CALIFA view of UGC9837

K. Viironen[1,2], S.F. Sánchez[1],E. Mármol-Queraltó[1,3], D. Mast[1,4], R.A. Marino[1,3], D. Cristóbal-Hornillos[2,4] and CALIFA TEAM

[1] Centro Astronómico Hispano-Alemán (CAHA), Calar Alto (CSIC-MPG), Spain
[2] Centro de Estudios de Física del Cosmos de Aragón (CEFCA), Teruel, Spain
[3] Departamento de Astrofísica, Facultad de CC. Físicas, Universidad Complutense de Madrid (UCM), Spain
[4] Instituto de Astrofísica de Andalucía (IAA), Granada, Spain

CALIFA Survey

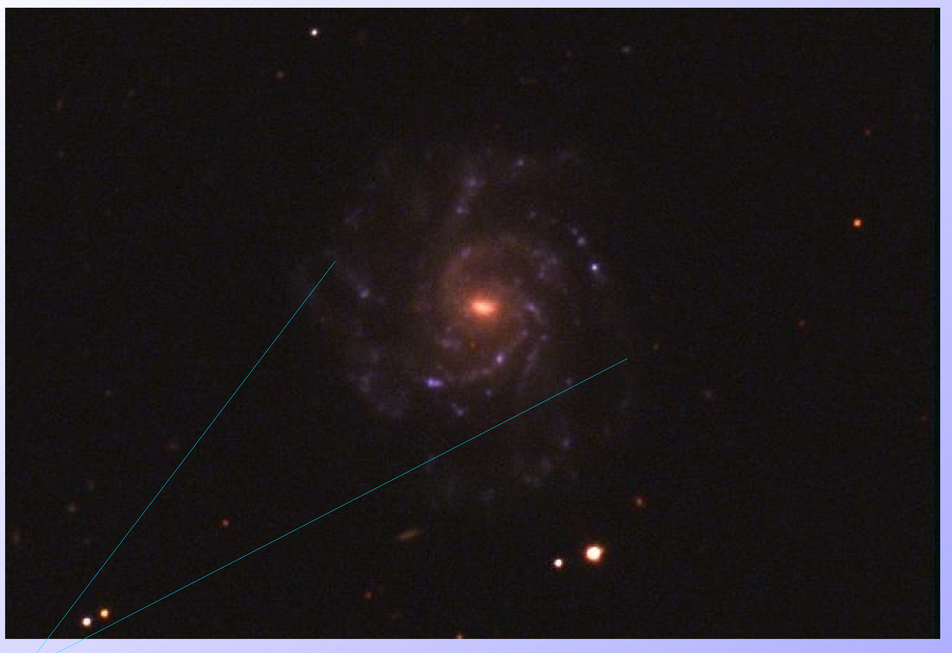
Abstract

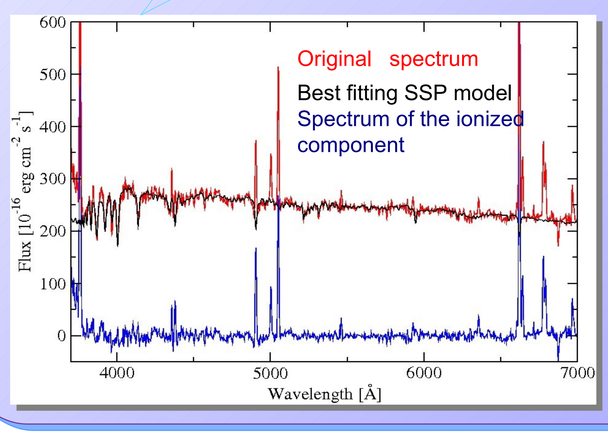
A detailed study of the spiral galaxy UGC9837 is carried out based on the IFU spectroscopic data from the CALIFA pilot survey. The integrated, radial and spatially resolved properties of the ionized gas are studied. In addition the possible biases caused by using a fixed aperture in studying galaxy properties at different redshift are simulated.

