Bose-Einstein condensation temperatures

Bose-Einstein and superfluid transitions have been observed in many materials. Evaluate the transition temperature $T_{BE} = (2\pi\hbar^2/k_B m)(N/2.612V)^{2/3}$ for the gases listed below. In each case, calculate the mean interatomic spacing $R = (V/N)^{1/3}$ and compare with the de Broglie quantum wavelength $\Lambda = \sqrt{2\pi\hbar^2/mk_BT}$ at $T = T_{BE}$. Also compare your calculated T_{BE} with the experimental transition temperature and discuss.

1. Bose condensation was reported in 1998 by Kleppner and Greytak (MIT) at T=50 μK in a gas of ^{1}H with density $n = N/V = 1.8 \times 10^{14}/\text{cm}^3$. Compare R and Λ with the Bohr radius of $a = 0.529$ Å.

2. Kapitsa discovered superfluidity in liquid ^{4}He at T=2.17 K in 1937. The atomic volume $v = V/N$ =46 Å^3.

3. Bose condensation in alkali metal atoms was discovered independently at 170 nK in ^{87}Rb in June 1995 by Wieman and Cornell (at JILA, Colorado) and four months later at 2 μK in ^{23}Na by Ketterle (MIT). Estimated densities were $1.5 \times 10^{14}/\text{cm}^3$ for ^{23}Na and $2.5 \times 10^{12}/\text{cm}^3$ for ^{87}Rb.

4. Except for ^{4}He, all the above gases come from the first column of the periodic table. Why are these gases popular targets for study?