

The OTELO Survey: The main sequence of low-mass galaxies

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ABSTRACT

Aims. This paper describes the relationship between the star formation rate and the stellar mass, the so-called main sequence (MS), of low-mass galaxies at three different redshifts from the OTELO survey. In particular, we study H α at $z = 0.38$, [O III] at $z = 0.83$, and [O II] at $z = 1.43$ emission line galaxies (ELGs). This is done to characterise the properties of low-mass ELGs.

Methods. We fitted the spectral energy distribution (SED) of each emitter and obtained the stellar masses, the total infrared luminosity, and the star formation rate. We found that 100% of the H α emitters and about 90% of the [O III] and [O II] emitters are low-mass galaxies ($<10^{10} M_{\odot}$). We generated a MS for each redshift regime, employing all galaxies and binning them in stellar mass. We obtained the parameters of the fit (turnover mass and slope of the low-mass regime) and compared them to results from the literature.

Results. We found that the colour–magnitude method employed to select ELGs leaves out a significant number of them. We also found that the whole sample contains few luminous infrared galaxies and no ultra-luminous infrared galaxies. We also found that the lack of infrared constraints in the input SEDs may generate problems when determining the total infrared luminosity. When comparing the MS obtained for our sample of low-mass ELGs with those from the bibliography, we found, in general, very good agreement. We can consider the MS to be almost the same for the relatively unexplored regime of low-mass galaxies. However, the turnover mass obtained by this work is higher for all redshifts compared with the ones from the literature. We suggest that this is an effect of the different methods and samples used in the generation of the MS compared to those of the bibliography.

Key words. galaxies: star formation – cosmology: observations

1. Introduction

The galaxy main sequence (MS) of star formation is a relationship between the stellar mass (M_{*}) of galaxies and their star formation rate (SFR). It was presented for local galaxies by Brinchmann et al. (2004). Since then, it has been extended to higher redshifts by several authors (see, for example,

Noeske et al. 2007 or Daddi et al. 2007; and for more recent works Popesso et al. 2023; Euclid Collaboration: Enia et al. 2026, and references therein).

The MS relationship is pretty tight, with a 0.2 dex width. Only a select number of star-forming galaxies (SFGs) lie outside the main body. Elbaz et al. (2011) found that the majority of the MS was composed of ‘normal’ SFGs, and that a population of high starburst galaxies with high specific star formation rates (sSFRs) fell above the MS. Rodighiero et al. (2011)

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showed that only a fraction of SFGs undergo merger events that should increase the SFR of the galaxies, so these galaxies are the ones that are part of the outliers in the MS (Lee et al. 2015). Taking this into account, the MS relationship seems to indicate that galaxies undergo a regular star formation history, in opposition to a history driven by mergers and starbursts (Popesso et al. 2019).

Noeske et al. (2007) and Speagle et al. (2014) proposed a functional form for the MS as a single power law. However, later on, with more data available, Lee et al. (2015) proposed a more complex form, given by

$$\text{SFR}(M_*) = \text{SFR}_{\text{max}} / (1 + (M_*/M_0)^{-\gamma}), \quad (1)$$

where SFR_{max} is the saturation value for the SFR, M_0 is the turnover mass, and γ is the slope for the low-mass regime. Lee et al. (2015) gave a range of $0.9 \leq \gamma \leq 1.3$ for the slope of the low-mass regime, and a turnover mass of about $M_0 \simeq 10^{10} M_\odot$, with some evolution at higher redshifts. Popesso et al. (2023) compiled a large set of data on SFGs from the literature in the redshift range $0 < z < 6$, and found strong evidence of a linear evolution of the turnover mass with time, as well as the saturation value. They found no evidence of γ evolution and obtained a value compatible with 1. The turnover mass is discussed there as determining the shape of the MS. For stellar masses well below the turnover mass, the galaxies have a nearly constant sSFR. In addition, for stellar masses larger than the turnover mass, the SFR is suppressed. Several authors (Popesso et al. 2019; Tacchella et al. 2016; Daddi et al. 2022, and references cited therein) found that the MS was dominated by central galaxies (the main galaxy occupying the dark matter haloes). Popesso et al. (2023) extend this relation to all redshifts and then interpret the turnover mass as defining the transition between an environment that sustains the star-forming processes for the central galaxy to a regime in which the star formation is suppressed.

On the other hand, the work on low-mass galaxies ($< 10^{10} M_\odot$) is less extensive. For example, Terao et al. (2022) found in the MS of a sample of H α emitters from $2.1 < z < 2.5$ that low-mass galaxies below their completeness limit present high sSFR values. They explained this, suggesting that the low-mass galaxies experienced a recent shorter-timescale starburst compared with larger galaxies. Along the same lines, Chen et al. (2024) in $z \sim 2.3$ found that H α -derived SFRs may be more sensitive to short recent starbursts than other indicators, and this may explain the scatter on the MS obtained by the simulations by Sparre et al. (2017). In opposition, the work of Schreiber et al. (2015) found that low-mass galaxies presented the same dispersion as galaxies with moderately high masses. More recently, several works have implied that this dispersion may be due to the incompleteness of the data for low-mass galaxies. For example, Simmonds et al. (2025), employing data from JADES (JWST Advanced Deep Extragalactic Survey), found that the sSFR is independent of stellar mass when the completeness of the sample is taken into account.

Here, we study the evolution of the MS with the redshift for a sample of low-mass emission line galaxies (ELGs) from the OTELO (OSIRIS Tunable Filter Emission Line Object) Survey. Since the low-mass regime for galaxies of MS is not well studied, comparisons with galaxies of intermediate- to high-mass regimes could help us to obtain a clearer picture of the true form of the MS. The paper is organised as follows. In Sect. 2 we describe the OTELO Survey and the three subsets of ELGs, selected covering the range $0.38 \leq z \leq 1.43$ in redshift. In Sect. 3 we fit the spectral energy distribution (SED) of the ELGs through

the CIGALE code and study several derived parameters such as the stellar mass, the total infrared luminosity, and the SFR. In Sect. 4 we fit the derived stellar masses and the SFRs to Eq. (1), to obtain the MS, and we show the comparison with the data available in the literature. In Sect. 5 we present the main conclusions of this work.

