

You are employed by a mining company as a scientific consultant in connection with a proposed new explosive for use in ore recovery. The proposed explosive device confines a metastable fermi gas of atoms at room temperature, with fermi energy of 10 eV, within an impenetrable container that thermally isolates the gas. With negligible added energy a special (unspecified) process transforms each fermion into a stable boson, and the boson gas, it is said, then explodes the container. You may assume that the particles in the container do not interact.

Answer the following questions from your employer:

- (a) If the transformation from fermions to bosons is carried out adiabatically, so that the particles experience no sudden forces, can the resulting bose gas explode the container?
- (b) Provide an estimate for the temperature T_B of the bose gas when it reaches equilibrium in the container.
- (c) Given that the container is comparable to the contained gas in total moles of material, and using reasonable estimates of thermal properties (eg of metals), has the bose gas enough energy to melt the container and so explode?
- (d) Do known processes exist that change fermionic atoms to bosonic atoms, or that pair two fermions to make a boson? If so give real examples in each case.
- (e) If the fermions could combine chemically as pairs into bosons with a binding energy of 1 eV, would the gas explode the container? Explain.
- (f) Is 10 eV a reasonable fermi energy for a fermi gas of atoms? Explain.