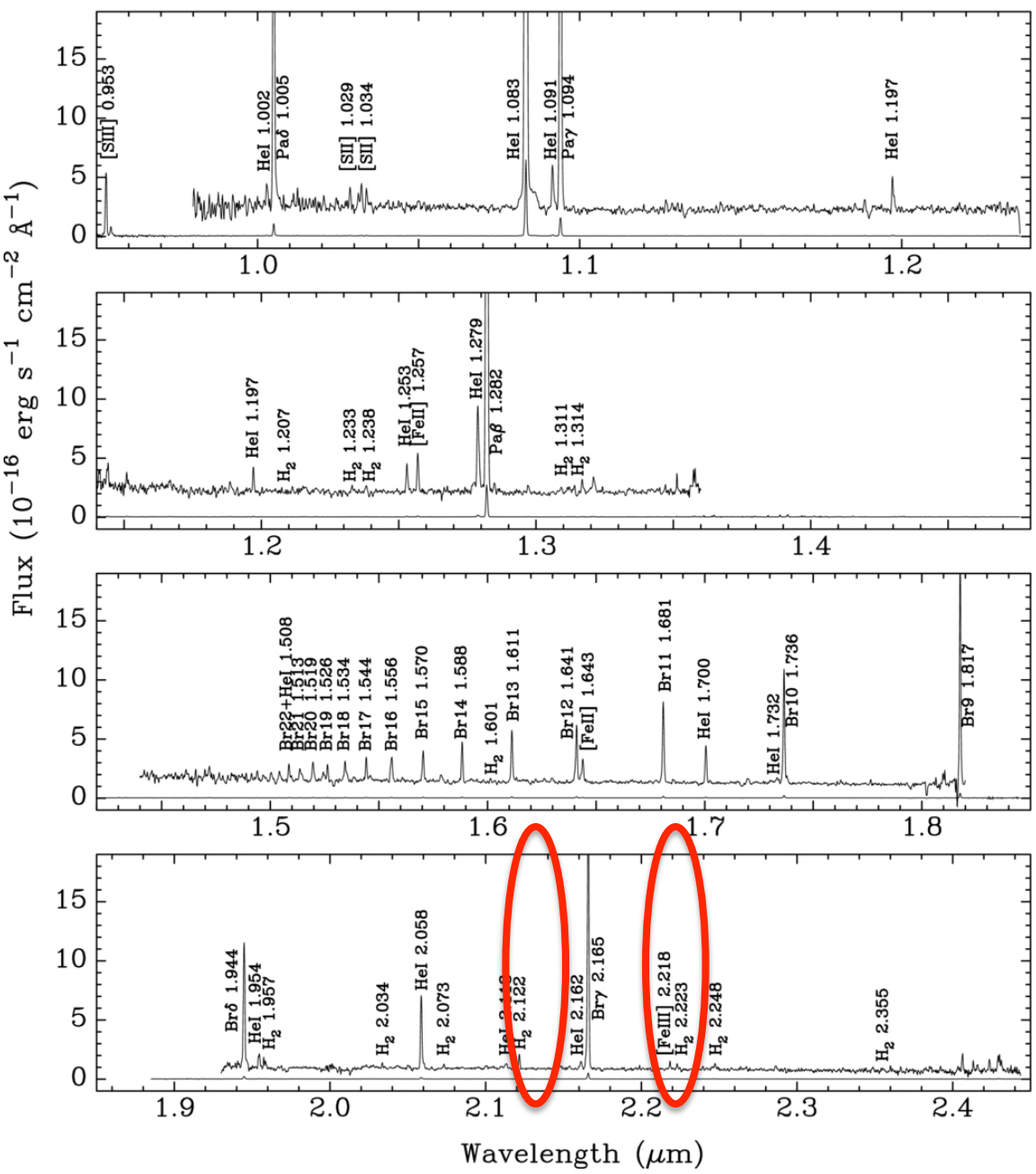


He emission lines

[HeI]: 1.701 µm
[HeI]: 2.058 µm
[HeII]: 2.189 µm

Combined with hydrogen lines to constrain photoionisation models (Teff, presence of WR stars..)

