Complementos de Física Estatística

Lecture 2

G_{3p} graph. Calculation of $\langle \ell_{AB} \rangle$.

Correlations. Calculation of probability that the two upper links in G_{3p} are present.

The history of statistical physics.

Derivation of the Maxwell–Boltzmann distribution (Maxwell, 1867). It follows from two assumptions: (i) rotational symmetry in the space of velocities and (ii) different components of velocity are uncorrelated.

Derivation of the Boltzmann distribution. The Boltzmann formula for statistical weights.

Nonequilibrium systems. The evolution of statistical weights. Linear master equation for statistical weights $W(g,t) \propto P(g,t)$ (probabilities of realization of members of a statistical ensemble):

$$\partial_t P(g,t) = \sum_{g' \in G} [w(g,g')P(g',t) - w(g',g)P(g,t)]$$

Derivation of equilibrium $P(g)$.

Boltzmann kinetic equation (Boltzmann, 1872) for $p(\mathbf{r},\mathbf{v};t)$. Bogolyubov's kinetic equation:

$$(\partial_t + \mathbf{v}\cdot\partial_\mathbf{r} + \dot{\mathbf{v}}\cdot\partial_\mathbf{v})p(\mathbf{r},\mathbf{v};t) = F[p_2(\mathbf{r},\mathbf{v}';\mathbf{r},\mathbf{w}';t), p_2(\mathbf{r},\mathbf{v};\mathbf{r},\mathbf{v};t)]$$

Boltzmann kinetic equation:

$$(\partial_t + \mathbf{v}\cdot\partial_\mathbf{r} + \dot{\mathbf{v}}\cdot\partial_\mathbf{v})p(\mathbf{r},\mathbf{v};t) = \int d\mathbf{w}d\mathbf{v}'d\mathbf{w}'\sigma[p(\mathbf{r},\mathbf{v}';t)p(\mathbf{r},\mathbf{w}';t) - p(\mathbf{r},\mathbf{v}$$

Probabilities of several variables. Convolutions.