

Automated morphological classification of galaxies using wavelet transform

Didier Curty¹, François C. Cuisinier^{2,1}, Carlos R. Rabaça²

¹ Observatório Nacional / MCT

² Observatório do Valongo / UFRJ

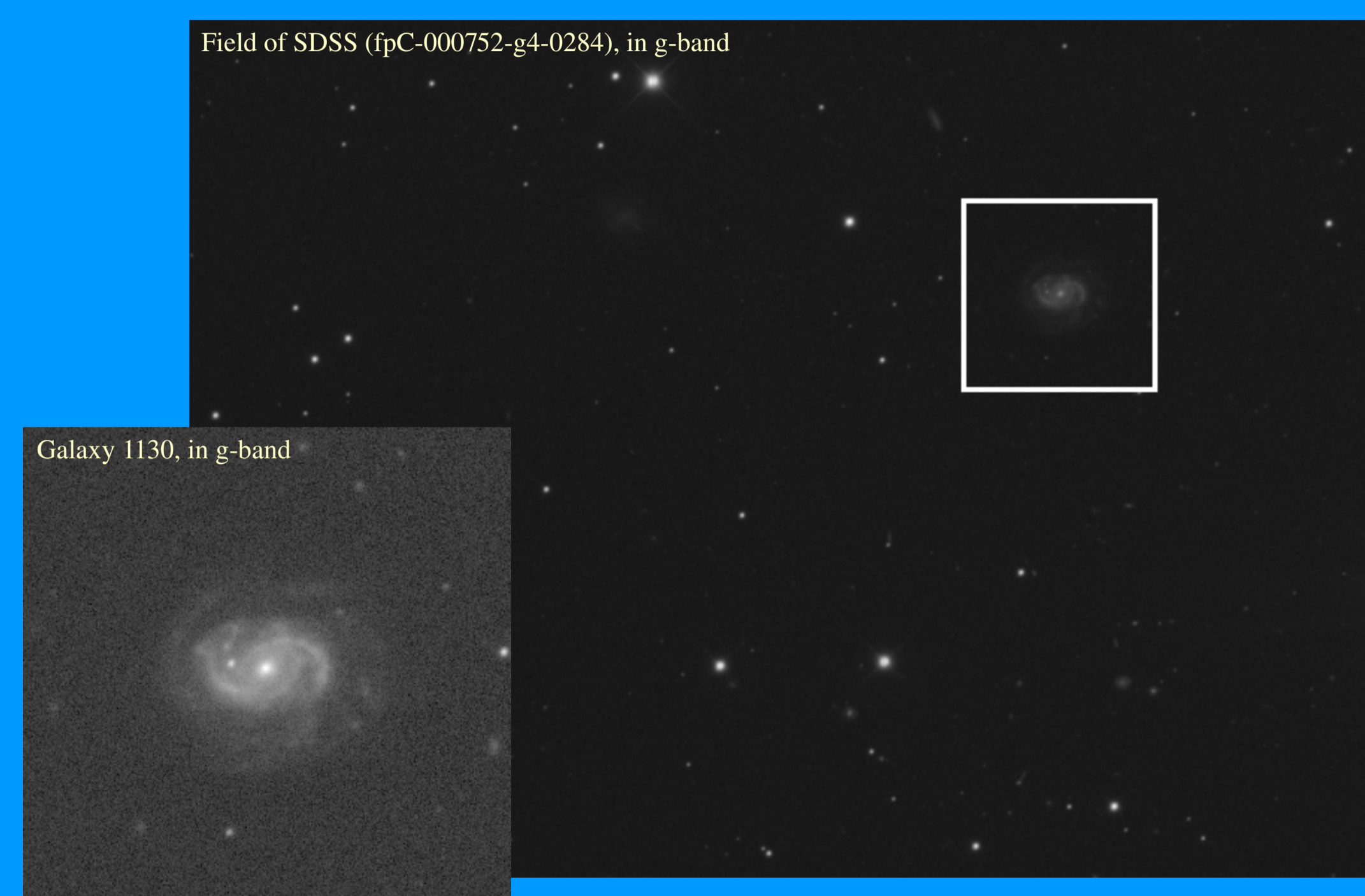
ABSTRACT

We pretend to analyse the galaxy lumpiness and the distribution of lumps in order to investigate the possible methods of automated classification for irregular galaxies, where the visual classifications are not efficient.

