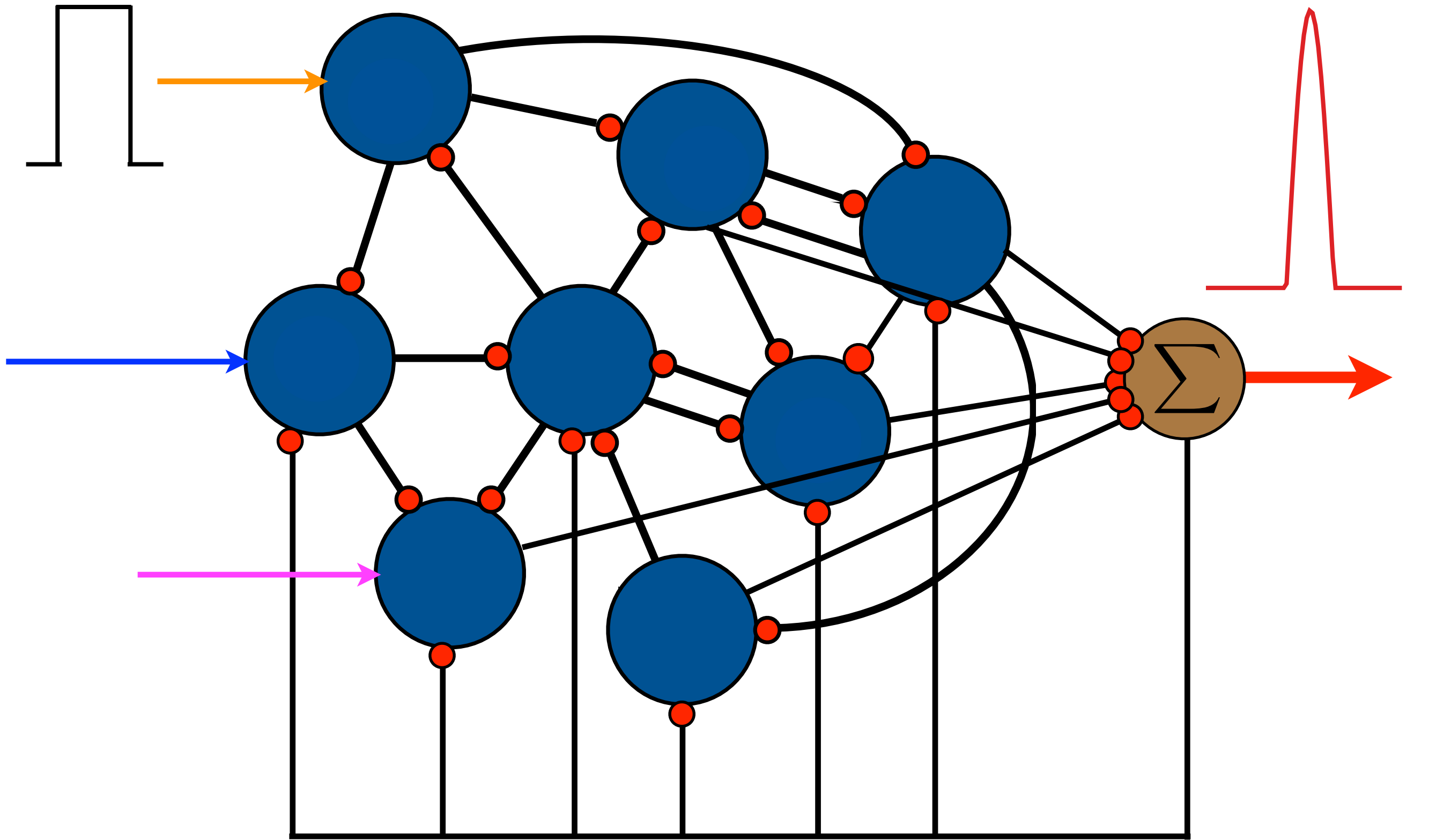
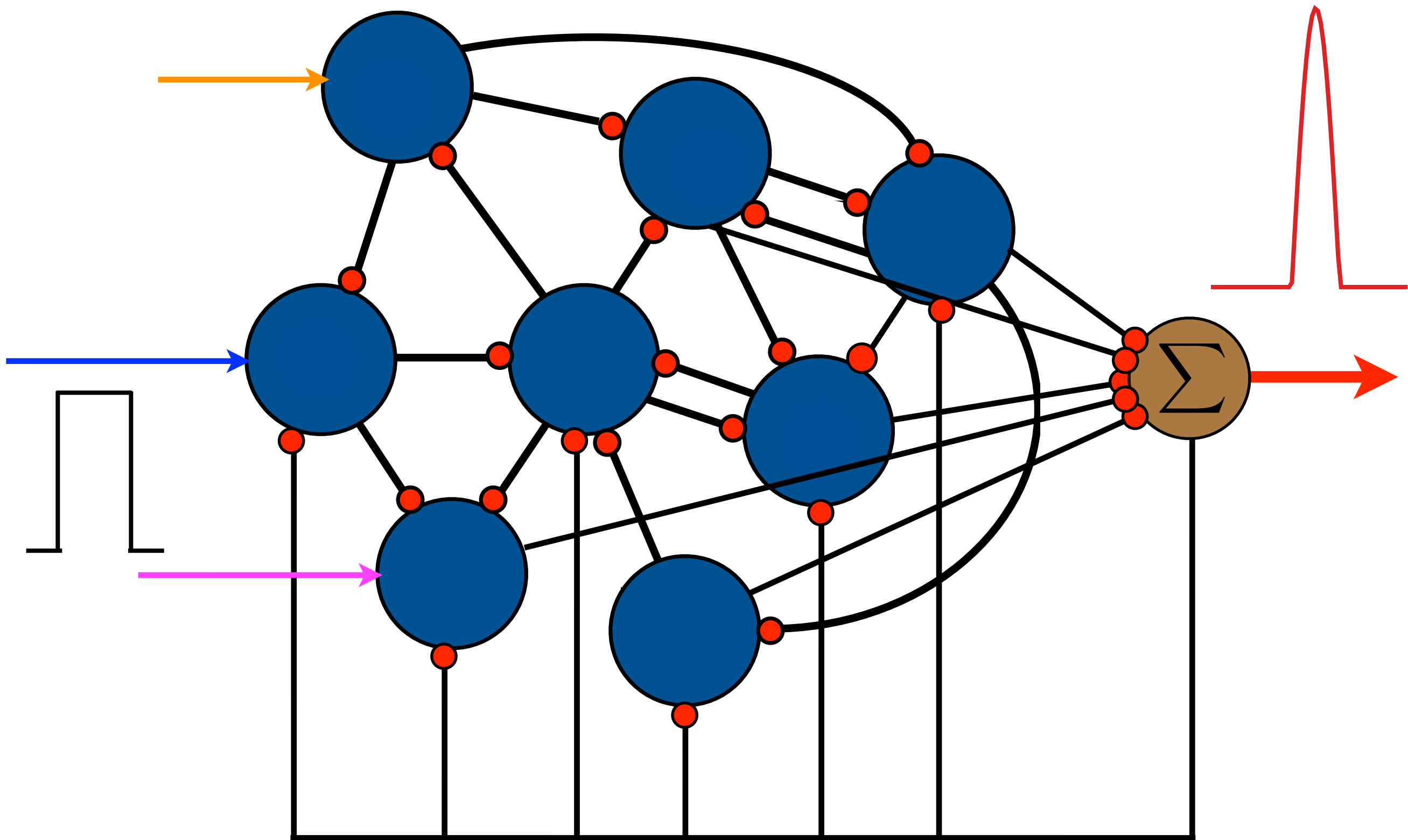
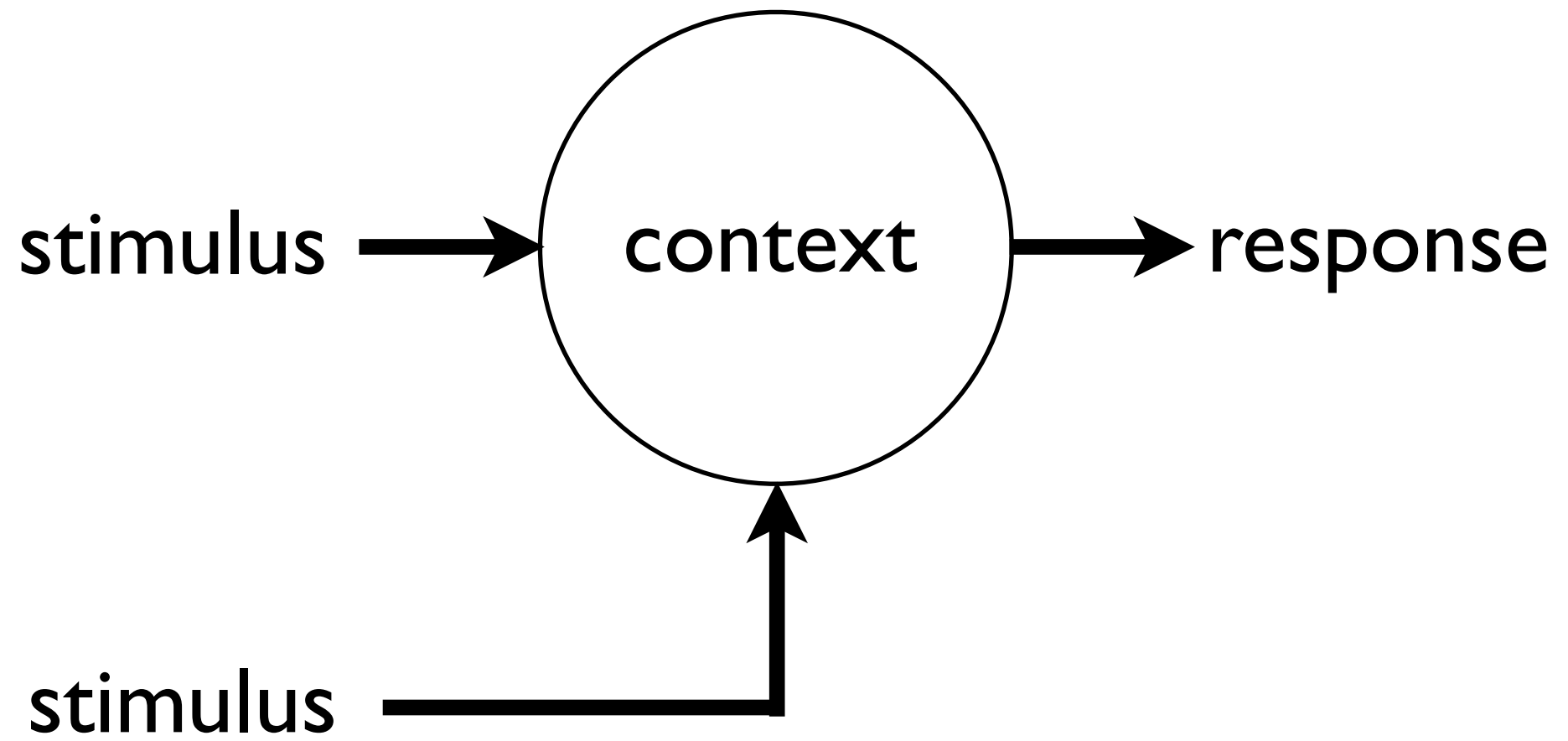


