

# The puzzling nature of RHRS1



Laure Ciesla,

M. Béthermin, M. Boquien, E. Daddi, T. Diaz-Santos,  
D. Elbaz, J. Richard, M. Sargent, et al.

*Herschel*/SPIRE RGB: 250, 350, 500 microns

RHRS1

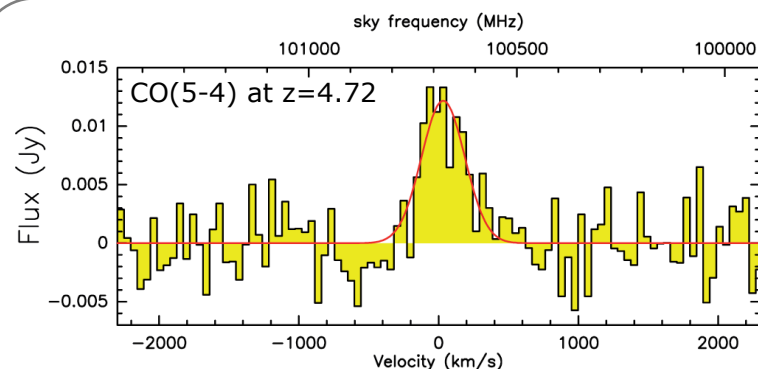
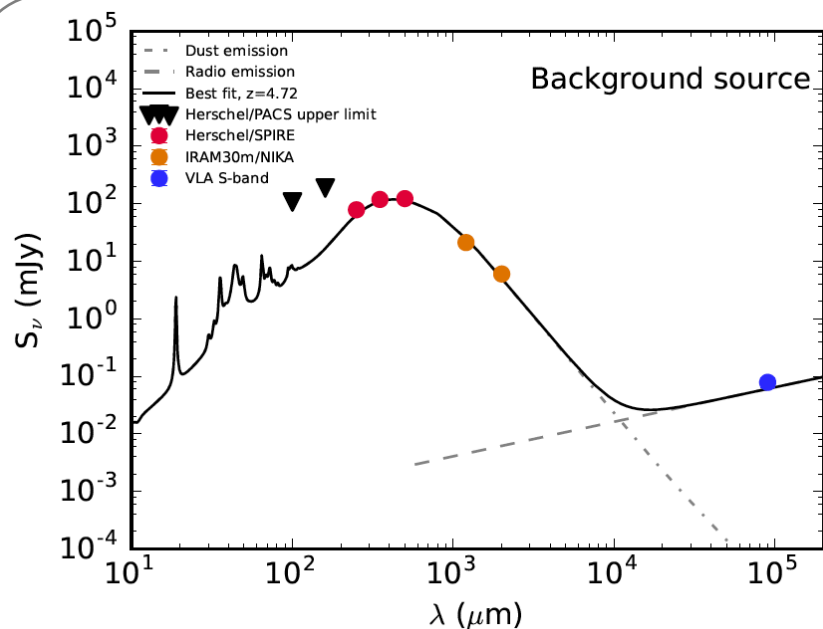
HRS local galaxy in Virgo

