Nic Bonne – *Please don't hesitate to approach me if you have any questions*

What Shapes the Local Universe Galaxy Luminosity Function?

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By measuring the luminosity function and its evolution, we can better understand what factors contribute to the star formation rate, growth and evolution of galaxies. Selecting galaxy samples based on colour or morphology can provide additional information as galaxy shape measures the distribution, and reflects the motions, of stars within a galaxy. Colour is connected to galaxy stellar populations, blue being younger, star forming and red being older.

Observationally, colour and galaxy shape correlate and thus, are often used as proxies for one another, that is, we assume that the majority of spirals should be blue and the majority of ellipticals and lenticulars should be red. Previous studies of local luminosity functions with morphology-selected samples have largely produced conflicting results and functions with varying shapes (Marzke et al., 1998, Kochanek et al., 2001, Devereux et al., 2009). Unexpectedly, such functions differ from functions derived from colour-selected samples (Bell et al., 2004, Brown et al., 2007), that is, early-type functions have faint end slopes which are flat or positive rather than the negative slopes observed in typical red galaxy luminosity functions.

We have created a dataset primarily using 2MASS, 6dF and RC3 data, limited to K_{total} < 10.75 mag and 704 < cz < 20,000 km/s, comprised of 13,321 galaxies, each with corresponding flow corrected redshift/redshift independent distances and morphological classifications. We have derived K-band local galaxy luminosity functions for our total sample as well as for late and early-type galaxies (Figures 1 and 2). We have also investigated the colour distributions of the different morphological populations (Figure 3).

Our results indicate a difference in the shape of our functions when compared to similar colour-selected luminosity functions. This is at least partially explained by a large population of M_K < -23 mag, high stellar mass red spiral galaxies Figures 4, 5, 6 and 7) which are included in our sample. If we add these red spirals to our early-type sample, and correct our galaxy counts for overdensities in the local Universe, the resulting luminosity function has a shape more similar to that observed for color selected red galaxy LF's.

In terms of the red spirals themselves, with such large stellar masses and such obvious structure, it is unlikely that these objects are formed through mergers or have recently blue stellar populations. If red spirals are formed through a more likely process such as the truncation of star formation, they must be relics of a much earlier age.

