Occupation numbers of the harmonically trapped few-boson system\textsuperscript{1} XIANGYU YIN, KEVIN DAILY, DOERTE BLUME, Washington State University — We consider a harmonically trapped dilute $N$-boson system with pair-wise interactions, which are characterized by the two-body $s$-wave scattering length $a_s$ and the effective range $r_e$. We construct the one-body density matrix of the weakly-interacting $N$-boson system and calculate the condensate fraction, defined as the largest occupation number, by employing a perturbative treatment within the framework of second quantization. The condensate fraction for the harmonically trapped $N$-boson system, calculated within first order perturbation theory, is $1 - (N - 1)0.420004a_s^2$. Corrections of order $a_s^3$ and $a_s^3 r_e$ are also considered. The condensate depletion induced by effective three-body interactions is identified to occur at order $a_s^3$. Our expression for $N = 2$ is confirmed by comparing with the expansion of the exact solution \cite{Busch}. Our results for $N = 3$ and 4 are compared with high precision \textit{ab initio} calculations for Bose gases that interact through finite-range two-body model potentials.

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