

Average distance between two particles in a box

In a one dimensional box with length L , two particles have random positions x_1, x_2 . The particles do not know about each other. The probability function for finding a particle in a specific location in the box is uniform. Let $r = x_1 - x_2$ be the relative distance of the particles. Find $\langle \hat{r} \rangle$ and the dispersion σ_r as follows:

- (1) By using theorems for "summing" the expectation values and variances of independent variables.
- (2) By calculating the probability function $f(r) dr = P(r < \hat{r} < r + dr)$.