Lockman-SpReSO: a deep OSIRIS spectroscopic survey

Mauro González-Otero[1,2], Carmen P. Padilla Torres[1,2,3],
Jordi Cepa[1,2] and the Lockman-SpReSO team

[1] Instituto de Astrofísica de Canarias, E-38205 La Laguna, Tenerife, Spain
[2] Universidad de La Laguna, Dept. Astrofísica, E-38206 La Laguna, Tenerife, Spain
[3] INAF, Telescopio Nazionale Galileo, Apartado de Correos 565, E-38700 Santa Cruz de la Palma, Spain

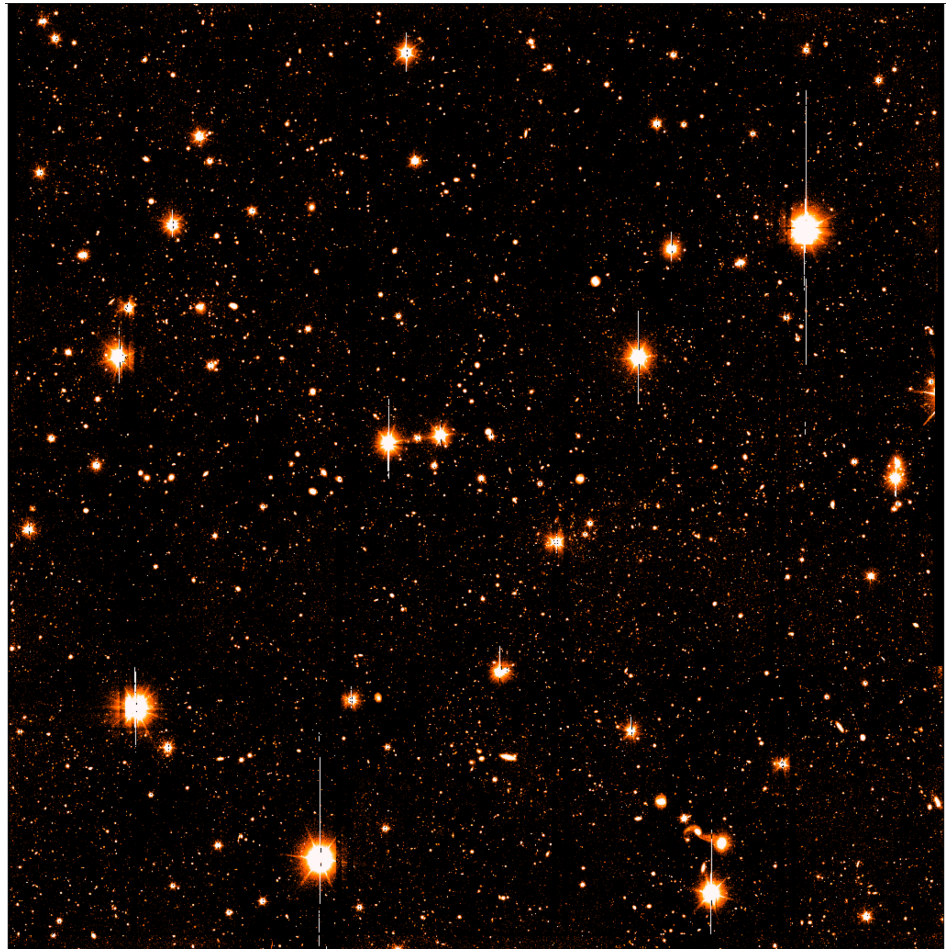
e-mail: mauro.gonzalez@iac.es

Lockman-SpReSO is a deep optical spectroscopic survey of a complete sample of galaxies previously observed at the greatest depth in X-ray, far infrared, and sub-millimeter, using, respectively, XMM, Spitzer, Herschel, and radio observations covering the central 24 x 24 arcmin² of the Lockman Hole field.

The main scientific objective is to study the spectroscopic properties of a complete, magnitude-limited sample (~18<R(AB)<24.5) of the optical counterparts of far-infrared galaxies, aiming for determining the evolution of fundamental parameters such as extinction, star formation rate and gas metallicity and their infrared biases.

The survey observations are in their final phase. The procedures for the analysis of spectra are currently being tested and refined. This presentation shows the results obtained so far.