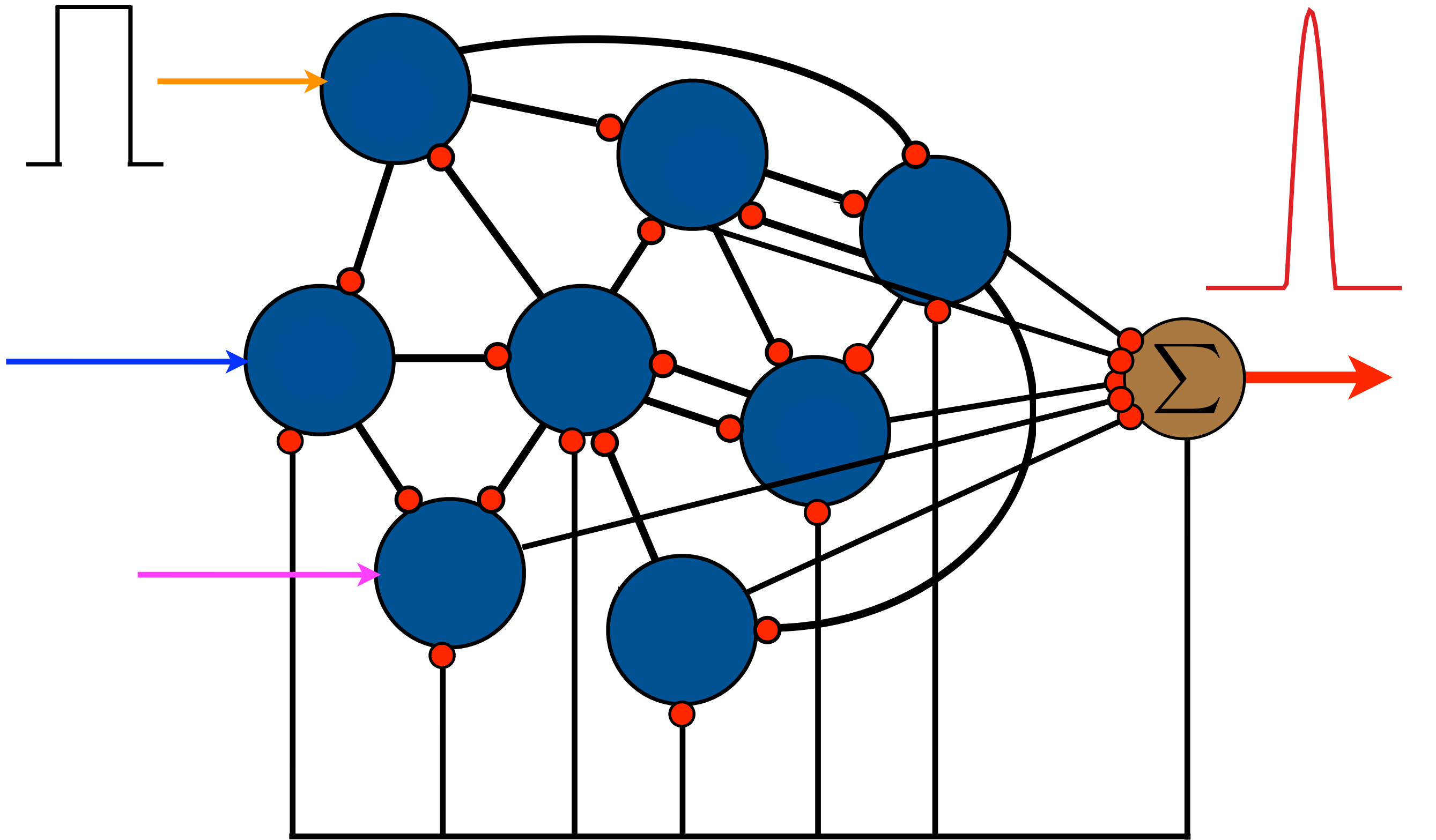
with David Sussillo
Omri Barak
Qing Yuan

