

1 Free Fermi gas: density matrix for same spin projection

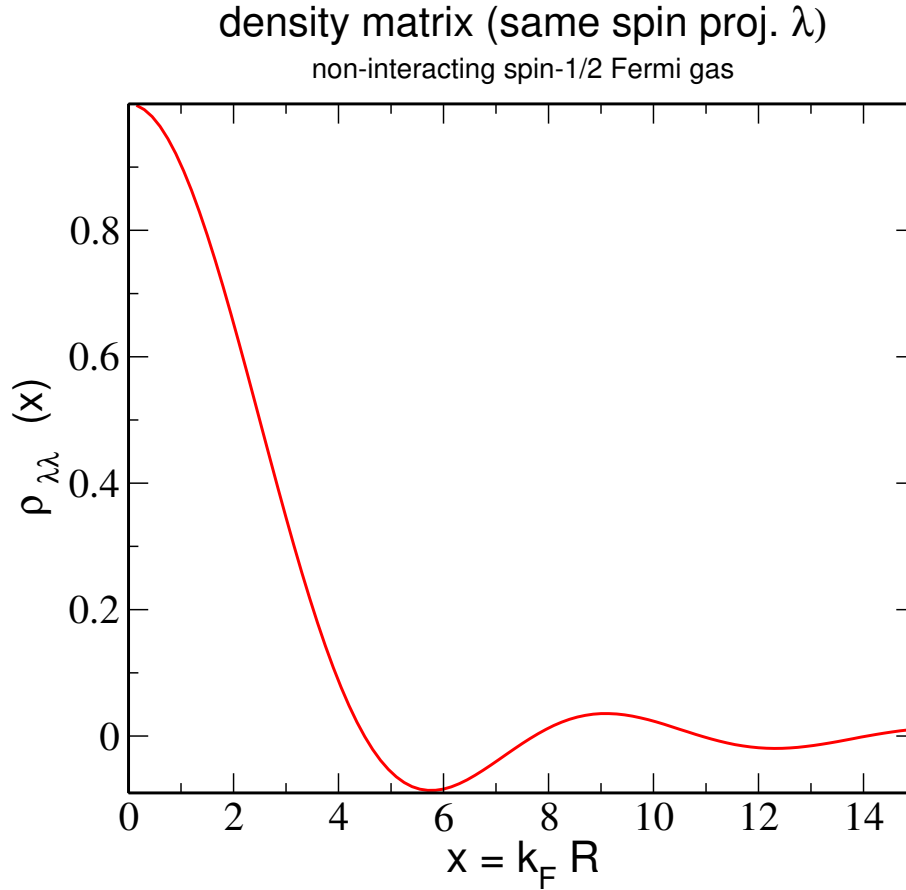
We plot the density matrix $\rho_{\lambda\lambda}(x)$ for two $s = \frac{1}{2}$ fermions with the same spin projection λ in a free Fermi gas, see lecture notes chapter 6, page 9:

$$\rho_{\lambda\lambda}(x) = \frac{\rho_0}{2} \left(3 \frac{j_1(x)}{x} \right) = \frac{\rho_0}{2} \left(3 \frac{\sin x - x \cos x}{x^3} \right) .$$

We denote the inter-particle distance as R and introduce the dimensionless distance parameter x via

$$x = k_F R = (3\pi^2 \rho_0)^{1/3} R .$$

The Fermi momentum $p_F = \hbar k_F$ depends on the density ρ_0 of the Fermi gas. In the plot of the density matrix below, we have normalized the Fermi gas density such that $\rho_0/2 = 1$.

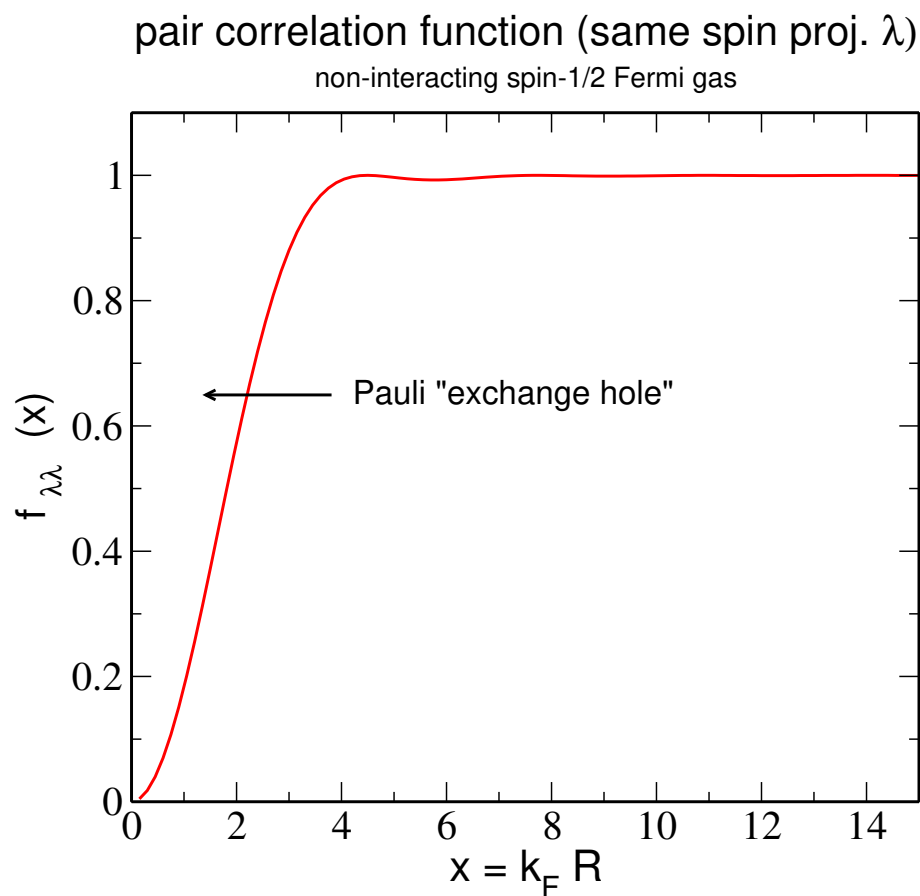


2 Free Fermi gas: pair correlation function for same spin projection

We plot the pair correlation function $f_{\lambda\lambda}(x)$ for two $s = \frac{1}{2}$ fermions with the same spin projection λ in a free Fermi gas, see lecture notes chapter 6, page 9:

$$f_{\lambda\lambda}(x) = \left(\frac{\rho_0}{2}\right)^2 - |\rho_{\lambda\lambda}(x)|^2 .$$

In the plot of the pair correlation function below, we have normalized the Fermi gas density such that $\rho_0/2 = 1$.



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