Forster-Schreiber et al. 2001



H_2 roto-vibrational emission lines

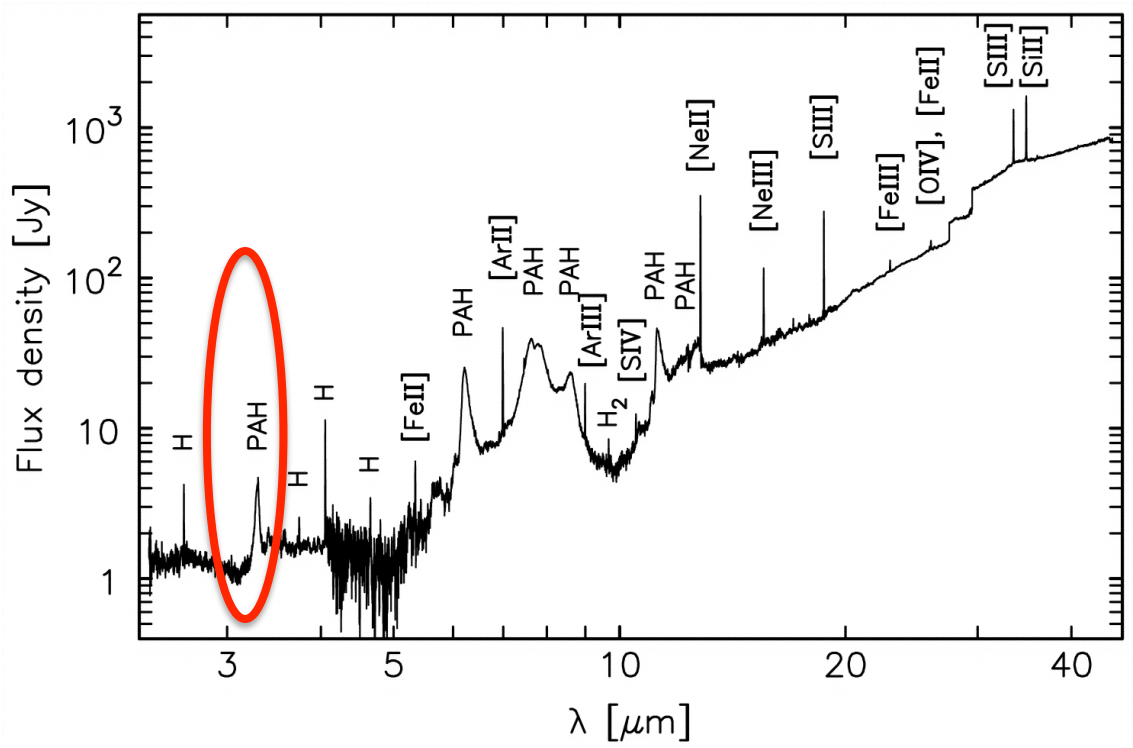
H_2: 1.9576 μm
H_2: 2.122 μm
H_2: 2.224 μm

Presence of hot (~2000 K) molecular gas in star forming regions; excited by UV fluorescence or collisions in the hot gas of shocks (Omont 2007)