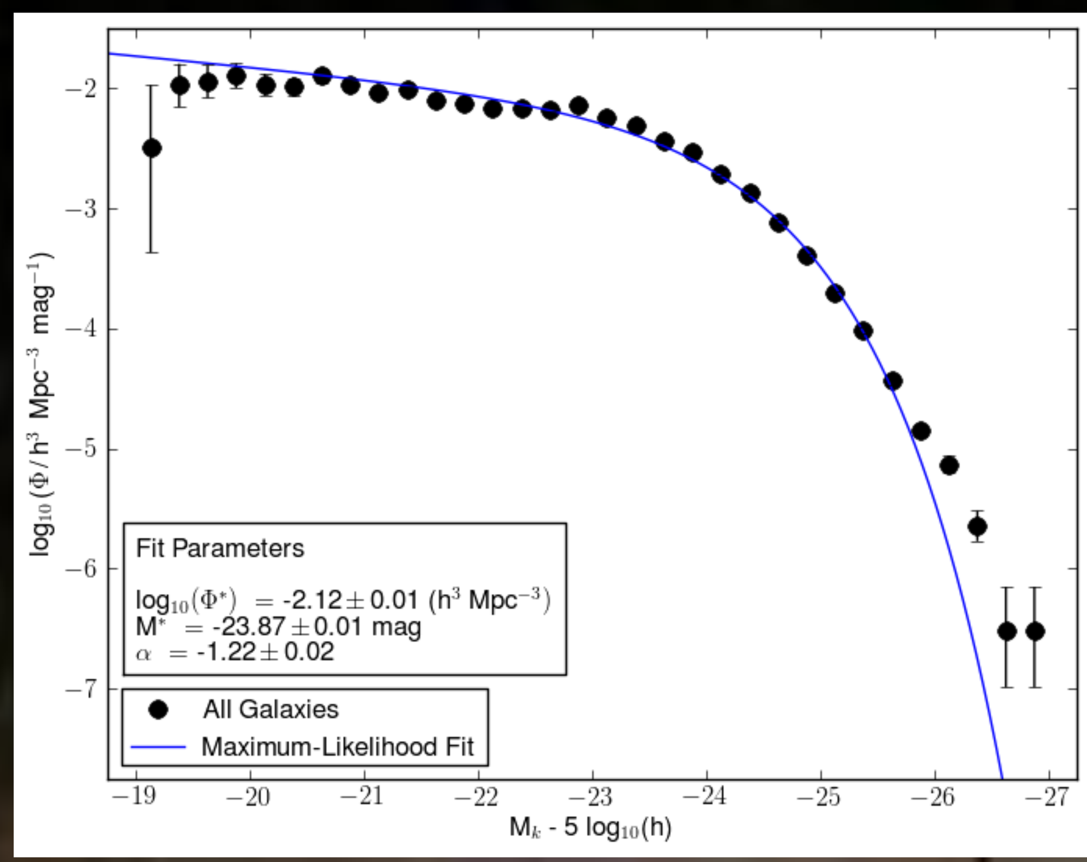

Figure 1. K-band luminosity function for the total galaxy sample fitted to a Schechter function. Note the inability of the Schechter form to fit the brighter end of the curve.