*Herschel* Reference Survey,  $\sim 300^{\circ 2}$

# Evidences for a strong lensing case

## The extreme $L_{\text{IR}}$

IRAM/NIKA PI: M. Béthermin  
IRAM/EMIR DDT, PI: L. Ciesla  
GBT PI: L. Ciesla



$$L_{\text{IR}} \sim 9 \times 10^{13} L_{\text{sol}}$$

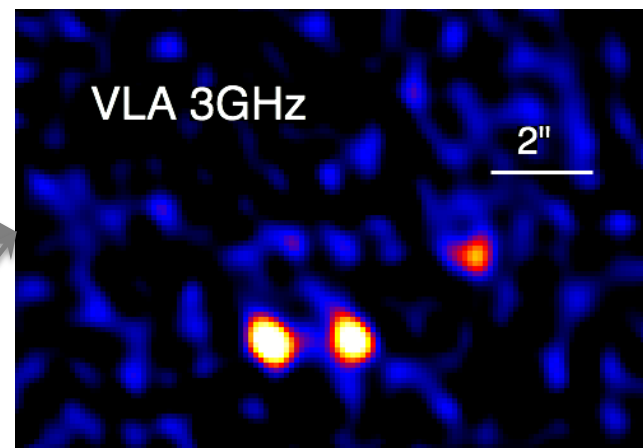
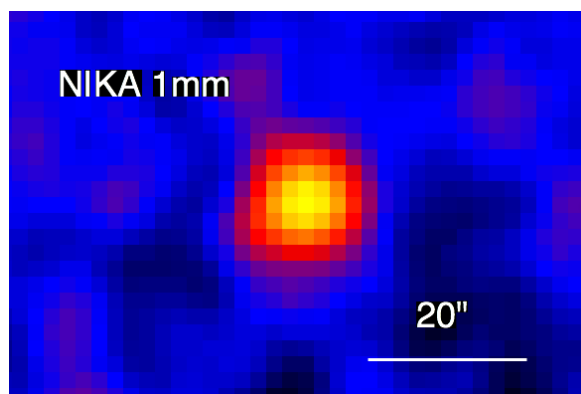
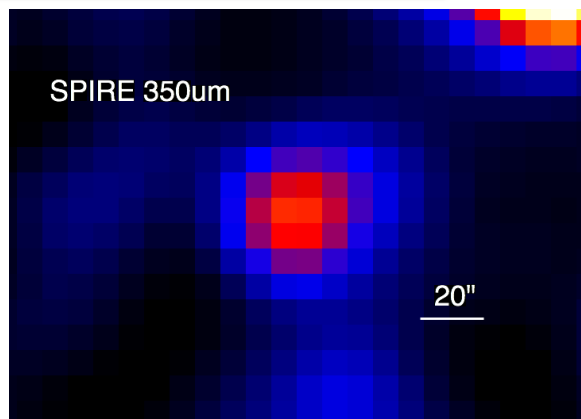
peaks at 500 microns:  $123 \pm 11 \text{ mJy}$

# Evidences for a strong lensing case



The morphology of the system

VLA PI: L. Ciesla  
IRAM/NIKA PI: M. Béthermin

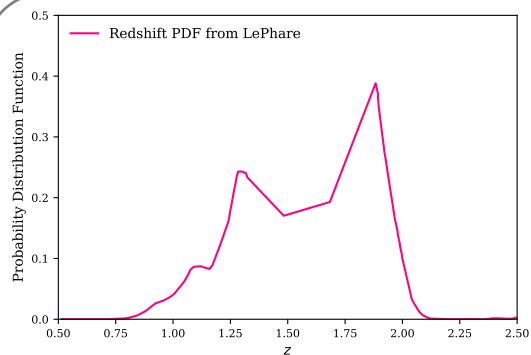
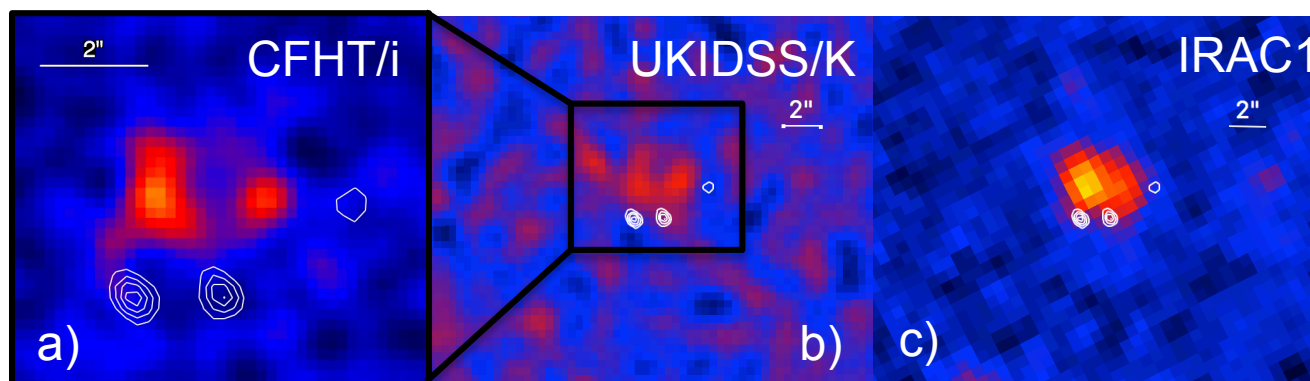


