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Elliptical Galaxies in Different Environments – Isolated versus Group Environment

Abstract:

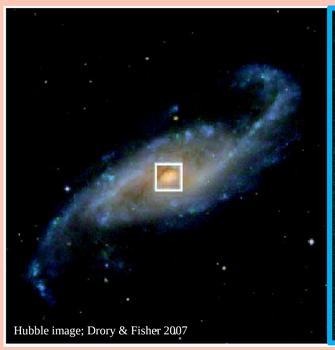
We explore the properties of elliptical galaxies in different environments (isolated galaxies versus crowded environments, i.e., groups with 4-10 galaxy members). Using a Fortran code (BUDDA – Bulge Disk Decomposition Analysis), we model the photometric parameters that describe each elliptical galaxy in terms of size and light profile. We then compare the derived model-dependent measures between the two samples of galaxies to test if they are statistically different, which would hint at gravitational influences of the neighbors. This process would allow us to gain more insight into the formation and evolution of elliptical galaxies.

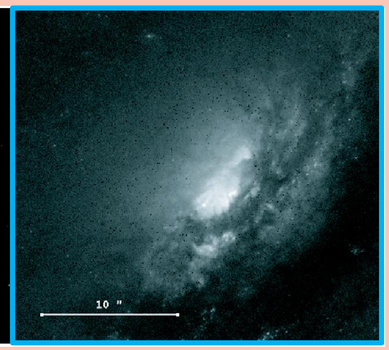
Sample selection: N=4 CIG (isolated) & N=35 LGG (group)

- E0-E7 galaxies
- available images in SDSS DR8
- $1500 < V_{Recession} < 5500$ km/s

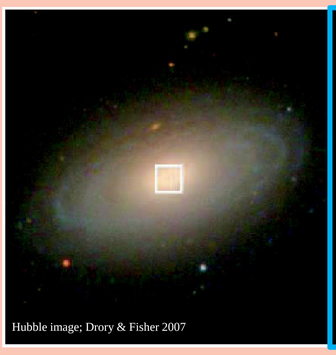
CIG – **C**atalog of **I**solated **G**alaxies
LGG –**L**yon **G**roup of **G**alaxies

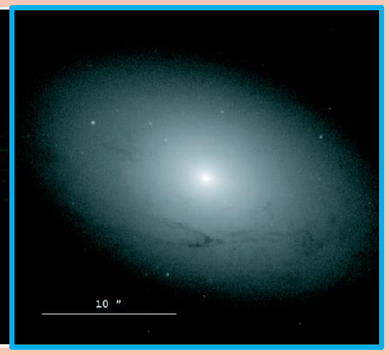
PSEUDO BULGE





CLASSICAL BULGE





Bulge/Disk /Bar Image Decomposition

BUDDA Fortran Code (**BU**lge/**D**isk **D**ecomposition **A**nalysis)- de Souza et al. 2004

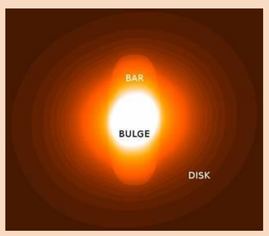
Bulge: **(Sérsic profile)**

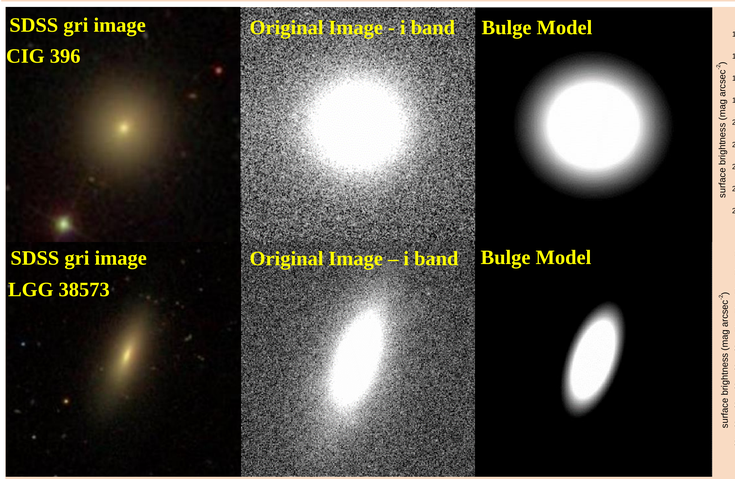
$$I(r) = I_e 10^{-b_n[(r/r_e)^{1/n}-1]}$$

