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IX. Impact of an evolving stellar initial mass function on early galaxies and reionisation
(Corrigendum)

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1. Intrinsic ionising emissivities and escape fractions for the evolving IMF model

We identified a mistake in the implementation of the evolving stellar initial mass function (IMF) model in ASTRAEUS, which resulted in an overestimation of the intrinsic ionising emissivities of galaxies. Consequently, the ionising escape fraction, $f_{\rm esc}^0$, was underestimated. After correcting the ionising emissivity calculations, we now find $f_{\rm esc}^0 = 0.071$, whereas it was previously reported as $f_{\rm esc}^0 = 0.038$. Fig. C1 shows the new relations between the intrinsic and escaping ionising emissivities and halo mass (Fig. C.1a and C.1c in the published manuscript). We briefly comment on the changes in these relations. Firstly, the median intrinsic emissivities are lower by about a factor of two at all redshifts and for all halo masses, due to correcting the previous overestimate. Secondly, the overall shape of the relations is now more similar to those of the Salpeter IMF: the scatter towards lower ionising emissivities has significantly increased for halo masses below $M_h \simeq 10^{10.2}\,{\rm M}_\odot$, $10^{9.8}\,{\rm M}_\odot$, and $10^{9.5}\,{\rm M}_\odot$ at $z = 6, 8$, and 12, and median emissivities drop by 1–2 orders of magnitude below $M_h \simeq 10^{8.8}\,{\rm M}_\odot$, $10^{8.4}\,{\rm M}_\odot$, and $10^{8.4}\,{\rm M}_\odot$ at $z = 6, 8$, and 12, both for the intrinsic and escaping ionising emissivities.

Comparing the corrected ionising emissivity relations for the evolving IMF with those of the Salpeter IMF, we conclude: Firstly, as the mass-to-light ratio remains lower for the evolving IMF, its median intrinsic ionising emissivity is still always larger than that of the Salpeter IMF. Secondly, since the ionising escape fraction, $f_{\rm esc}$, does not depend on the ionising emissivity in our model, the relation between the median escaping ionising emissivity and halo mass remains flatter for the evolving than for the Salpeter IMF at higher halo masses ($M_h \gtrsim 10^{10}\,{\rm M}_\odot$). Thirdly, the scatter in the ionising emissivities is larger in lower-mass halos ($M_h \lesssim 10^{10}\,{\rm M}_\odot$) by about 0.2 dex and extends to more massive halos (by about 0.3 dex) in the evolving IMF model compared to the Salpeter IMF model. Both effects are due to the evolving IMF model's stronger and more immediate supernova feedback.

Finally, since the change in intrinsic ionising emissivities is offset by the adjustment of $f_{\rm esc}^0$, the impact on the ionisation history, ionisation maps, and 21cm power spectra remains negligible.

2. Equation for galaxy star formation efficiency

The equation describing the maximum star formation efficiency of a galaxy contained a typographical error, which propagated into Eq. (5) as well. The equations, as implemented in ASTRAEUS, are

$$f_{\star,\rm max} = f_\star \frac{\tau_{\rm dyn}(z=9)}{\tau_{\rm dyn}(z)} \frac{\Delta t}{20\,{\rm Myr}}$$

and

$$f_w^{\rm eff}(z) = \frac{f_w}{1 + \left(\frac{\Delta t}{20\,{\rm Myr}} - 1\right)\frac{M_g^{\rm mer}(z)}{M_g^i(z)}}. \qquad (5)$$

3. Equation for the evolving IMF

Equation (12) contained an incorrect normalisation due to a typographical error in the manuscript. The implementation in ASTRAEUS was correct and simulation results are unaffected. The correctly normalised form of the evolving IMF is

$$\frac{{\rm d}N}{{\rm d}M} = \begin{cases} (1 - f_{\rm massive})\ \frac{\gamma+2}{M_{\rm c}^{\gamma+2} - M_{\rm i}^{\gamma+2}}\ M^{\gamma}, & M_{\rm i} \le M < M_{\rm c} \\ f_{\rm massive}\ \frac{1}{M_{\rm f} - M_{\rm c}}\ M^{-1}, & M_{\rm c} \le M \le M_{\rm f} \end{cases} \qquad (12)$$

with $\gamma = -2.35$.

