
Neutron and X-ray Scattering of Quantum Materials

PHYS-640

Week 1 exercises

1: Neutron production

(a) Hydrogen as a moderator

Exercise 4.P.1 in the neutron notes.

Do we have to consider the neutron as relativistic particles before the moderation process? What about after?

(b) Wavelength distribution

The wavelengths of the neutrons coming from a moderator in thermal equilibrium at a given temperature, T , follow a Maxwell distribution as follows:

$$P(\lambda) \propto \frac{1}{\lambda^2} e^{\frac{-h^2}{2k_B m T \lambda^2}},$$

where λ is the neutron wavelength, h the Planck constant, k_B the Boltzmann constant and m the neutron mass.

- Show that the most probable kinetic energy is $E = k_B T$
- What is the most probable neutron wavelength at room temperature?

2: Neutron interaction with matter

(a) Scattering cross section

Exercise 2.P.1 in the neutron notes.

(b) Attenuation

Exercise 2.P.2 in the neutron notes.

(c) Incoherent cross section

Exercise 2.P.4 in the neutron notes

(d) Material selection

Exercise 2.P.5 in the neutron notes