The IR emission splits in 3 radio sources disposed on an "arc"

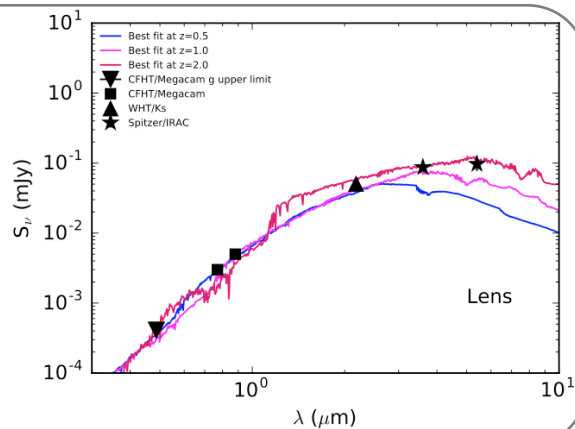
# Evidences for a strong lensing case

The morphology of the system

VLA PI: L. Ciesla  
Xshooter PI: T. Diaz-Santos  
WHT PI: M. Boquien



$Z_{\text{phot}}$  Le Phare: GAzPAR



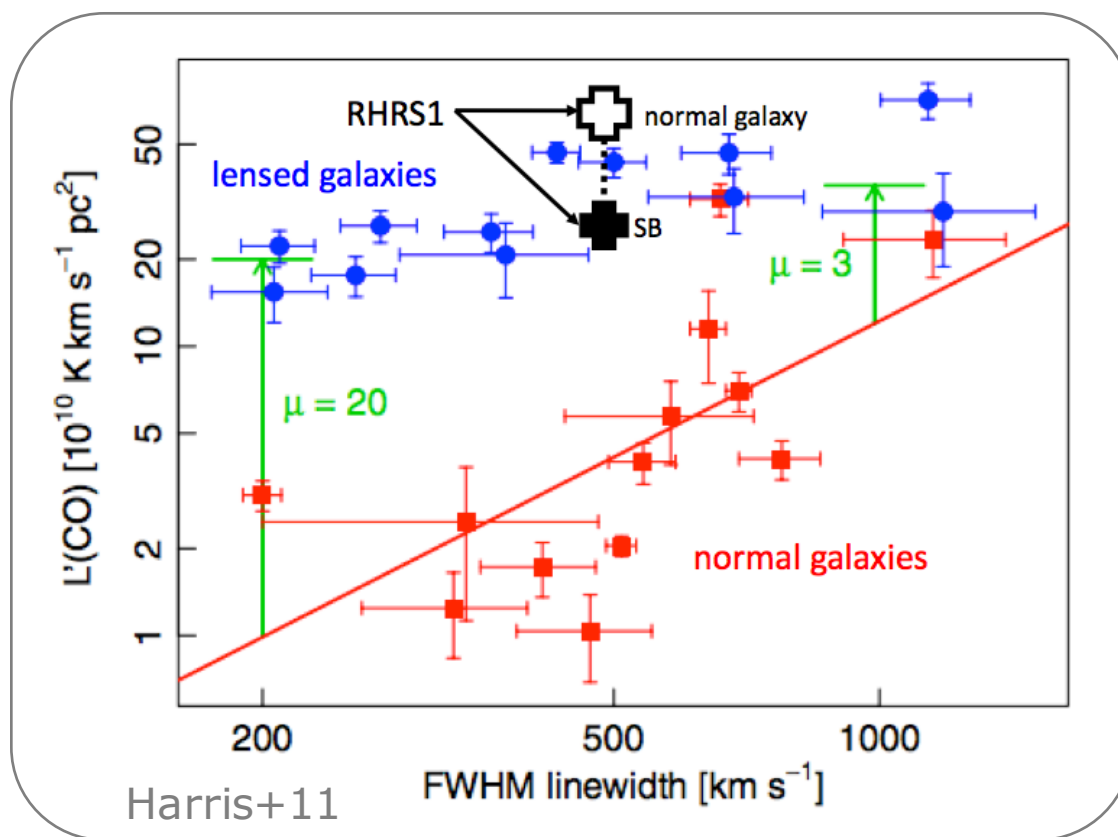
Optical counterpart at the center of the 3 VLA blobs:

