Fermi Project Update

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Contents

1 Universal Parameters

- $\theta = 0.1 =$ *Rate of Convergence; inversely proportional to the Gaussian's width*
  - $1/\theta = 10$ steps to converge back to the mean
- $\sigma = 0.9 =$ *Degree of Randomness; directly proportional to the Gaussian's width*
- $v_{p,i} = 10^{-4}c \approx 30km/s =$ *Probe's Initial Velocity*
- $d_{p,i} = 10^{-2.51}kpc \approx 10lyr =$ *Probe's Initial Range/Distance*
- $t_{p,i} = d_{p,i}/v_{p,i} = 100,000\ yrs = 10^5\ yrs =$ *Probe's Initial Travel Time*
- $\#\ Systems = 10^3$

2 Galaxy Model Parameters

- $T_{tot} = 10^9\ yrs =$ *Total Simulation Runtime*
- $T_s = 10^8\ yrs =$ *Civilization Lifetime*[1]
- $T_{first} = 10^5\ yrs =$ *Time to Launch First Probe*
- $T_p = 10^5\ yrs =$ *Probe Launch Period (after first)*

[1] settled duration in namelist

3 Periodic Box Model Parameters

- $T_{tot} = 10^6\ yrs =$ *Total Simulation Runtime*
- $T_s = 10^{4.7}\ yrs = 5.01 \times 10^4\ yrs =$ *Civilization Lifetime*
- $T_{first} = 10^3\ yrs =$ *Time to Launch First Probe*
- $T_p = 10^3\ yrs =$ *Probe Launch Period (after first)*
- $v_s = 100\ km/s =$ *average velocity of stellar substrate*[2]
- $Box\ Volume = (0.055kpc)^3 = 1.66 \times 10^{-4}\ kpc^3$
- $f\rho = \dfrac{\#\ Systems}{Box\ Volume} \approx 6 \times 10^6\ kpc^{-3}$
- Initial Dimensionless Quantities
  - $\eta_i = f\rho d_{p,i}^3 \approx 0.177$
  - $\nu_i = \dfrac{v_s}{v_{p,i}} = 3.3$
  - $\tau_i = \dfrac{T_p}{t_{p,i}} = 0.01$
- Other timescales
  - $T_{c,i} = 5.42 \times 10^4\ yrs$
  - $T_R = 5.38 \times 10^4\ yrs$
- Ratios
  - $T_c/T_s = 1.082$
  - $T_c/T_R = 1.008$

4 Definitions

- Dimensionless Quantities
  - $\eta = f\rho d_p^3 =$ *Normalized density of settleable systems within probe range*
  - $\nu_s = v_s/v_p =$ *Velocity of stellar substrate normalized by probe speed*
  - $\tau_p = T_p/t_p =$ *Probe launch period normalized by probe travel time*
- Timescales
  - $T_c = (f\rho v_s \pi d_p^2)^{-1} =$ *Encounter time between systems due to stellar motions (collision timescale)*
  - $T_R = (f\rho)^{-1/3}/v_s =$ *Reconfiguration Timescale*
- Ratios
  - T_c/T_s
    - If ≥ 1, then their will be exponential growth.
    - If < 1, then systems will die out.
  - T_c/T_R
    - If ≤ 1, then pockets will form.
    - If > 1, then the systems will be well-mixed.

[2] v_{rms} in namelist