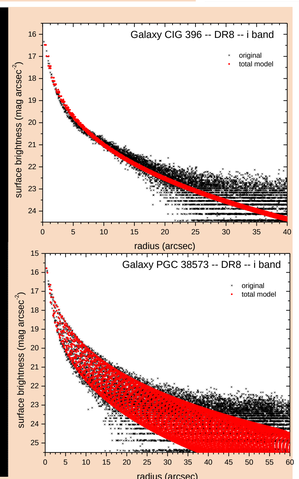
I_e - effective intensity

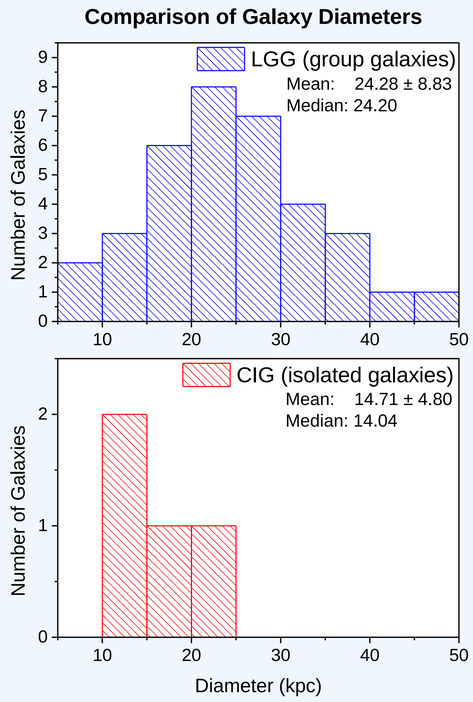
r_e – effective radius

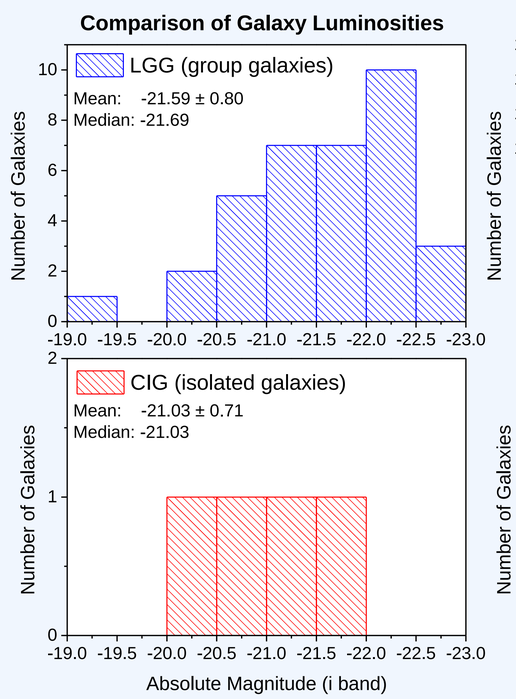
n – Sérsic index

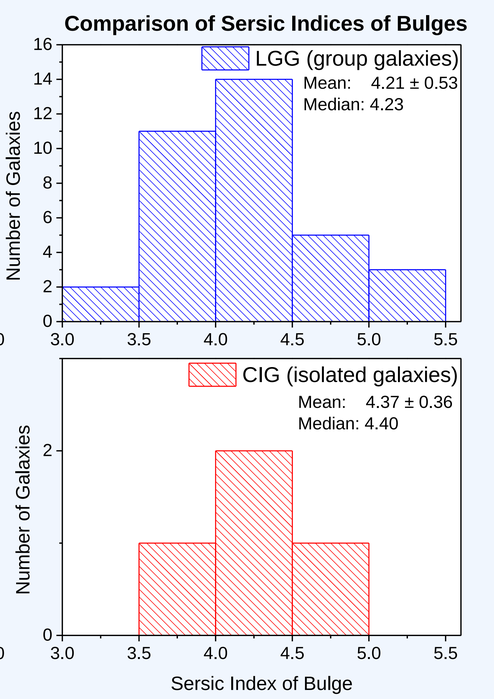




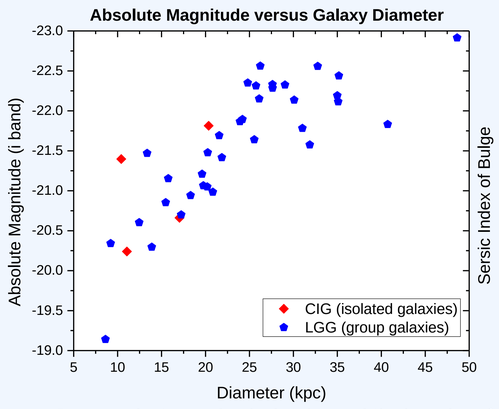


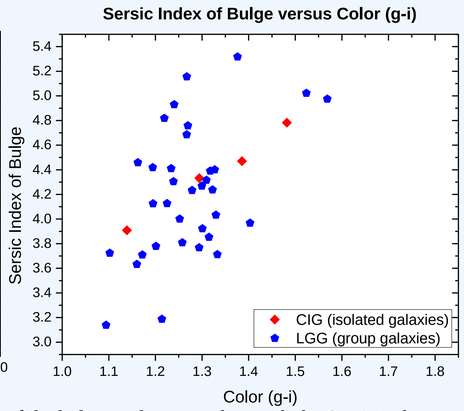




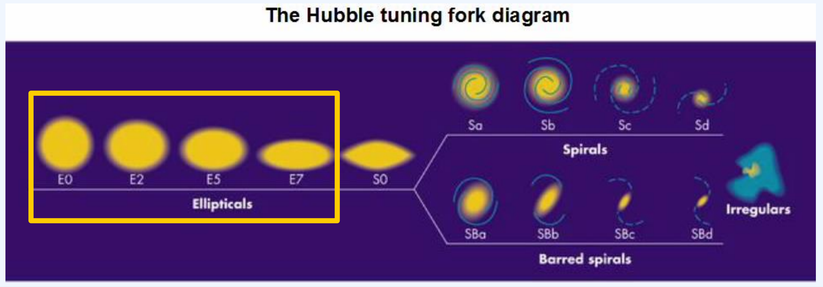


- Compared to CIG (isolated) galaxies, LGG (group) galaxies tend to be larger (left histograms) and more luminous (middle histograms). Both samples have similar Sersic indices (right histograms).

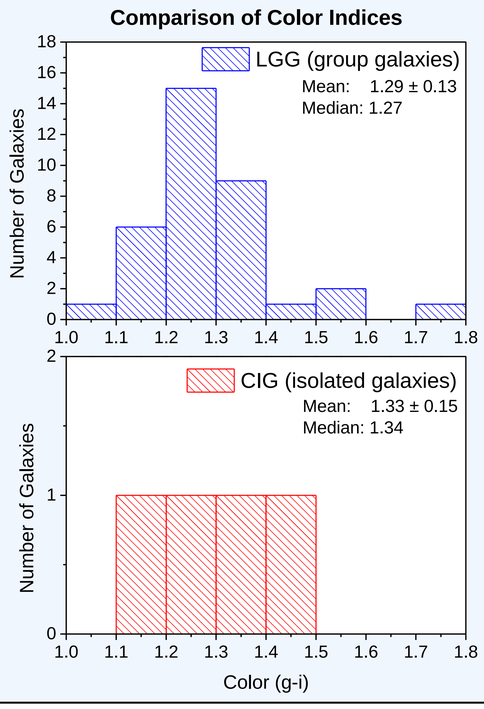




- Larger galaxies tend to be brighter, while the color of the bulge tends to correlate with the Sersic index (redder galaxies have higher Sersic index) – see graphs above.
- Both samples have similar colors (right histograms).



- It has been proposed that galaxies with bulges characterized by $n_{bulge} < 2.5$ contain pseudobulges and galaxies with bulges characterized by $n_{bulge} > 2.5$ contain classical bulges. Both samples (isolated and group samples) contain 100 % classical bulges. Classical bulges are the product of mergers, whereas pseudobulges are the product of "secular" evolution.



Conclusions and Future Work

- Elliptical galaxies in group (nurtured) environments seem to be larger and more luminous than those in isolated environments. Both samples are comprised of galaxies with classical bulges ($n_{bulge} > 2.5$) with similar colors (red). Theoretical models predict that pseudobulges form through internal processes as a result of secular evolution, while classical bulges form by mergers. This might suggest that elliptical galaxies in both samples consumed their surrounding neighbors in the past. However, the group sample galaxies more likely experienced additional mergers in the past (compared to the isolated sample), as suggested by their larger sizes.
- The color of the galaxies correlates with the Sersic index of their bulges.
- It has been proposed that bulges in elliptical galaxies can be boxy or disky, with giant ellipticals being more boxy. We could derive the boxiness parameter (ellipse index of the bulge) from the bulge decomposition photometric analysis. We expect that the galaxies in the group sample will be more boxy, and the ones in the isolated sample will be more disky.

Acknowledgements

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