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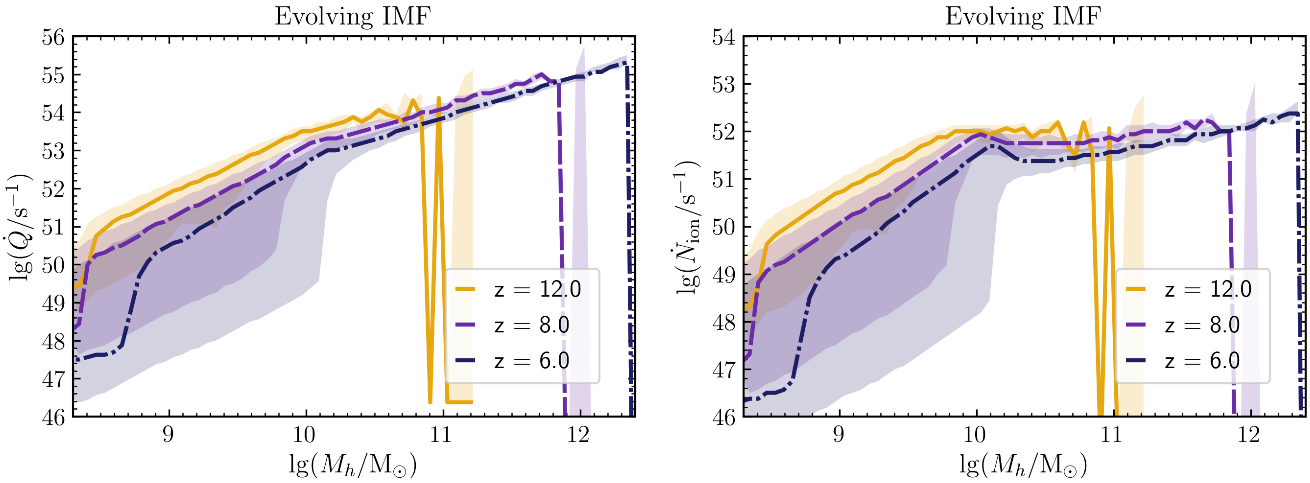

(a) Intrinsic ionising emissivity for the evolving IMF model

(c) Escaping ionising emissivity for the evolving IMF model

Fig. C1. Intrinsic (left) and escaping (right) ionising emissivities as a function of halo mass, M_h, for the evolving IMF model at $z = 6$ (dark blue), 8 (violet), and 12 (orange). Solid lines show the median ionising emissivity, and transparent shaded coloured regions the 1σ limits of the ionising emissivity values at a given halo mass.

4. Luminosities for continuous star formation

The equations describing the ionising emissivities, $\dot{Q}(t)$, and UV luminosities, $L_\nu(t)$, of stars forming with the evolving IMF implemented in ASTRAEUS were previously stated with incorrect units. The correct units for Equation (15), which describes the UV luminosity for a starburst, are

$$\frac{L_\nu(t, z, Z)}{\mathrm{erg\,s^{-1}\,\mathring{A}^{-1}\,M_\odot}^{-1}}. \tag{15}$$

The correct units for Equations (A.1) and (A.2), describing the time evolution of the ionising emissivity and UV luminosity with a constant star formation rate, are

$$\frac{\dot{Q}(t, t_i, t_f, s_0, z, Z)}{\mathrm{s}^{-1}} \tag{A.1}$$

and

$$\frac{L_\nu(t, t_i, t_f, s_0, z, Z)}{\mathrm{ergs^{-1}\mathring{A}^{-1}}}, \tag{A.2}$$

respectively.