- complex morphology
- possibly @  $z \sim 1-2$

# Evidences for a strong lensing case

$L'_{\text{CO}(1-0)}$  – linewidth relation

$L'_{\text{CO}(1-0)}$  – linewidth  
typical of lensed galaxies



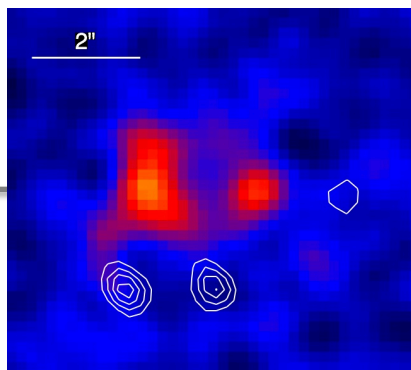
$L'_{\text{CO}} - L_{\text{IR}}$   $\rightarrow$  Sargent+14, assuming the same linewidth than CO(5-4)

# Evidences for a strong lensing case

To summarize



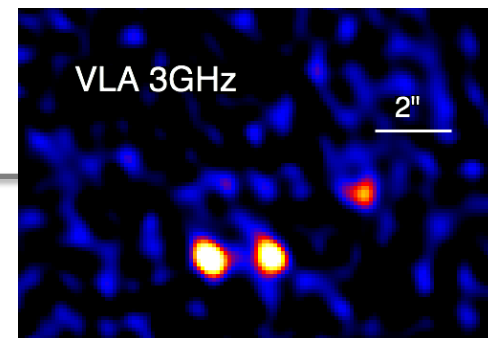
Lens



$z \sim 1-2$

CFHT,  
WHT, UKIDSS  
IRAC  
Xshooter

Background source

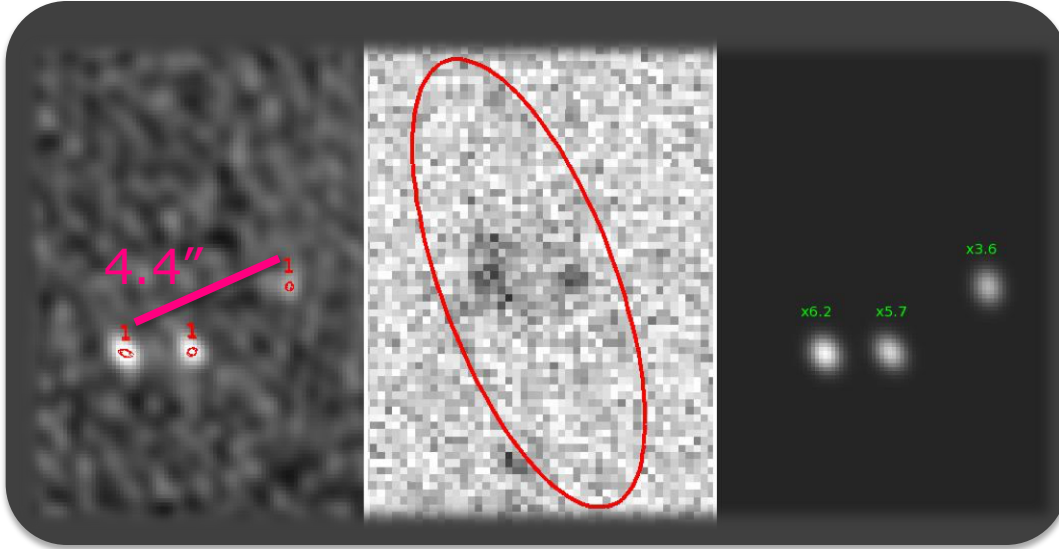


$z = 4.72$

Herschel/SPIRE  
NIKA  
VLA  
IRAM/EMIR  
