is solved subject to appropriate boundary conditions to get E_R and the hyperradial wave function $\zeta_0(r)$. The many-body wave function can be constructed in terms of $\zeta_0(r)$ and $\chi_{K0}(r)$[24].

III. RESULTS

Now in order to study the correlation properties of the interacting Bose gas we choose a realistic interatomic potential having a strong repulsive core at a small separation and an attractive tail at large atomic separations. This is approximately represented by the van der Waals potential with a hard core of radius r_c and a $\frac{1}{r^6}$ attractive tail, *viz.* $V(r_{ij}) = \infty$, for $r_{ij} \leq r_c$ and $-\frac{C_6}{r_{ij}^6}$ for $r_{ij} > r_c$. The effective interaction is characterized by the s-wave scattering length (a_s), which depends strongly on r_c[23]. Usually the potentials are chosen to be purely attractive or purely repulsive according to whether a_s is negative or positive respectively. In our many-body calculation, we solve the zero-energy two-body Schrödinger equation with $V(r_{ij})$ to obtain a_s[19,23]. The value of r_c is adjusted so that a_s has the values corresponding to the JILA experiments[25,26]. A typical value of r_c is of the order of 10^{-3} o.u. In atomic units this is a few tens of Bohr, which is larger than the atomic radius. Note that r_c is expected to be larger than the atomic radius, as the van der Waals potential with the hard core of radius r_c is the *effective potential* which produces the correct experimental *zero-energy* scattering cross-section (given by a_s).

A. One-body density

We define the one-body density, as the probability density of finding a particle at a distance $\vec{r}_k$ from the center of mass of the condensate

$$R_1(\vec{r}_k) = \int_{\tau'} |\psi|^2 d\tau' \tag{7}$$

where ψ is the full many-body wave function and the integral over the hypervolume τ' excludes the variable $\vec{r}_k$. After a lengthy but straightforward calculation we arrive at a closed form given by