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MEASURING THE REDSHIFT OF ULTRA-DIFFUSE GALAXIES CANDIDATES AT OHP WITH MISTRAL

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Abstract. We present spectroscopic observations of a sample of ultra-diffuse galaxy (UDG) candidates conducted with the MISTRAL spectrograph at the T193 telescope of the Observatoire de Haute-Provence (OHP). Galaxies were selected from the SMUDGES and COSMOS surveys to identify the bluest field UDG candidates, maximizing the probability of Hα emission detection. Out of 12 observed galaxies, four show significant Hα lines (SNR>3), allowing us to derive spectroscopic redshifts in the range 0.005-0.077. Based on redshift-corrected sizes and surface brightness profiles, we confirm one galaxy as an UDG, identify two as dwarfs galaxies, and classify one as a potential giant low surface brightness (GLSB) galaxy candidate. These results demonstrate the potential of MISTRAL for distance confirmation of faint, large galaxies and highlight the diversity of low surface brightness systems in the field.

Keywords: Ultra-diffuse galaxies, spectra, redshift

1 Introduction

Low surface brightness (LSB) galaxies are an important class of galaxies as established by O'Neil & Bothun (2000). They are characterized as galaxies fainter than the night sky surface brightness (around 22-22.5 B-mag/arcsec^{-2}). In recent years, a new subclass of LSB named Ultra Diffuse Galaxy (UDG) has been revealed in large numbers by van Dokkum et al. (2015); Koda et al. (2015) in the Coma cluster. These galaxies are characterized by large effective radii (> 1.5 kpc) and a very low central surface brightness (> 24 g-mag/arcsec^{-2}). Despite their large size, their stellar mass is low, comparable to that of dwarf galaxies. Their nature and formation are still largely debated. Some are likely dark-matter dominated and they may play an important cosmological role. Since their discovery, they have been found not only in clusters (where they are mostly red and quiescent), but also in the field or in galaxy groups. Field UDGs are blue and star-forming (Prole et al. 2019; Junais et al. 2022) but their distance is more uncertain.

For now, there are few distance confirmations. The aim of this work is to observe the H_α emission in order to calculate the redshift and then extend the number of known UDGs. We obtained time at OHP to measure the H_α line position to get a redshift determination of 20 galaxies to improve the number of known distances.

2 Sample and observations

We selected 20 galaxies from the SMUDGES catalog of Zaritsky et al. (2023) based on 7070 UDGs candidates and from COSMOS2020 (Weaver et al. 2022). We targeted the fields UDGs, we selected the bluest one by applying a color cut of (g-r) < 0.25, and r< 19 mag to obtain the most star-forming candidates and increase the probability of H_α detection. Due to the meteorological conditions we could only observed 12 galaxies among the sample so far. For each galaxies, we did two exposures of 1800s in the blue configuration of MISTRAL (4200Å-8000Å). We used the pipeline provided with MISTRAL to reduce the data and binned the 1D spectra to increase the SNR.

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3 Results

We detected four H_α emission above a SNR of 3, for four galaxies among the 12 galaxies observed. The binned 1D spectra is shown in Fig. 1 in which the line is clearly seen and the flux and redshift are indicated.