*IRAM/NOEMA*

# Modelling the strong lensing configuration

Modelling: J. Richard



$$R_{\text{Einstein}} \sim 2.2''$$

One Single Isothermal Elliptical mass distribution



Good position of the modeled blobs  
 Good flux ratios between the modeled blobs

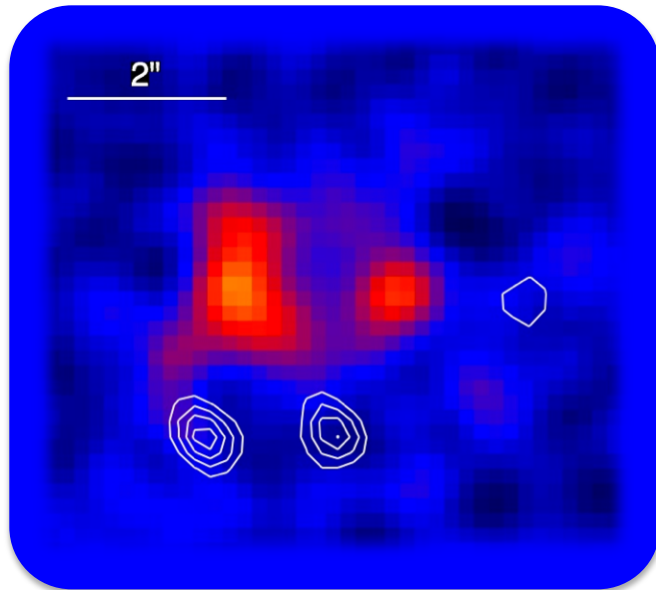
$z$	$M_*$ ( $M_\odot$ )	$M_{DM}$ ( $M_\odot$ )	$r_{\text{Einstein}}$ (kpc)	$M_{DM} / M_*$
0.5	$4.47 \times 10^{10}$	$2.34 \times 10^{12}$	13.5	52.3
1.0	$3.07 \times 10^{11}$	$4.43 \times 10^{12}$	18.5	14.4
1.5	$5.92 \times 10^{11}$	$6.08 \times 10^{12}$	19.5	10.3
2.0	$8.17 \times 10^{11}$	$7.35 \times 10^{12}$	18.5	9.0





