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Evidence of environmental dependencies of Type Ia supernovae from the Nearby Supernova Factory indicated by local Hα *(Corrigendum)*

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While undertaking the next phase of analysis of the correlation of Type Ia supernova (SN Ia) brightnesses with properties of their local host environments, we discovered a software error affecting the measurements used in Rigault et al. (2013). The measurements of host-galaxy Hα emission, $\Sigma_{\mathrm{H}\alpha}$, and resulting local star formation rate, LSFR, measured for the environment surrounding each SN in Rigault et al. (2013) where not in units of $M_{\odot}\,\mathrm{yr}^{-1}\,\mathrm{kpc}^{-2}$, as intended, but rather in units of $M_{\odot}\,\mathrm{yr}^{-1}\,\mathrm{arcsec}^{-2}$ averaged over a 1 kpc aperture. Here we provide corrected values for several key quantities, finding that these do not significantly change the main conclusions of the original paper.

At our typical redshift of $z \sim 0.05$, the 1 kpc aperture used in Rigault et al. (2013) has a projected angular size of ~1 arcsec, so the overall scale of the measurements is unchanged. Measurements for SNe Ia spanning our lowest to highest redshift, i.e., $0.03 < z < 0.08$, have scale ranges from 1.65 arcsec per kpc to 0.66 arcsec per kpc, changing $\Sigma_{\mathrm{H}\alpha}$ by at most ±0.4 dex at the redshift extremes and producing an RMS change of 0.2 dex. This is to be compared to the nearly 3 dex range spanned by $\Sigma_{\mathrm{H}\alpha}$.

In Rigault et al. (2013) the sample was divided evenly between SNe Ia in local environments above (Iaα) or below (Iaϵ) $\log(\Sigma_{\mathrm{H}\alpha}) = 38.35$ dex. There we further identified two grouping of SNe Ia: M_1 were those fainter than average and having $\Sigma_{\mathrm{H}\alpha}$values spanning the full observed range, while M_2 were those brighter and having $\Sigma_{\mathrm{H}\alpha}$values below our $\Sigma_{\mathrm{H}\alpha}$ threshold. With the corrections here, this boundary shifts by −0.03 dex, to $\log(\Sigma_{\mathrm{H}\alpha}) = 38.32$ dex.

While the boundary barely moves, some SNe Ia cross the boundary. In particular, two overly bright SNe Ia formerly assigned to the Iaϵ group move into the Iaα group. These SNe Ia were part of a group of three cases discussed in Sect. 7.3 of Rigault et al. (2013), where we explored the impact of moving the $\Sigma_{\mathrm{H}\alpha}$ threshold and the potential impact of misassociations for Iaϵ with the Iaα group due to boosting by the warm interstellar medium (WIM) or accidental projection onto H II regions. One of these is just below our original inclination cut, reinforcing projection as an issue for this case. We originally decided that these SNe Ia belong to the M_2 group and they lie more than $4\,\sigma$ from the M_1 group, so we retain them in the M_2 group even though their corrected $\Sigma_{\mathrm{H}\alpha}$ values are now slightly higher.

Figure 1 shows the distribution of Hubble residuals with the corrected $\Sigma_{\mathrm{H}\alpha}$ values, to be compared with the top and bottom panels of Fig. 6 in the original paper. The two SNe Ia mentioned above are highlighted using a lighter shading to fill their markers. It is apparent that the bimodality originally discovered in Rigault et al. (2013) is still present. The dispersion of the Iaα group remains tight, 0.114 ± 0.013 mag, after rejecting the (now 3)