All images are shown in logarithmic scale.

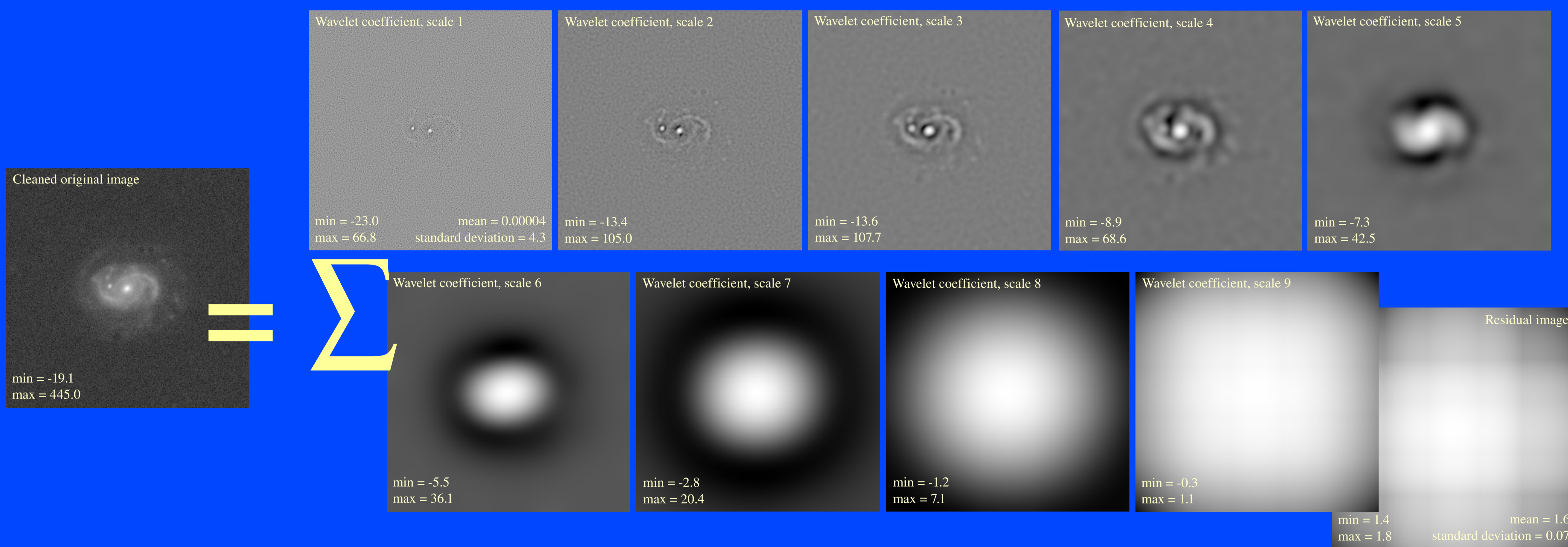
THE SAMPLE

We base our study on a sub-sample of 2253 visually classified galaxies from the Sloan Digital Sky Survey (Fukugita et al., 2007) covering the equatorial area with $145^\circ < \alpha < 236^\circ$; that means in the Virgo.



