3.8 Magnetocaloric cooling: adiabatic demagnetization

Adiabatic demagnetization is the first method developed for cooling below 0.3 K. As illustrated in Fig. 3.7 a) it essentially contains two steps:

- A-B: A sample of a paramagnetic salt (such as cerium magnesium nitrate), already cooled to low T by other means, is magnetized isothermally (contact with thermally well conducting He gas), which results in a decrease of the entropy for paramagnetic salt
- B-C: adiabatic demagnetization (pumping out He gas to enforce thermal isolation) resulting in decrease of temperature

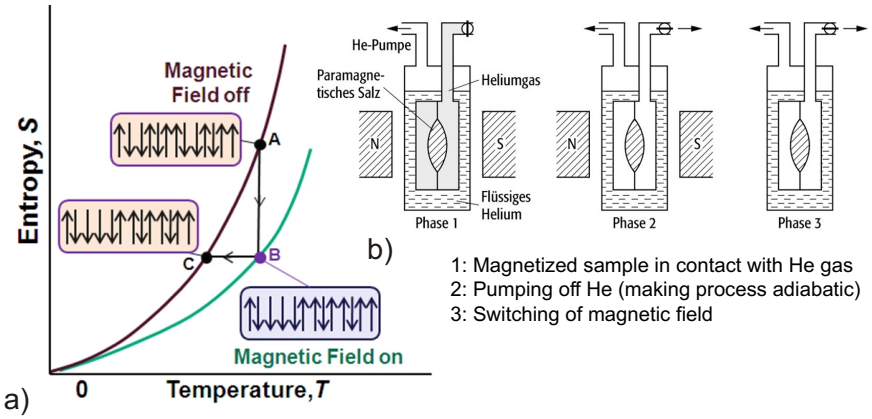

Figure 3.7: Adiabatic demagnetization. a) $T - S$ diagram; b) scheme of the process steps.

BUT: By this method (or by any other) $T = 0$ K cannot be reached since it would need an infinite number of steps, since the two curves must have a common point according to Nernst's theorem of vanishing transition entropy ($\Delta S = 0$ for $T \to 0$).