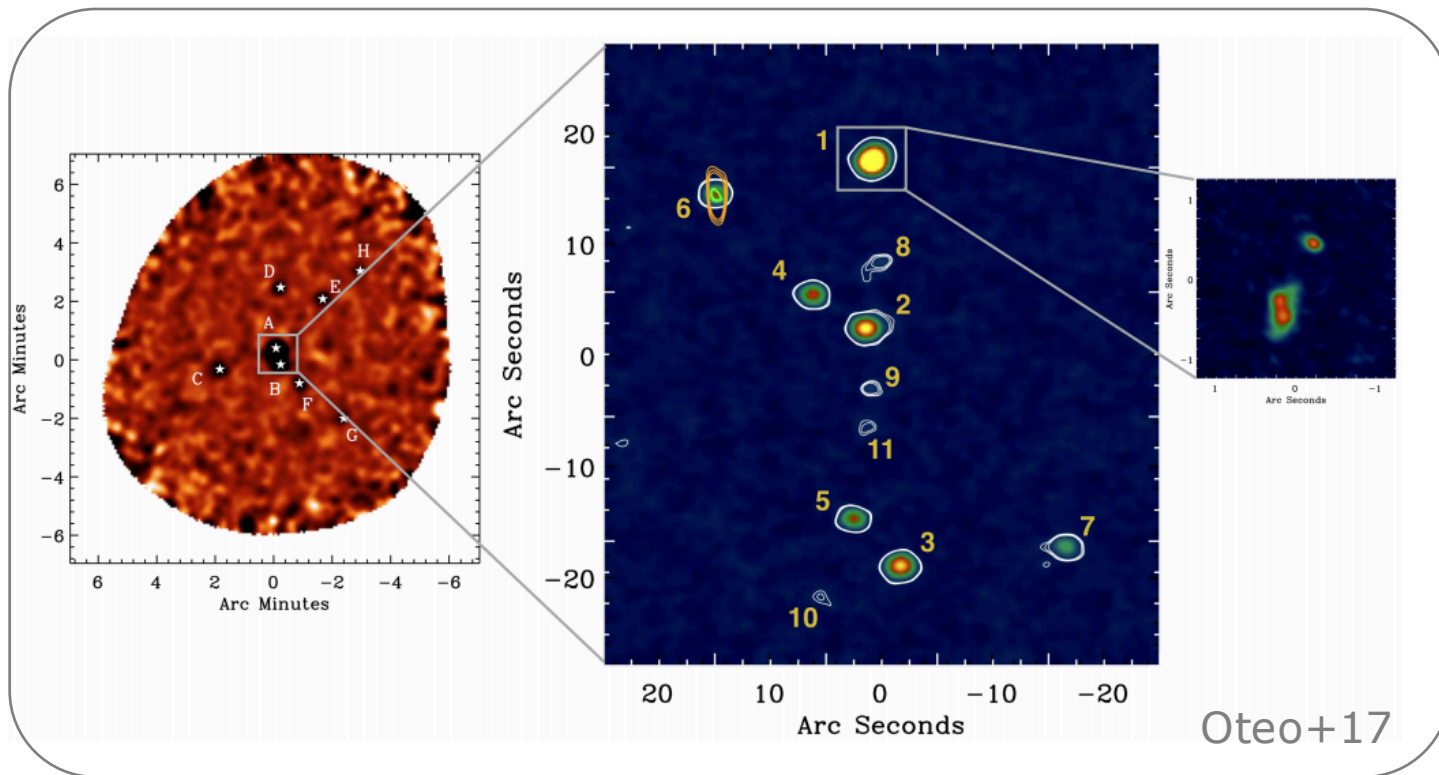
# And if not lensed?

10,000  $M_{\text{sol}}/\text{yr}$  within 20kpc at  $z=4.72$  !



Extreme protocluster?

# And if not lensed?



$$z_{\text{spec}} = 4.0$$

$$L_{\text{IR}} = 3.7 \times 10^{13} L_{\text{sol}}$$

11 sources over 300 x 300 kpc

# Solving the problem...

Proper reduction of Xshooter data expected in December

redshift of the optical/NIR emission

IRAM/NOEMA PI: L. Ciesla  
Ranked A; Winter Semester

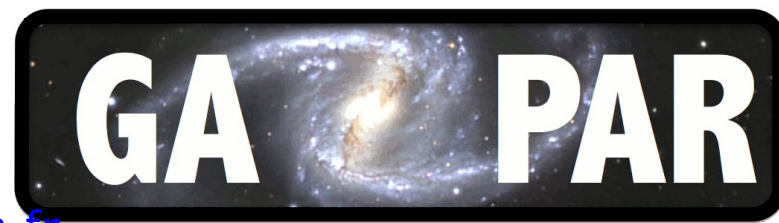
CO detection of each VLA blob  
resolved 1mm continuum

Are the blobs the same image  
of one source or 3 different  
galaxies?



