

Binary interactions and SFR calibrations

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Abstract. We discuss the effect of binary interactions on the tracers of star formation rate (including L_{1500} , L_{2800} , $L_{H\alpha}$, $L_{[OII]}$ and L_{FIR}) at different metallicities (0.0001–0.03).

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1. Models

In this work, we use the evolutionary population synthesis (EPS) models from the Yunnan group and several forms of star formation rate (SFR) tracers to discuss the effect of binary interactions (BIs) on the SFR calibrations.

The main characteristic of the Yunnan models is the inclusion of various BIs. Yunnan models have given the results of SPs with and without BIs at seven metallicities (from 0.0001 to 0.03) and 90 ages (from 0.1 Myr to 15 Gyr). A δ -function SFR, six exponentially decreasing SFRs with timescale $\tau=1, 2, 3, 5, 15$ and 30 Gyr and a constant SFR are used to construct burst-, E-, S0-, Sa-Sd and Irr-type galaxies (see Zhang *et al.* 2012 for details).

2. Results and conclusions

We do two sets of calculations by using the Yunnan models with and without BIs, respectively. We refer to the two sets of models as Models A and B. By comparing the results between Models A and B, we can obtain the effect of BIs on the SFR calibrations. We firstly obtain the luminosity of the $H\alpha$ recombination line ($L_{H\alpha}$), the luminosity of the [OII] $\lambda 3727$ forbidden-line doublet ($L_{[OII]}$), the ultraviolet fluxes at 1500 and 2800 Å (L_{1500} and L_{2800}) and the far-infrared fluxes (L_{FIR}) of burst, E, S0, Sa-Sd and Irr galaxies for both Models A and B at $Z = 0.0001, 0.0003, 0.001, 0.004, 0.01, 0.02$ and 0.03, then present the calibrations of SFR in terms of these diagnostics. Our conclusions are as follows.

- **For the SFR versus $L_{H\alpha}$ conversion factor $C_{H\alpha}$,** the inclusion of BIs lower it by 0.2–0.05 dex. The higher the metallicity, the larger the differences in $C_{H\alpha}$ caused by BIs.
- **For the calibrations of SFR from L_{1500} , L_{2800} and L_{FIR} ,** the effect of BIs is insignificant at all metallicities.
- **For the calibration of SFR from $L_{[OII]}$,** the effect of BIs (0.2–0.05 dex) is the same as that on the SFR versus $L_{H\alpha}$ calibration at all metallicities because $L_{[OII]}$ is obtained by an empirical method, $L_{[OII]}/L_{H\alpha} = 0.45$.

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References

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