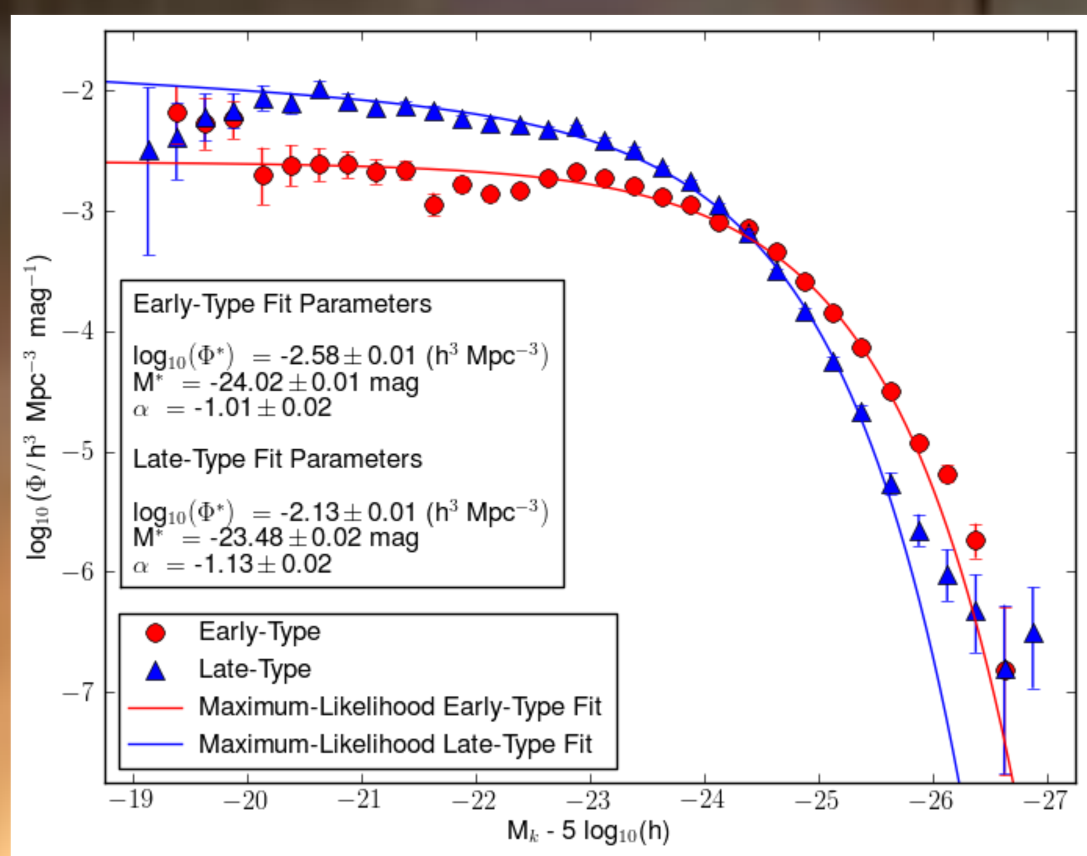

Figure 2. K-band luminosity function for late and early-type samples fitted to Schechter functions. High stellar mass early type galaxies dominate at the bright end and lower mass late-types dominate at the faint end. The faint end slope of the early-type functions is clearly positive, rather than the negative slope seen in most red galaxy luminosity functions. This indicates that the simple assumption that all early-type galaxies are red, and that all late-type galaxies are blue is incorrect.

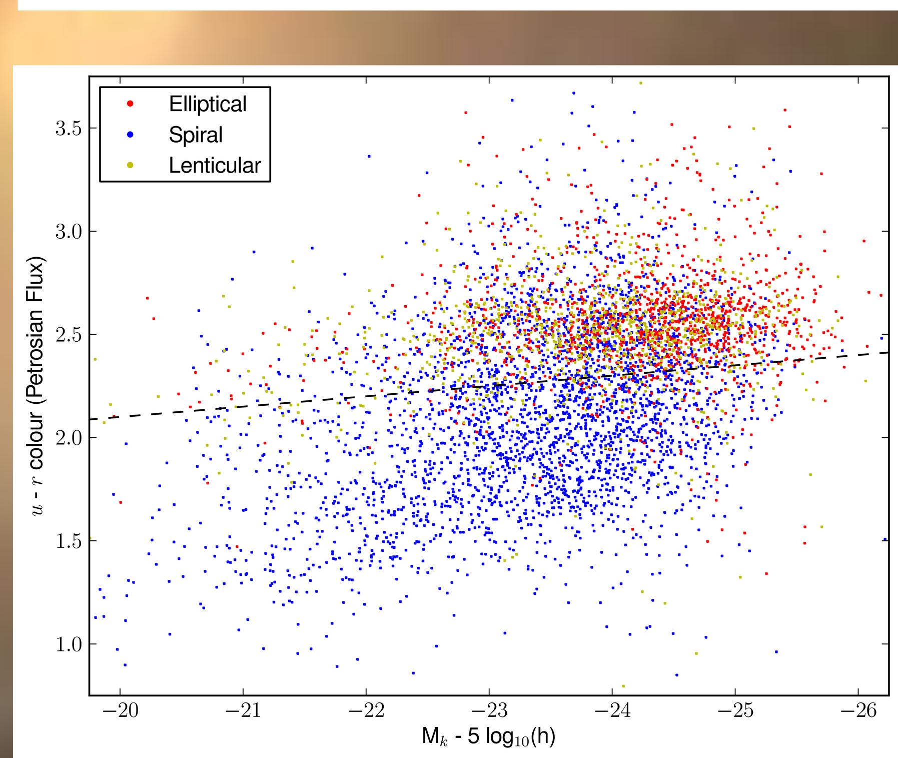

Figure 3. Colour-Magnitude distribution of galaxies included in SDSS catalogue. Galaxies above the dotted line are red, those below are blue. There are clearly spirals above the colour cut, and these objects are more common at the bright/high stellar mass end.