1. Lockman Hole (LH) context



Our observation's mosaic of LH
(24x24 arcmin^2)

- **Low Galactic hydrogen column density** (N_H=$5.8 \cdot 10^{19}$cm^{-2}, Dickey, J.M. et al. 1990).
- Observed with a **wide spectral coverage** by e.g. ROSAT, XMM-Newton, GALEX and PACS-Herschel.
- Of entire field**, few objects** have spectroscopic redshifts (~600).
- Performing the **most comprehensive study** of Herschel's optical counterparts, only limited in magnitude (**R_C(AB)<24.5**).
- **1171 objects** have been observed in **240 hours** of Guaranteed Time with **OSIRIS-GTC in multi-object spectroscopy** configuration

Herschel counterparts	Unstudied XMM-Newton sources	Unstudied radio-galaxies	Very red AGN	SMG	Galactic targets
952	66	8	72	30	185

Note: there is multiplicity between the groups

2. Methodologies

OBSERVATIONS

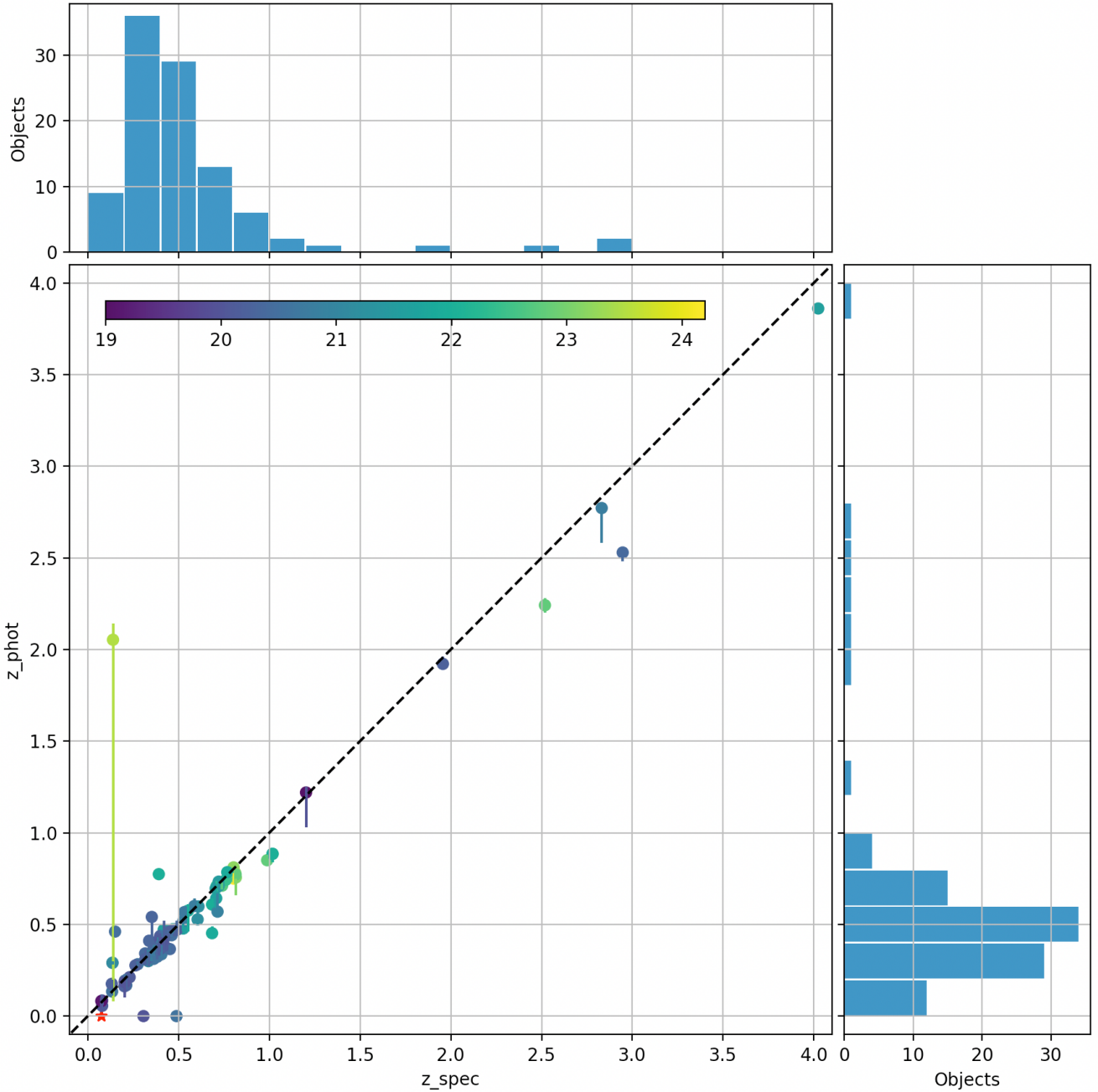
- **All observations** have been done. A few must be repeated (**12%**) because of: low S/N ratio, bad weather conditions or an instrumental problem.
- Each mask observed between 3 and 4 times. This allows us to have a **good statistic.**
- The ”ON+OFF+ON” observation strategy was applied for a **better sky correction**.