Throughout this paper, we assume a standard Λ cold dark matter cosmology with $\Omega_\Lambda = 0.7$, $\Omega_m = 0.3$, and $H_0 = 70 \text{ km s}^{-1} \text{ Mpc}^{-1}$. We also assume a Chabrier (2003) initial mass function (IMF), unless otherwise stated.

2. The OTELO Survey

The OTELO Survey is a blind, pencil-beam survey that covers a region of 56 arcmin^2 of the Extended Groth Field. It was observed with the OSIRIS instrument, located at Gran Telescopio Canarias (GTC). The survey aims to detect galaxies with emission lines. It uses 2D spectroscopy techniques, employing the tunable filter mode of the instrument, with a tomography of 36 slices evenly distributed, covering an atmospheric window between 8950 and 9300 Å, with a spectral resolution of $R \sim 700$. The catalogue contains 11237 sources and is 50% complete with an AB magnitude of 26.38. The catalogue also includes a pseudo-spectrum for each object detected. This pseudo-spectrum is the result of the convolution of the object SED by the response of the OSIRIS instrument. The catalogue also contains ancillary photometric data that cover from the X-ray to far-infrared range. The survey, its data products, and reduction processes are described in detail in Bongiovanni et al. (2019)¹. The photometric redshifts for all objects were obtained by fitting the data to SED templates using the LePhare code (Arnouts et al. 1999; Ilbert et al. 2006).

From the OTELO Survey, we selected three subsets of sources based on their emission in H α at $\langle z \rangle = 0.38$, with 34 emitters (Ram n-P rez et al. 2019), [O III] at $\langle z \rangle = 0.83$, with 184 emitters (Bongiovanni et al. 2020), and [O II] at $\langle z \rangle = 1.43$, with 60 emitters (Cedr s et al. 2021a). The selection criteria used for each subset were based, first, on locating all objects with the appropriate photometric redshift, and then on visually inspecting each pseudo-spectrum for emission by several researchers. The specific details of the selection process for each subset are explained in the reference articles (Ram n-P rez et al. 2019; Bongiovanni et al. 2020; Cedr s et al. 2021a for H α , [O III], and [O II], respectively). The spectroscopic redshift, as well as the integrated fluxes for the lines and the continua, was obtained for all galaxies in the subsamples, calculated through the inverse convolution method, developed in Nadolny et al. (2020). In short, a series of Monte Carlo simulations were performed ($\sim 10^6$), simulating the redshift, the flux of the continuum, the dispersion of the line, and the flux of the line; then, each simulation was convolved with the response of the tunable filter system and a set of synthetic pseudospectra were obtained. After a χ^2 minimisation procedure, the parameters mentioned above were obtained.

Regarding possible contamination of the subsets by the AGNs, Navarro Mart nez et al. (2021) found a very low fraction ($\sim 2\%$) of AGNs in their emitter sample at $z \sim 0.9$. They explained this by the fact that OTELO is a very deep survey, but covers a small volume, and taking into account that the AGN fraction depends more on luminosity than redshift (Chiang et al. 2019), the general low luminosity of the emitters (linked to

¹ The catalogue can be accessed at <http://research.iac.es/proyecto/otelo/pages/otelo.php>

the low masses) implies a negligible number of AGNs. On the same note, Ram n-P rez et al. (2019) found no galaxies hosting AGNs at low luminosities, and Cedr s et al. (2021a) concluded, based on assumptions by Drake et al. (2013), that the possible AGN contamination of their sample at $z \sim 1.43$ was about 6%, and together with the selection criteria that the subsets comprise only galaxies fitted by a SED corresponding to templates belonging to a starburst or a star-forming galaxy. Taking all this into account, we may assume that all subsets have little contamination by AGNs.

In Fig. 1 we show a colour–magnitude diagram from all OTELO sources, represented as density following the grey scale of the colour bar, and the selected emitters are drawn as yellow, red, and black dots for H α , [O III], and [O II] emitters, respectively. There, the OTELO_{AB} magnitudes are the instrumental fluxes measured in the OTELO–Deep image (resulting from the weighted combination of all the slices of the tomography obtained by the tunable filter) and converted into AB magnitudes (see Bongiovanni et al. 2019). The dash-dotted line represents the 2Σ isoline of colour-excess significance obtained after Bunker et al. (1995) and also presented in Bongiovanni et al. (2019). There, it is defined as

$$(Z - \text{OTELO}_{\text{AB}}) = -2.5 \log \left[1 - \delta \Sigma 10^{-0.4(zp - \text{OTELO}_{\text{AB}})} \right], \quad (2)$$

where $zp = 30.504$ is the photometric zero-point of OTELO_{AB} data, δ is the sum in quadrature of the sky background in each band, and Σ is the colour excess significance. This line was used as a discriminant for the ELGs in the OTELO Survey, where all sources with $\Sigma > 2$ and a signal-to-noise ratio on the continuum better than 5σ were selected as emitters. It can be seen that most of the emitters from the subsets are located above the 2Σ line, but there is a non-negligible number of emitters from all subsets below the line. This happens because the emitters employed in this study were selected by visual inspection of the pseudo-spectrum of pre-selected candidates (a detailed report of the method is described in Cedr s et al. 2021a). This shows that employing only colour–magnitude relationship techniques in the selection of ELGs will rule out an important number of them; in this case, it is $\sim 29\%$ of all the emitters in our sample. This limitation in the detection of emitters was also reported in Bongiovanni et al. (2019).

3. CIGALE fits

In order to study the physical properties of the selected subsamples, we performed a SED fitting using CIGALE (Boquien et al. 2019). The bands used in the fittings were the ones included in the ancillary data from the core catalogue, as well as the ones from the multi-wavelength catalogue, when available, from the OTELO survey (Bongiovanni et al. 2019), i.e.: u, g, i, and z from the CFHTLS survey; F606W and F814W from HST-ACS; the J, H, and K_s bands from WIRDS; the far-UV and near-UV from Galaxy Evolution Explorer (GALEX, Martin et al. 2005); 3.6, 4.5, 5.8, and 8.0 μm from the IRAC instrument and 24 μm from the MIPS instrument at Spitzer Space Observatory; 100 and 160 μm from the PACS instrument; and 250, 300, and 500 μm from the SPIRE instrument at Herschel Space Observatory. However, not all bands were available for the full subsamples. In Table 1 we summarise the total number of objects with emission detected in the IR bands.

Table 2 summarises the parameters employed in the fitting. Those were selected for sampling all the parameter space, although restricted enough to have reasonable computation times.

