A Comprehensive Comparative Test of Seven Widely-Used Spectral Synthesis Models Against Multi-Band Photometry of Young Massive Star Clusters

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We test the predictions of spectral synthesis models based on seven different
massive-star prescriptions against Legacy ExtraGalactic UV Survey (LEGUS)observations of eight young massive clusters in two local galaxies, NGC 1566 and NGC 5253, chosen because predictions of all seven models are available at the published galactic metallicities. The high angular resolution, extensive cluster inventory and full near-ultraviolet to near-infrared photometric coverage make the LEGUS dataset excellent for this study. We account for both stellar and nebular emission in the models and try two different prescriptions for attenuation by dust. From Bayesian fits of model libraries to the observations, we find remarkably low dispersion in the median E(B-V) (~0.03 mag), stellar masses (~10^4 M_\odot) and ages (~1 Myr) derived for individual clusters using different models, although maximum discrepancies in these quantities can reach 0.09 mag and factors of 2.8 and 2.5, respectively. This is for ranges in median properties of 0.05-0.54 mag, 1.8-10x10^4 M_\odot and 1.6-40 Myr spanned by the clusters in our sample. In terms of best fit, the observations are slightly better reproduced by models with interacting binaries and least well reproduced by models with single rotating stars. Our study provides a first quantitative estimate of the accuracies and uncertainties of the most recent spectral synthesis models of young stellar populations, demonstrates the good progress of models in fitting high-quality observations, and highlights the needs for a larger cluster sample and more extensive tests of the model parameter space.

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