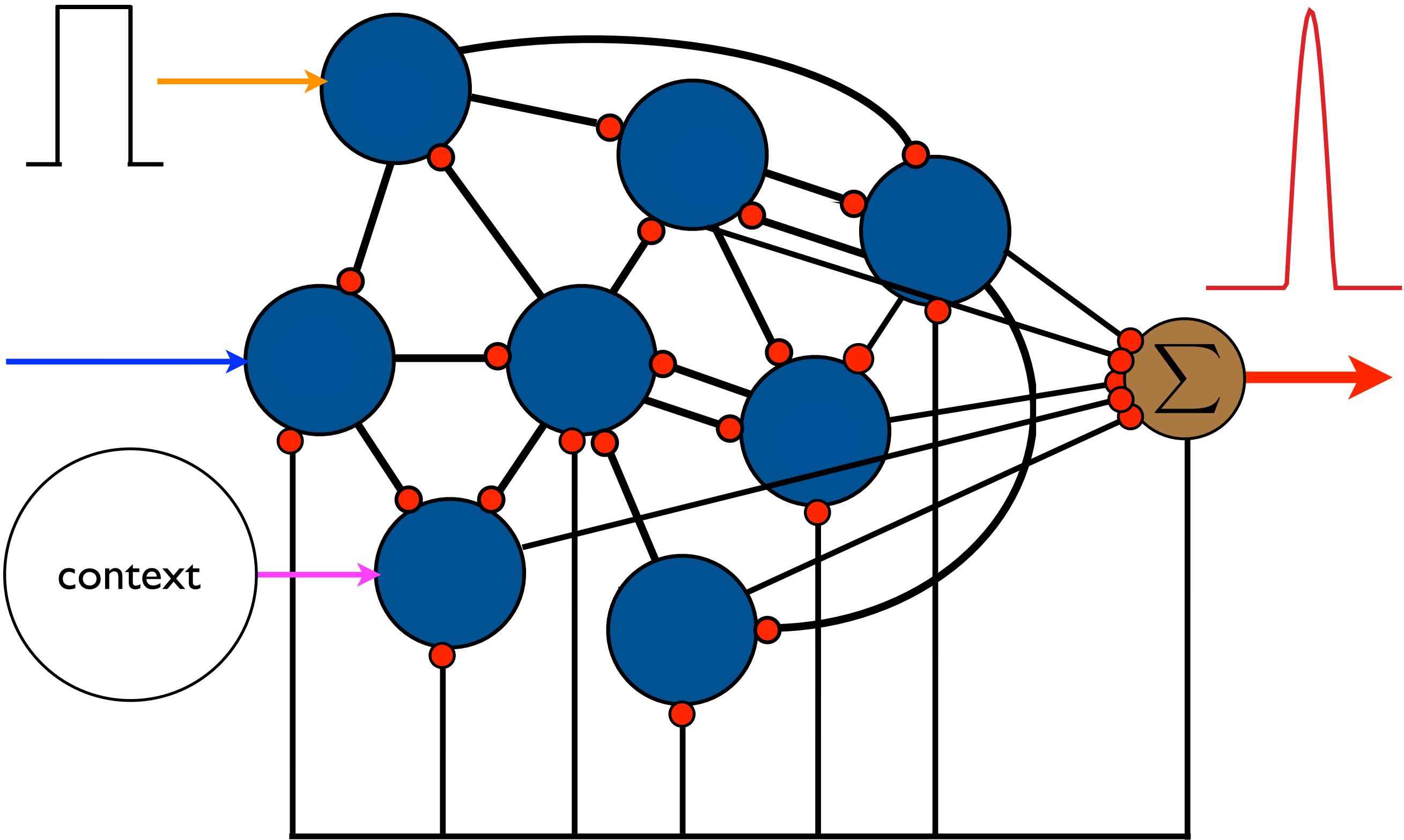


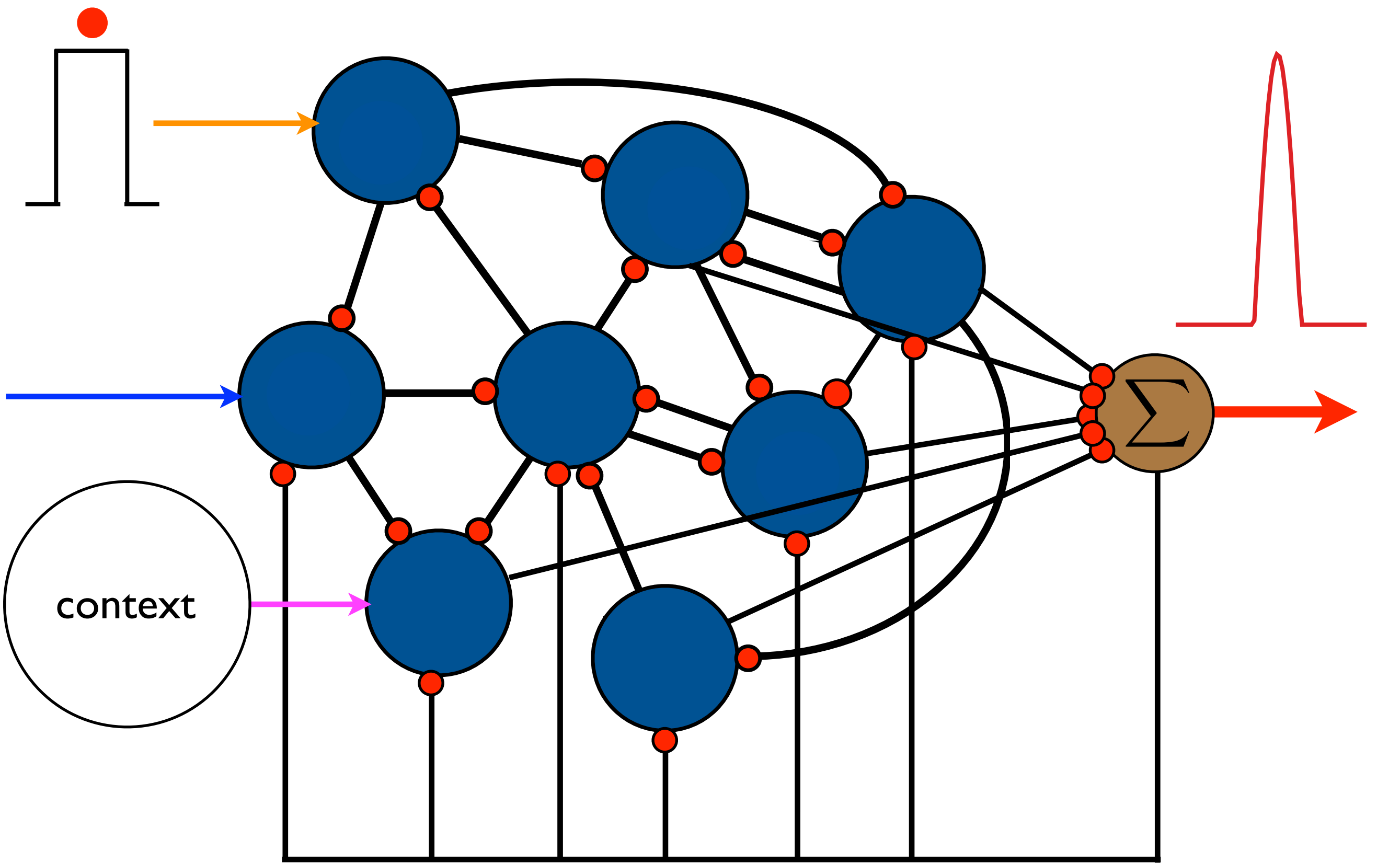


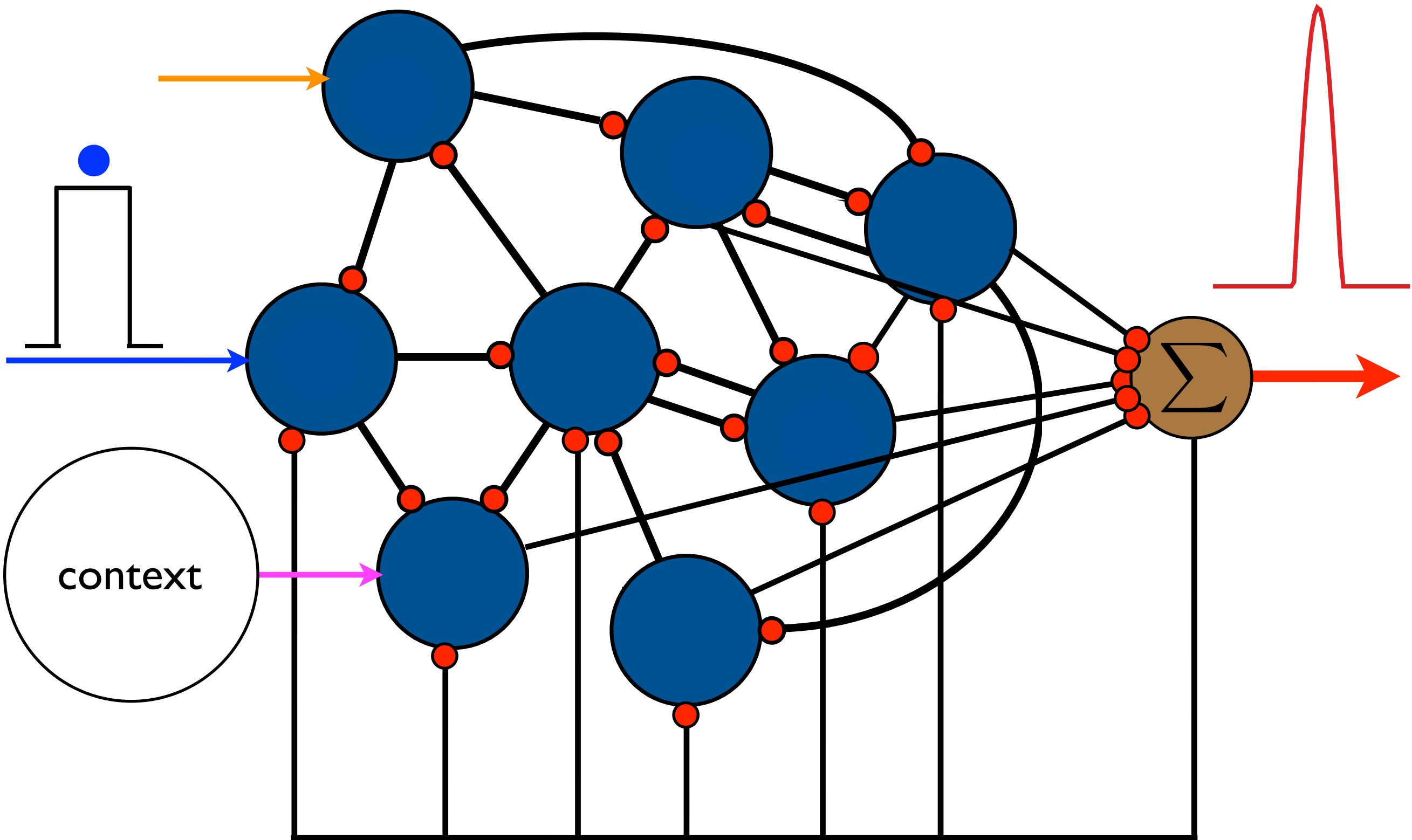




