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## Detailed Balance

Clearly a sufficient (but not necessary) condition for an equilibrium (time independent) probability distribution is the so-called detailed balance condition

$$W(A \rightarrow B) P(A, t) = W(B \rightarrow A) P(B, t)$$

This method can be used for any probability distribution, but if we choose the Boltzmann distribution

$$\begin{aligned} \frac{W(A \rightarrow B)}{W(B \rightarrow A)} &= \frac{p(B)}{p(A)} = \frac{e^{-E(B)/kT}}{e^{-E(A)/kT}} \\ &= e^{-\Delta E/kT} \\ \Delta E &= E(B) - E(A) \end{aligned}$$

N.B.  $Z$  does not appear in this expression! It only involves quantities that we know ( $k, T$ ) or can easily calculate ( $E$ ).

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