Izotov & Thuan 2011

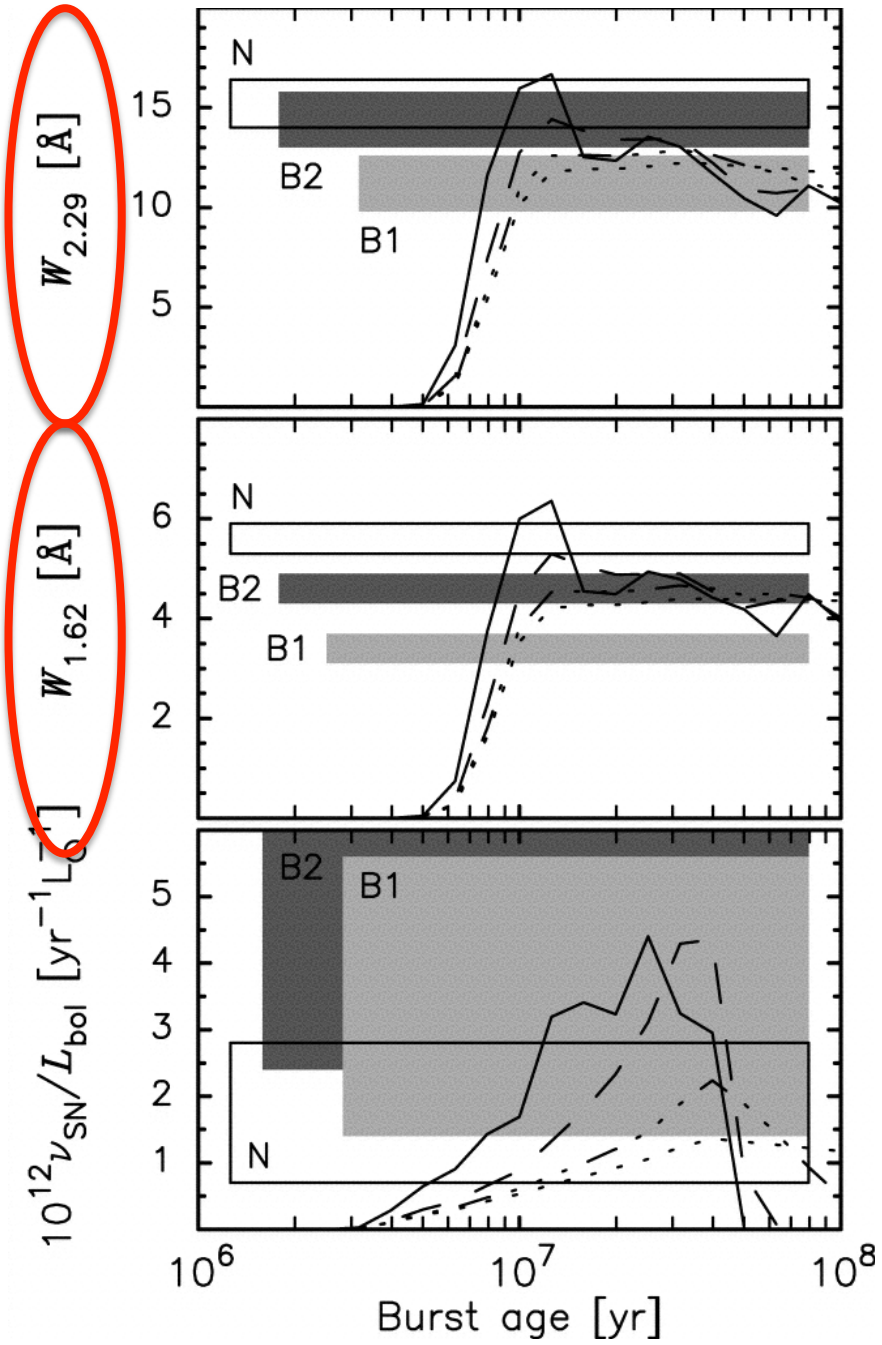
PAH emission lines

PAH: 3.3 μm



Indirect tracer of star formation

Forster-Schreiber et al. 2001

