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Aspects of the Interstellar Medium in Starburst Galaxies

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We are engaged in a multifaceted program to investigate the stellar content and star formation history of actively star-forming galaxies. A large body of stellar spectra have been examined to identify spectral features characteristic of specific stellar types. These spectral diagnostics are then calibrated in terms of temperature (spectral type), gravity (luminosity class) and metallicity. The spectral data is compiled into a stellar library whose members represent specific locations in the HR diagram. Through the use of population synthesis techniques, both optimizing and evolutionary approaches, the stellar luminosity function in composite populations can be determined by analysis of their integrated light. We have concentrated on the ultraviolet wavelength region ($\lambda\lambda$ 1200 – 3200), utilizing the *IUE* archives supplemented by additional observations. In the optical, virtually all stars will contribute to the integrated light. In the ultraviolet however, cool stars will produce negligible flux due to their steep ultraviolet-to-visual continua, greatly simplifying the investigation of the hot component in a composite population.

Our initial stellar library has been applied to several blue compact galaxies, (BCGs), a class of starburst galaxy which is UV luminous. BCGs possess a complex interstellar medium which affects the emergent stellar continuum in several ways. This presents a challenge to the stellar analysis but affords insight into the properties of the gas and dust from which the massive OB stars have formed.

The optimizing synthesis method solves for the stellar luminosity function and extinction simultaneously. This therefore provides an independent measure of the extinction affecting the hot population component. Despite the rise of the reddening law towards the ultraviolet, BCGs are found to be brighter in the ultraviolet than expected. In general, measured extinctions are low, ($0.0 \leq E(B-V) \leq 0.35$), and found to be lower than values determined from Balmer line ratios or 6_{cm} thermal radio continuum fluxes. Use of the Balmer decrement to deredden galaxy continuum spectral energy distributions may be erroneous. The lack of heavy extinction implies a modest dust content in the star-forming regions. There is a trend for the more luminous starbursts to exhibit larger extinction. Haro 1, the most luminous object in our sample may be a link between 'ordinary' starbursts and the dusty systems observed by *IRAS*.

The 2200 Å interstellar extinction feature is not observed in most BCGs although a definitive analysis is hindered by the signal-to-noise characterisitics of the long wavelength cameras on *IUE*. We have recently detected a strong 2200 Å bump in a starburst nucleus of unusually high ultraviolet surface brightness. Its depth is ≈60% of the interpolated continuum at the center and is believed to be the strongest 2200 Å feature observed in a composite extragalactic population.

Additionally, spectra of star-forming regions can be affected by interstellar absorption lines. Most of the observed features are found to arise in the stellar component but the interpretation is muddled in the case of resonance lines such as Mg II $\lambda\,2800$ which are both very prominent in stellar spectra and commonly seen in absorption from the gas. Mg II $\lambda\,2800$ is detected in most of our sample of BCGs.

An ionizing photon rate can be determined directly from the derived stellar population. Employing standard assumptions this rate can be used to predict observables such as I(Hα) and S_{6cm} in other bandpasses. Predicted values of the 6_{cm} flux are compared with observations. The ratios of predicted to observed flux are found to be in the range 0.36 – 0.72 for 5 objects with known 6_{cm} fluxes. Although no firm conclusions can be drawn with this limited sample the results imply that the ionizing population is accurately modeled. We believe that this 'multiple constraint' approach whereby predictions derived from data in one bandpass are compared to observations in other bandpasses promises to provide greatly improved accuracy to models of starburst systems.