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Project Title: Classification of bulges through spatially resolved kinematics

1. Background:

Numerous studies have found strong correlations between galaxy bulges and global properties of their hosts. Since the role of AGN feedback in a given galaxy likely couples to its bulge properties, these correlations suggest that understanding bulge formation is a crucial component of any complete theory for galaxy evolution and baryon processing. It is accepted that galaxy bulges come in two flavours; disk-like 'pseudo-bulges' and dispersion-supported 'classical' bulges. These bulge types have distinct properties, such as their light profile (or Sersic index), as well as their position in the Kormendy relation between size and surface-brightness. However, these properties are secondary to understanding the distinct origins of these two types of stellar systems because they do not probe the orbits of bulge stars directly.

2. Aims and objectives of the project

We will use open data from the MaNGA survey in SDSS-IV, an IFU survey of thousands of nearby galaxies, to measure the spatially-resolved kinematic structure of galaxy bulges. The kinematic data provides a direct, structural measure of the bulge type as well as the host galaxy. We will use this to test the performance of traditional classification techniques, to disentangle pseudo- and classical-bulge host galaxies, and to study the formation of S0 galaxies.

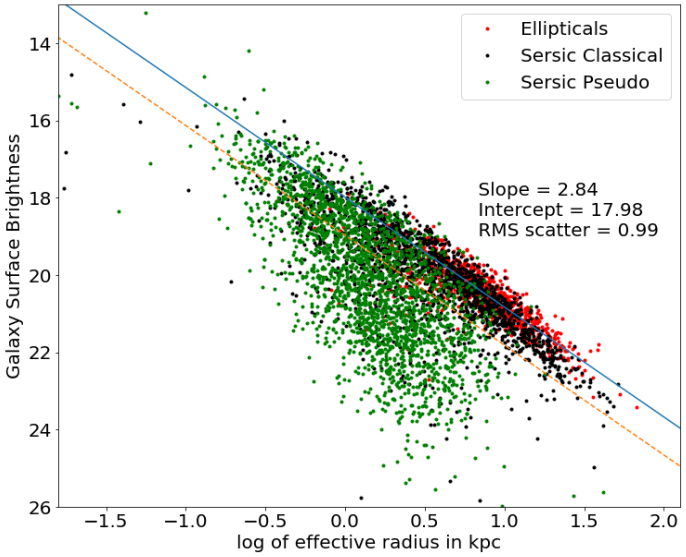

Figure: Photometric classification of bulge properties via standard scaling relation of bulge effective radius and surface brightness. Strong overlap can be seen in smaller effective radius and low surface brightness bulges. A spatially resolved kinematic classification can disentangle this regime.

3. Requirements

Understanding of galactic dynamics and exposure on galaxy/bulge formation theory would be relevant but not necessary. The student would require a fair grasp of python or similar scripting language. Prior experience in handling large datasets is not necessary but would be built upon during the project. However, a keen interest and willingness to learn and apply systematically developed coding practices towards programming applications would be important.

4. Reference

a. Dimitri A. Gadotti, MNRAS, Volume 393, Issue 4, March 2009, Pages 1531–1552
b. Mark T Graham et al., MNRAS, Volume 477, Issue 4, July 2018, Pages 4711–4737
c. Yifei Luo et al., MNRAS, Volume 493, Issue 2, April 2020, Pages 1686–1707
d. Michele Cappellari, Annual Review of Astronomy and Astrophysics 2016 54:1, 597-665
e. Michele Cappellari, MNRAS, Volume 432, Issue 3, 01 July 2013, Pages 1862–1893,