

Direct detection

1. Ignoring form factor effects, and considering a 100 kg detection volume of xenon (atomic mass 132), what WIMP-nucleon scattering cross section $\sigma_{\chi n}$ do you need to observe 1 event/year for a 100 GeV WIMP? You may neglect energy threshold effects, and an order-of-magnitude estimate is sufficient.
2. Consider inelastic scattering instead of elastic; the DM particle scatters into a slightly higher-mass state with $m'_\chi = m_\chi + \Delta$. What is the minimum recoil energy in this case? You may assume that Δ/m_χ is a small parameter, and treat it perturbatively. Describe how the shape of the recoil energy spectrum dR/dE_R changes relative to the elastic case $\Delta = 0$.