# Cosmic Structure Formation

Heidelberg University
Winter term 2022/23

Lecturer: Prof. Dr. Matthias Bartelmann
Head tutor: Selin Üstündağ

## Problem Sheet 4

Discussion in the tutorial group on Nov. 24th, 2022

1. **Nearest-neighbour distance distribution**. Consider a collection of points distributed randomly in three-dimensional space with spatially constant number density $n$.

   (a) Show that the probability distribution $p(r)$ for finding the nearest neighbour of a given point within d$r$ of $r$ satisfies the differential equation

   $$\frac{\mathrm{d}}{\mathrm{d}r}\left[\frac{p(r)}{4\pi r^2 n}\right] = -p(r)\ .$$

   (b) Solve this equation and normalise the result.

   (c) Along the same lines, derive $p(r)$ if the point set has the homogeneous and isotropic correlation function $\xi(r)$.

2. **Correlation functions and power spectra**. For the correlation function

   $$\xi(r) = A\mathrm{e}^{-\lambda r}\ ,$$

   calculate the power spectrum

   (a) in one,

   (b) in two, and

   (c) in three dimensions.