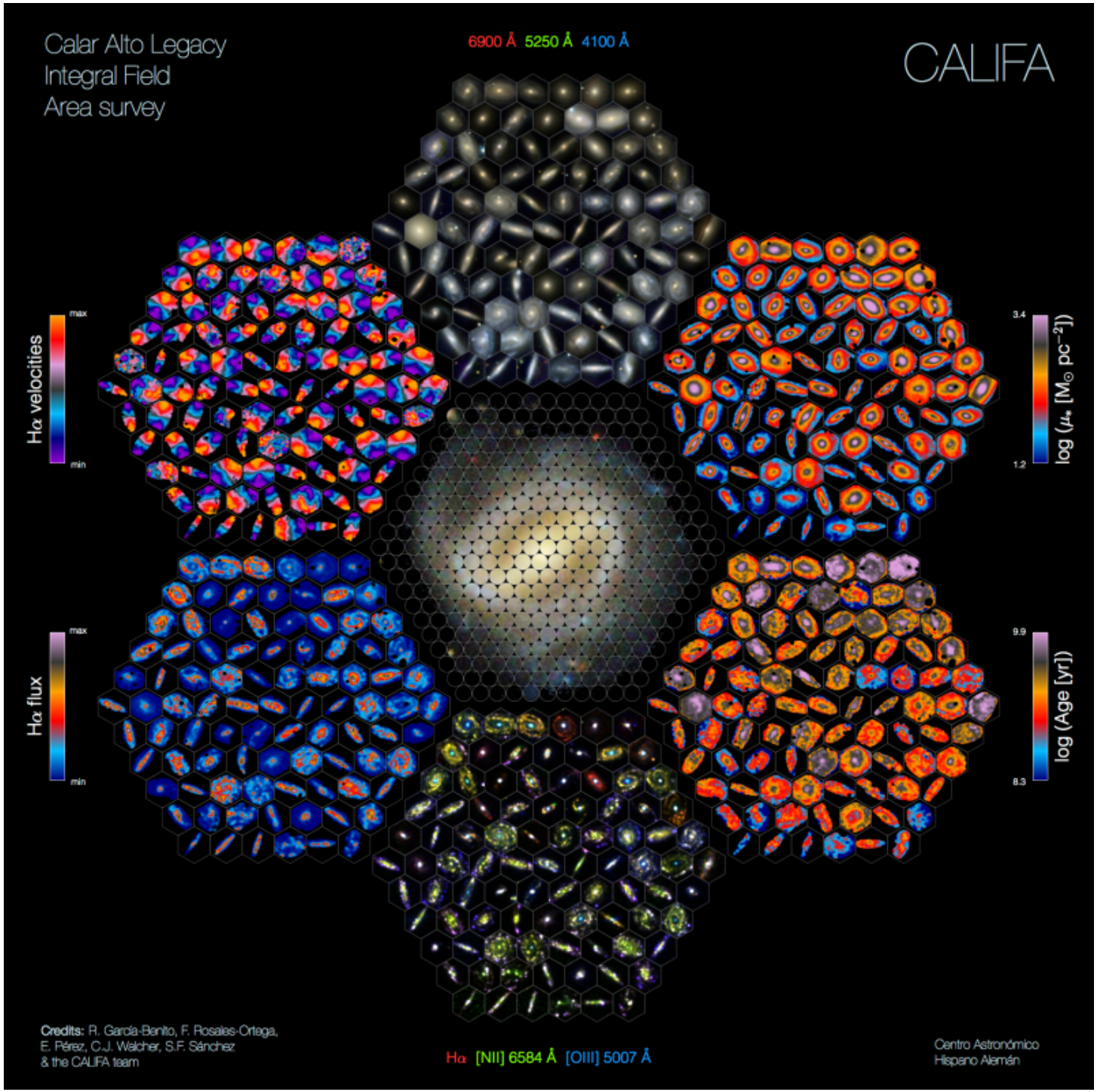


CO absorption lines

CO: 1.620 µm
CO: 2.290 µm
Mg I: 1.575 µm
Si I: 1.588 µm
Mg I: 1.711 µm
Na I: 2.207 µm
Ca I: 2.263 µm

