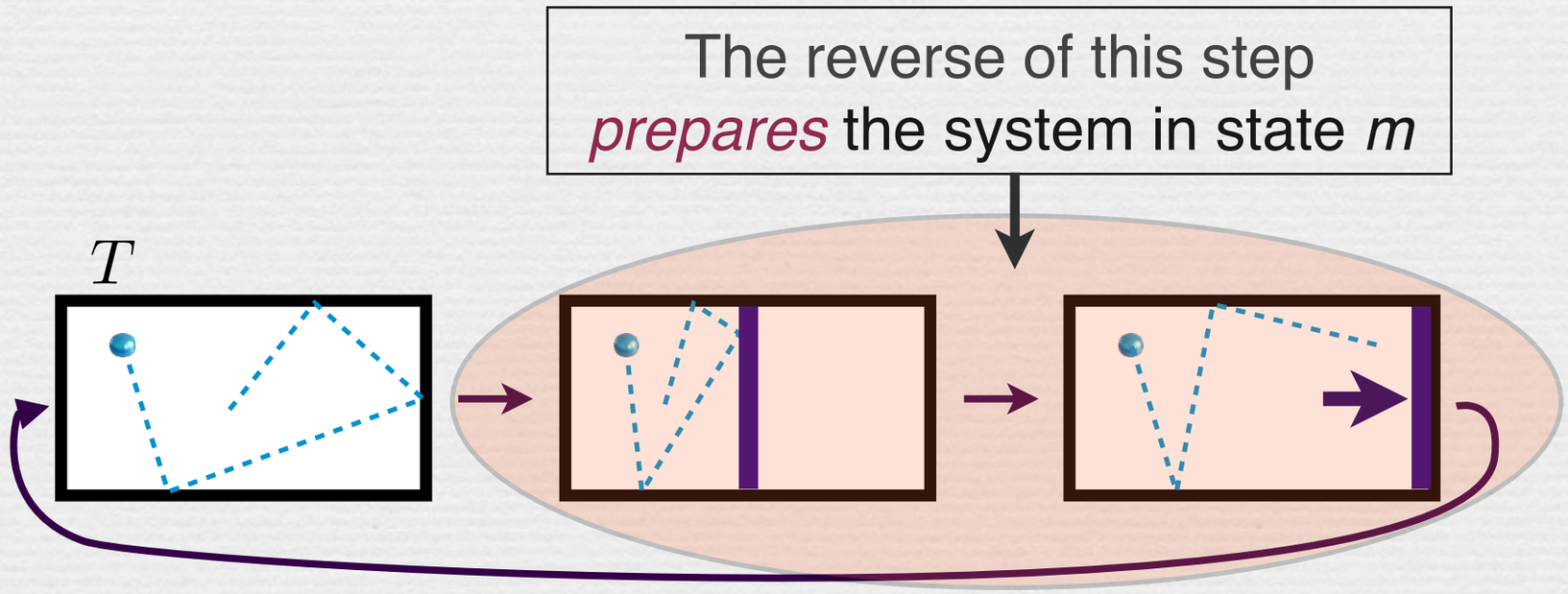
6. Optimal Maxwell demons

The protocol after measuring *m* must be such that, when it is run backwards in time, prepares the system in state *m*