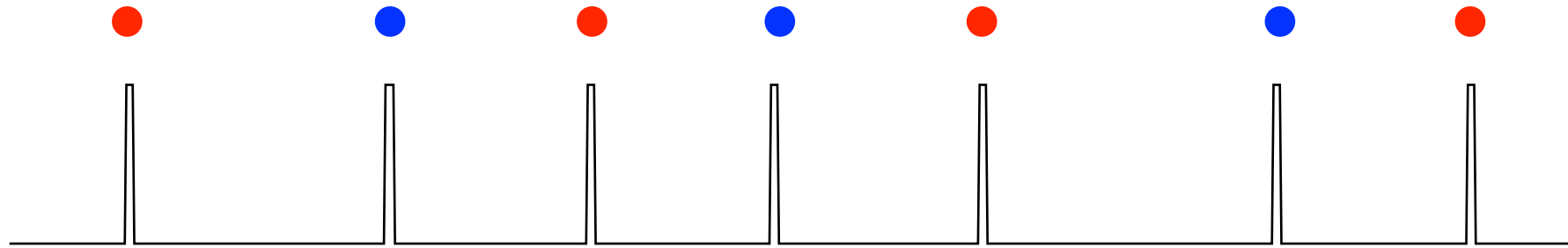


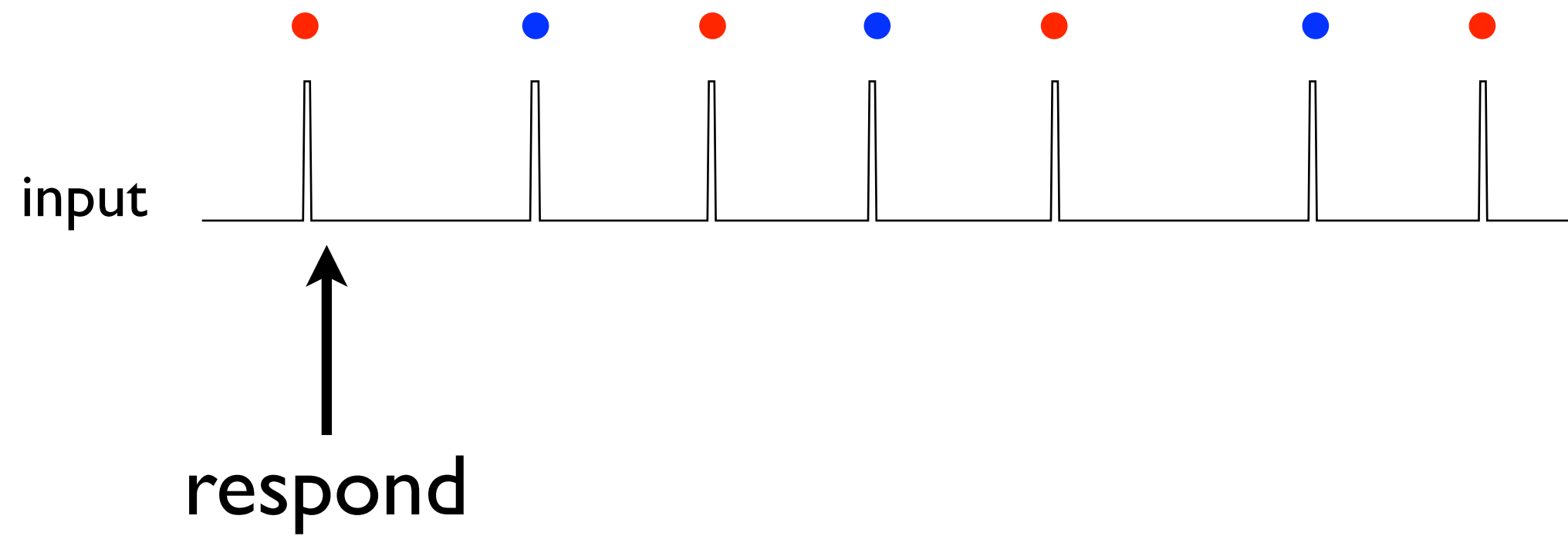


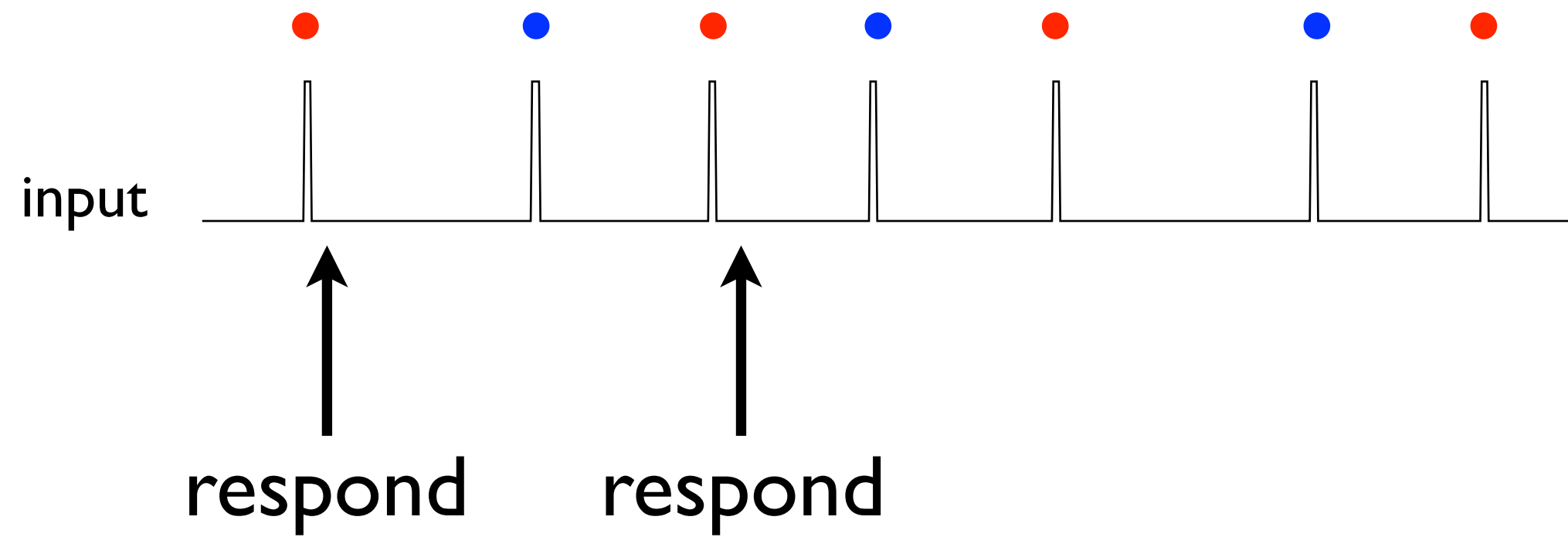


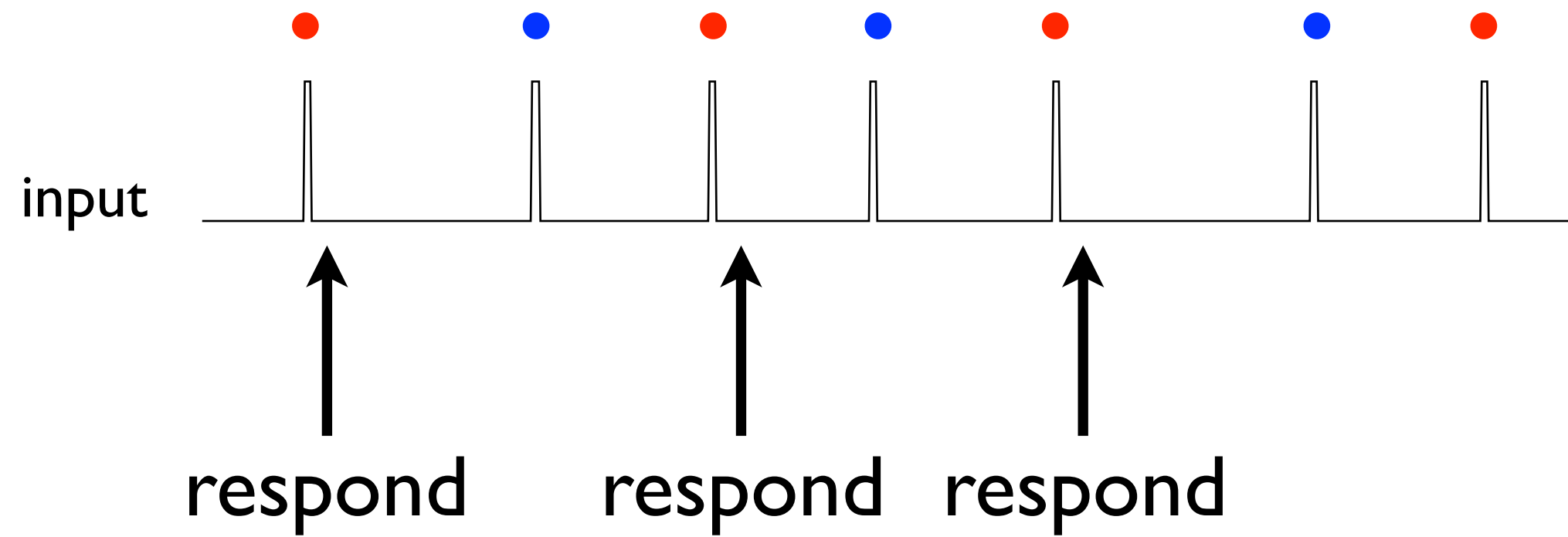