DATA REDUCTION

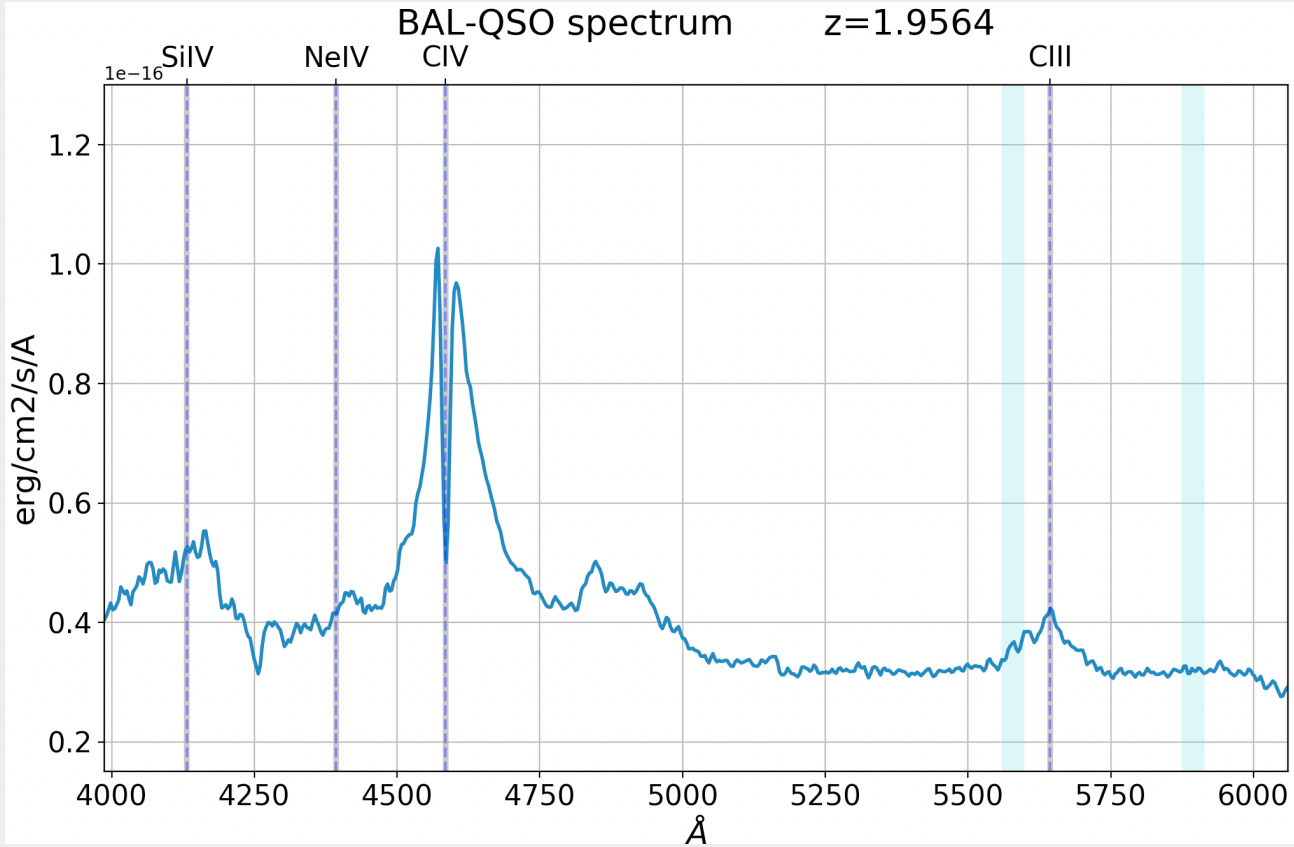
- **81% of the data** has been completely reduced.
- The basic reduction has been done with the ***IRAF* based D. Mayya’s pipeline *GTCMOS***.
  www.inaoep.mx/~ydm/gtcmos/gtcmos.html
- **Complementary *Python* programs** were created for processes like cosmic rays correction, image statistic and redshift determination, among others.
- The sky correction was developed with **ESO’s *SkyCorr* software** (Noli et al., 2014).
- An **automated** procedure for **lines identification** is being developed.