An example: multiparticle Szilard engines

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Quantum Szilard Engine

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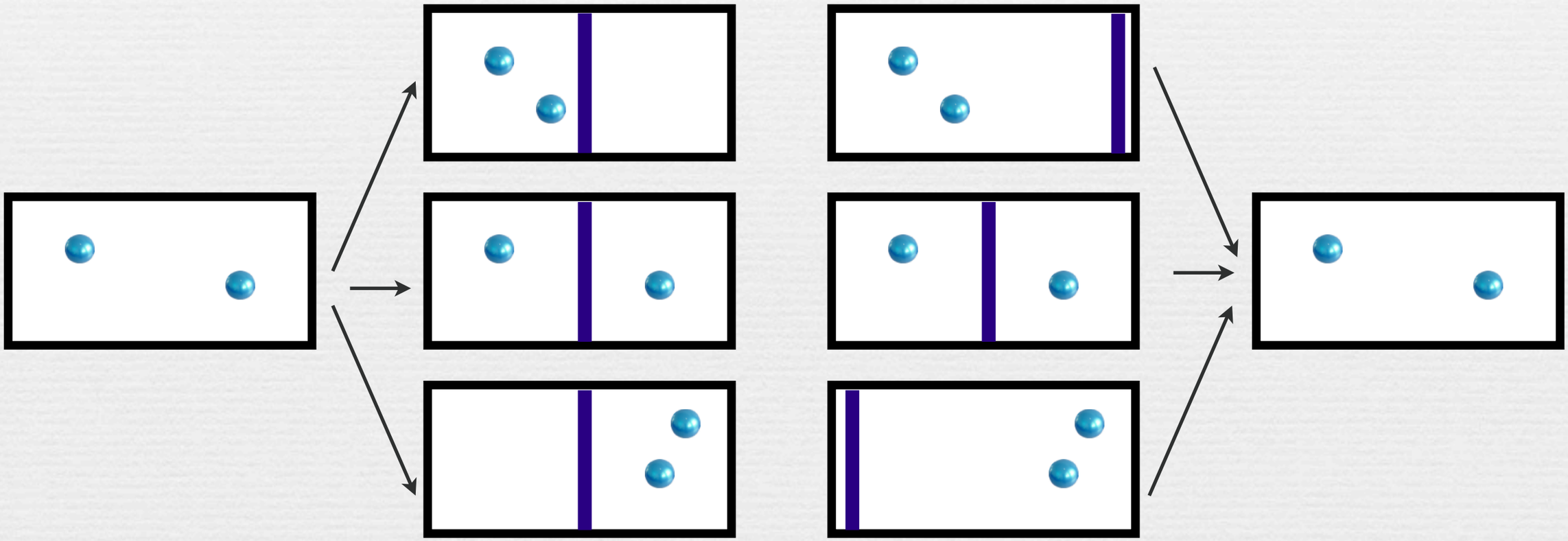
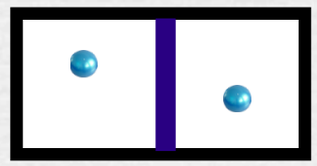
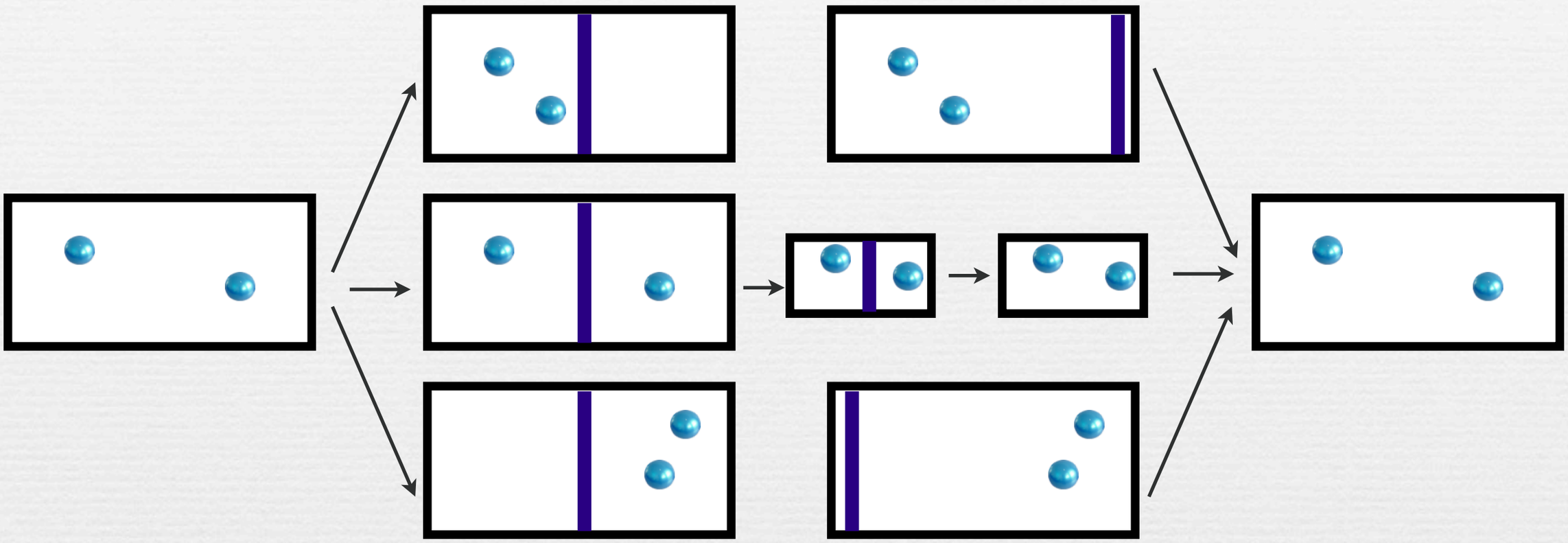


$$H = \frac{1}{4}\log 4 + \frac{1}{4}\log 4 + \frac{1}{2}\log 2 = \frac{3}{2}\log 2$$

$$W_{\mathrm{extract}} = kT\left(\frac{2}{4}\log 2 + \frac{2}{4}\log 2\right) = kT\log 2$$

We waste half a bit.Can we extract work from  ?