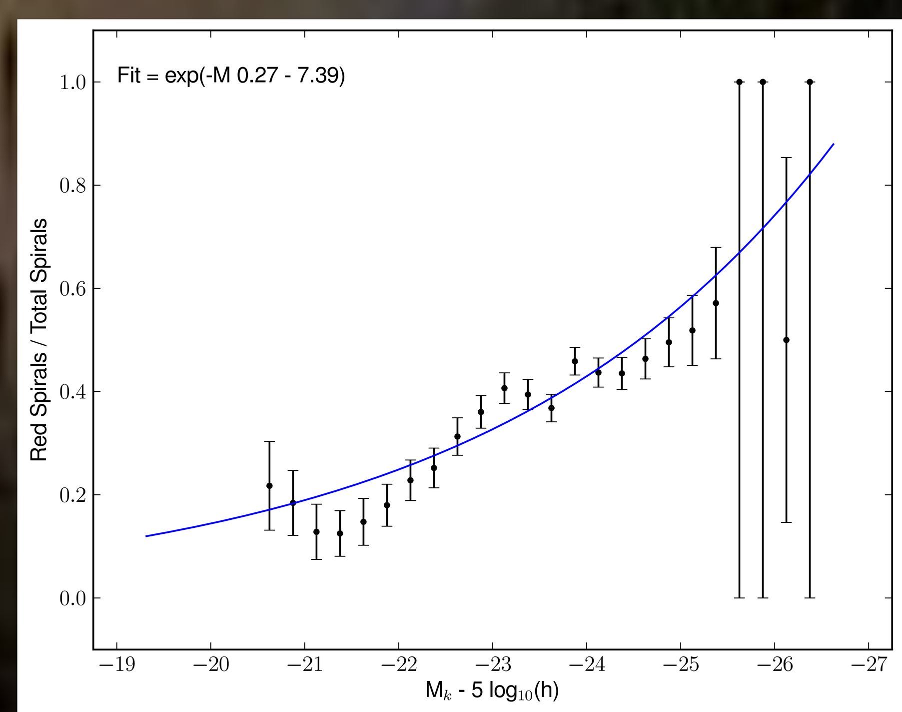

Figure 4. Fraction of red spirals to total spirals with fitted exponential function. This fit is applied to the entire late-type sample to create a red and blue spiral sample. The fit is weighted according to the number of galaxies contained within each bin