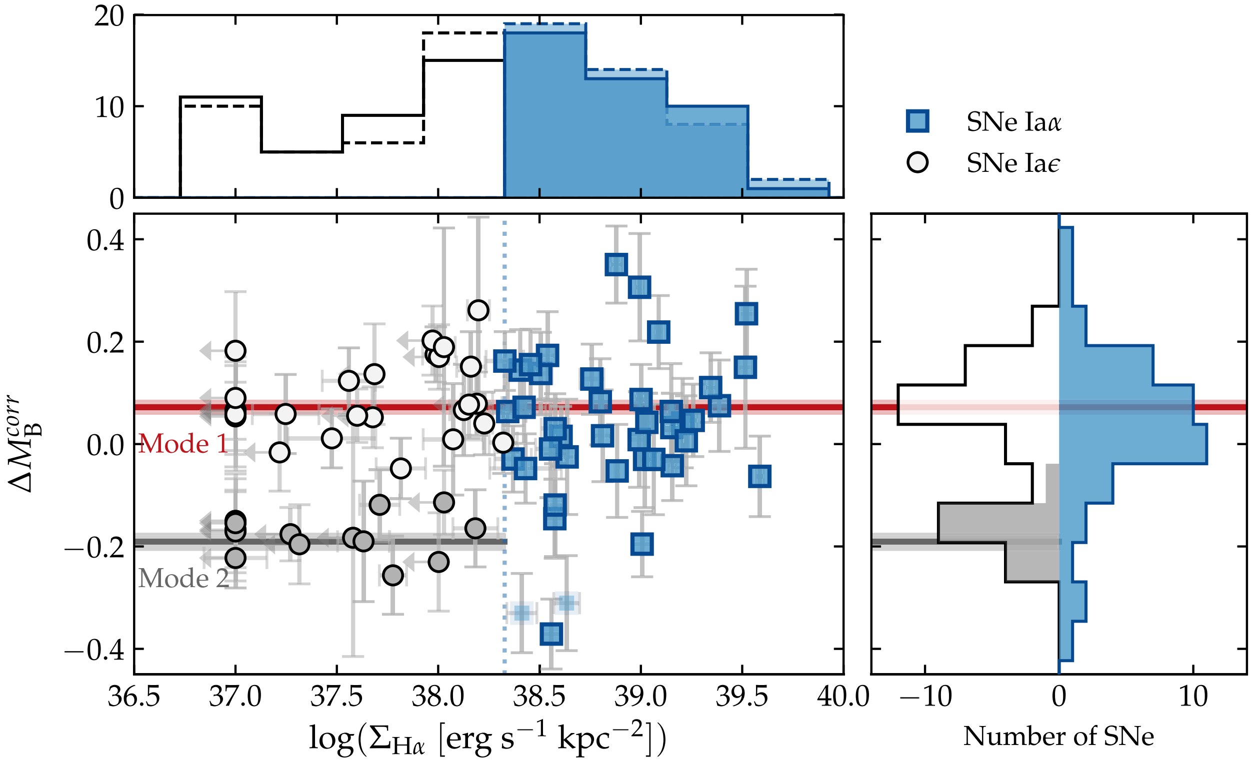

Fig. 1. Hubble residuals versus the now-corrected $\Sigma_{H\alpha}$ within 1 kpc surrounding each SN Ia. Squares represent Iaα SNe Ia, while circles represent those categorized as Iaϵ. Among the Iaϵ, those with lighter gray belong to M_1, while those with darker gray are in M_2. The two SNe Ia that are overly bright and that have now moved above the SFR threshold (vertical dashed line) are shaded light blue. The *original* means of the M_1 and M_2 subsamples are shown as horizontal lines, and labeled accordingly. It can be seen that the two modes have moved slightly closer together. The *upper panel* shows the $\Sigma_{H\alpha}$ histograms for the corrected (solid line) and the original (dashed line) values.

bright SNe Iaα, and the dispersion of the Iaϵ group remains larger, at 0.143 ± 0.016 mag. The difference in standardized magnitudes now has a step of 0.063 ± 0.029 mag between SNe Ia in the Iaα and Iaϵ groups, within the error bar of the original 0.094 ± 0.031 mag. The offset between the means of the M_1 and M_2 samples is 0.260 ± 0.020 mag, compared to the original 0.262 ± 0.019 mag. As these values are essentially unchanged, our estimate for the evolution of the step in Hubble residuals with host galaxy mass and its implications for cosmology still hold. The correlations originally noted between $\Sigma_{H\alpha}$ and the light curve stretch ($x1$) and color (c) are also unaffected.

Subsequent to the analysis in Rigault et al. (2013) we have developed a more refined metric describing the local environments of SNe Ia (Rigault et al. 2015). This metric, the local specific star formation rate (LsSFR), more accurately separates these environment into younger and older categories. When applying this new indicator to the Rigault et al. (2013) dataset (as corrected here) the offset in brightness between SNe Ia from low and high LsSFR environments is 0.110 ± 0.030 mag. For completeness, we also note that this error has no effect on the results of Rigault et al. (2015), which used GALEX data and separate computer code.

References

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