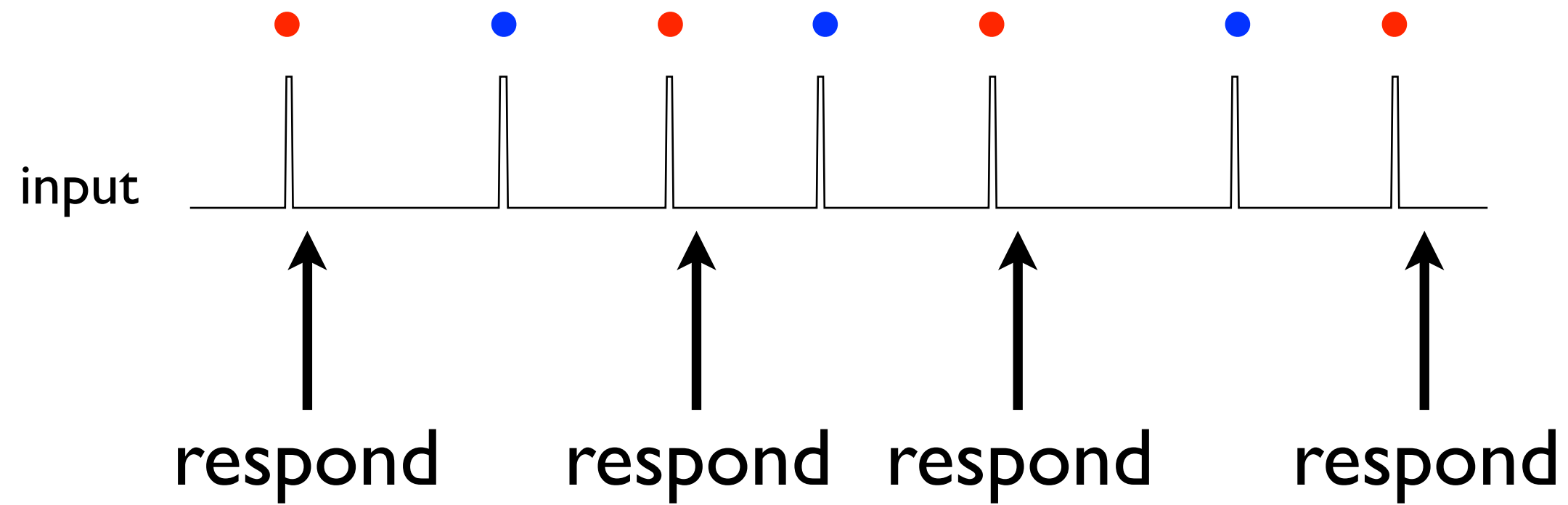
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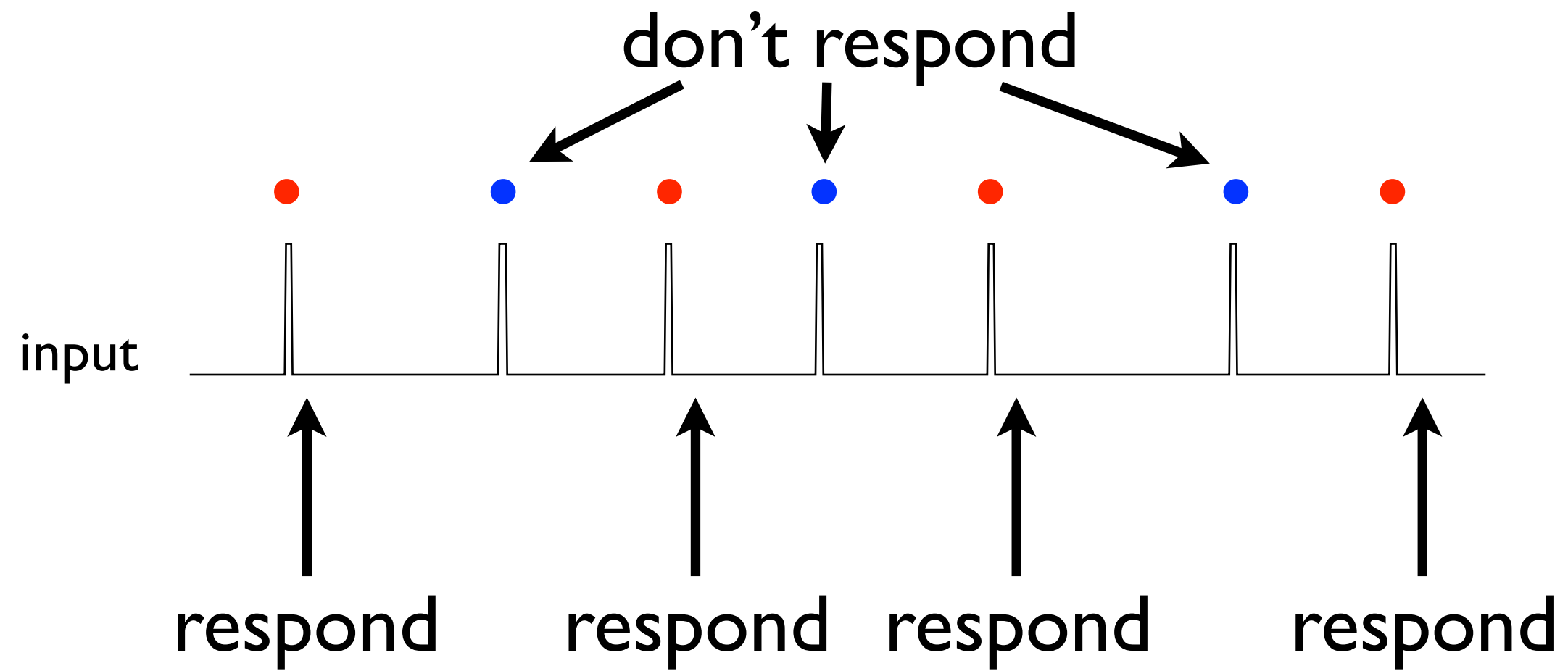