Important constraints for the underlying stellar population

Forster-Schreiber et al. 2003

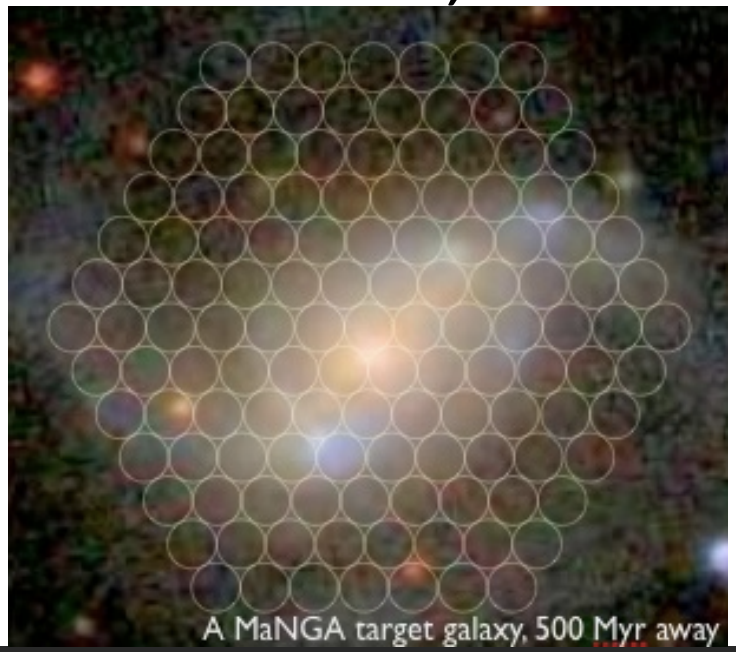


PPAK at the 3.5m Calar Alto telescope

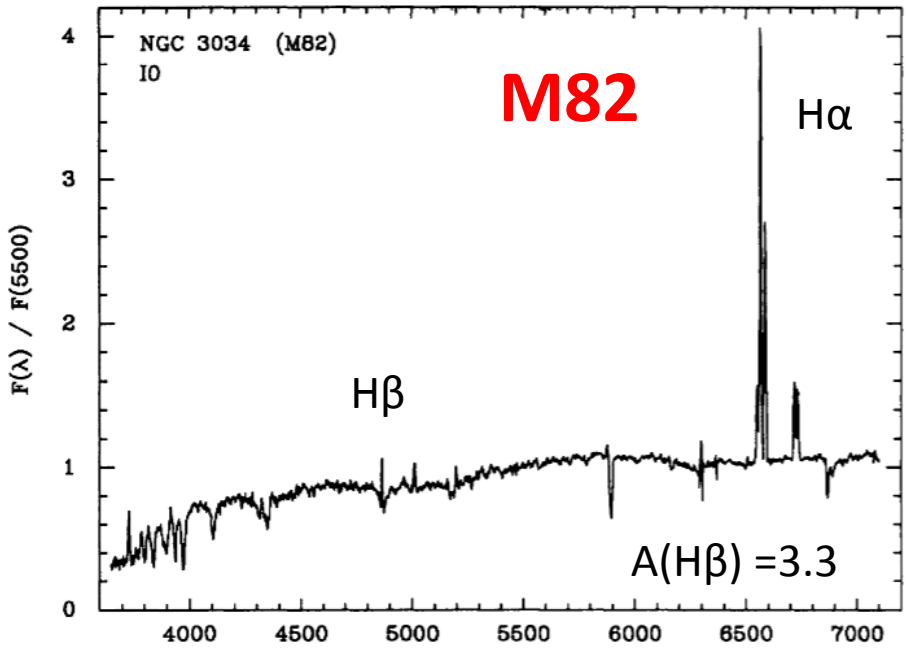
Sanchez et al 2012

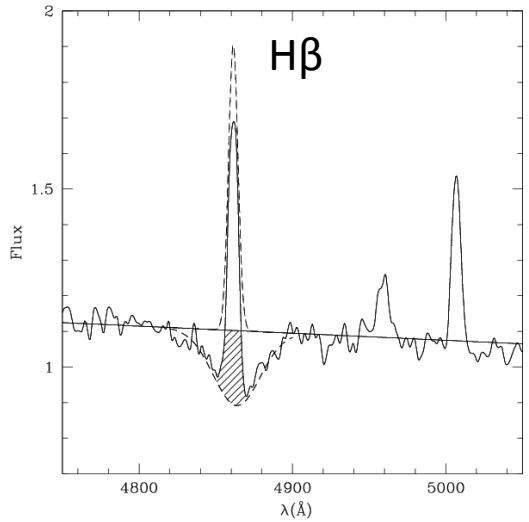
MANGA - SDSSIII

Mapping ~ 10000 nearby galaxies with 17 IFUs per 7deg^2, λ3600-10000A, R~2000



Limits of optical surveys





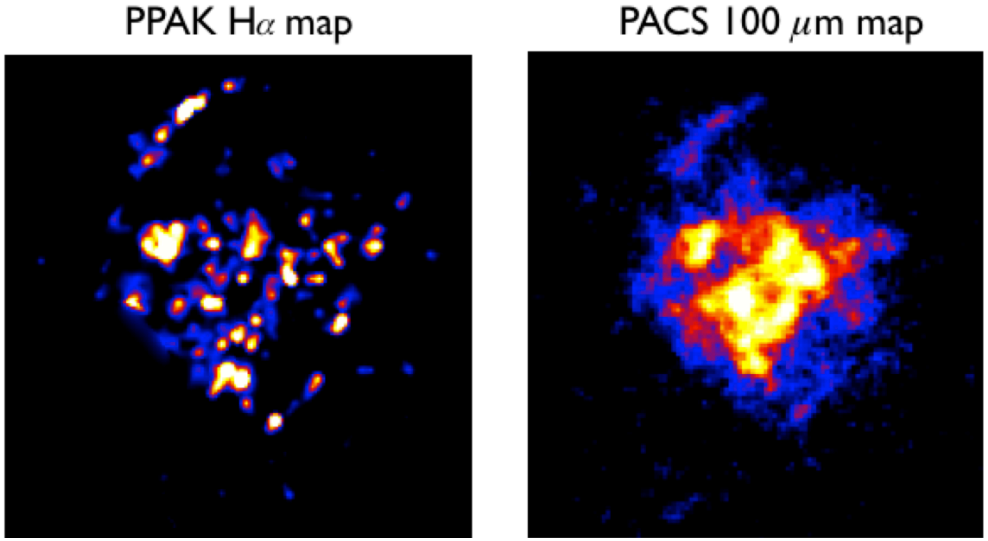
Gas attenuation using the Balmer decrement:

Is Hβ always measurable?