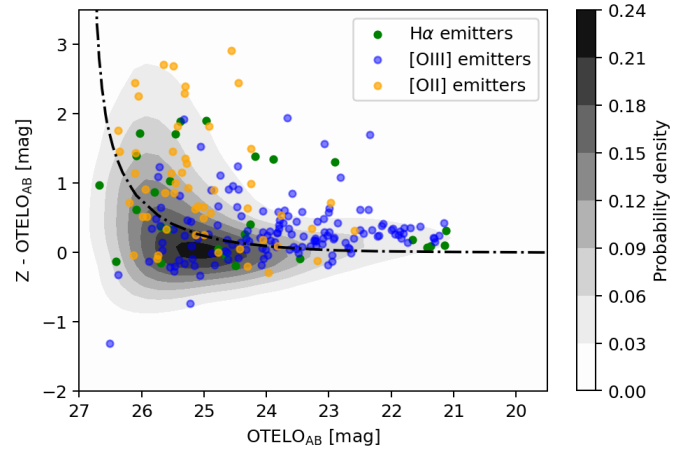


Fig. 1. Z-OTELO_{AB} colour–magnitude diagram. The filled grey contours represent the density of all the OTELO sources. The H α , [O III], and [O II] emitters are presented by green, blue, and orange dots, respectively. The dash-dotted black line is the 2Σ isoline of colour significance from Bongiovanni et al. (2019).

In Fig. 2 we show the reduced χ^2 of the SED fittings obtained with CIGALE. We have marked with the dash-dotted line the value of $\chi^2 = 10$. This value was selected, following Santos et al. (2021) and Wang et al. (2020), as the maximum tolerable for a good fit. As can be seen, only one galaxy presents a $\chi^2 > 10$, so it was discarded in the subsequent analysis. The rest of the galaxies of all subsamples have mean values of χ^2 of 1.6, 1.5, and 1.5 for H α , [O III], and [O II] respectively. Thus, we consider them to be reliable fits and we used them in the generation of the MS.

From the fitting, we obtained, among others, the following parameters: bayes.stellar.m_star_old, which gives us the total stellar mass; bayes.dust.luminosity, which gives us the total IR luminosity; and bayes.sfh.sfr, which gives us the total SFR from the SFH fitted by CIGALE.

In Fig. 3 we show the histogram of the total IR luminosity, extracted from CIGALE fits. The dotted line indicates the regime of luminous IR galaxies (LIRGs) at $10^{11} L_{\odot}$, and the dash-dotted line indicates the regime of ultra-luminous IR galaxies (ULIRGs) at $10^{12} L_{\odot}$, defined by Sanders & Mirabel (1996). It can be seen that only a few galaxies can be classified as LIRGs, just for [O II] (7%) and [O III] (4%), and none as ULIRGs. This indicates a low brightness in general on the IR regime for all galaxies in the subsamples.

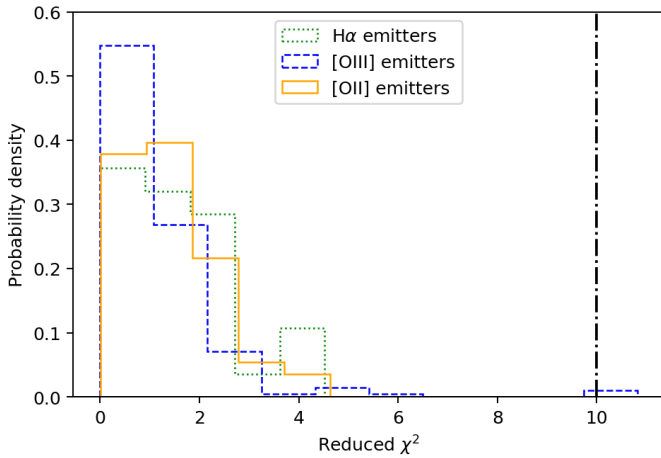
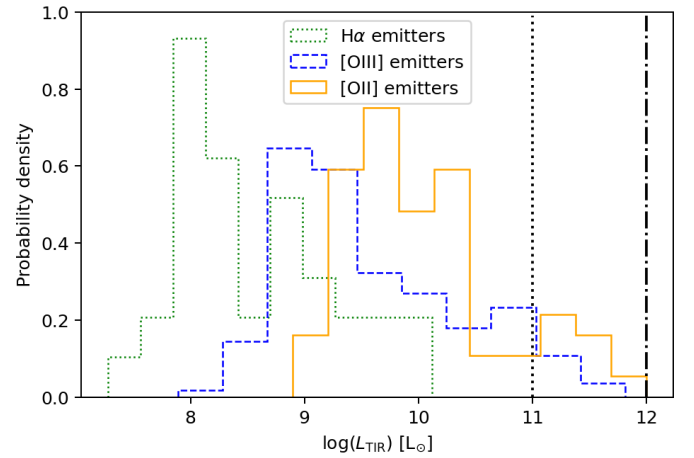
In Fig. 4 we use a histogram to represent the stellar mass of our emitters. The median values for the logarithm of the masses (in $M_{\odot}$) are 7.67, 8.85, and 9.11 for the emitters H α , [O III], and [O II], respectively. Most of the emitters ($>90\%$) are below $10^{10} M_{\odot}$, with galaxies reaching as low as $10^7 M_{\odot}$. Taking this into account, we can consider most of our emitters to be found in the low-mass regime. This is a direct consequence of the OTELO Survey being a pencil-beam survey, which generates a bias towards low-mass galaxies (see, for example, Impey & Bothun 1997; Moster et al. 2011; Cedr s et al. 2021a). Taking into account also that the median significative mass for LIRGs is about $6.3 \times 10^{10} M_{\odot}$ (Paspaliaris et al. 2021), it is reasonable to expect few LIRGs in our sample, and no ULIRGs at all, as is seen in Fig. 3.

Table 1. Percentage of emitters with data in each IR band.

Subsample	IRAC 3.5 μ m	IRAC 4.5 μ m	IRAC 5.8 μ m	IRAC 8.0 μ m	MIPS 24 μ m	PACS 100 μ m	PACS 160 μ m	SPIRE 250 μ m	SPIRE 300 μ m	SPIRE 500 μ m
H α	20.5%	17.6%	14.7%	14.7%	14.7%	0%	0%	3.0%	3.0%	0%
[O III]	52.2%	48.3%	35.7%	32.9%	15.4%	1.1%	0.5%	7.1%	4.4%	1.6%
[O II]	26.6%	25.0%	20.0%	18.0%	5.0%	0%	1.7%	1.7%	3%	0%

Table 2. Modules and parameters employed in CIGALE for the SED fittings of the emitters.