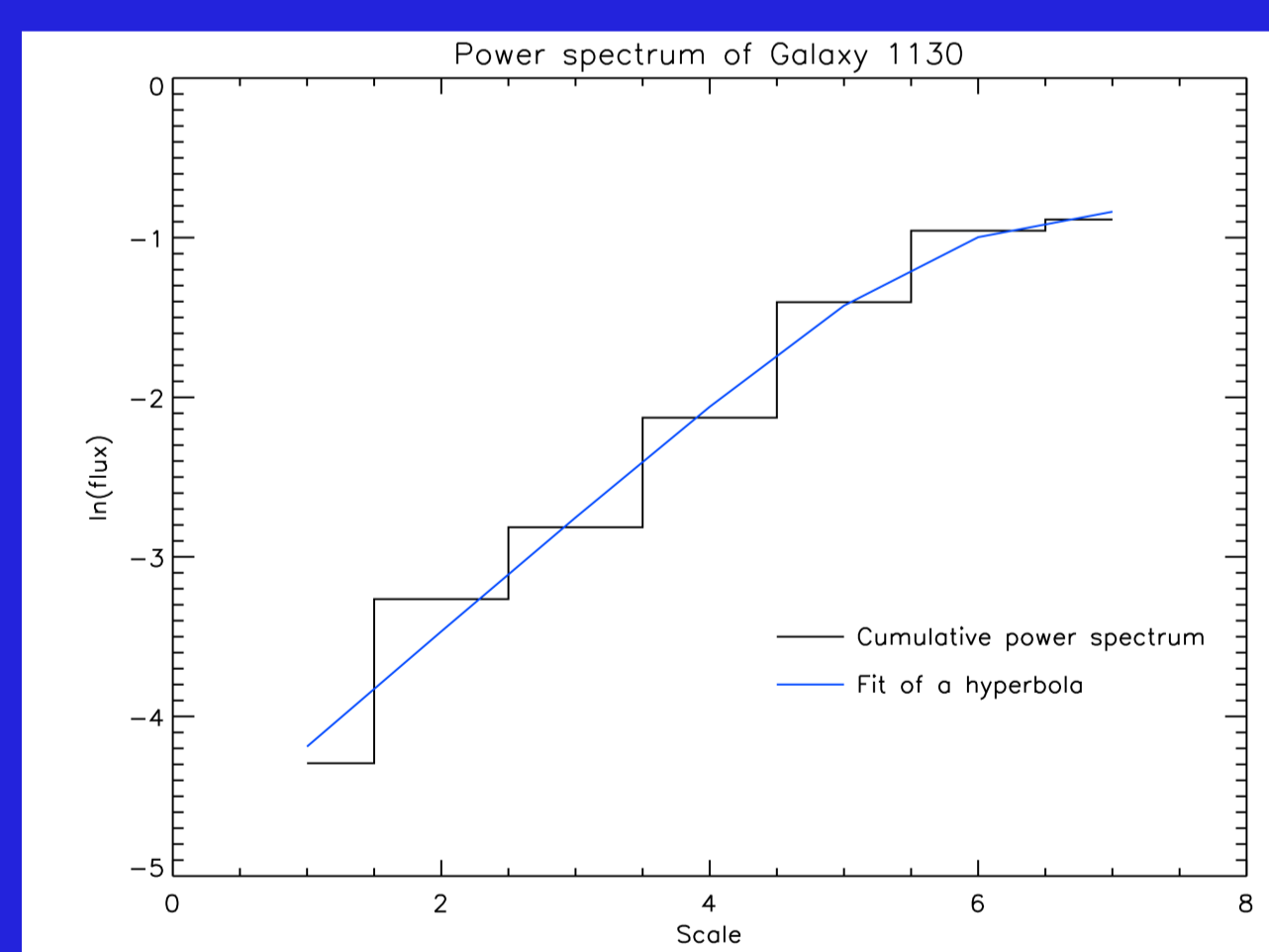
THE WAVELET TRANSFORM

The wavelet transform projects an image on finite and located basis, which spacial scale varies. The wavelet coefficients are therefore a representation of the structures contained in the image. They are images forming only of objects with a characterized size. The wavelet transform acts to segregate the objects (bulge, stellar clusters, spiral arms, high star formation regions) in function of their size.