UGC9837 was observed as part of the CALIFA pilot survey using the PMAS PPAK integral field unit. The spectra is reduced and calibrated and the stellar and ionized components separated. Using typical strong emission line ratios of the ionized gas, the source of ionization, the dust extinction, the star formation rate, the electron density and the oxygen abundance are studied.

We find out that the lack of spatial coverage indeed causes biases in the derived galaxy properties. We also demonstrate that use of fixed aperture in studying the properties of galaxies at different redshift can cause important biases distorting the results derived for the lower redshift objects. CALIFA will remove these biases in ~ 600 galaxies of the Local Universe.

UGC9837

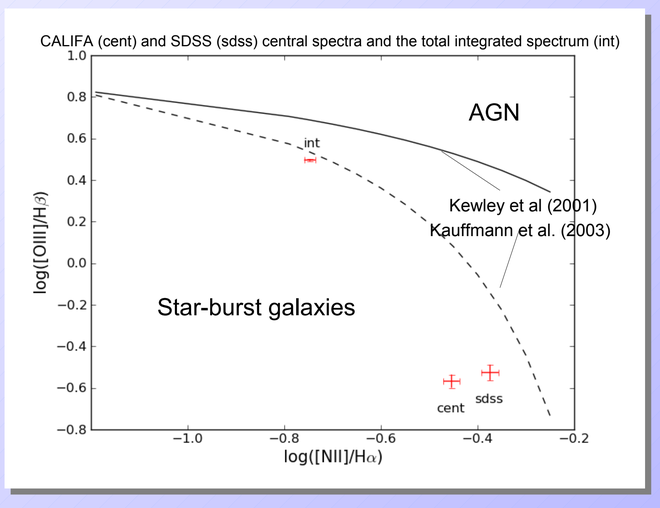




Integrated properties

One of the advantages of integral-field spectroscopy is that the combination of the observed spectra can be used to produce an integrated spectrum of the object, using the IFU as a large aperture spectrograph. This high signal-to-noise integrated spectrum can be used, for the first time, to derived the real average spectroscopic properties of the galaxy. This way no assumptions need to be made, in contrary to previous studies (based on long-slit spectroscopy, for example) attempting to describe the average spectroscopic properties of the galaxy based on individual spectra taken at different regions.

The most similar approach would be the spectrum derived by using drift-scanning technique. The advantage of using IFU with respect to the drift-scan technique is that all the spectra are obtained simultaneously and that the IFU spectra allows a comparison between the integrated and the spatially resolved properties of the galaxy.



Oxygen abundance

According to Pettini et al. (2004):

12 + log(O/H) = 8.69 ± 0.02 (sdss)
12 + log(O/H) = 8.67 ± 0.03 (cent)
12 + log(O/H) = 8.43 ± 0.01 (int)

According to Viironen et al. (2007):

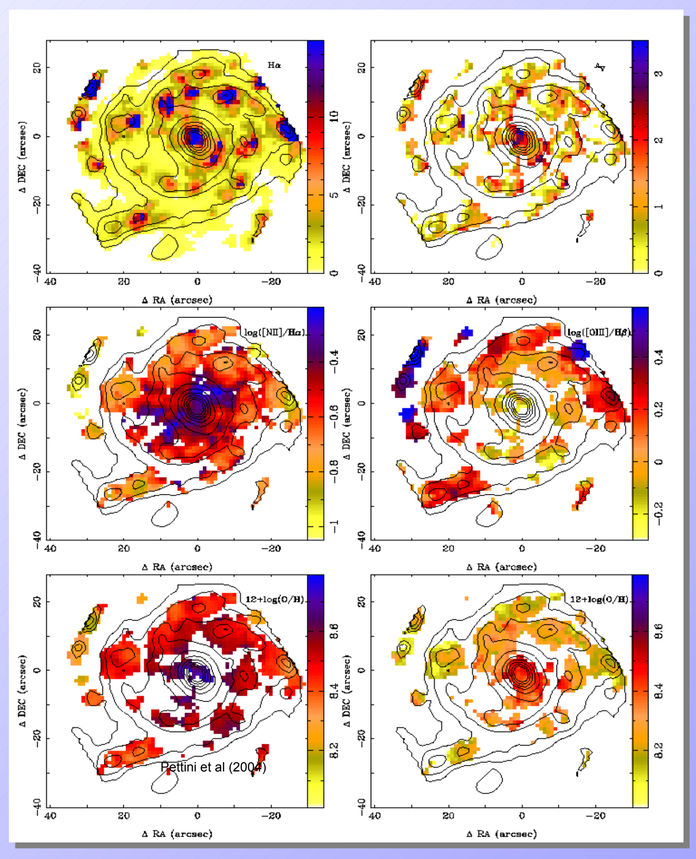
12 + log(O/H) = 8.43 ± 0.07 (sdss)
12 + log(O/H) = 8.29 ± 0.09 (cent)
12 + log(O/H) = 8.14 ± 0.02 (int)

