

6. Ideal Gas

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- The ideal gas is a gas of noninteracting atoms in the limit of low concentration.
- An **orbital** is a state of the Schrodinger equation for only one particle.
- Any particle with half-integral spin is a **fermion**, and any particle with zero or integral spin is a **boson**.
- Occupancy rules of orbital model:
 - An orbital can be occupied by any integral number of bosons of the same species, including 0.
 - An orbital can be occupied by 0 or 1 fermion of the same species. (also known as the **Pauli exclusion principle**)
- The limit in which the orbital occupancy is small in comparison with unity is called the **classical regime**
- **Fermi-Dirac distribution function** - gives the average number of fermions in a single orbital of energy ϵ (value lies between 0 and 1):

$$f(\epsilon) = \frac{1}{\exp[(\epsilon - \mu)/\tau] + 1}$$

- **Bose-Einstein distribution function:**

$$f(\epsilon) = \frac{1}{\exp[(\epsilon - \mu)/\tau] - 1}$$

- **classical distribution function** - when $f(\epsilon)$ is $\ll 1$:

$$f(\epsilon) = \lambda \exp(-\epsilon/\tau)$$

- Any theory which contains \hbar cannot be a classical theory.
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