Star formation history (SFH)	sfh_delayedbq	tau_main: 2000.0, 6000.0, 8000.0 Myr age_main: 3000.0, 4000.0, 6000.0, 8000.0, 9000.0 Myr age_bq: 10, 25, 500, 1500 Myr r_sfr: 0., 0.2, 0.7, 1., 3., 5.
Single stellar population (SSP)	BC03 Bruzual & Charlot (2003)	metallicity: 0.004, 0.008, 0.02, 0.05 IMF: Chabrier
Nebular emission	Nebular	Ionisation parameter: -4.0, -2.0, -1.0 Gas metallicity: 0.004, 0.02
Dust attenuation	dustat_modified_starburst Calzetti et al. (2000)	E_BV_lines: 0., 0.01, 0.05, 0.1, 0.3, 0.5, 0.7, 0.9, 1.1 UV_bump_with: 0.0, 3.0 Powerlaw_slope: -1.5, -0.5, 0.0, 0.5
Dust emission	dl2014 Draine et al. (2014)	umin: 0.100, 1.000, 10.00, 50.00 powerlaw slope: 1.0, 1.3, 1.7, 2.3, 2.7, 3.0

**Fig. 2.** Histogram of the value of the reduced χ^2 from the CIGALE fits. The dotted green line, the dashed blue line, and the solid orange line represent the values of H α , [O III], and [O II] emitters respectively. The vertical dash-dotted black line represents the value of $\chi^2 = 10$.**Fig. 3.** Histogram of the logarithm of the L_{TIR} obtained from CIGALE. Colours and line types coded as in Fig. 2. The vertical dotted black line indicates the luminosity limit for LIRGs ($10^{11} L_{\odot}$), and the vertical dash-dotted line indicates the luminosity limit for ULIRGs ($10^{12} L_{\odot}$).

4. The main sequence of galaxies

4.1. Star formation rate

The SFR can be estimated from hydrogen recombination lines of H II regions (see Kennicutt 1998 and references therein), since they scale linearly with ionizing photons produced by recently formed OB stars. This SFR estimate is actually an average of the star formation history over the last 10 Myr (see Cervi o et al. 2016, for a formal description). In the case of the optical range, when Balmer lines are not available, some intense collisional forbidden lines have, as in [O II] (e.g. Kewley et al. 2004) or [O III] (e.g. Suzuki et al. 2016), been proposed as a SFR estimate, although, since such lines do not scale linearly with the

ionizing flux of OB stars (Villaverde et al. 2010), extra assumptions would be needed about the ionization structure and flux of the galaxy, and to include a metallicity dependence in their use as a SFR tracer.

Another alternative is to use the total infrared luminosity (L_{TIR}) as an estimate of the SFR, although in this case it produces a value averaged over the last 100 Myr, a time span much larger than the one obtained from emission lines. Using L_{TIR} will give us the possibility of employing all the subsets, sampling the whole range of redshifts, and therefore different windows on the age of the Universe.

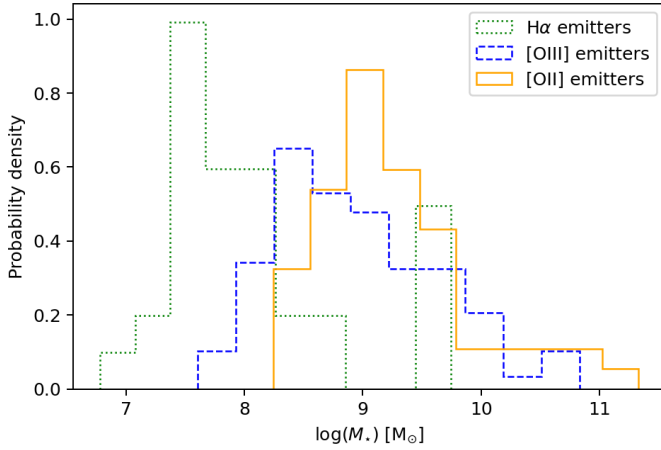


Fig. 4. Histogram of the logarithm of the stellar mass obtained from CIGALE fit of the subsets emitters. Colours and line types are coded as in Fig. 2.

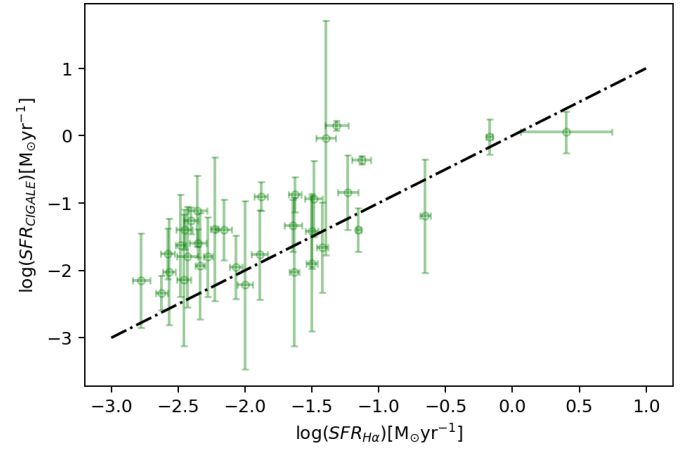


Fig. 6. Logarithm of the instantaneous SFR obtained by CIGALE vs the logarithm of the SFR from H α emission line. The dash-dotted line represents 1:1 equivalence.

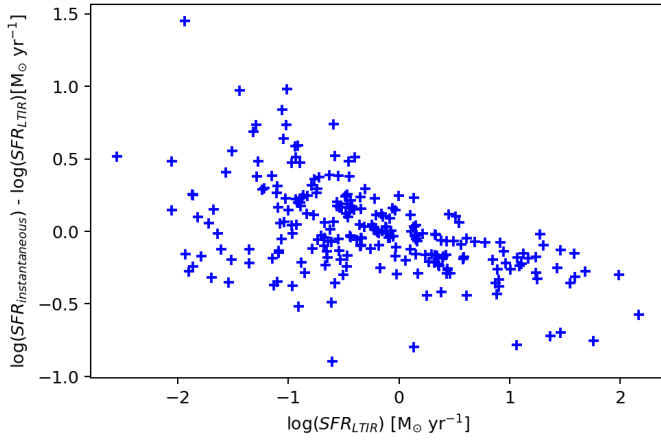


Fig. 5. Difference between the logarithm of SFR_{instantaneous} and the logarithm of SFR_{LTIR} as a function of the logarithm of SFR_{LTIR} for all the emitters in the sample.

