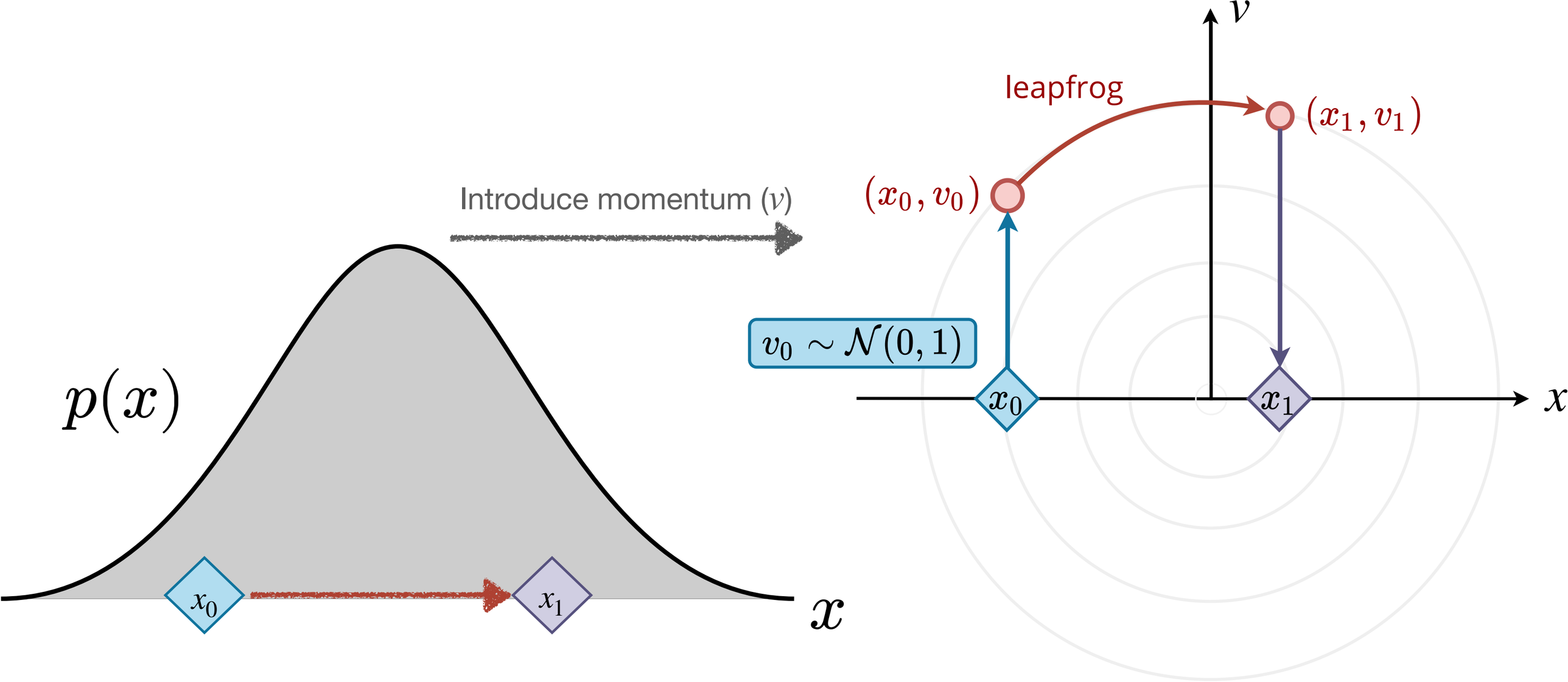
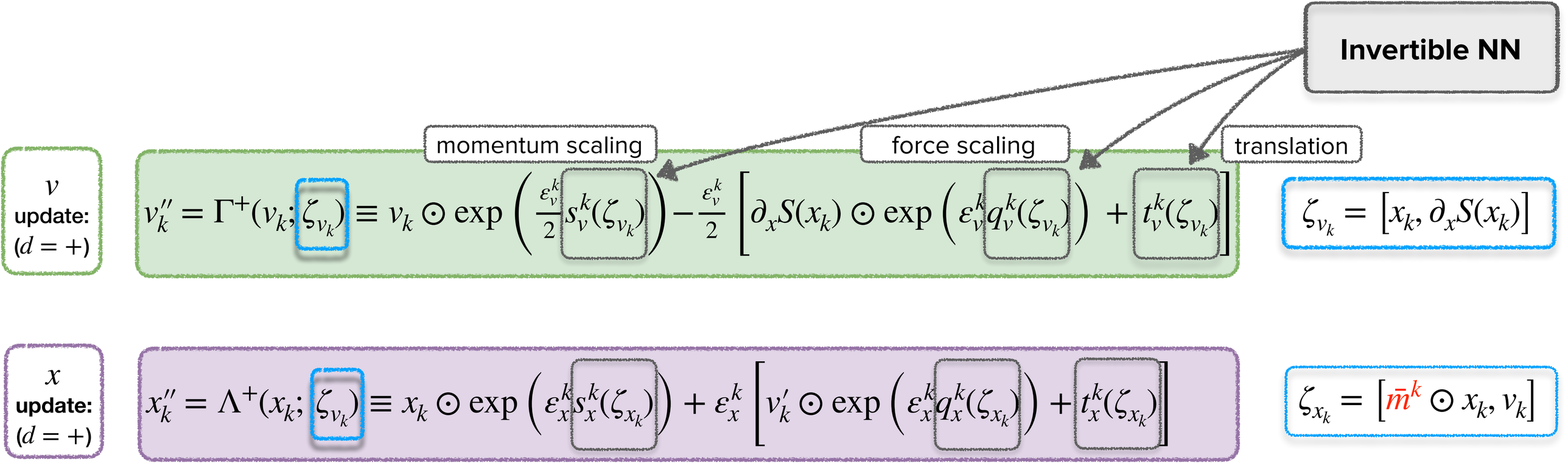

Introduce momentum (v)
$p(x)$
x_0
x_1
x
leapfrog
(x_0, v_0)
(x_1, v_1)
$v_0 \sim \mathcal{N}(0, 1)$
v
x


Invertible NN
momentum scaling
force scaling
translation
v update: (d = +)
$v_k'' = \Gamma^+(v_k; \zeta_{v_k}) \equiv v_k \odot \exp\left(\frac{\varepsilon_v^k}{2} s_v^k(\zeta_{v_k})\right) - \frac{\varepsilon_v^k}{2}\left[\partial_x S(x_k) \odot \exp\left(\varepsilon_v^k q_v^k(\zeta_{v_k})\right) + t_v^k(\zeta_{v_k})\right]$
$\zeta_{v_k} = \left[x_k, \partial_x S(x_k)\right]$
x update: (d = +)
$x_k'' = \Lambda^+(x_k; \zeta_{v_k}) \equiv x_k \odot \exp\left(\varepsilon_x^k s_x^k(\zeta_{x_k})\right) + \varepsilon_x^k\left[v_k' \odot \exp\left(\varepsilon_x^k q_x^k(\zeta_{x_k})\right) + t_x^k(\zeta_{x_k})\right]$
$\zeta_{x_k} = \left[\bar{m}^k \odot x_k, v_k\right]$

(input) $\xi_0 \to \xi_1 \to \cdots \to \xi_k \to \xi_{k+1} \to \cdots \to \xi_{N_{\mathrm{LF}}} \equiv \xi''$ (proposal)