An example: multiparticle Szilard engines



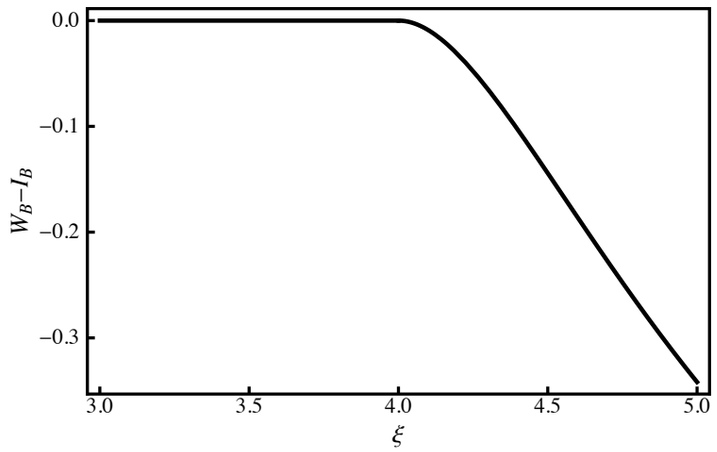
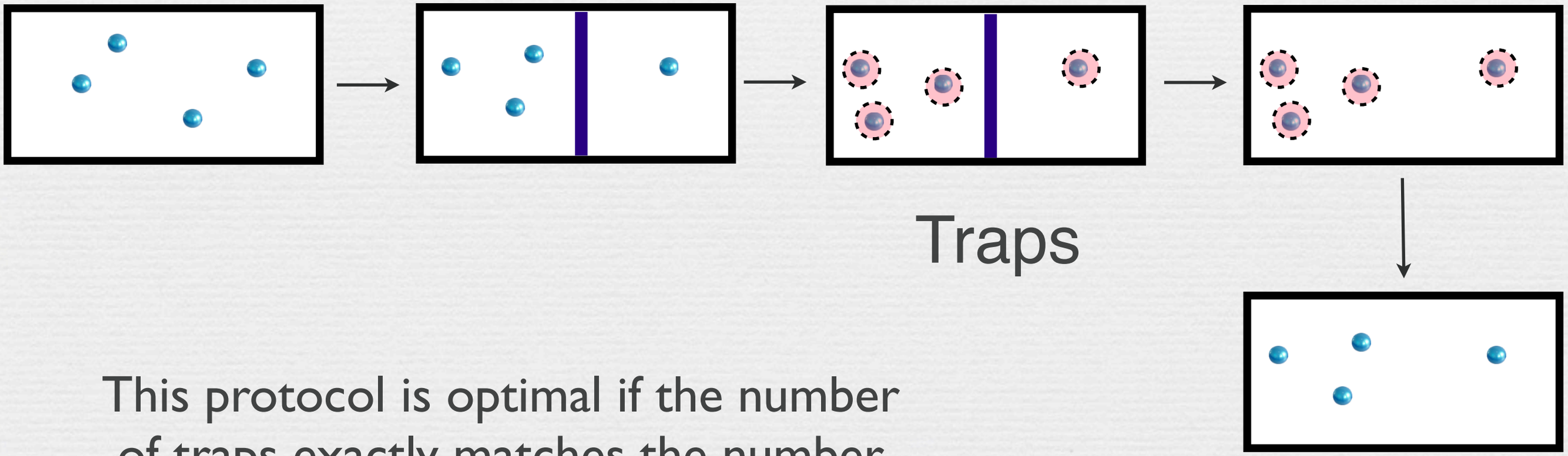


Figure 3. Plot of the deviation from reversibility $W_B - I_B$ for the two-particle Szilard engine protocol implemented in response to measuring each particle in a separate half of the box (outcome B) as a function of the box size parameter $\xi = l_x/d = 2l_y/d$.