The SFR from the L_{TIR} can be calculated following Kennicutt & Evans (2012):

$$\log(\text{SFR}) = \log(L_{\text{TIR}}) - 43.41, \quad (3)$$

where the SFR is expressed as units of solar masses per year and L_{TIR} has units of ergs per second.

The values for L_{TIR} are part of the output of CIGALE. We can compare this SFR from L_{TIR} (thereafter SFR_{LTIR}) with the SFR given by the SFH of the CIGALE fit. In Fig. 5, we represent the difference between the logarithm of SFR_{LTIR} and the logarithm of the instantaneous SFR from the derived SFH, SFR_{instantaneous}, as a function of the logarithm of SFR_{LTIR}.

We should expect a constant value of the difference, with some dispersion and an offset around 0. However, there is a clear dependence on the SFR_{LTIR}. Such a dependence indicates that galaxies with very low emission in the IR part of the spectrum present lower SFR_{LTIR} values than expected. This means that the determination of L_{TIR} is not accurate, at least for low-luminosity galaxies. This could be due to a problem with obtaining the dust luminosity from CIGALE without enough information in the IR part of the SED. In fact, most of the emitters are largely devoid of IR data, with only a select number of galaxies having data

at MIPS24 μm and at longer wavelengths, as can be seen in Table 1. It is possible that the lack of IR constraints generates problems when calculating L_{TIR} for CIGALE. This behaviour has been reported for other models of SED fittings (Hunt et al. 2019) but not on CIGALE. Taking this into account, we used the SFR given directly by CIGALE from the SFH. As previously seen, low-mass galaxies have low dust content, so L_{TIR} is also low. For this reason, those galaxies are not detected at IR wavelengths, and L_{TIR} in general is not a good indicator of the SFR. On the other hand, the CIGALE SFR we are going to use is bayes.sfh.sfr, which corresponds to the instantaneous SFR (Boquien et al. 2019), while the SFR from L_{TIR} provides a measure of the SFR obscured by the extinction (Calzetti et al. 2000; Kennicutt et al. 2009). This instantaneous SFR should be pretty similar to the one obtained by the emission of the emission lines. In Fig. 6 we have represented the SFR derived from CIGALE against the SFR obtained by H α emission line (from Ram n-P rez et al. 2019) for our subsample of H α emitters. CIGALE derived SFRs have large uncertainties, which generates a large scatter, and there are few galaxies with H α derived SFRs. However, taking into account the uncertainties, there is a correspondence between the two quantities.

4.2. Fitting of the main sequence

Taking into account that the parameters presented in Eq. (1) may depend on the age of the Universe, we can rewrite this equation, following Popesso et al. (2023), as

$$\log \text{SFR}(M_*, t) = a_0 + a_1 t - \log \left(1 + (M_*/10^{a_2 + a_3 t})^{-a_4} \right), \quad (4)$$

where $a_0 = 2.68$, $a_1 = -0.186$, $a_2 = 10.83$, $a_3 = -0.0729$, a_4 as γ , where a_1 and a_3 go with inverse time units, and t as the age of the Universe, expressed in gigayears. Employing the parameters a_2 and a_3 , it is possible to parameterize the value of the turnover mass over time.

In Fig. 7 we have represented the histogram of the logarithm of the SFR for all the emitters in the subsamples. It can be seen that the distribution of the emitters is different, with H α emitters presenting lower values of the SFR. A similar effect is seen in Fig. 8, where we show the logarithm of the SFR as a function of age of the Universe. The grey lines are obtained from Eq. (4) and represent the evolution of the SFR of galaxies with fixed stellar

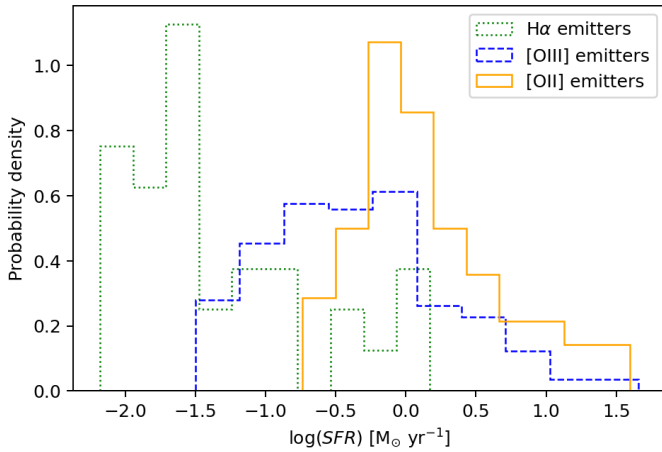


Fig. 7. Histogram of the logarithm of the SFR from CIGALE for all the selected emitters. Colours and line types are coded as in Fig. 2.

masses across time. Although there is a large dispersion, it can be seen that there is an evolution of the SFR with time, with median values of the SFR larger for a lower age of the Universe. This implies a different distribution of the SFR for the $H\alpha$ emitters, as can be seen in Fig. 7, with lower SFR values compared with the other two subsamples. However, it should be noted that we are not detecting low-SFR galaxies at a lower age of the Universe due to its low brightness (the so-called Malmquist effect).

In Fig. 9 we represent the logarithm of the SFR as a function of the stellar mass for the $H\alpha$, [O III], and [O II] emitters. The data were fitted to Eq. (1) following a Monte Carlo procedure. A random value was assigned to each data point within their error bars, and then the entire data were fitted using a least squares minimization algorithm based on the Levenberg–Marquardt method. This process was repeated 10^5 times. For each parameter fitted, it was assumed that the median of all the fittings was their main value, and as their uncertainty the standard deviation was selected. Taking into account the lack of galaxies at higher masses ($\log(M_*/M_\odot) > 10$), it was not possible to determine the value of $SFR_{\max}$ without increasing the uncertainties for the rest of the parameters. Then, we used the value given by Popesso et al. (2023). The results are summarised in Table 3, where we have also included the value of the age of the Universe used in each subsample.