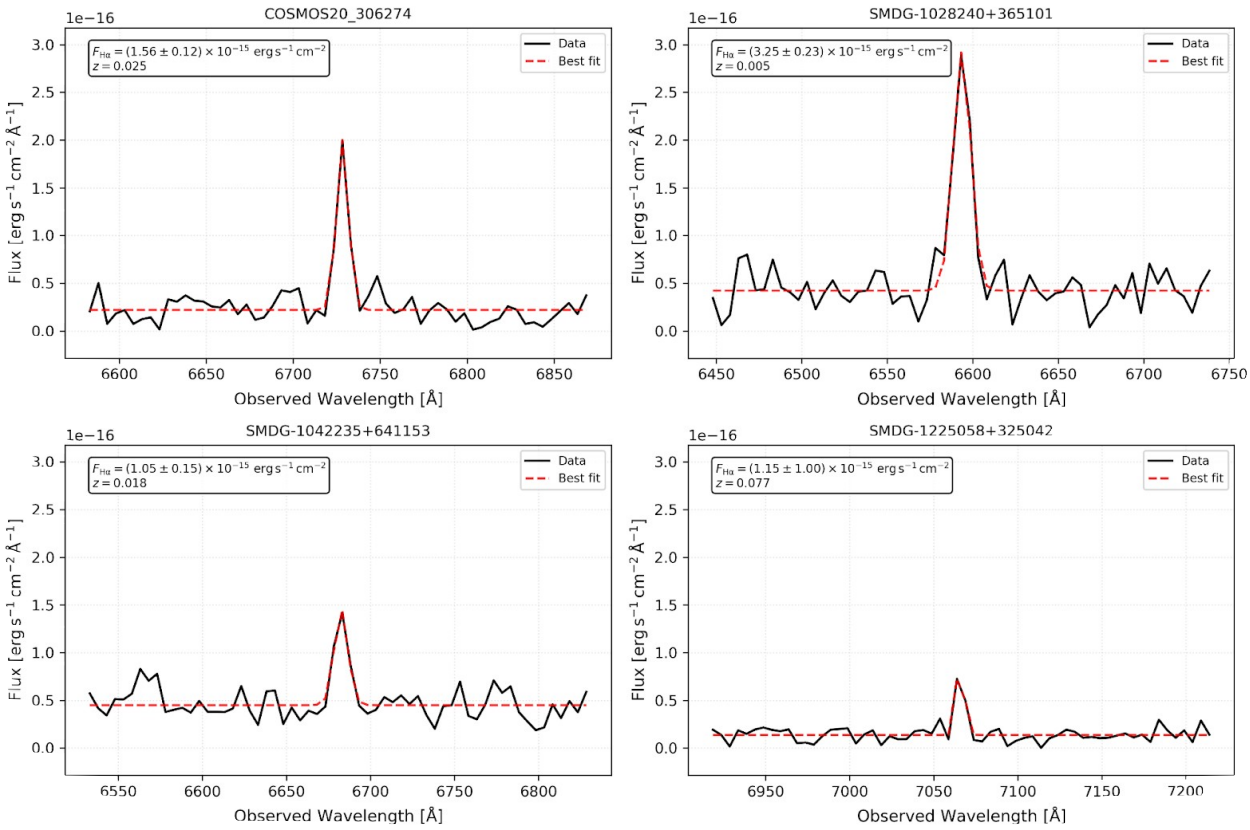

Fig. 1. 1D binned spectra around the H_α position for detected galaxies.

We were able to calculate the redshift for those four galaxies. We found a range of redshift from 0.005 to 0.077. With the redshift, we can convert the effective radius from arcsec to kpc. By using a size-luminosity relation, the nature of these galaxies can be established as in the left panel of the Figure 2. SMDG-1028240 has a small effective radius (< 1.5 kpc) and is classified as a dwarf galaxy. The three other galaxies validate the criteria of size for an UDG. We calculated the central surface brightness $\mu_{0,g}$ with PANSTARRS data (except for COSMOS20-306274 for which we used HSC data). We found that only SMDG-1042235 is an UDG, while COSMOS20-306274 is at the limit for a dwarf galaxy, and SMDG-1225058 has a large size but not a central surface brightness faint enough to be classified as an UDG. It is faint enough, however, to be called an LSB, even a Giant LSB (GLSB). A GLSB is a LSB galaxy with a large extended disk. Sprayberry et al. (1995) characterized these galaxies by a low central surface brightness and a large scale length. They are often characterized also with an important stellar masses. This galaxy has a large effective radius and stellar mass. The central surface brightness computed is lower than 23 mag.arcsec^{-2} and make this galaxy a good candidate to be a GLSB.

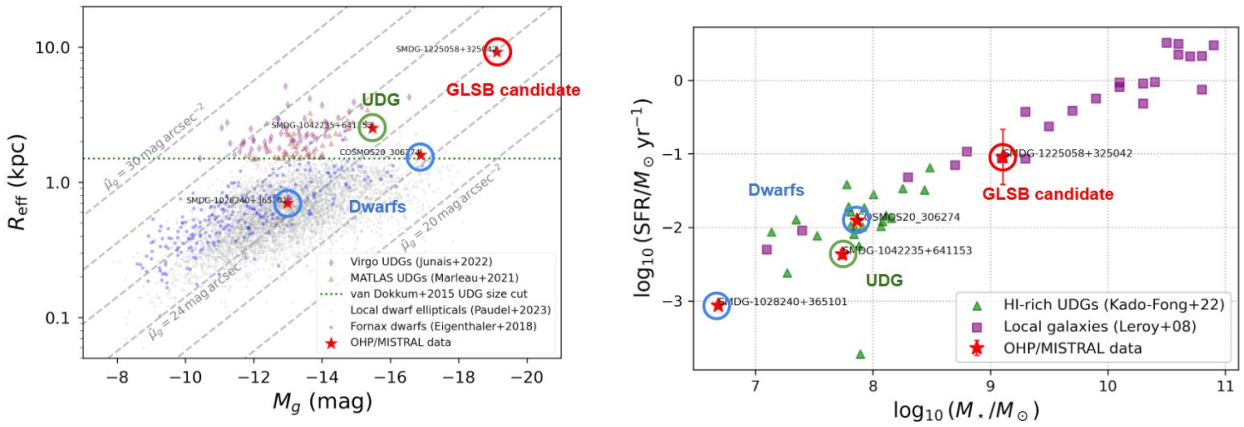

Fig. 2. Left: Size-Luminosity Relation. **Right:** Star forming main-sequence.

4 Conclusions

We performed the first spectroscopic observations of field UDG candidates with MISTRAL at OHP, targeting 12 blue UDG candidates from the SMUDGES and COSMOS catalogs. We detected Hα emission in four galaxies, enabling secure redshift measurements and physical characterization. Among them, one is confirmed as a UDG, two are dwarfs galaxies, and one is a Giant LSB galaxy. This work illustrates both the efficiency of our color-magnitude selection for detecting star-forming low surface brightness systems and the versatility of MISTRAL for such faint targets. Expanding this program to a larger sample will improve our understanding of UDG in low-density environments and their connection to other LSB galaxy populations.

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