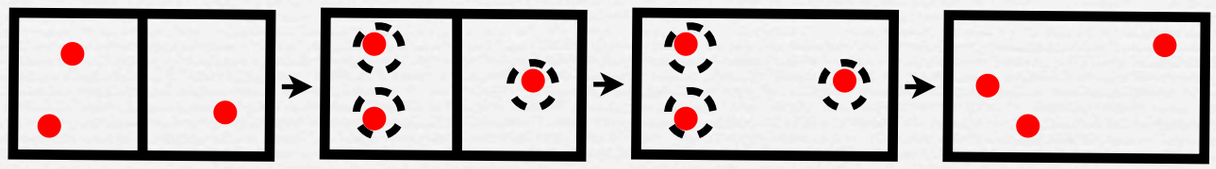
No information is wasted (*W=kTH*) if the box is small and the particle have a finite size.

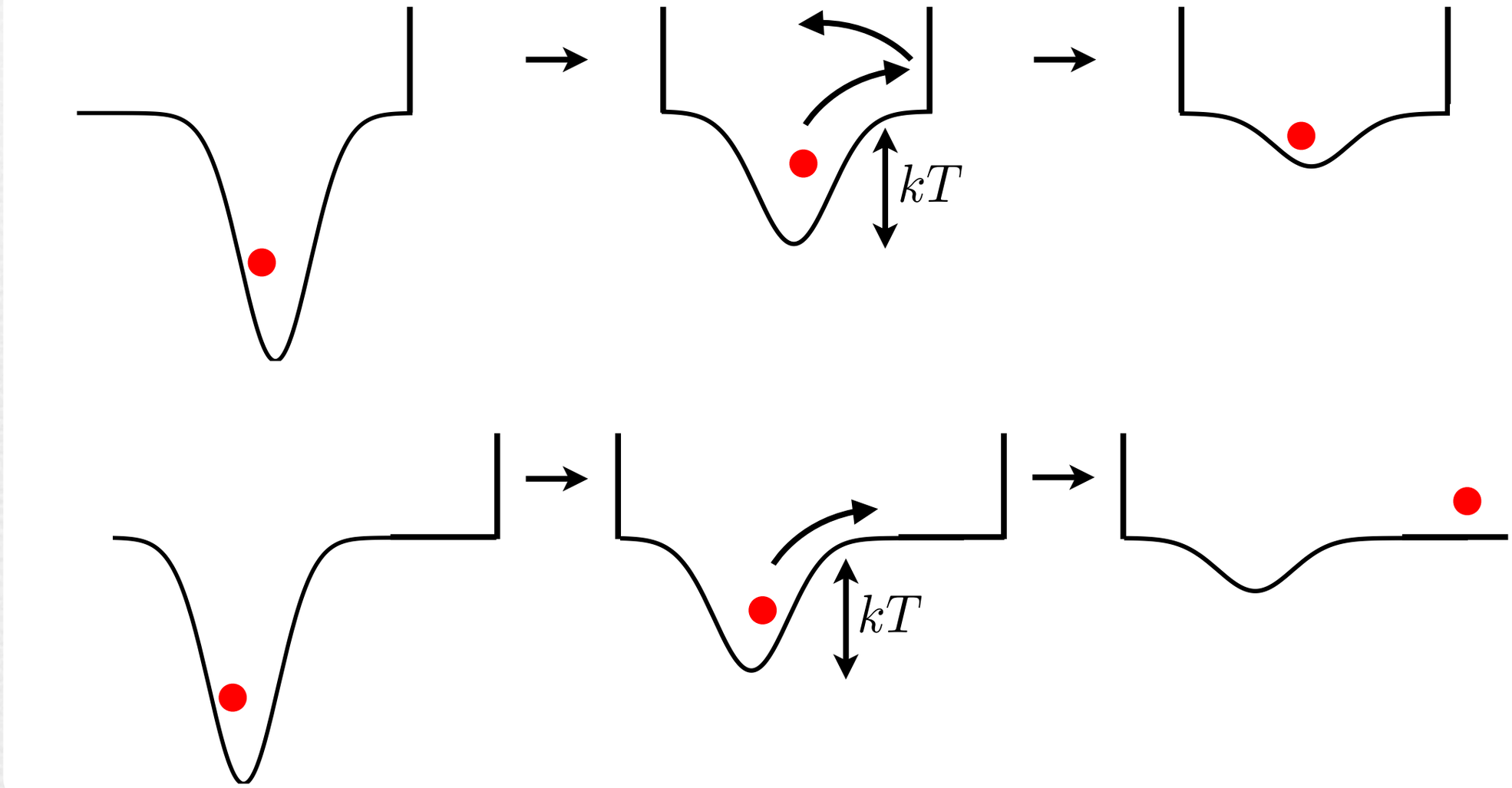
Many particles (Hal Tasaki)



This protocol is optimal if the number of traps exactly matches the number of particles in each side of the box.

Why the protocol extracts energy?





The number of traps has to match the number of particles in each side of the box