Project list

1. Friends of Friends
   Consider a square shaped region of area L*L. Populate the region with randomly distributed N*N particles. Identify haloes of particles. Use the criteria: Consider one particle, find all particles which are within 0.2*L/N distance. Consider each particle, perform the same exercise for all those particles and identify groups of friends.
2. Use circular averaged method and the criteria surface density of a region>200*mean density to find groups.
3. Solve Friedman equations and calculate scale factor as a function of time. Calculate the acceleration parameter as a function of time and find the time where universe undergoes from deceleration to acceleration. Repeat the same expertise for different dark energy models.
4. Solve the linear growth parameter for dark matter density fluctuations as a function of scale factor. Calculate linear distortion parameter for standard LCDM model and other dark energy models.
5. Consider a representative 3D volume of universe. Populate it with spherical ionised bubbles of radius R with number density n/Mpc^3. Calculate overlap fraction as a function of R and n. Calculate the power spectrum for each parameter set. Study how that differs with non-overlapping model.
6. Find a match:
   According to matched filter theory if the filter signal matches exactly with the signal then the signal to noise is maximum. Apply this to a known given signal and noise and confirm the matched filter hypothesis.
7. Calculate matter density profile as function of r from a given galaxy rotation curve. Assume spherical symmetry of mass distribution.
8. Calculate luminosity, transverse, angular diameter distance for any given cosmology (LCDM, CDM, curved universe)
9. Component separation:
   Two signals, one smoothly behaving and other randomly behaving in frequency, get mixed and recorded at different frequencies. Use a polynomial fitting to fit-out the smoothly behaving component and separate the random component. Try with different degree of polynomial and compare results.
10. Consider N number of particles which are randomly distributed in a 3D cube. Each particle has same mass of M and they all are static initially. Calculate positions and velocities of each particle at a series of time steps dt_i. Take a very small number of particles, use the simple gravitation laws to calculate force on each particle, also assume that the distance between two particles can not be smaller that twice the radius of each particle. Take reasonable values of the size of the cube, particle mass, time step, radius of each particles.