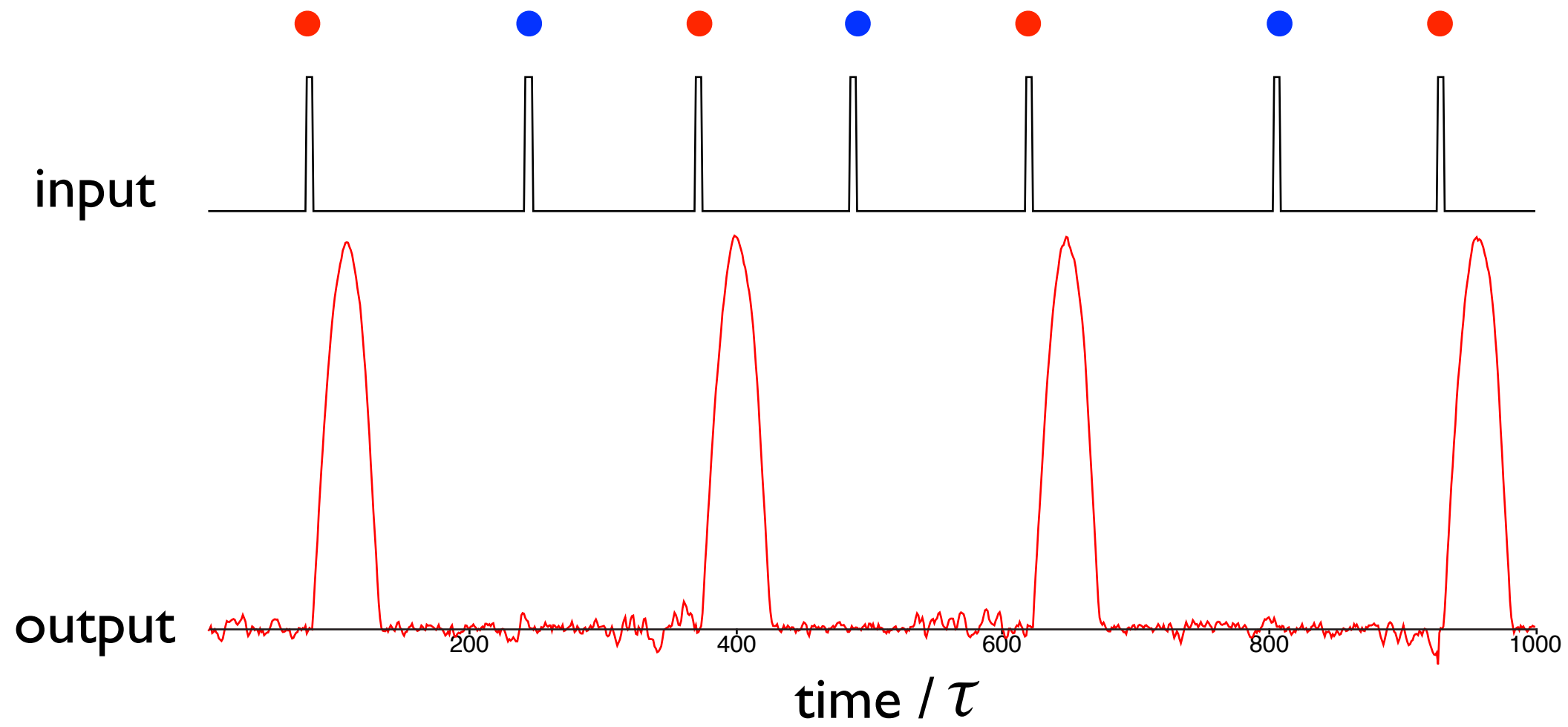


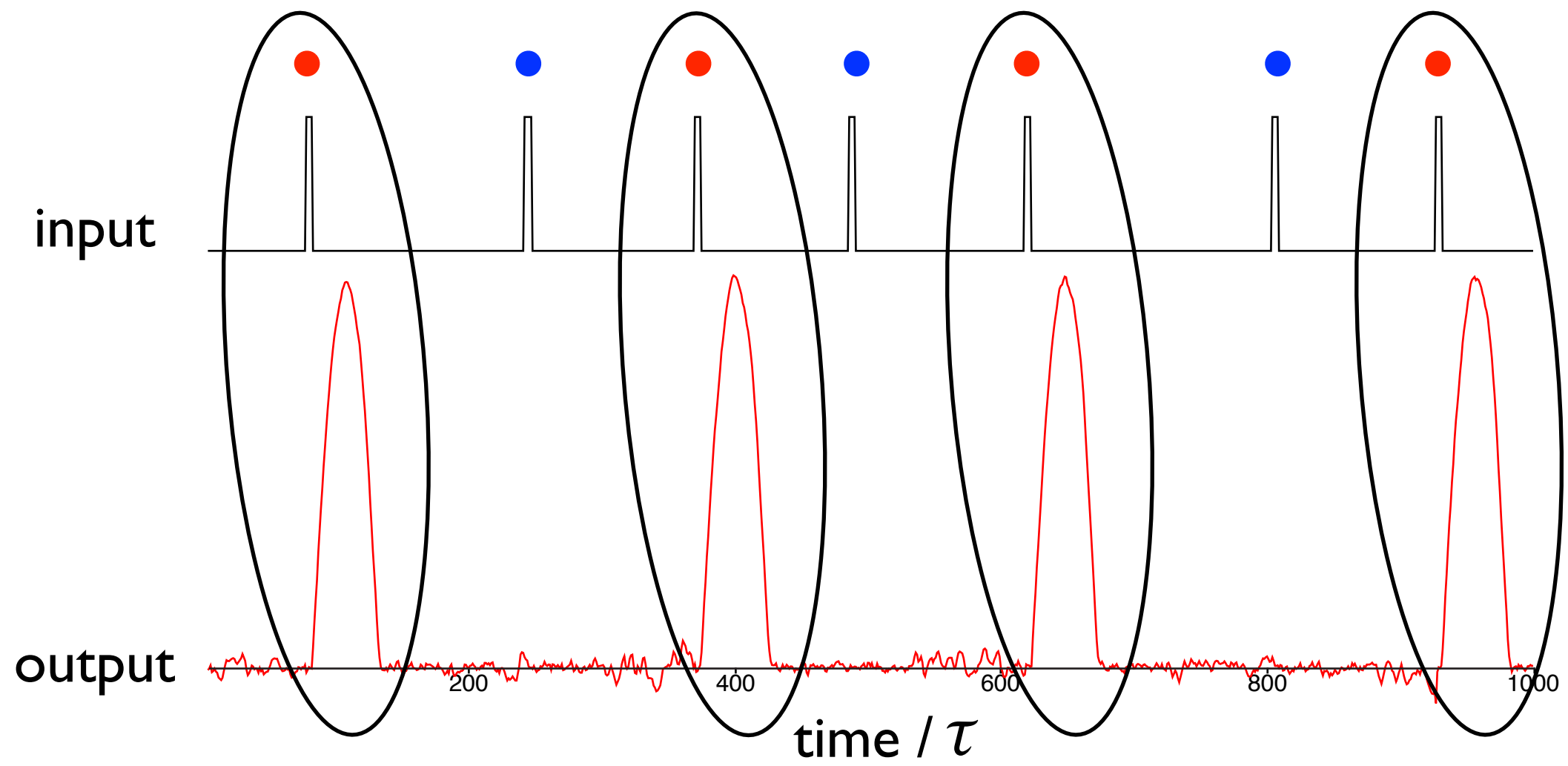


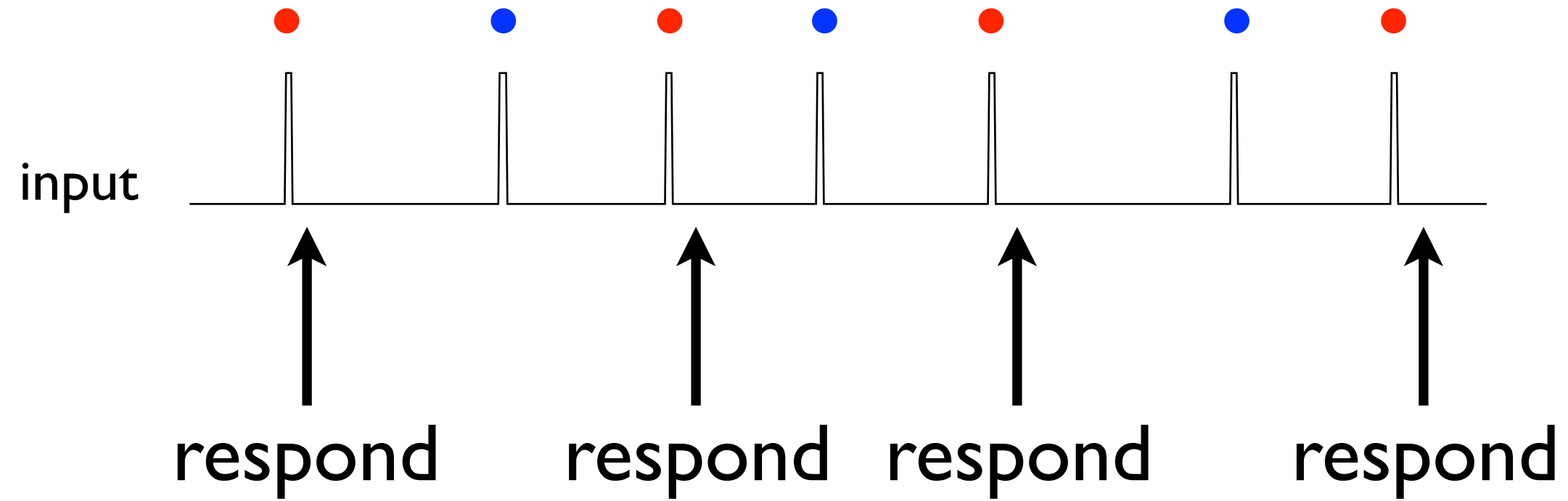


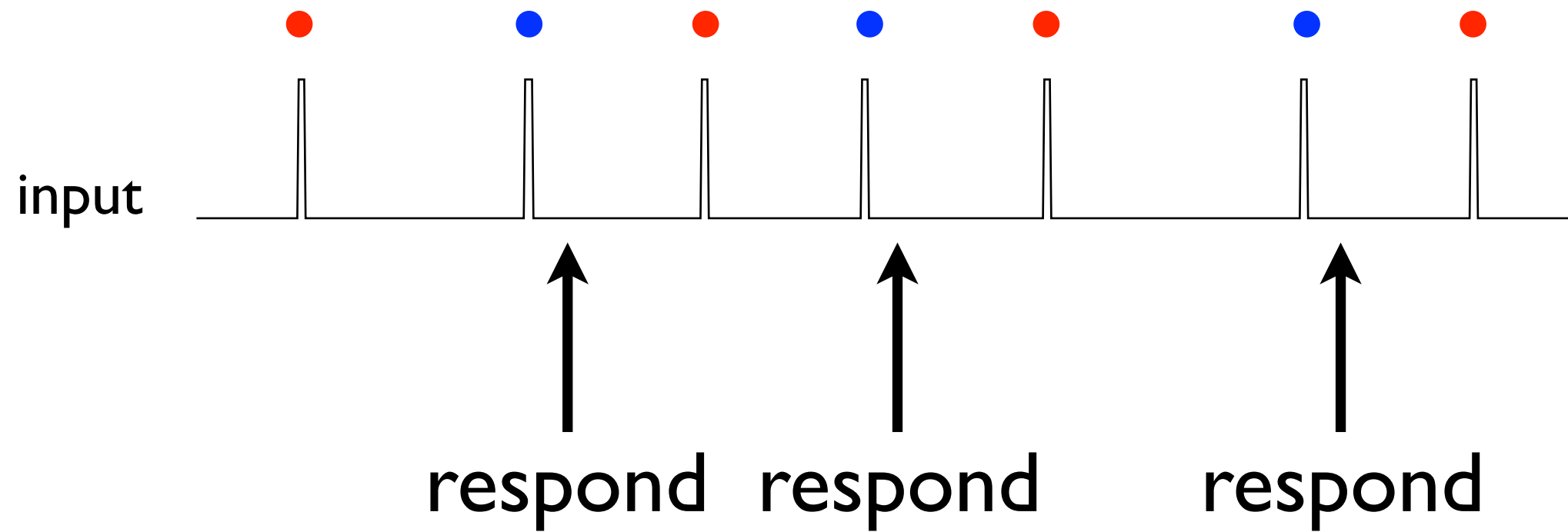
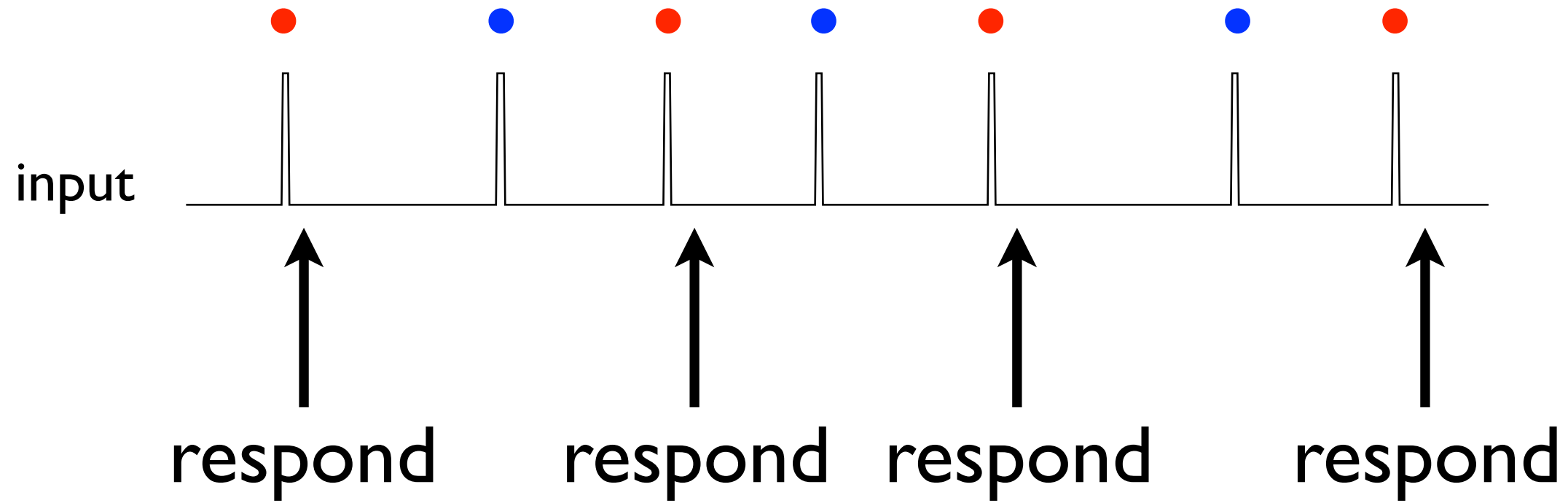