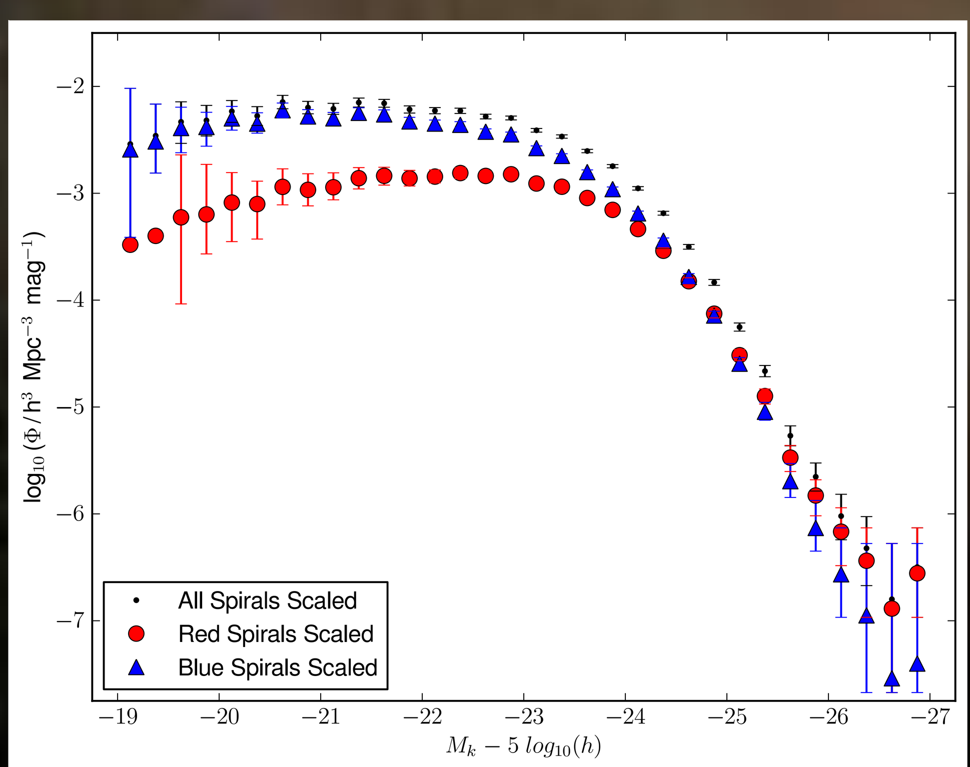

Figure 5. K-band luminosity function for blue and red spirals using the fit in Figure 4, scaled to account for local galaxy population overdensities. Note that at the bright end of the function (higher stellar mass) the red spirals clearly dominate the sample.

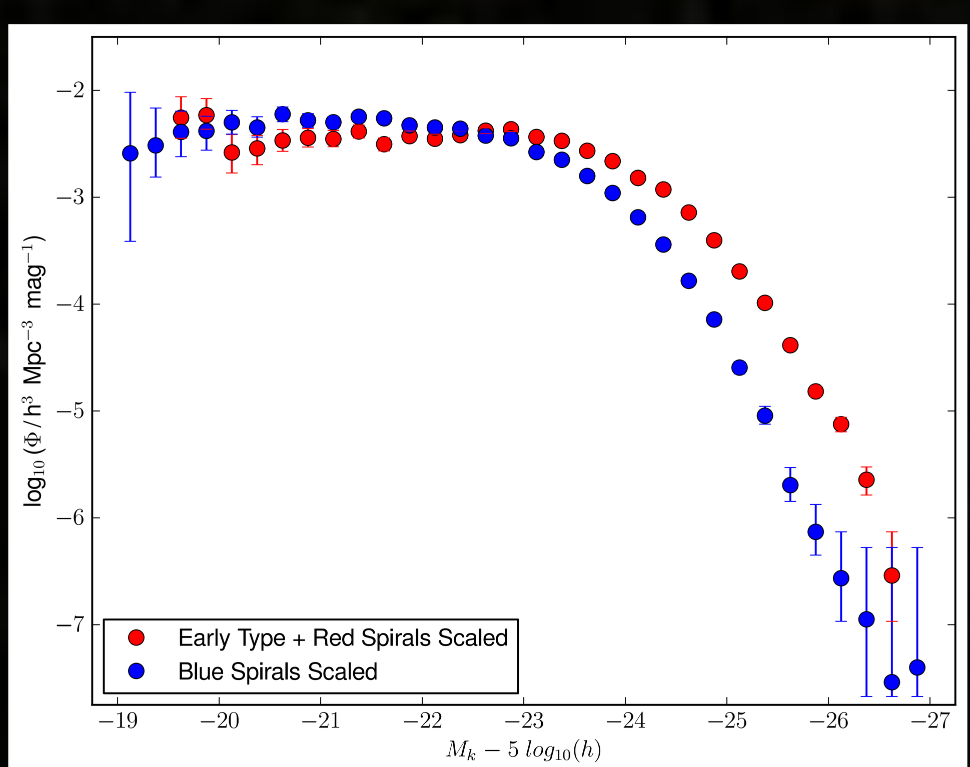

Figure 6. K-band luminosity function for blue spirals and red spirals added to the early-type population, scaled to account for galaxy population overdensities. At the bright end of the function (higher stellar mass) the red galaxies clearly still dominate the sample. Of interest also is the downturn now evident at the faint end of the hybrid red spiral/early-type function. This is more similar in shape expected from a red color selected luminosity function, but is not as extreme.

