PHYS304 HW0

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1. MY FAVOURITE EQUATION

1.1. Hubble's Law Formula

The Hubble's law formula is given in the following as

$$v = H_0 d \tag{1}$$

where, v is the velocity of the galaxy in km/s, H_0 is the Hubble constant of around 69.8 in km/s/Mpc, and d is the distance of the galaxy in Mpc (Mpc = megaparsec $\approx$ 3.26 million light years).

Hubble's law, also known as the Hubble–Lemaître law, named after American astronomer Edwin Hubble and Belgian astronomer Georges Lemaître to acknowledge the scientific contributions to the theory of the expansion of the Universe. It states that the velocity of the galaxy, called the redshift, is directly proportional to its distance. If the universe is static and unchanging, there should be no correlation between distance and velocity. However, according to the the Hubble–Lemaître law, a correlation between distance and velocity is expected, therefore, the state of the universe is expanding.

In Hubble's publication in 1929, he plotted the distance to a galaxy, measured from Cepheid variables, and the velocity of the galaxy, measured by the shift in the spectral lines, showing that the two quantities are directly correlated [1].

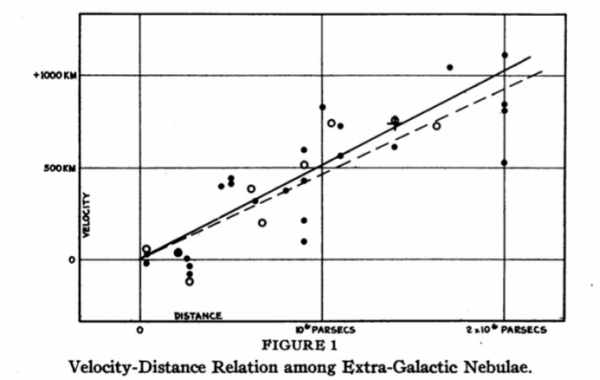

FIG. 1: Edwin Hubble's plot of the Velocity-Distance relationship for galaxies

[1] E. Hubble, in *The Early Universe: Reprints*, edited by E. W. Kolb and M. S. Turner (1988), p. 9.

For future assignments, always include an external citation

7/7

Computational Physics/Astrophysics, Winter 2023:

Grading Rubrics [1]

Haverford College, Prof. Daniel Grin

For coding assignments, roughly 25 points will be available per problem.

1. Does the program complete without crashing in a reasonable time frame? If yes, up to +3 points.

2. Does the program use the exact program files given (if given), and produce an answer in the specified format? If yes, +1 points

3. Does the code follow the problem specifications (i.e numerical method; output requested etc.) Up to +2 points

4. Is the answer correct? Up to+4points

5. Is the code readable? Up to+2points

. 5.1. Are variables named reasonably?

. 5.2. Are the user-functions and imports used?

. 5.3. Are units explained (if necessary)?

. 5.4. Are algorithms found on the internet/book/etc. properly attributed?

[1] Inspired by rubric of D. Narayanan, U. Florida, and C. Cooksey, U. Hawaii

6. Is the code well documented? +3points

. 6.1. Is the code author named?

. 6.2. Are the functions described and ambiguous variables defined?

. 6.3. Is the code functionality (i.e. can I run it easily enough?) documented?

7. LaTeX writeup (up to 10 points)
   - Are key figures and numbers from the problem given? (3 points)
   - Is a brief explanation of physical context given? (2 points) 2/2
   - If relevant, are helpful analytic scalings or known solutions given? (1 point) 1/1
   - Are 3-4 key equations listed (preferably the ones solved in the programming assignment) and algorithms named? (2 points) 2/2
   - Are collaborators clearly acknowledged? (1 point) 1/1
   - Are any outside references appropriately cited? (1 point) 1/1

Note, even if (1), (2), (3), or (4) are not correct, one can still obtain many points via (5), (6), and (7).