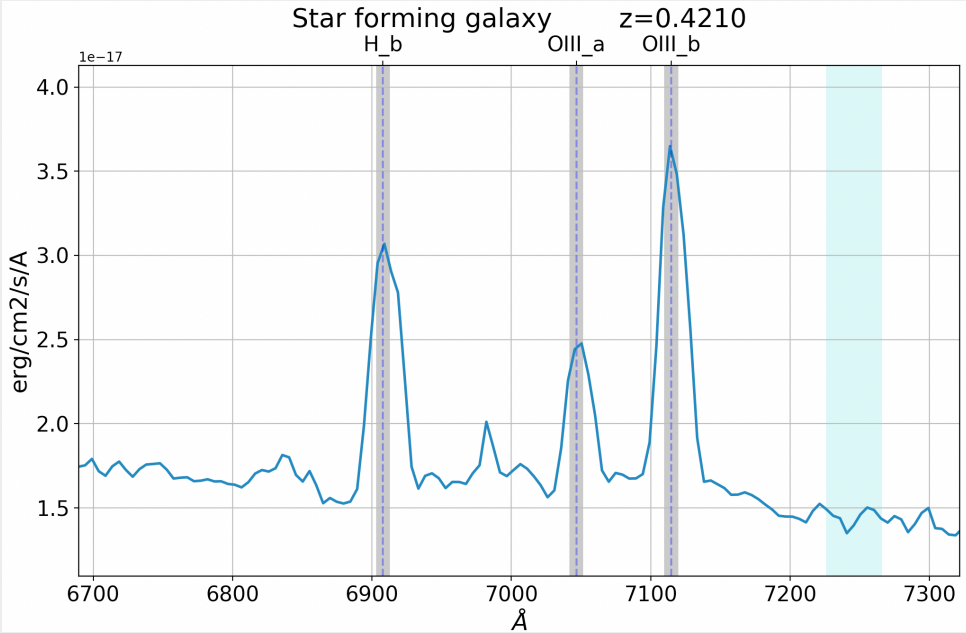
3. Results

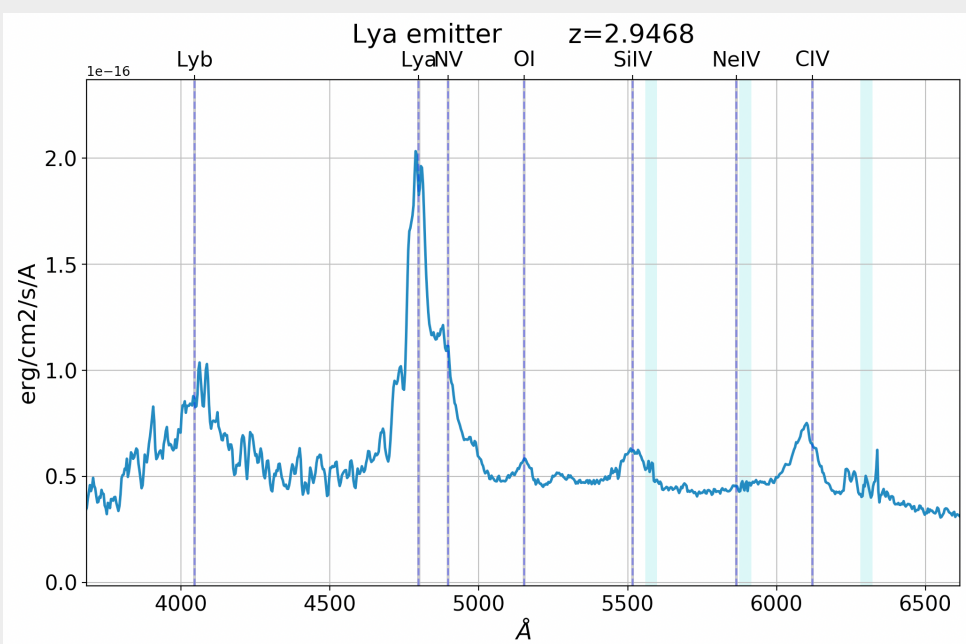
- We have computed spectroscopic redshift (z_spec) for about **10% of the objects** in our survey
- In the figure a comparison between z_spec and photometric redshift (z_phot) can be seen. z_phot comes from **Fotopoulou et al. 2012** within the PEP exploration (Lutz et al. 2011).
- Colorbar represents Rc(AB) magnitude obtained by PEP team.
- z_phot errors bar represents the **90% significance**.
- z_spec errors bar are plotted, but cannot be seen because they are on the **order of 10^{-4}.**



3. Results:
Examples of obtained spectra







- Blue areas indicates regions where **sky lines** are prominent.

4. Prospects for the future

- **Complete the reduction** of all data.
- **Measure the redshifts of remaining objects:** it involves making improvements in the method, specially for weaker objects with worse S/N ratio because they suffer the most from the sky correction.
- **Improve the fit program** to start measuring spectral lines.
- Calculate **optical/NIR SFR** estimation via Balmer Hα luminosities, together with **integrated attenuations** using Hα/Hβ, and gas **metallicities** via R23 or N2 proxies.
- Study local **L-Z relations** observed and dependences with **LFIR and redshift** using metallicities and FIR based luminosities.
- Generate and maintain the **Lockman SpReSO database**.