In Fig. 10 we represent the variation in γ as a function of the age of the Universe. Lee et al. (2015) suggested a possible evolution of γ with the age of the Universe, with higher values at higher redshifts. Our results may indicate a different trend if taken alone. However, if we include the data from Popesso et al. (2023) in the context, the general trend is compatible with a constant value of $\gamma = 1$, as stated in Popesso et al. (2023).

In Fig. 11 we represent the turnover mass as a function of the age of the Universe. We have included data from Popesso et al. (2023), Euclid Collaboration: Enia et al. (2026), and Navarro Mart nez et al. (2026). Our results are within the uncertainties presented in the previous works and follow the general trend of lower values of $\log(M_0)$ with the age of the Universe, as stated in Lee et al. (2015). However, our data consistently present a higher value of turnover mass for all samples compared to the data from Popesso et al. (2023).

In Table 4 we summarise the fits to a straight line of the turnover mass with the age of the Universe in the form $\log(M_0) = a_2 + a_3t$, where a_2 and a_3 are the same as in Eq. (4). We can

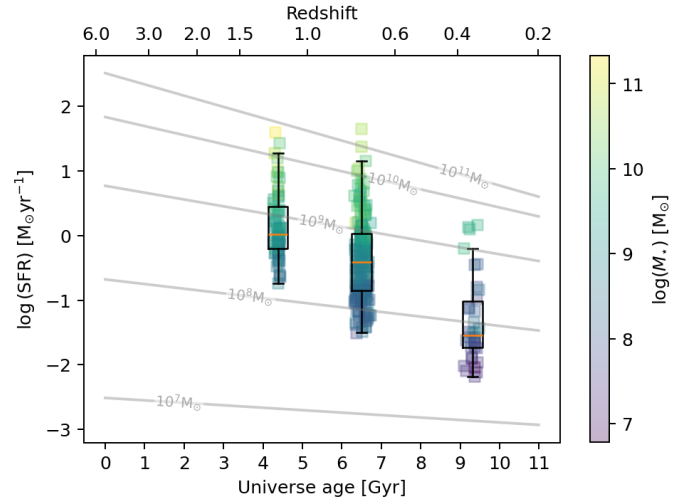


Fig. 8. Logarithm of the SFR as a function of the age of the Universe. The median value is indicated by the orange line. The boxes are defined by the first quartile as the bottom line, and the third quartile as the upper line. The whiskers are calculated as 1.5 times the inter-quartile range. The masses of the emitters are color-coded following the color bar on the right. The grey lines are from Eq. (3) from Popesso et al. (2023).

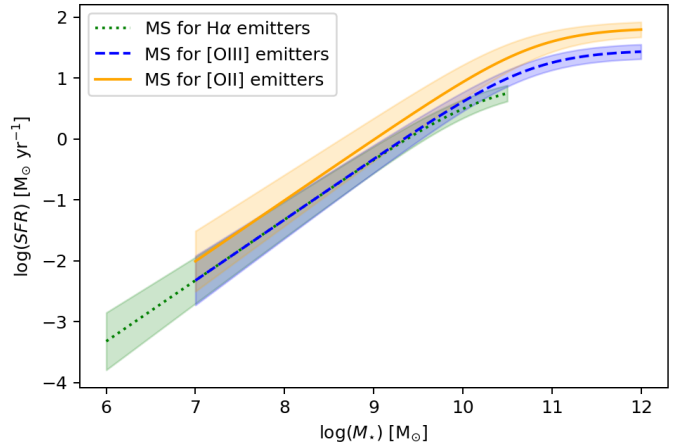


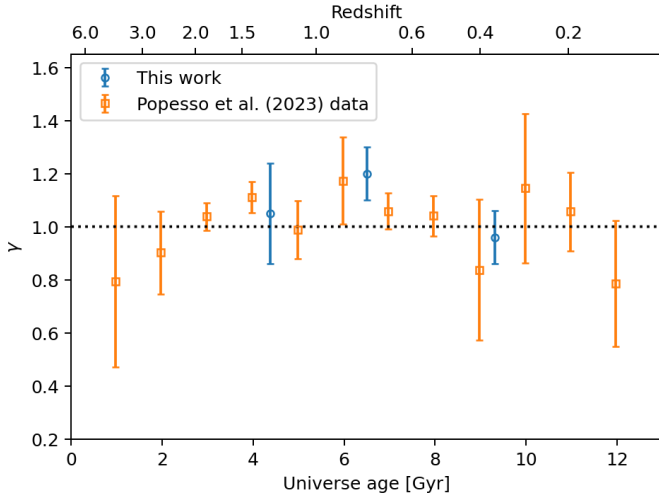
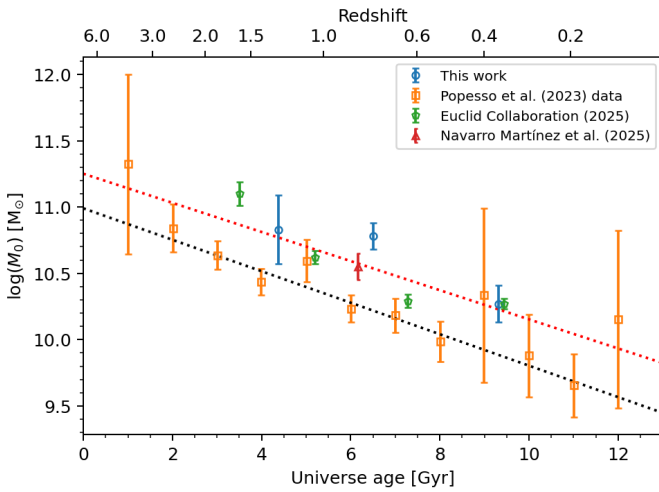
Fig. 9. Fitted MS for the different emitters in the sample following Eq. (1). The dotted green line, dashed blue line, and solid orange line represent the fit for $H\alpha$, [O III], and [O II] emitters, respectively. The shaded areas represents the propagation of 1σ uncertainties.

observe that the main difference lies in the intercept value, a_2 , which is larger for our data, and slightly larger for the combination of our data with Euclid Collaboration: Enia et al. (2026) and Navarro Mart nez et al. (2026) data. However, the differences are within the range of the uncertainties.

