Star clusters and black holes in galaxies across cosmic time
Proceedings IAU Symposium No. 312, 2014
Y. Meiron, S. Li, F.-K. Liu & R. Spurzem, eds.

doi:10.1017/S1743921315007917

The grey extinction curve in NGC 3603

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Abstract. We use photometry in the *F220W*, *F250W*, *F330W*, *F435W* filters from the High Resolution Channel of the Advanced Camera for Surveys and photometry in the *F555W*, *F675W*, and *F814W* filters from the Wide Field and Planetary Camera 2 aboard the Hubble Space Telescope to derive individual stellar reddenings and extinctions for member stars in the HD 97950 cluster in the giant H II region NGC 3603. Within the standard deviation associated with $E(\lambda - \mathrm{F555W})/\mathrm{E(F435W - F555W)}$ in each filter, the cluster extinction curve at ultraviolet wavelengths tends to be greyer than the average Galactic extinction laws from Cardelli *et al.* (1989) and Fitzpatrick *et al.* (1999). It is closer to the extinction law derived by Calzetti *et al.* (2000) for starburst galaxies, where the 0.2175 μm bump is absent.

Keywords. star cluster, extinction, reddening

1. Extinction Curve in NGC 3603

We have obtained extinctions in the *F220W*, *F250W*, *F330W*, *F435W*, *F555W*, *F675W*, and *F814W* filters for the a hundred cluster main-sequence (MS) member stars in the HD 97950 cluster in NGC 3603. The membership of these stars was determined via relative proper motions in Pang *et al.*(2013). We adopt the foreground reddening from Pandey *et al.* (2000), with an assumption of a Fitzpatrick (1999) extinction law for the foreground ($R_V = 3.1$). After correcting for foreground reddening, the total to selective extinction ratio is $R_{F555W} = 3.75 \pm 0.87$ in the cluster.

In Figure 1, we plot the mean extinction curves for the MS members (black line) already corrected for the foreground extinction, and compare it with Cardelli *et al.*'s ($R_V = 3.1$, 1989), Fitzpatrick's ($R_V = 3.1$, 1999), and Calzetti *et al.*'s ($R_V = 4.05$, 2000) extinction laws (red dashed lines). We normalize the extinction curves to both the visual color excess $E(F435W - F555W)$ (upper panels) and extinction A_λ/A_{F555W} (lower panels). Within the standard deviation associated with $E(\lambda - \mathrm{F555W})/\mathrm{E(F435W - F555W)}$ (error bars), the extinction curve (black line) we obtained for the HD 97950 cluster (upper panels) tends to be greyer than the Galactic extinction laws with $R_V = 3.75$ (red solid lines) and $R_V = 3.1$ (red dashed lines, Cardelli *et al.* 1989; Fitzpatrick 1999) in the near-UV. The cluster extinction curve is closer to the extinction law of Calzetti *et al.* (2000), especially in the UV pass bands (black box). This indicates an anomalous extinction in NGC 3603, which may due to the clumpy dust distribution within the cluster, and the size of dust grains being larger than the average Galactic ISM.

Acknowledgements

This work is funded by Shanghai Key Lab for Astrophysics, No: SKLA1301; and by National Natural Science Foundation of China, No: 11347205.

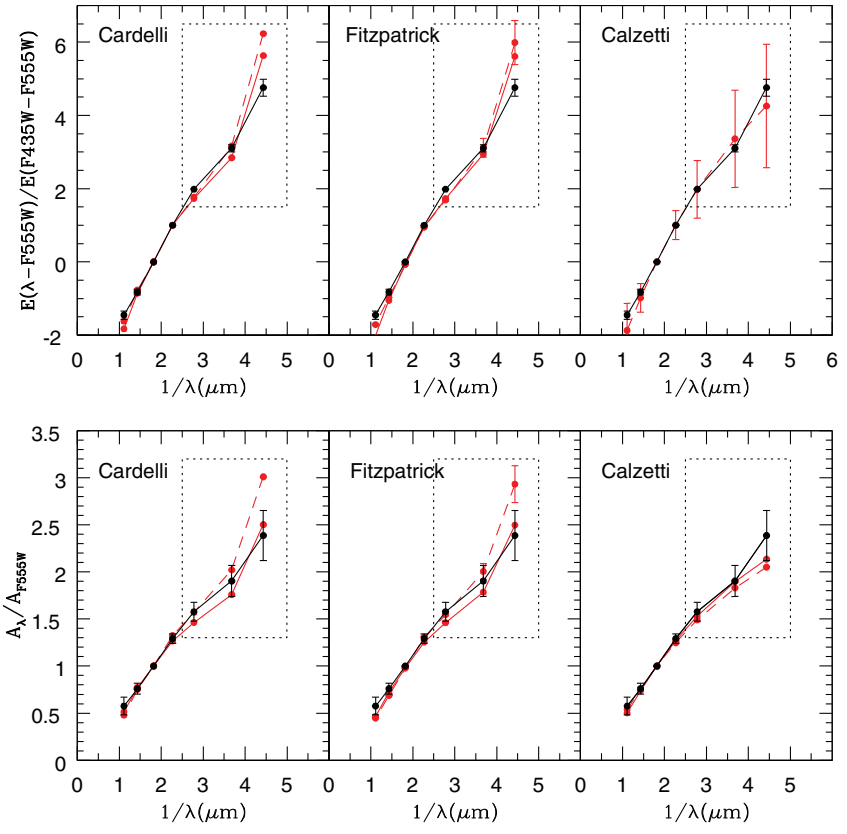

Figure 1. Mean extinction curve $E(\lambda - \mathrm{F555W})/\mathrm{E(F435W - F555W)}$ (upper panels) and A_λ/A_{F555W} (lower panels) for the HD 97950 cluster in NGC 3603 (black lines) already corrected for foreground extinction. The red solid lines trace Cardelli *et al.*'s (1989), Fitzpatrick's (1999) and Calzetti *et al.*'s (2000) extinction laws with the same value of R_V as the cluster ($R_V = 3.75$). The red dashed lines are the average Galactic extinction laws ($R_V = 3.1$) of Cardelli *et al.* (1989) and Fitzpatrick (1999), and Calzetti *et al.*'s (2000) extinction law for starburst galaxies ($R_V = 4.05$). The error bars are the standard deviation associated with $E(\lambda - \mathrm{F555W})/\mathrm{E(F435W - F555W)}$ and A_λ/A_{F555W} in each filter. Uncertainties of Fitzpatrick's (1999) and Calzetti *et al.*'s (2000) extinction laws are also indicated with error bars. For Fitzpatrick's (1999) extinction law, its uncertainty approaches zero for wavelengths larger than 4000 Å owning to the normalization to visual band. No such information is available for Cardelli *et al.*'s (1989) extinction law. The dashed black boxes cover the UV filters where the cluster extinction curve differs most dramatically from the reference extinction laws.

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Pang, X., Grebel, E. K., Allison, R. J., *et al.* 2013, *ApJ*, 764, 73

https://doi.org/10.1017/S1743921315007917 Published online by Cambridge University Press