Spectroscopic Bulge–Disc Decomposition: a new method to study the evolution of lenticular galaxies

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Introduction

Lenticular galaxies (S0s) are seen as a transitional phase between spirals and ellipticals, and understanding their origins is a key stage in understanding galaxy evolution. We present a new method to study the star formation histories of the bulges and discs of S0s. Spectroscopic bulge–disc decomposition is similar to multi-waveband photometric decomposition, but uses the light profile for individual wavelengths instead of wavebands. A two-dimensional spectrum is divided into two one-dimensional spectra representing the bulge and disc light. These spectra can provide clues to the star formation histories of each component, and thus the galaxy's evolution.

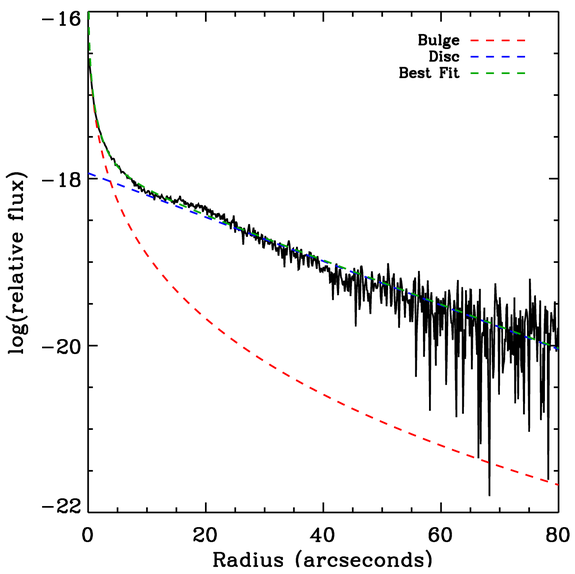

Figure 1. Light profile of NGC 1375 at 5195 Å, showing the best fit from bulge and disc models.

Spectroscopic Bulge–Disc Decomposition

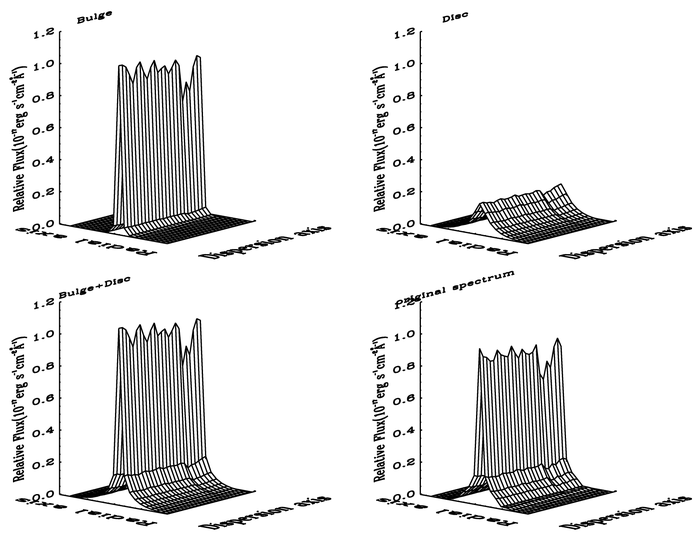

Figure 2. Section of the bulge, disc and composite models, with the original spectrum of NGC 1381 for comparison.

From a two-dimensional spectrum, the luminosity is plotted against the radius at each wavelength. The light profile is fitted with a de Vaucouleurs bulge[1] and an exponential disc[2] (see figure 1), and model spectra produced like those in figure 2. The total luminosity of bulge and disc at each wavelength is calculated by integration, and plotted against wavelength to give the decomposed spectra shown in figure 3.

Applications

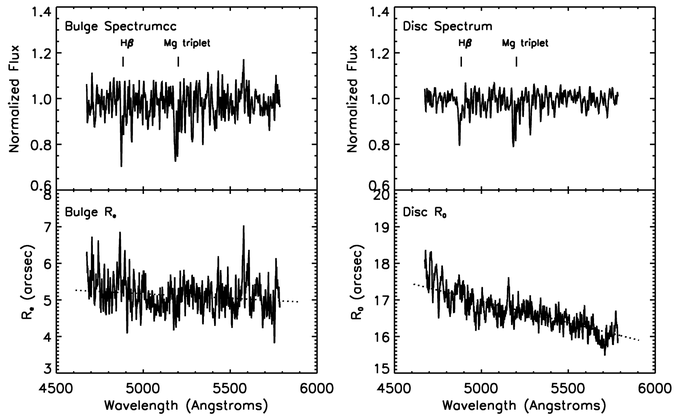

Figure 3. Decomposed bulge and disc spectra for NGC 1375 (top), and variation in R_e and R_0 with wavelength (bottom).

This technique works best where both components are well resolved, with little contamination from dust lanes or bars.

Possible analysis includes comparisons of:

- Ages and metallicities,
- Colour gradients,
- Line strength gradients,
- Age and metallicity gradients,

within the bulge and disc of a galaxy.

References

1 de Vaucouleurs G., 1953, MNRAS, 113, 134

2 Freeman K. C., 1970, ApJ, 160, 811