Forward modelling galaxy colours (No 325)

ePoster

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The modelling of galaxy spectral energy distributions has wide-ranging applications in astronomy, from gaining insight into the fundamental properties that shape galaxy evolution to setting unbiased constraints on cosmological parameters. Among the properties shaping the light of a galaxy, the star formation history (SFH) is one of the most challenging to model due to the variety of physical processes regulating the formation of stars in a galaxy. Using stellar population synthesis models and SFHs predicted by the cosmological hydrodynamical simulation IllustrisTNG and the empirical model UniverseMachine, I show that the influence of physically-motivated SFH variations on broad-band optical colours is strikingly simple: these variations modify galaxy colours along a single direction in colour space, the SFH-direction. Then, using SFH models with adjustable levels of star formation variability, I show that the precision of galaxy colours degrades as the level of star formation variability not resolved by SFH models increases and that variability in metallicity and dust attenuation presents practically a negligible impact on colours relative to star formation variability. I provide a fitting function capturing the impact of star formation variability on colours, which can be used to determine the minimal SFH model that leads to colours with target precision. Finally, I show that modelling the colours of individual galaxies with per cent level precision demands resorting to complex SFH models, while producing precise colours for galaxy populations can be achieved using models using just a few degrees of freedom.