

Galaxies final exam II, course 2005-2006

Please write down your name and your student ID on every page. You can answer the questions in English or in Dutch. Please explain clearly all the steps you have used to derive a result, and make sure your handwriting is readable.

1. Practical exercises for a total of 30 points. Explain clearly the steps you have used to derive the final results
 - (a) Assume that the gravitational potential of a system is $\Phi(r) = -V_h^2 \log(1 + r^2/d^2)$. Derive the (volume) density and the circular velocity of this system. Plot the circular velocity as function of distance from the center r . Could this functional form be a good representation of the rotation velocity of a galaxy? Why? *Hint:* Recall that $\nabla^2 f = \frac{1}{r^2} \frac{\partial}{\partial r} (r^2 \frac{\partial f}{\partial r}) + \frac{1}{r^2 \sin \theta} \frac{\partial}{\partial \theta} (\sin \theta \frac{\partial f}{\partial \theta}) + \frac{1}{r^2 \sin^2 \theta} \frac{\partial^2 f}{\partial \phi^2}$
 - (b) Interpreting the colors and spectra of galaxies
 - i. You observe that a nearby galaxy is extremely blue. However, it shows not sign of recent star formation. What is your interpretation of why the stars in this galaxy are so blue?
 - ii. You measure the spectrum of a galaxy and note that it has absorption line features similar to a K-giant star. Why does that imply that the galaxy formed most of its stars more than 10 Gyr ago?
 - iii. Draw and label a plot of a possible isochrone for stars which make up the galaxy in (b)
 - iv. Was this galaxy brighter or dimmer in the past? Why?
2. Answer briefly (a minimum of 4–5 sentences) the following questions (60 points in total)
 - Explain why we think that AGNs are powered by super-massive black holes.
 - Suppose you would like to derive the metallicity distribution of halo stars in our Galaxy. Explain how you would construct a sample from which this distribution could be derived, describe in detail your choices and provide justifications for those.
 - Explain the closed-box model of chemical evolution.
 - Elaborate on a topic of your choice that has been discussed in the lectures (do not focus on the Hubble classification scheme).
3. Fill in the blanks. On your answer sheet, write out each sentence and underline the missing word or words that you filled in [10pt]
 - (a) We live in a [type of galaxy] galaxy.
 - (b) The Sun is [distance in kiloparsecs] from the center of the Milky Way.
 - (c) Most of the gas and dust in a galaxy is in the [part of a galaxy].
 - (d) New stars form in the [part of a galaxy].
 - (e) Older stars inhabit the [part of a galaxy] and [another part of a galaxy].
 - (f) Stars in the [part of a galaxy] are on circular orbits.
 - (g) Stars in the [part of a galaxy] are on random orbits.
 - (h) Star formation has mostly ceased in [type of galaxy] galaxies.
 - (i) The Magellanic Clouds are [type of galaxy] galaxies.
 - (j) Bright O and B stars would be found in the [part of a galaxy]