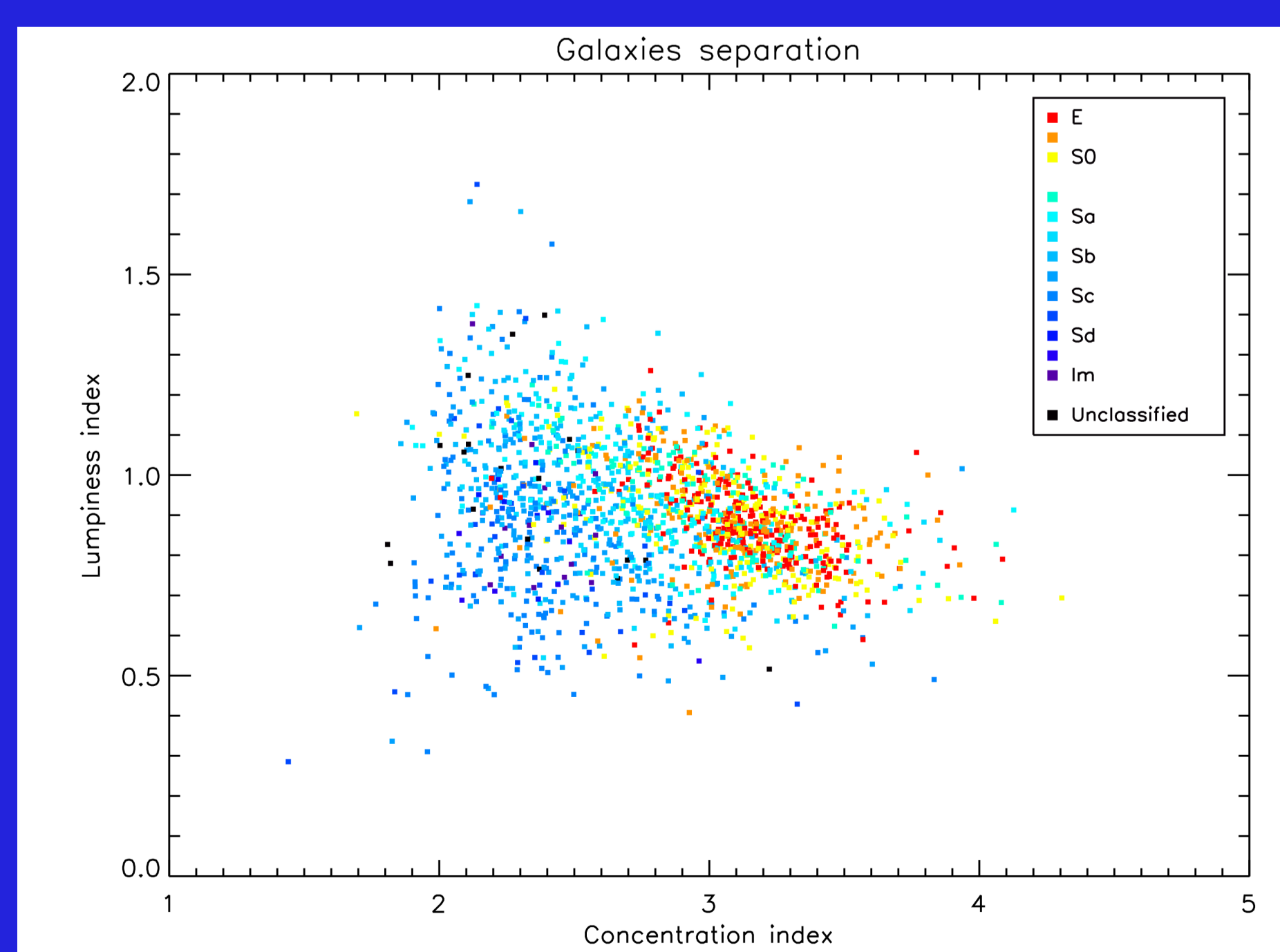


POWER SPECTRUM AND LUMPINESS INDEX

The fluxes of the wavelet coefficients describe the cumulative power spectrum of spacial frequencies. Based on this spectrum, we propose a quantification of the structuration - that means the measurement of the lumpiness - of the galaxies. The lumpiness index is defined as the inclination of the power spectrum (in logarithmic scale).



As expected, the lumpiness index keeps small and quite invariant for earlytype galaxies. In the opposite, for latetype galaxies, it covers a large range of values and can be much larger. Combined with a second parameter, as the concentration index, the lumpiness index is able to successfully separate galaxy types.



DETECTION OF OBJECTS AND RADIAL DISTRIBUTION

In each wavelet coefficient, luminous peaks are detected. A peak present on two successive coefficients defines an object. The distribution of objects in function of the deprojected distance to the galactic center shows a different behaviour according to the galaxy type. The irregular galaxies seems to manifest a double peak of lumps, which can be assimilated to star-forming complexes.