[cesam.lam.fr/aspic](http://cesam.lam.fr/aspic)

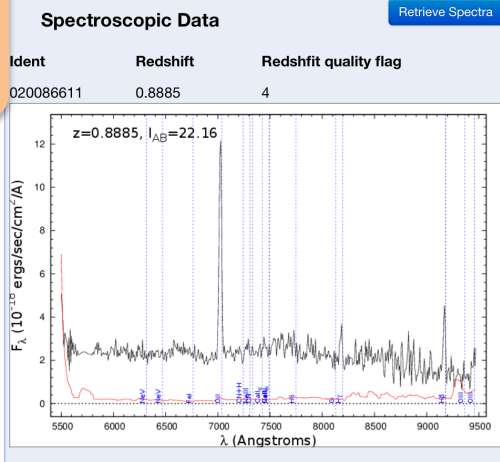
[gazpar.lam.fr](http://gazpar.lam.fr)



Archive of spectro-photometric galaxy surveys

Photo-z and physical parameter estimates

ask to  
integrate  
your data!



Photometric Data

- MAG\_I\_CFH12K
- MAG\_U\_CFH12K
- MAG\_G\_CFH12K
- MAG\_R\_CFH12K
- MAG\_I\_CFH12K
- MAG\_Z\_CFH12K

22 ± 0.01

CFH12K  
[5" x 5"]



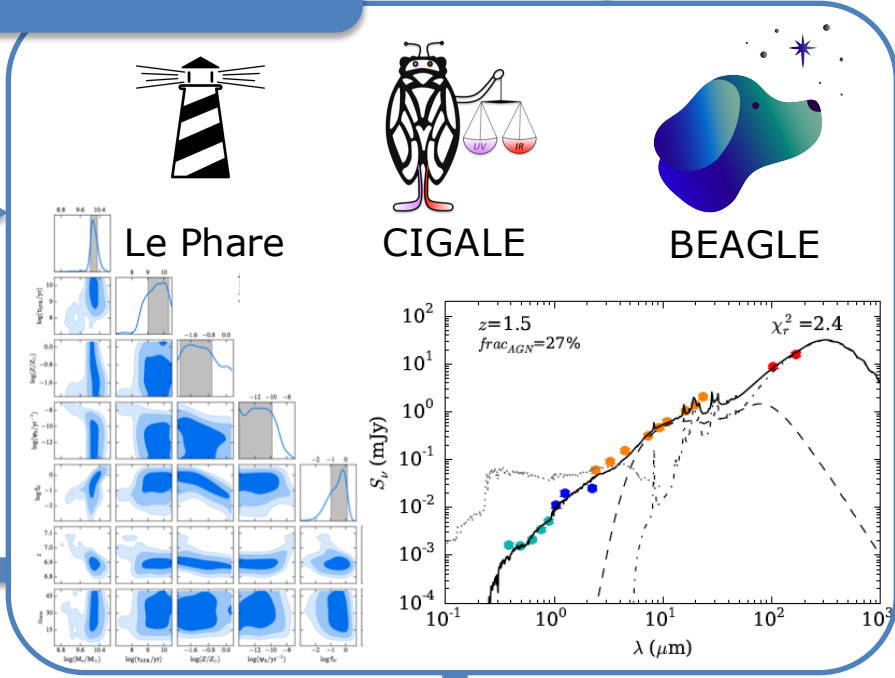
+ added-values  
from GAZPAR

Select the ASPIC datasets

- VUDS**
  - VUDS-COSMOS (DR1)
  - VUDS-ECDFS (DR1)
- VVDS**
  - VVDS2h Ultra Deep
  - VVDS2h Deep
  - VVDS-CDFS Deep
  - VVDS10h Wide
  - VVDS14h Wide
  - VVDS22h Wide
- zCOSMOS**
  - zCOSMOS 20k BRIGHT (DR3)
- GAMA**
  - GAMA LT (DR2)
  - GAMA AAT (DR2)
- 6dFGS**
  - 6dF Galaxy Survey (DR3)

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