<u>Distances to galaxies and the Tully-Fisher relation</u>

MSc - II Practical

I. The Tully-Fisher relation

The Tully-Fisher relation applies to spiral galaxies, where the luminosity of the galaxy is found to be empirically linked to its rotation velocity, that is, $L \propto V_{max}^4$. Alternately, the absolute magnitude of a galaxy and the width of its emission lines may be used to represent this relation. It is also applied to derive order-of-magnitude estimates of distances to galaxies and galaxy clusters.
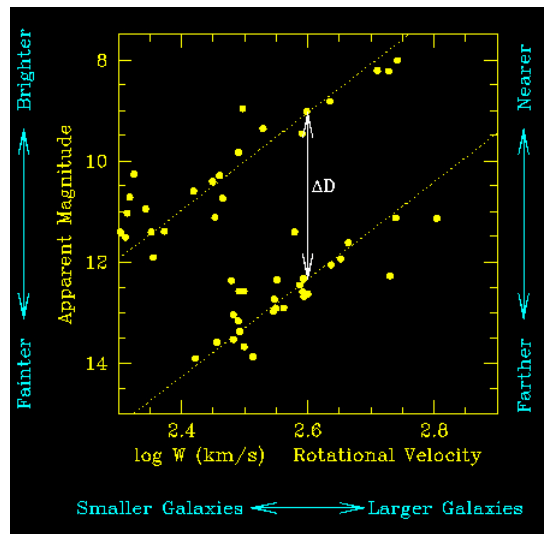

Figure 1: Tully-Fisher relation and distance between galaxy clusters; Credit: `https://www.ngawhetu.com/index.php/stellar-distance-hdn?start=17`

II. Practical exercise

- Select the first twenty spiral galaxies from the dataset provided to you.

- Correct the H I line width determined at 20 per cent of the peak level as per the inclination of each galaxy and obtain W_i.

- Use the corrected line width to account for self-extinction due to dust and gas in the same galaxy. You can apply the following relation: $[1.57 + 2.75(\log W_i - 2.5)] \log(a/b)$. Here, a and b refer to the major and minor axes of the galaxy.

- Consider both self-extinction and Galactic extinction as per the data provided and obtain the corrected apparent magnitude for each galaxy.

- Using the known estimates of absolute magnitude, determine the approximate distance in Mpc to each of the twenty NGC galaxies.

- Further, plot with uncertainties the absolute magnitude against the H I line width in order to represent the Tully Fisher relation. Determine the slope.

- Comment on your results.

III. References

- https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=f67255b1534318f885d8a6e8bb554f1ae0df2c9a

- https://www.alma.ac.uk/nas/gbendo/Web/Sci/Teach/experiment_tullyfisher.pdf

- http://www.astro.gsu.edu/lab/Supplemental_labs/online_labs/ASTR1020/TFLab.pdf

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