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ABOUT ONE NEWELL'S RESSULT AND THE QUANTUMMECHANICAL CHECK OF THE MICROCANONICAL DISTRIBUTION

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1. The microcanonical distribution hypothesis in classical statistical mechanics states the equilibrium particle density for the given value λ of the energy, $\rho(p, x, \lambda)$, to be

$$\rho(p, x, \lambda) \sim \delta(H(p, x) - \lambda), \tag{1}$$

where $H(p, x)$ is the energy expressed in terms of the coordinates x and momenta p.

The Schrödinger equation written in the Abstract corresponds to

$$H(p, x) = \sum_1^k p_i^2 + q(x_1, x_2, \dots, x_k). \tag{2}$$

Let us define the function $\rho(x, \lambda)$ as

$$\rho(x, \lambda) = \int \rho(p, x, \lambda)\, d^k p. \tag{3}$$

Then eqs. (1), (2), (3) imply

$$\rho(x, \lambda) \sim [\lambda - q(x)]^{k/2-1}. \tag{4}$$

The function $\rho(x,\lambda)$ from the quantum-mechanical point of view is something like

$$\sum_{\lambda-\epsilon<\lambda_n<\lambda} |\psi_n(x)|^2/\epsilon$$

(where the interval $\lambda - \epsilon, \lambda$ contains many levels, $\epsilon \ll \lambda$) and can be obtained by taking the derivative of eq. (a) with respect to λ.

Thus, eq. (a) really leads to eq. (4).

1.1. So, the microcanonical distribution statement, which is the unproved hypothesis of the classical statistical mechanics, can be checked in quantum mechanics.

2. It is a pleasure to note that the Newell's derivation of eq. (a) is remarkably simple.

REFERENCES

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