Galaxy Distances using Tully-Fisher

Finding the Distance to NGC7331

Answers:

1	**Due to the Doppler effect, what happens to the radio waves emitted by the side of the galaxy approaching us and what happens to the radio waves on the other side?**
	Approaching us = Higher frequency (1) Other side = Lower frequency (1)
2	**Use the graph to determine the centre velocity v0 and the velocities of the two peak radio emissions from the spiral arms of the galaxy, v1 and v2, along with the Δv.**
	v0 = 820 km/s (1) v1 = 600 km/s (1) v2 = 1040 km/s (1) v2-v1 = Δv = 440 km/s (1)
	To what accuracy can you reliably read velocities from the graph? Select one response from these three. Having decided, check your answers, above.
	Allow slight variations in the answers as the graph is only precise to about +/- 10km/s (1)
3	**If a galaxy was face-on to us, like this picture of M101, what would the radial velocity be?**
	0 km/s (1)
	Returning to NGC7331, we need to measure the long and short dimensions, as shown in the diagram below. You need a ruler for this and can measure in millimetres.
	Appropriate measurements made of each line (2)
	If the long axis is 'a' and the short axis is 'b' then b/a =
	1/4 (1)
	The formula for adjusting the observed velocity difference to the real one is: Δv = Δvobs / √(1- (b/a)2) So, using the observed velocity data from NGC7331 calculate the true value of Δv:
	Δv = 440 / √(1- (1/4)2) Δv = 440/ √(1- 1/16) Δv = 440/√0.9375 Δv = 454 ≈ 450km/s (3)
4	**Using Δv to estimate the Absolute Magnitude of NGC7331** **Use your true velocity value with the following graph to determine the likely absolute magnitude M for NGC7331.**
	M = -20 (1)
5	**Using the Distance Modulus to find the distance to NGC7331.**
	m – M = 5log(d/10)

	10.4 – –20 = 5log(d/10) (1) *(note the – – on the left of the equation)* log(d/10) = 30.4/5 = 6.08 (1) d/10 = 106.08 (1) d = 10 x 106.08 =107.08 (1) d =12 million pc (1) The 'official' answer is: 12.2 million pc
6	**Reliability of Data: Consider what factors may affect the reliability of your data. Your teacher may give you some ideas about this.**
	Students should consider the limitations of this method. Possible problems could include: • Heterogeneity of galaxies, i.e. would this method work the same way for spiral and elliptical galaxies? • The Tully-Fisher method determines galaxy mass, whether all of it is emitting light or not. Assumptions have to be made. • The apparent magnitude of a galaxy will be dimmed by blocking materials between the observer and the source, whether that is dust within our own galaxy or the galaxy under observation. Doubtless, students may think of other factors. (5)