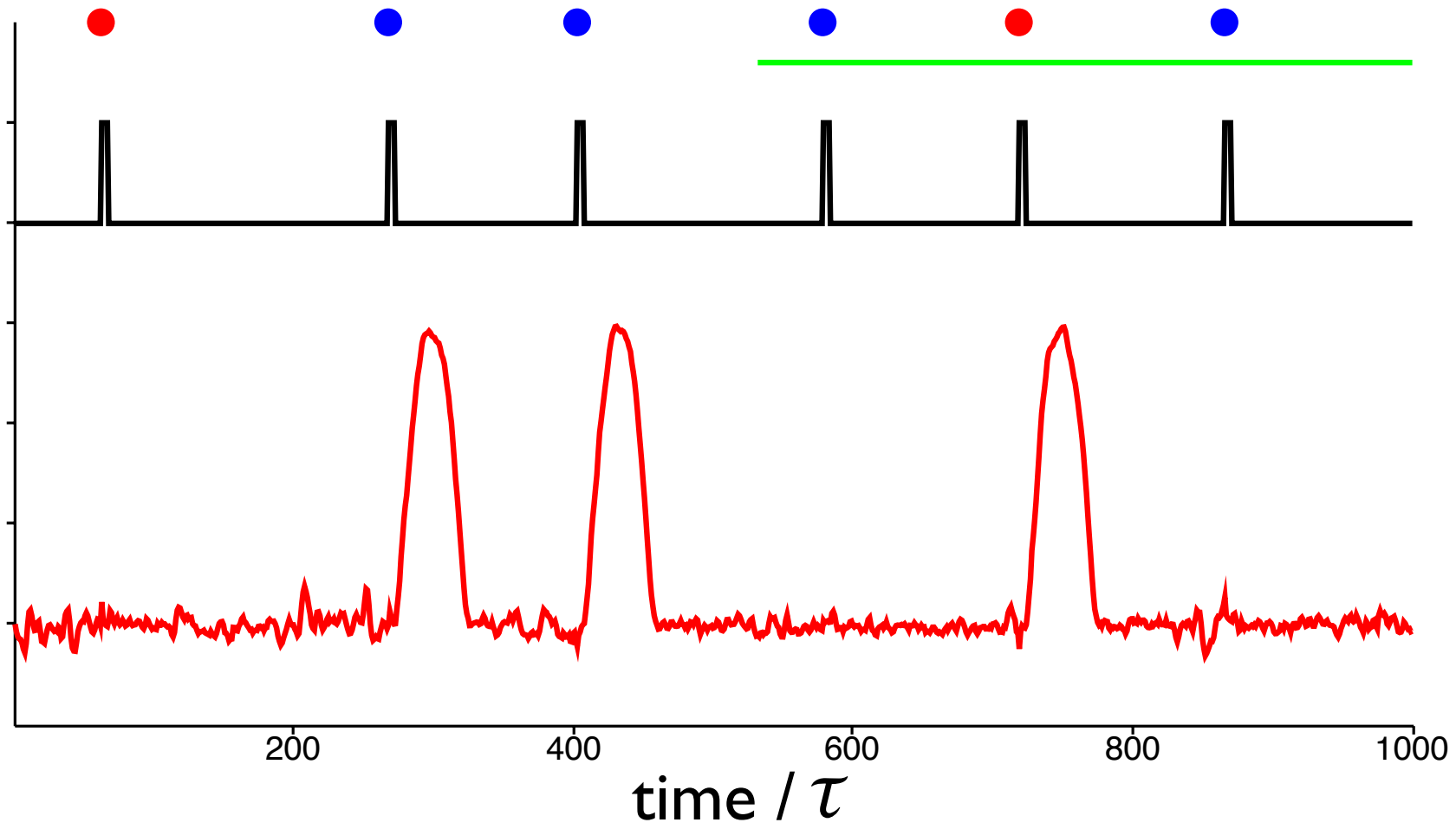


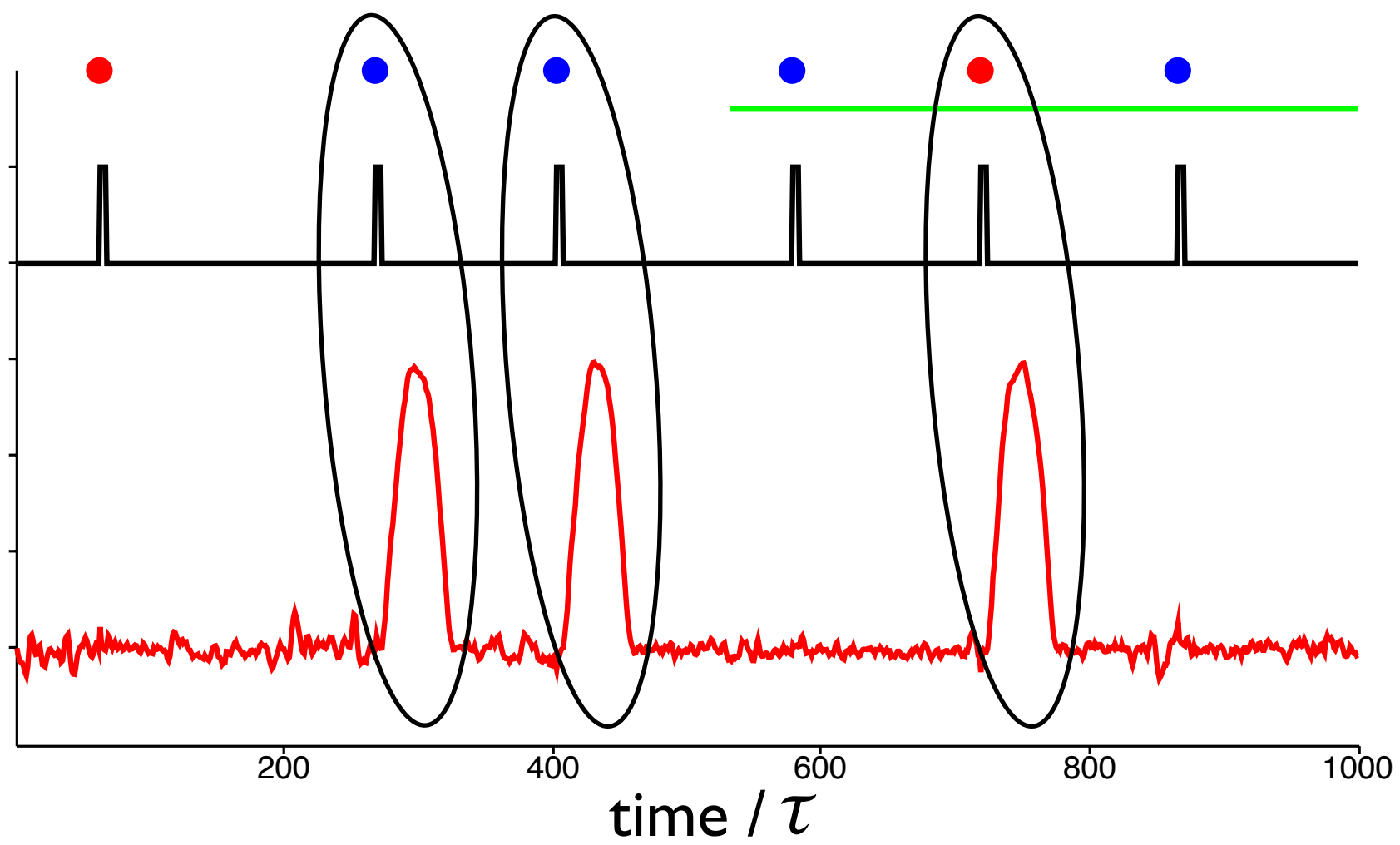


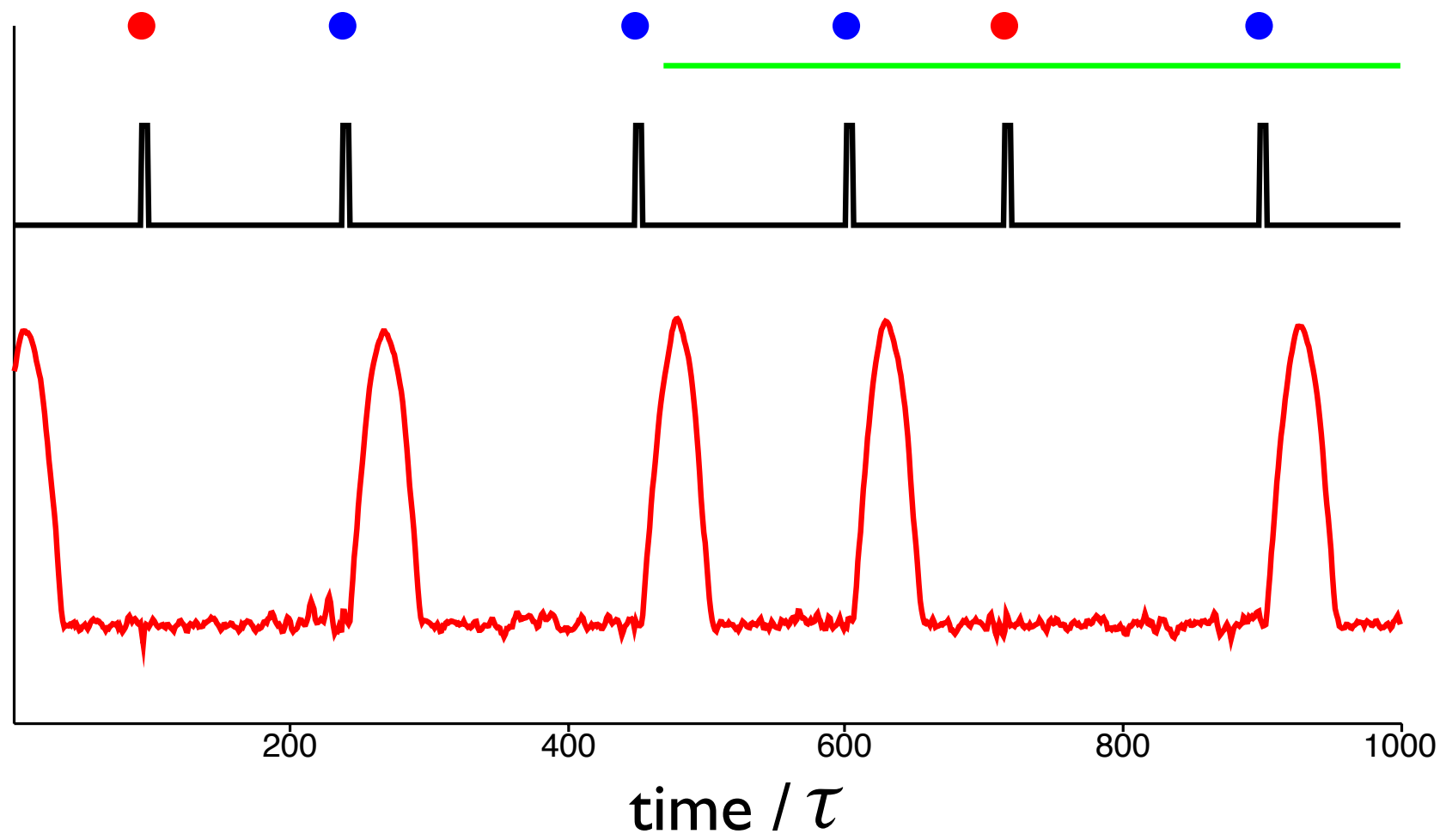
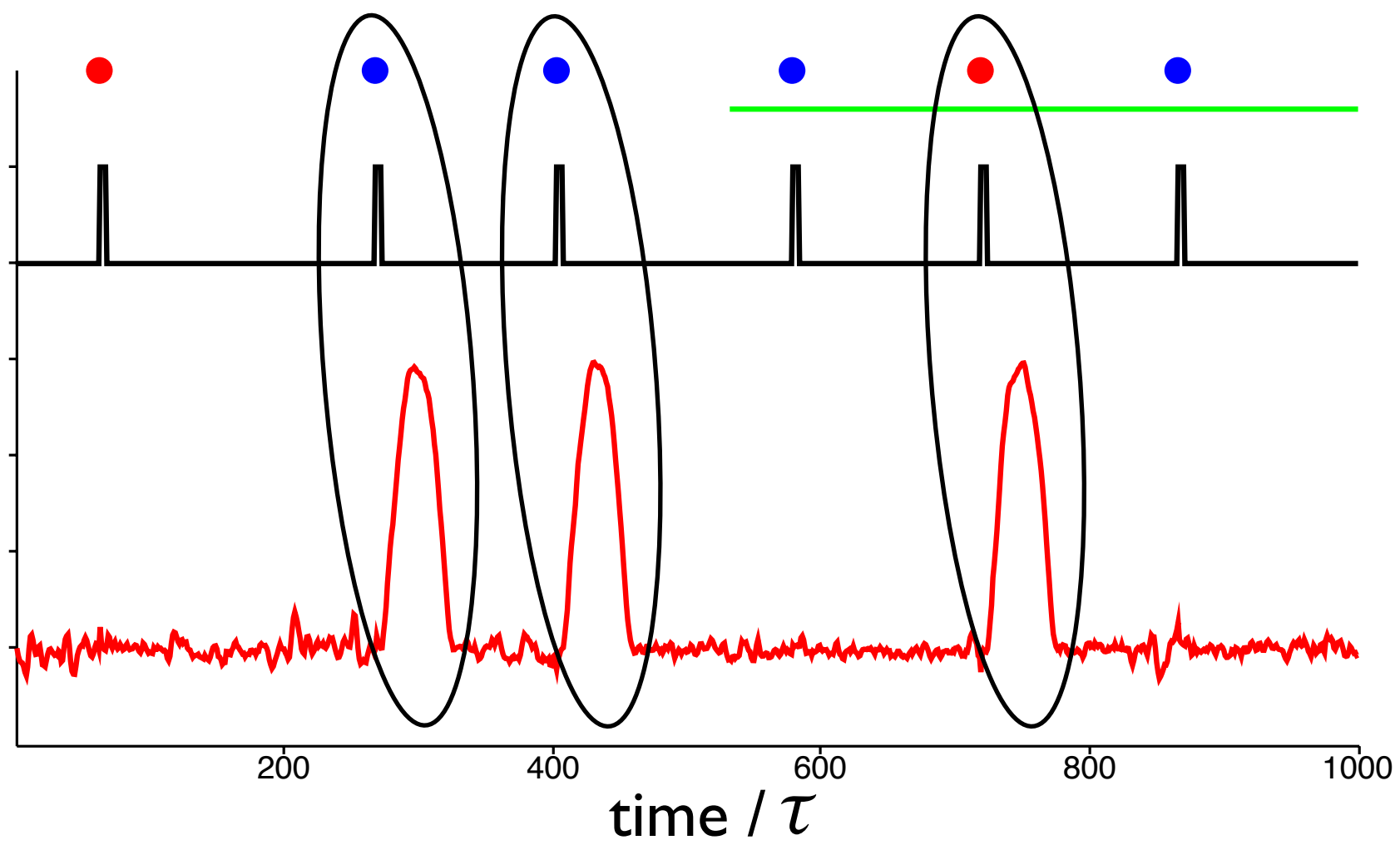


