ASTR 400B In Class Worksheet 1

Jan 25 2018

1 Schechter Function

The galaxy luminosity function in the nearby universe is well described by a Schechter Function:

$$\Phi(M)dM = (0.4\,ln10)\,\phi_*\,10^{0.4(M_*-M)(\alpha+1)}e^{-10^{0.4(M_*-M)}}dM \quad (1)$$

With the following parameters from Smith+2009 for Field Galaxies in SDSS at z$\sim$0.1 in the Kband:

1. ϕ_* =1.66 $\times 10^{-2}$ Mpc^{-3}
2. α = -0.81
3. M* = M$^*_k$= -23.19

This function is long so try to break this up into different components. E.g. a = power law part, b= exponential part.

1.1 Question 1

Define a function called *Schechter*, that takes as input: α, M*, ϕ_*. tip: import numpy as np then you can use np.log and np.exp

Plot the Schechter Function using the above parameter values over a magnitude range of -17 to -26. Try to reproduce the black solid line in Figure **??**, from Smith+2009

Plotting tips:

1. *import matplotlib.pyplot as plt* - this lets you use plotting functions.
2. np.arange(0,10,0.1) will return an array from 0 to 10 spaced in intervals of 0.1
3. plt.semilogy lets you plot the y axis as log.

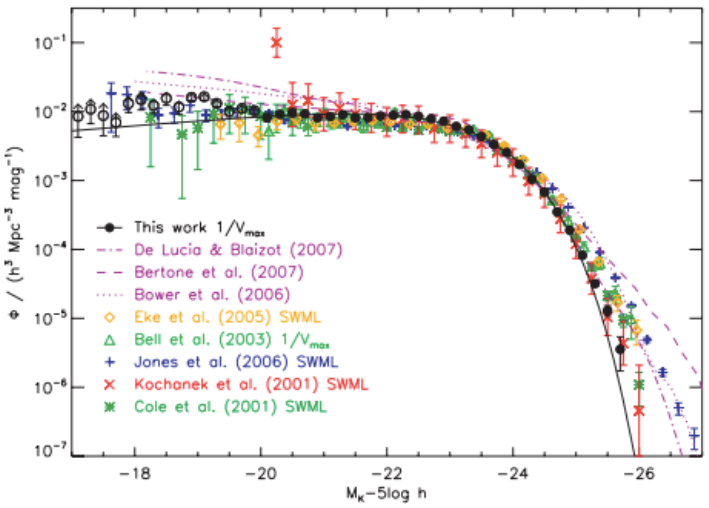

Figure 1: Luminosity Function from Smith+2009, UKIDSS + SDSS KBand

1.2 Question 2

Galaxies in the Virgo Cluster have different parameters, like α=-1.35 (Ferrarese+2016 ApJ 824) Overplot the Schechter Function with this new value of α. Try a smaller value of $\alpha = -0.6$. How does the function change? What does this mean?

2 The IMF

Create a function called *Salpeter* that defines the Salpeter IMF:

$$\xi(M) = \xi_0 (M/M_\odot)^{-\alpha} \tag{2}$$

$\alpha = 2.35$ The function should take as input an array of stellar masses, M. You will need to determine the normalization, ξ_0, by integrating this equation over mass from 0.1 to 120 $M_\odot$ and setting the value to 1. The function should then return $\xi(M)$, which will now represent the fractional number of stars.

- from scipy.integrate import quad
- quad(lambda x: fxn(x),xmin,xmax)
- quad returns an array with 2 values. you want the first value.

2.1 Question 3

Integrate your normalized function to compute the fraction of stars with stellar masses greater than the sun and less than 120 $M_\odot$. ** Double Check: if you integrate your function from 0.1 to 120 you should return 1.0