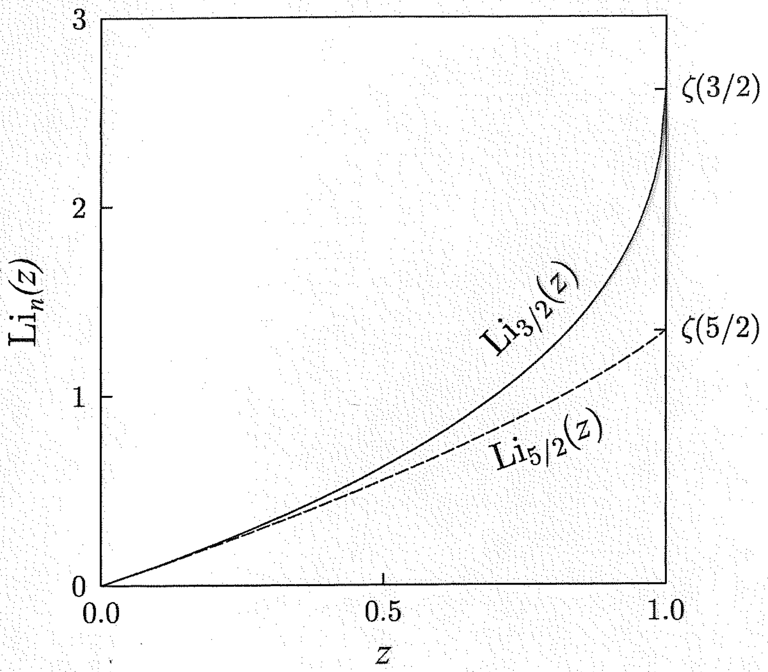

Fig. 30.3 The functions $\mathrm{Li}_{3/2}(z)$ and $\mathrm{Li}_{5/2}(z)$. For $z \ll 1$ (the classical regime), $\mathrm{Li}_n(z) \approx z$. Also, $\mathrm{Li}_n(1) = \zeta(n)$.

We can perform a corrected analysis of the problem as follows. We separate N into two terms:

$$N = N_0 + N_1, \tag{30.54}$$

where N_0 is

$$N_0 = \frac{1}{1 - \mathrm{e}^{\beta\mu}} = \frac{z}{1-z}, \tag{30.55}$$

the number of particles in the ground state, and N_1 is our original integral representing all the other states. Thus above T_c,

$$N = N_1 = \frac{(2S+1)V}{\lambda_\mathrm{th}^3} \mathrm{Li}_{3/2}(z), \tag{30.56}$$

but below T_c, N_1 is fixed to be

$$N_1 = \frac{(2S+1)V}{\lambda_\mathrm{th}^3} \mathrm{Li}_{3/2}(1), \tag{30.57}$$

so that the concentration of particles in the excited state is

$$n_1 \equiv \frac{N_1}{V} = \frac{(2S+1)\zeta(\frac{3}{2})}{\lambda_\mathrm{th}^3}. \tag{30.58}$$

Any remaining particles must be in the ground state, so that

$$n \equiv \frac{N}{V} = \frac{(2S+1)\zeta(\frac{3}{2})}{\lambda_\mathrm{th}(T_\mathrm{c})^3}. \tag{30.59}$$