K(Hβ) λ4861A= 3.588

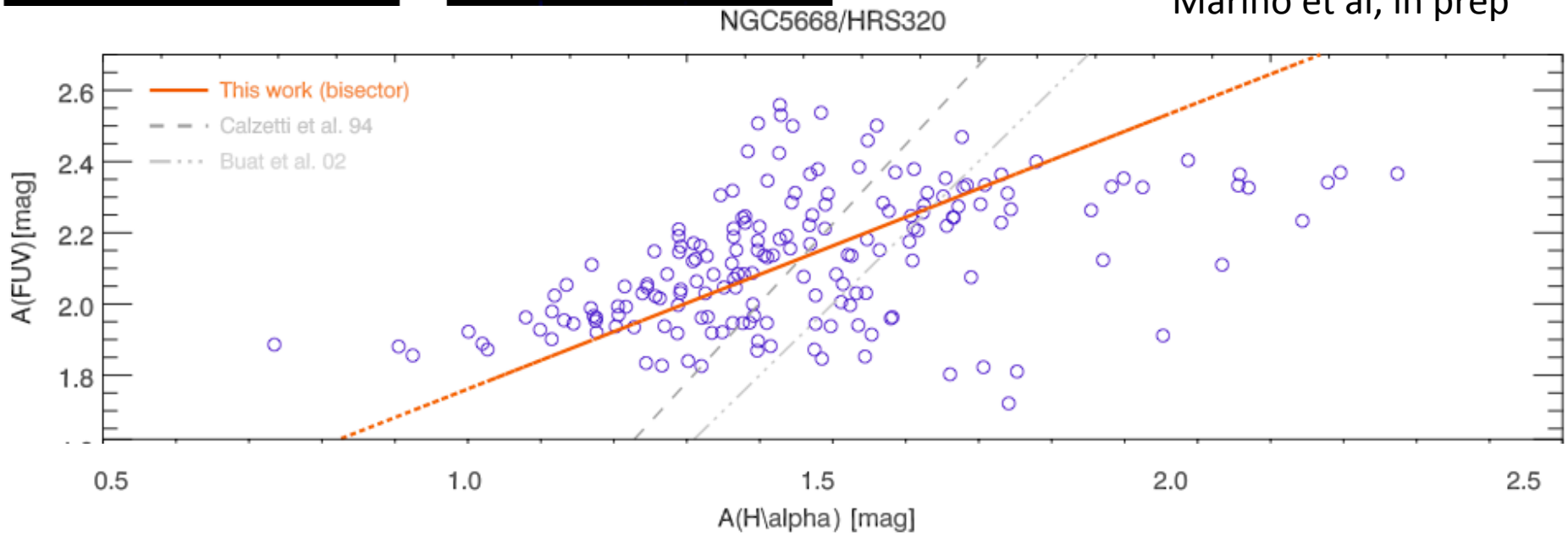
K(Paα) λ18750A = 0.451

Limits of optical surveys



Possible biases do to the detection limit of Hβ

Marino et al, in prep



A WISH spectroscopic survey of nearby galaxies

- Dust attenuation un a sub kpc scale even in highly attenuated galaxies (starbursts)
- New tracers of star formation (less sensitive to dust)
- Signatures of different stellar populations
- Constraints to photoionisation/shock models for the gas component
- PAHs
- Kinematics?