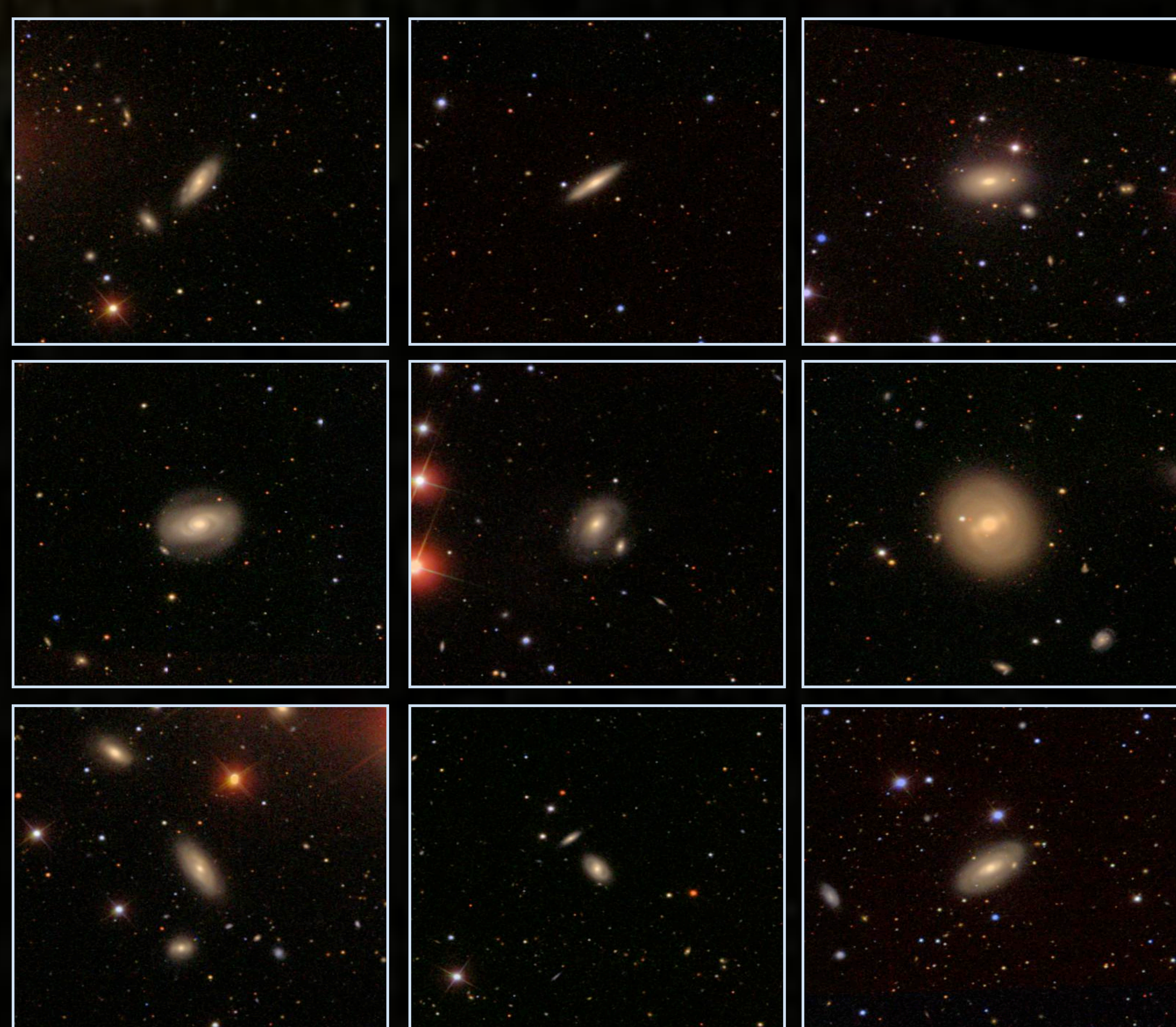

Figure 7. A sample of 9 SDSS red spiral galaxies with M_K > 24 mag

References

Bell, E. F., et al, 2004, ApJ, 608, 752 ; Brown, M. J., et al, 2007, ApJ, 654, 858 ; Devereux, N., et al, 2009, ApJ, 702, 955 ; Kochanek, C. S., et al, 2001, ApJ, 560, 566 ; Marzke, R. O., Huchra, J. P., and Geller, M. J, 1994b, ApJ. 428, 43A

Background Image: red spiral galaxy NGC2713 from SDSS