

# ASTR615 HW#4

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## Problem 2

### Mass distribution

We implement in all of our simulations the Kroupa IMF:

$$\phi(m) \propto \begin{cases} m^{-1.3} & (0.08M_{\odot} < m < 0.5M_{\odot}) \\ 0.5 m^{-2.3} & (0.5M_{\odot} < m < 100M_{\odot}) \end{cases} \quad (1)$$

after doing transformation we get

$$m = \begin{cases} -\frac{0.566179}{\sqrt[3]{1.7987 - x}(x^3 - 5.39611x^2 + 9.70599x - 5.81939)} & (0 < x < 0.760707) \\ \frac{0.166558}{(1.00024 - x)^{10/13}} & (0.760707 < x < 1) \end{cases} \quad (2)$$

### Morphology

We use disk galaxies in our simulation. Each disk galaxy has two components: a thin disk and a thick disk. Each component has a density profile  $\rho(r, h) = \rho_0 e^{-r/r_H} e^{-h/h_H}$ .  $r$  and  $h$  are given by the solution to the equation

$$x = 1 - \left(1 + \frac{r}{r_H}\right) e^{-\frac{r}{r_H}} \quad (3)$$

where  $x$  is a uniform random number between 0 and 1.

### Disk Rotation

We use a uniform angular velocity  $\omega$ .

### Setups

|            | $M/M_{\odot}$         | $r_H/\text{kpc}$ | $h_H/\text{kpc}$ | $\omega/?$ |
|------------|-----------------------|------------------|------------------|------------|
| thin disk  | $5 \times 10^{10}$    | 3.5              | 0.3              | 1?         |
| thick disk | $0.75 \times 10^{10}$ | 3.5              | 1.0              | 1?         |

Table 1: Parameters and errors from Lorentzian and Gaussian fits.

### 0.1 Units

[L] = kpc, [M] =  $10^9 M_{\odot}$ , [T] = 14.91 Myr.