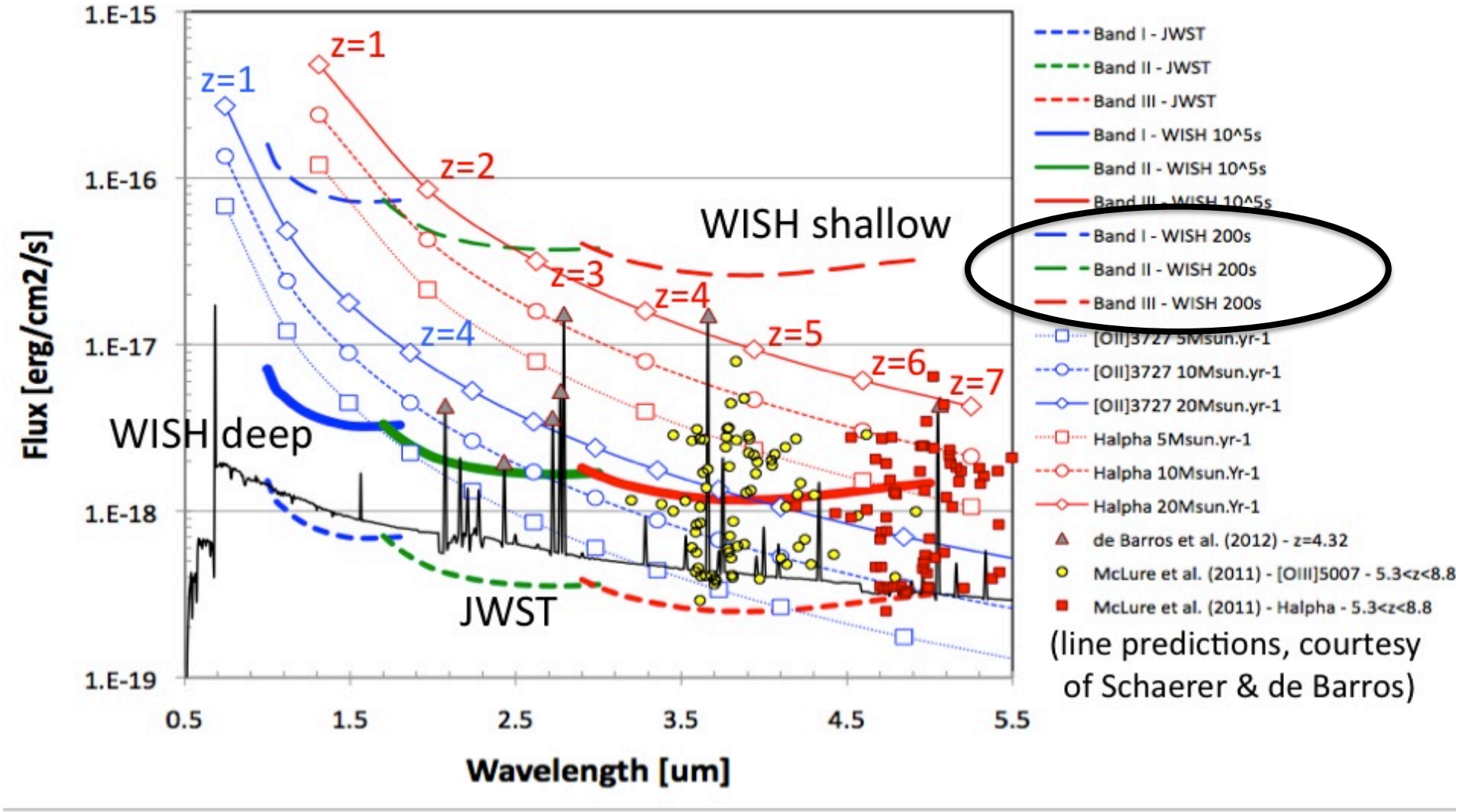
A WISH spectroscopic survey of nearby galaxies

Example: the Herschel Reference Survey (HRS; Boselli et al 2010)

