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Empirical Dust Models

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ABSTRACT

dust

Keywords: keyword1 – keyword2 – keyword3

1. INTRODUCTION

2. SIMULATIONS

2.1. *Illustris TNG*

describe what galaxy properties (SFH, ZH, etc) are available TODO

2.2. *SIMBA*

describe what galaxy properties (SFH, ZH, etc) are available TODO

2.3. *Spectral Energy Distributions*

describe how the SED is generated using the SFH and ZHs TODO

2.4. *Forward Modeling SDSS Photometry and Spectra*

3. EMPIRICAL DUST MODELING

$$F_o(\lambda) = F_i(\lambda) 10^{-0.4 A(\lambda)} \tag{1}$$

where F_o is the observed flux, F_i is the intrinsic flux, and $A(\lambda)$ is the attenuation curve.

$$A(\lambda) = A_V \frac{k(\lambda)}{k_V} \tag{2}$$

Throughout we use the slab model (Somerville & Primack 1999) for the V band attenuation:

$$A_V = -2.5 \log \left[\frac{1 - e^{-\tau_V \sec i}}{\tau_V \sec i} \right] \tag{3}$$

i is the inclication, which we uniformly sample

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3.1. *Naive Model*

We use Calzetti (2001)

$$k_{\rm Cal}(\lambda) = \begin{cases} 2.659(-1.857 + 1.040/\lambda) + R_V, & 6300\AA \leq \lambda \leq 22000\AA \\ 2.659(-2.156 + 1.509/\lambda - 0.198/\lambda^2 + 0.011/\lambda^3) + R_V & 1200\AA \leq \lambda \leq 6300\AA \end{cases}$$

and

$$\tau_V = m_\tau \log\left(\frac{M_*}{10^{10}M_\odot}\right) + c_\tau \tag{4}$$

We also split the attenuation on the star light and nebular emission

$$F_o(\lambda) = F_i^{\rm star}(\lambda)10^{-0.4A(\lambda)} + F_i^{\rm neb}(\lambda)10^{-0.4A_{\rm neb}(\lambda)} \tag{5}$$

where we parameterize

$$A_{\rm neb}(\lambda) = f_{\rm neb}A(\lambda) \tag{6}$$

3.2. *Less Naive Model*

We use the attenuation curve from Noll et al. (2009)

$$k(\lambda) = (k_{\rm Cal}(\lambda) + D(\lambda))\left(\frac{\lambda}{\lambda_V}\right)^\delta \tag{7}$$

λ_V is the V band wavelength. $D(\lambda)$ is the bump.

$$D(\lambda) = \frac{E_b(\lambda\Delta\lambda)^2}{(\lambda^2 - \lambda_0^2)^2 + (\lambda\Delta\lambda)^2} \tag{8}$$

we assume fixed $\lambda_0 = 2175\AA$ and $\Delta\lambda = 350\AA$. E_b is the strength of the bump. δ, the slope of the attenuation curve, also correlates with galaxy properties. Kriek & Conroy (2013), and **?** more recently with simulations, demonstrated E_b correlates with the slope of the attenuation curve. So we parameterize δ and E_b:

$$\delta(M_*) = m_\delta \log\left(\frac{M_*}{10^{10}M_\odot}\right) + c_\delta \tag{9}$$

$$E_b = m_E\ \delta + c_E \tag{10}$$

3.3. *Less Less Naive Model*

We use the attenuation curve from Noll et al. (2009)

$$\tau_V = m_{\tau,1} \log\left(\frac{M_*}{10^{10}M_\odot}\right) + m_{\tau,2}\log{\rm SFR} + c_\tau \tag{11}$$

$$\delta(M_*, {\rm SFR}) = m_{\delta,2} \log\left(\frac{M_*}{10^{10}M_\odot}\right) + m_{\delta,2}\log{\rm SFR} + c_\delta \tag{12}$$

$$E_b = m_E\ \delta + c_E \tag{13}$$

table of free parameters

3.4. *Likelihood-Free Inference*

Approximate Bayesian Computation with Population Monte Carlo Hahn et al. (2017), discussion of observables and distance metric Ishida et al. (2015)

4. RESULTS

5. SUMMARY

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APPENDIX

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