Nevertheless, we can explore why the results from Popesso et al. (2023) present a somewhat lower value for the turnover mass compared to our data. If we consider this difference to be a physical one, that means that the sSFR of low-mass galaxies is lower for our emitters when compared with the galaxies from Popesso et al. (2023). This means that our low-mass emitters, the bulk of our sample, are less efficient in forming stars than the galaxies of Popesso et al. (2023). However, from Cedr s et al. (2021b), it is clear, at least for $H\alpha$ and [O II] emitters, that they present a sSFR compatible with so-called normal SFGs, so there has to be another

Table 3. Parameters and fitting results of Eq. (1) for the MS.

Source	Age of the Universe [Gyr]	$\log(\text{SFR}_{\text{max}})$ [$\text{M}_{\odot} \text{yr}^{-1}$]	$\log(M_0)$ [$\text{M}_{\odot}$]	γ	$\log(M_0)$ binned [$\text{M}_{\odot}$]
H α	9.31	0.95 (fixed)	10.27 ± 0.14	0.96 ± 0.10	10.14 ± 0.13
[O III]	6.50	1.46 (fixed)	10.78 ± 0.10	1.20 ± 0.10	10.52 ± 0.11
[O II]	4.38	1.82 (fixed)	10.83 ± 0.26	1.05 ± 0.19	10.85 ± 0.13

**Fig. 10.** Slope of the low-mass regime, γ , as a function of the age of the Universe. Symbols are indicated in the legend.**Fig. 11.** Turnover mass as a function of the age of the Universe. Symbols are indicated in the legend. The dotted black line represents the fit given by Popesso et al. (2023). The dotted red line represents the fit obtained employing the data from Euclid Collaboration: Enia et al. (2026), Navarro Mart nez et al. (2026), and this work.

reason for the difference. It is important to note that the data from Popesso et al. (2023) and our data are very different. Our sample reaches very low SFR values ($\log(\text{SFR}) < -1.0 [\text{M}_{\odot} \text{yr}^{-1}]$ for H α and [O III] subsamples), while the full dataset by Popesso et al. (2023) stops at $\log(\text{SFR}) \sim -1.0 [\text{M}_{\odot} \text{yr}^{-1}]$. The Popesso et al. (2023) data are a compilation of different obtained SFRs and different selection processes. For example, our data are selected

only by emission line detection, while in the Popesso et al. (2023) compilation there is only one instance of selection by H α emission line between 28 different subsets. Moreover, the SFR indicators are also different, ranging from SED fits (like ours) to a combination of NUV+IR, radio, emission lines, or IR, among others. Although Popesso et al. (2023) performed extensive work to homogenize the different datasets, there is a clear difference in the methods employed in the work presented there, and some dispersion may have been introduced in the final determination of the evolution of MS over time (see, for example, Fig. A.2 from Popesso et al. 2023, where a comparison between different determinations of the SFR is presented). On the other hand, our results are pretty close to those of Euclid Collaboration: Enia et al. (2026), which are based on a homogeneous dataset, although it is a survey that covers a larger surface of the sky, compared to the OTELO survey ($\sim 63 \text{ deg}^2$ for Euclid Collaboration: Enia et al. 2026, and only 56 arcmin^2 for OTELO). It can be assumed then that part of the difference may come from the homogeneity versus inhomogeneity of the datasets.

Furthermore, the differences in the methods of obtaining the MS cannot be overlooked either, because they may play a role in the observed difference, as Popesso et al. (2023) pointed out. In our case, we did not employ the binning in mass while generating the MS, unlike previous works (i.e. Popesso et al. 2023; Daddi et al. 2022; Lee et al. 2015, or Euclid Collaboration: Enia et al. 2026).

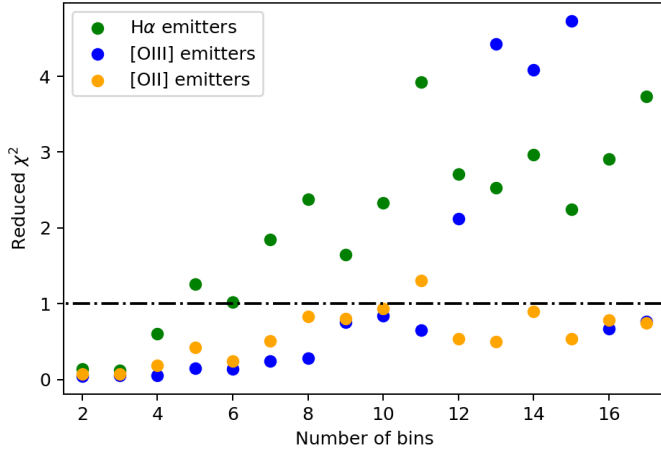
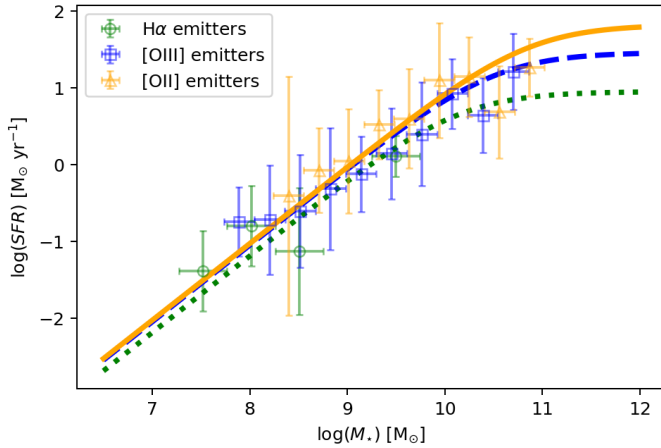
4.3. Binning the data for the MS

In order to make a comparison with the rest of the data, we chose to bin our data. Taking into account that the sample variable in the MS is the stellar mass, we decided to bin into equal-size bins in $\log(M_*)$. To select the size (and therefore the number) of bins that best sample our dataset, we generated fits of the MS for 2 bins to 17 bins. We then calculated the weighted average of the SFR in each bin. The weight given to each emitter was the inverse of the quadrature sum of the uncertainties in both the mass and the SFR. In this case, we fixed both values of $\gamma = 1$ and $\log(\text{SFR}_{\text{max}})$. As a metric, to evaluate the goodness of each fit, we employed the reduced χ^2 , and selected as the best fit the one with the closest value to 1. These fits gave us 6, 10, and 10 bins, with a mean value of 6, 18, and 6 galaxies per bin, for H α , [O III], and [O II], respectively. In Fig. 12 is shown the variation in χ^2 with the different number of bins employed. In Table 3 are indicated the values obtained in the turnover mass for each subset of emitters and in Fig. 13 we represent the MS obtained by binning the data.

