In this work we use a sample of galaxies at 1<z<3 drawn from the GMASS survey (Kurk+13) to study different SFR estimators. In particular, we concentrated mainly on two spectroscopic estimators (the UV luminosity and the [OII]λ3727 emission line) and the infra-red luminosity (LIR). Using LIR to calibrate the other two estimators, we were able to build a set of self-consistent SFR recipes.

1. The multi-wavelength dataset

GMASS (Galaxy Mass Assembly ultra-deep Spectroscopic Survey) is an ESO VLT Large Program project based on data acquired using the FORS2 spectrograph. The sample is pure Tgal limited with a limiting magnitude $m_{AB}(4.5\mu m)<23.0$ (AB).

The photometric catalogue of the GMASS survey was taken as parent sample. Only galaxies with a spectroscopic redshift $1<z<3$ were selected, either from public or from data from other public ESO spectroscopic surveys. The photometric information from U band to PACS data, in the GMASS photometric catalogue, was extended with four IR bands, from 24 to 160 μm, including data from the PACS instrument mounted on the HERSCHEL space observatory.

2. The selection of SFGs

The parent spectroscopic catalogue was cleaned of passive objects and active galactic nuclei (AGNs). Galaxies with a passive-like spectrum were excluded based on their red continuum, metal absorption lines, absence of nebular emission lines. Galaxies with AGN spectral features (like broad emission lines) and/or an X-ray detection in the Chandra 4Ms catalogue and $L_{X}>3\times10^{40}$ ergs were also excluded from the sample.

The validity of LIR as a SFR indicator relies on the assumption that young stellar populations heat dust that when added to the total SFR, leading to an overestimate of the SFR when using LIR as sole estimator. We used three spectroscopic continuum indices: MgUV (2000-2900Å), C29-30 (2900-3300Å), D4000 (3750-4250Å).

3. IR Luminosity

The total infrared luminosity (LIR) is defined as the integrated luminosity between 8-1000 μm. To derive LIR from the UV photometric points (i.e. 24 μm plus at least one Herschel band), we performed a SED fitting procedure, based on 2 minimization, using the MAGPHYS code in its default configuration (da Cunha et al. 2008) and all the available photometric information, from U band to PACS data.

To improve the statistics of the sample, especially at low luminosities, LIR was calculated also for those galaxies with a detection at 24 μm but no PACS data. We adopted the main sequence templates of Magdis (2012) to extrapolate LIR from the 24 μm flux densities. These templates, tested on the sub-sample of PACS detected galaxies, provide LIR values that are highly consistent to those derived using available IR data (mid- and far-IR), with no need of additional corrections.

The SFR Cookbook at 1<z<3

New recipes for spectroscopic estimators

(MU continuum & [OII]λ3727)

Talia et al., 2014 A&A in preparation

The luminosity of the [OII] forbidden line can be calibrated empirically as a quantitative SFR tracer. However, the observed luminosities suffer from dust extinction and should be corrected for that. We found a relation between the UV continuum slope and the rest-frame equivalent width (EW) that motivated us to derive a direct relation between EW and dust attenuation, and obtain a self-consistent way of computing the dust correction for SFR from spectroscopic information alone.

Following the same formalism applied to UV luminosity, we used the IR luminosity to define an extinction correction to be applied directly to the [OII] flux: $A_{[OII]}=\frac{A_{IR}}{A_{UV}}L_{IR}$

We found an anti-correlation between $A_{[OII]}$ and the rest-frame equivalent width (EW) of the [OII] line: $A_{[OII]} = -3.34 \times \log(\text{EW}_{\text{[OII]}}) + 6.70$.