On the bulge-to-disk size ratio for spiral galaxies

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From a detailed structural analysis of the sample of spiral galaxies from de Jong & van der Kruit (1994), we present new results on the bulge-to-disk size ratio as a function of morphological type. A Sersic $r^{1/n}$ bulge and an exponential disk model, both convolved with an appropriate Gaussian PSF, were simultaneously applied to the galaxy light profiles to obtain the best-fitting bulge effective radius, r_e, and disk scale-length, h. The Hubble sequence of spiral galaxies is scale-free if the ratio of these two quantities is uncorrelated with morphological type, and this was in fact claimed to be the case by de Jong (1996) and also Courteau et al. (1996) using R-band data. Although, applying exponential bulge models to the K-band data resulted in the mean r_e/h ratio for the early-type spirals being smaller than mean r_e/h ratio for the late-type spirals at the 98% significance level. However, early-type spiral galaxy bulges are known to be better described with models having Sersic shape parameters $n>1$ (Andredakis, Peletier, & Balcells 1995; Graham & Prieto 1999). It was therefore of interest to re-evaluate the above claim allowing for the full range of bulge profile shapes that exist and can be described by the Sersic $r^{1/n}$ model. In so doing, the mean r_e/h ratio for the early-type spirals (Sa,Sab,Sb) was found to be significantly (3σ) larger than the mean r_e/h ratio obtained when using the exponential bulge models. Intriguingly, the mean r_e/h ratio for the early-type galaxies was discovered to be larger than the mean r_e/h ratio for the late-type (Scd–Sm) spirals at only the 1.5-2σ significance level in the optical bands and at the 1σ significance level in the K-band. These results only weakly suggest, in the traditional optical passbands (B and R), that the Hubble sequence for spiral galaxies is not scale-free.

References

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