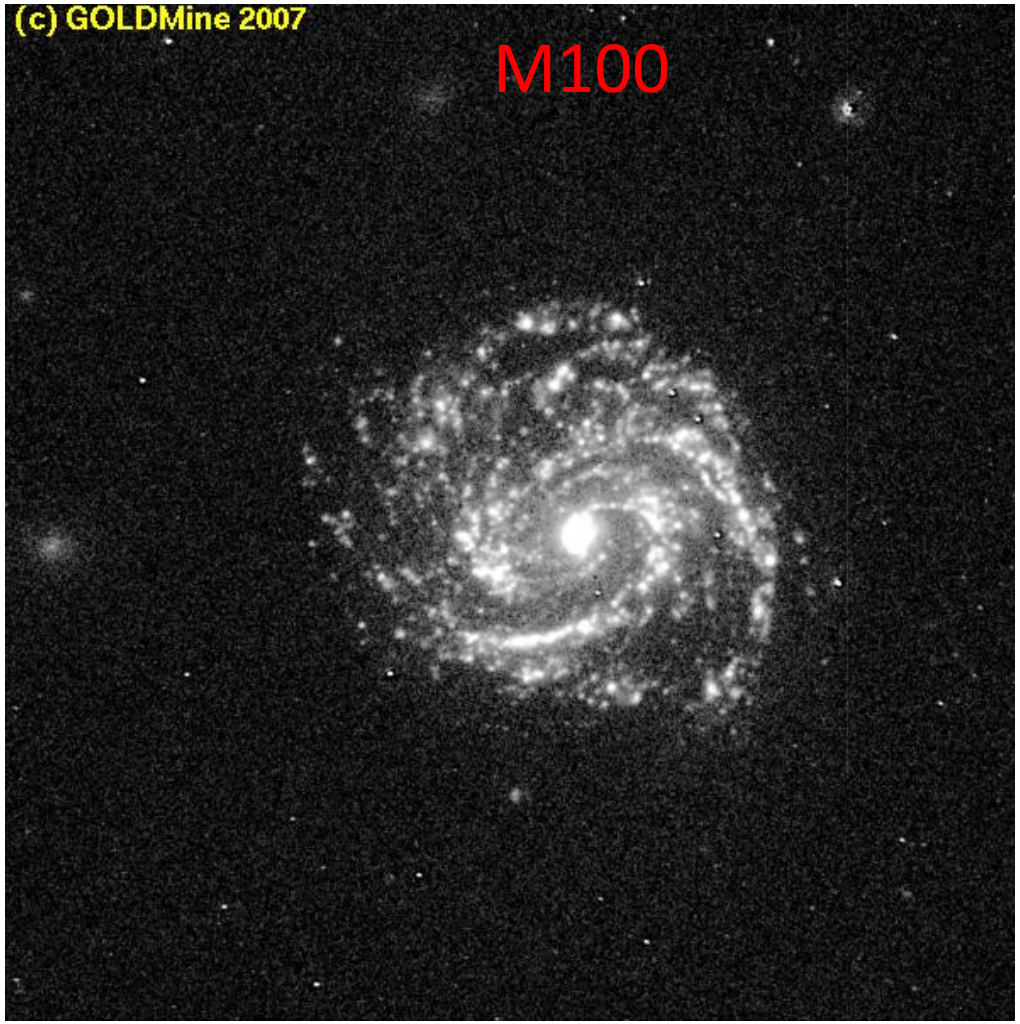
323 local (15<Dist<25 Mpc) of K-band selected galaxies of all morphological type (E-S0-spirals-Irr) and stellar mass ($M^* = 10^9$-10^{11}Mo) with multifrequency data (http://hedam.lam.fr)

Angular sizes 1<diam<6 arcmin

A WISH spectroscopic survey of nearby galaxies



A WISH spectroscopic survey of nearby galaxies



Sensitivity at Hα+[NII]
~ 6 10^{-17} erg cm^{-2} sec^{-1} $arcsec^{-2}$

FOV of ~ 1 $arcmin^2$
3x3 fields are required to cover a typical HRS galaxy

~ WISH sensitivity in 200 sec integration

↓

~ 160 hours to cover the whole sample

+ NIR imaging for free

A spectroscopic survey of a statistically representative sample of nearby galaxies is thus an excellent project for WISH

- Largest possible field of view (1x1 arcmin)
- Largest possible range in the spectral domain (1-5 microns)
- High resolution mode (R~ 1000)