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Cylindrical Harmonic Galaxy Classification[1] JEFF RIESS, MICKEY KUTZNER, Andrews University, ANDREWS UNIVERSITY TEAM — In this study, we investigate the use of features in the Spherical Harmonic power spectra to aid in the classification of galaxies. Let $I(r, \theta)$ represent a galaxy image function in polar coordinates. The image function may be represented as a two-dimensional Fourier-Bessel series. The coefficients in the expansion, $A_{n,i}$ and $B_{n,i}$, multiply the radial Bessel functions of order n, $J_n(\alpha_{n,i} r/R)$ and the polar functions $cos(n\theta)$ and $sin(n\theta)$, respectively. The coefficients are known as the Fourier-Bessel Transform (FBT) of $I(r, \theta)$. The parameter $\alpha_{n,i}$ is the ith root of the Bessel function of the first kind of order n, $J_n(x)$, and R is the radius to the edge of the galaxy image. We have computed the coefficients $A_{n,i}$ and $B_{n,i}$ for a number of representative FBT spectra. Spectra are presented as 3D plots of the modulus of $A_{n,i}$ and $B_{n,i}$ versus the root number, i, and the order n. Radial structures (such as spiral arms) are manifested in the spectra as peaks in amplitude at certain values of i, whereas, azimuthal variations are seen as amplitude peaks at particular values of n. Since each galaxy type will have a unique spectrum type due to its distinct matter distributions, we investigate the possibility of automatically classifying galaxies by minimizing the Euclidean distance of the galaxy's FBT spectrum to typical spectra of each morphological type.

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