- Ionization due to star-formation
- The total integrated spectrum points to harder ionization as compared to the central spectra

The oxygen abundance measured from the total integrated spectrum is lower than the one derived from the central spectra

Two-dimensional properties of ionized gas

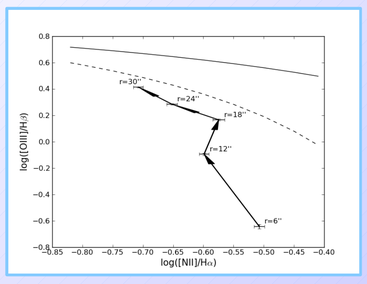
The real power of integral field spectroscopy is naturally in its capability of deriving two-dimensional information of the target. The emission line maps are created by interpolating the intensities derived for each individual line at each individual spectrum, corrected by aperture effects.

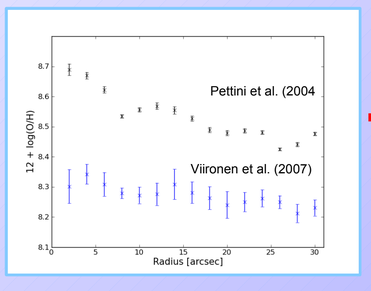


Radial gradients and fixed aperture effects

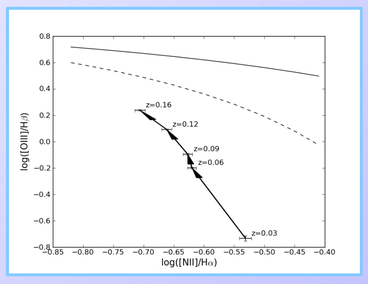
To study the dependence of the galactic properties on the distance from the center of the galaxy, we summed the spectra of individual fibers inside concentric rings of 2" width each until a distance of 30" from the center and normalized this summed spectra by the area of the ring.

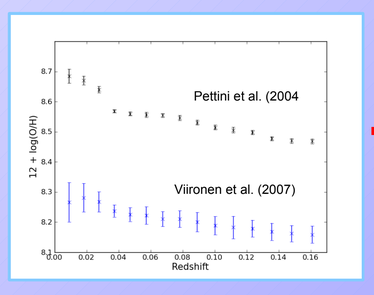
Next we summed the spectra of an increasing amount of these rings in order to simulate how the galaxy would be seen at different redshifts through a fixed aperture of 2" radius.





Ionization gets harder and oxygen abundance decreases with increasing galacto-centric radius.





If fixed aperture was used when studying the galaxy properties at different redshifts, the oxygen abundance would be overestimated and the hardness of the ionization underestimated in the nearby galaxies due to fixed aperture effects only.

Conclusions

We have shown that the integrated properties of the ionized gas of UGC9837 derived from the SDSS (central) spectrum and the integrated CALIFA spectrum differ. This demonstrates that results on galaxy properties derived from spatially undersampled spectra, such as SDSS for nearby galaxies, for example, should be considered with caution. We have also shown that use of fixed apertures in the study of galaxies at different redshifts causes important on the derived results.

The data from the ongoing CALIFA survey can remove the biases caused by spatial undersampling in the ~ 600 galaxies of the Local Universe covered by the survey. About 200 of these galaxies are face-on spirals which will allow statistics to be carried out on their properties such as the radial abundance gradients.