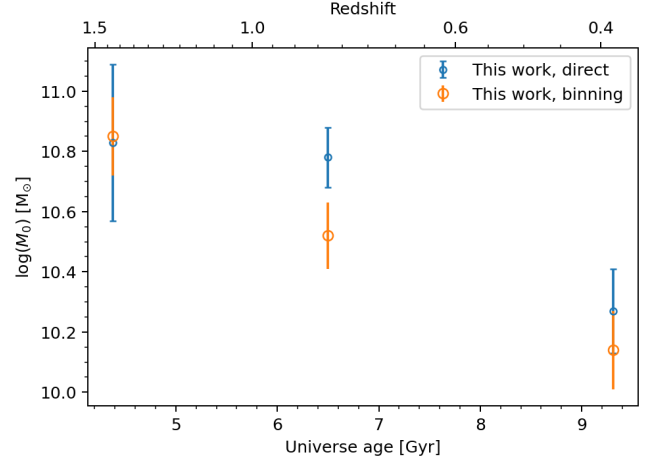
In Fig. 14 we show the comparison of the turnover mass obtained from the direct fit and the turnover mass obtained by binning the data, represented by open blue circles and open orange circles, respectively. The results of the two methods seem to be compatible, although for H α and [O III] the values of the binned turnover mass are lower. The binning may

Table 4. Results of the linear fitting of $\log(M_0)$ with the age of the Universe.

Source	a_2	a_3
Popesso et al. (2023) fit	10.99 ± 0.08	-0.118 ± 0.013
This work only fit	11.68 ± 0.37	-0.146 ± 0.051
Euclid Collaboration: Enia et al. (2026) + Navarro Mart�nez et al. (2026) + this work fit	11.25 ± 0.19	-0.11 ± 0.02

**Fig. 12.** Reduced χ^2 of the fit as a function of the number of bins for each emitter. Symbols are indicated in the legend. The horizontal dashed-dotted line represents a value of $\chi^2 = 1$.**Fig. 13.** Binned MS for the emitters. Symbols are indicated in the legend. The dotted green line, the dashed blue line, and the solid orange line represent the fitted MS for the H α , [O III], and [O II] emitters, respectively.

explain some of the differences between our results and those of Popesso et al. (2023), and the method used to generate the MS may play a role in the determination of the turnover mass. However, the variations seem to be smaller than the ones presented in Fig. 11, and our non-binned results match better with those of Euclid Collaboration: Enia et al. (2026) and Navarro Mart nez et al. (2026), which were obtained by binning the data. It should be taken into account that the compilation from Popesso et al. (2023) has a heterogeneous sample of data from different authors and methods. Even with careful conversions made to the data to homogenise them, there is variability

**Fig. 14.** Turnover mass for our data as a function of the age of the Universe. The open blue circles were obtained by the direct fitting of all the emitters. The open orange circles were obtained by employing the binned data.

that results in values of $\log(M_0)$ with a high uncertainty and this may have an influence on the difference obtained in this work.

5. Conclusions

In this work, we have presented a study in the evolution of the MS of ELGs from redshift 0.38 to 1.43, using three subsamples of ELGs (H α , [O III], and [O II] lines) from OTELO Survey. We confirmed the results from Bongiovanni et al. (2019), where the use of only colour-magnitude relationships techniques in the selection of ELGs will exclude a larger ($\sim 29\%$) number of emitters.

Employing the CIGALE code, we fitted a SED for each galaxy of the subsamples. We selected a value of $\chi^2 < 10$ as a limit to consider a fit as a ‘good’ fit, with mean values for our sample of 1.6, 1.5, and 1.5 for H α , [O III], and [O II], respectively. From the SED fitting, we obtained the stellar mass, L_{TIR} , and SFR of each emitter.

As expected from the previous works (Ram n-P rez et al. 2019; Bongiovanni et al. 2020; Cedr s et al. 2021a; Navarro Mart nez et al. 2021), almost all of the emitters from the three subsets are low-mass galaxies ($< 10^{10} M_\odot$). This, as a consequence, is translated as a small number of LIRGs, and a total absence of ULIRGs in our samples.

We found that the determination of SFR_{LTIR} was not reliable due to a lack of IR constraints in the fitting of the SEDs. The low stellar masses of our emitters also implied low dust masses, and consequently low IR brightness. This means that L_{TIR} is not a good indicator of the SFR for low-mass galaxies. For this reason, we decided to use the SFR directly from the SFH fitted by CIGALE.

We generated the MSs for the $H\alpha$, [O III], and [O II] emitters, and fitted them to the functional form proposed by Lee et al. (2015). From these fits, we derived the slope value of the low-mass regime, γ , and the turnover mass, $\log(M_0)$. Due to our low number of high-mass galaxies ($>10^{10} M_\odot$), we decided to use the value for $SFR_{\max}$ given by Popesso et al. (2023). The results for γ were compatible with a constant value of 1 throughout the age of the Universe, as suggested in Popesso et al. (2023). We also find an evolution of the $\log(M_0)$ with the age of the Universe. However, in this case, the values of M_0 obtained in our fits are larger than the values given in Popesso et al. (2023) for all the redshifts sampled. This trend is also present when including data from Euclid Collaboration: Enia et al. (2026) and Navarro Mart nez et al. (2026). However, the general slope of the variation in $\log(M_0)$ is compatible between our results and the fit from Popesso et al. (2023). When instead of using all emitters, we generated a binned average of the SFR, we obtained values similar to our not-binned results (although still somewhat lower for $H\alpha$ and [O III]). However, it should be noted that the data from Euclid Collaboration: Enia et al. (2026) and Navarro Mart nez et al. (2026) are closer to our results than to those of Popesso et al. (2023). This may be due to the use of more homogeneous data in Euclid Collaboration: Enia et al. (2026), Navarro Mart nez et al. (2026), and this work, compared to the compilation from different sources presented in Popesso et al. (2023). We can assume, then, that at least some of the differences are attributable to the uncertainties introduced by the different methodologies employed.

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