Keystone: Chapter 9

A <sup>57</sup>Fe nucleus is at rest and in its first excited state, 14.4 keV above the ground state (14.4e3 eV, where 1 eV = 1.6e-19 J). The nucleus then decays to the ground state with the emission of a gamma ray (a high energy photon).

1) What is the recoil speed of the nucleus?

2) Calculate the slight difference in eV between the gamma-ray energy and the 14.4 keV difference between the initial and final nuclear states.

3) The "Mössbauer effect" is the name given to a related phenomenon discovered by Rudolf Mössbauer in 1957, for which he received the 1961 Nobel prize for physics. If the <sup>57</sup>Fe nucleus is in a solid block of iron, occasionally when the nucleus emits a gamma ray the entire solid recoils as one object. This can happen due to the fact that neighboring atoms and nuclei are connected by the electric interatomic force. In this case, repeat the calculation of part (2) and compare with your previous result. Explain briefly.