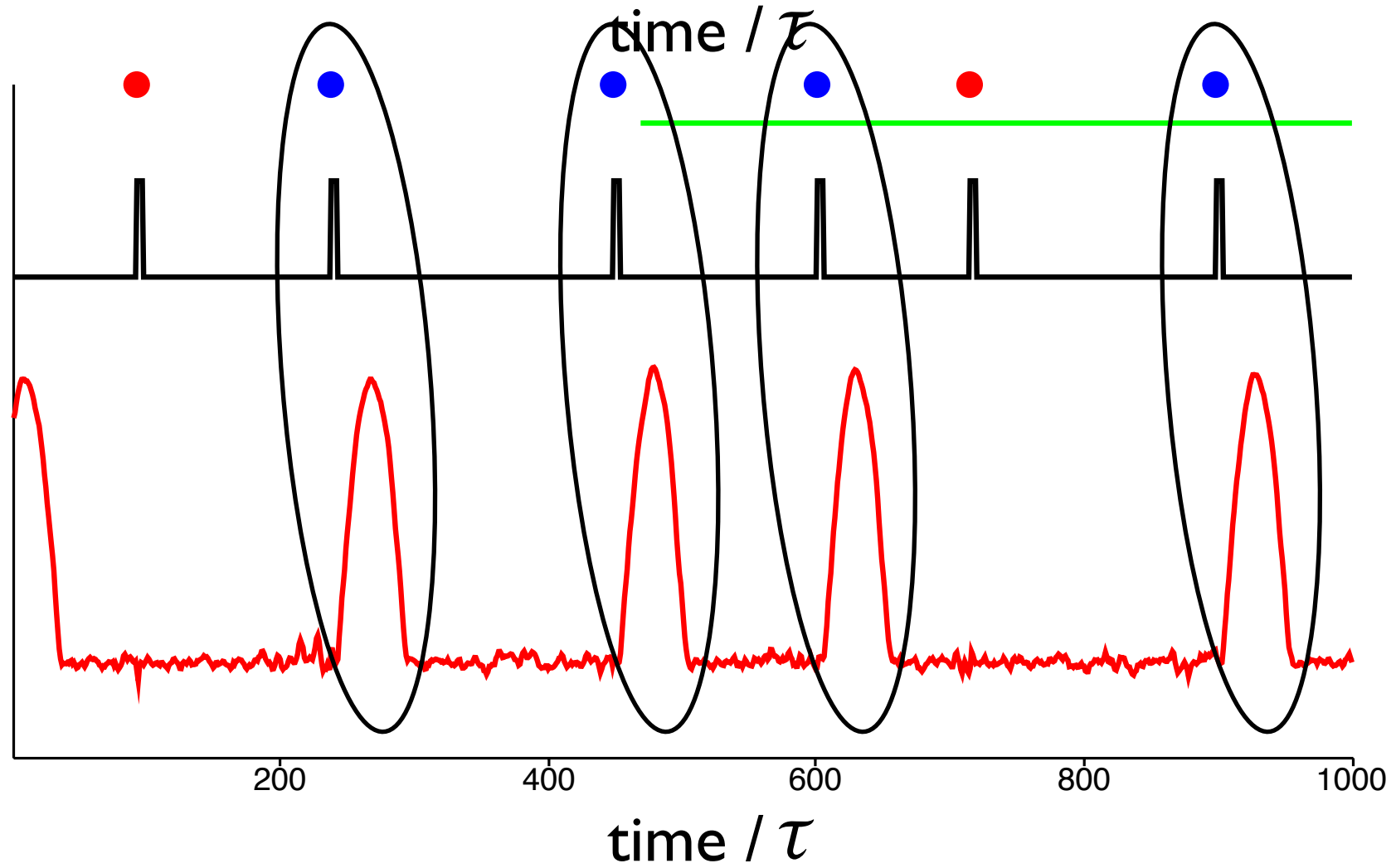
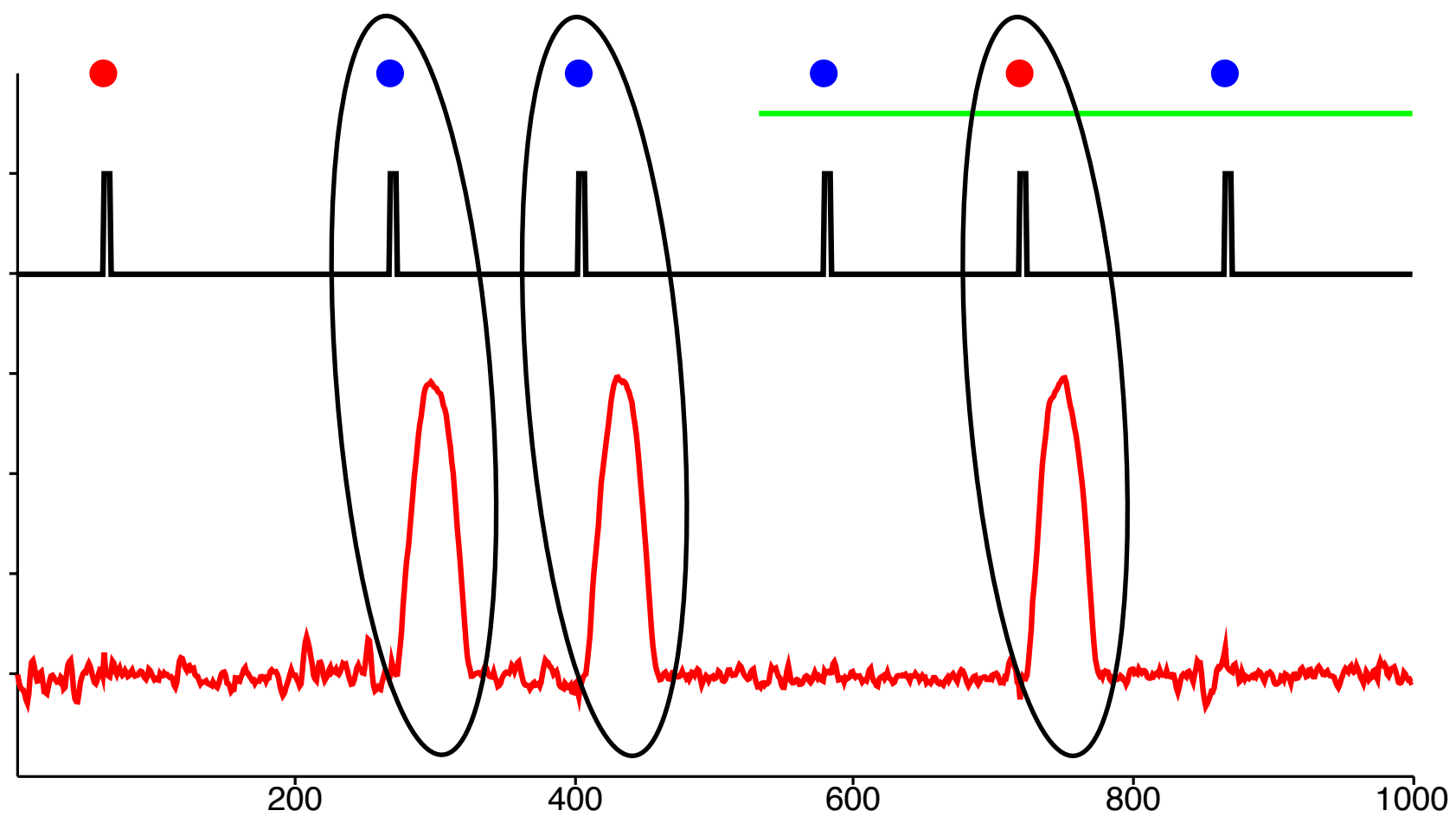


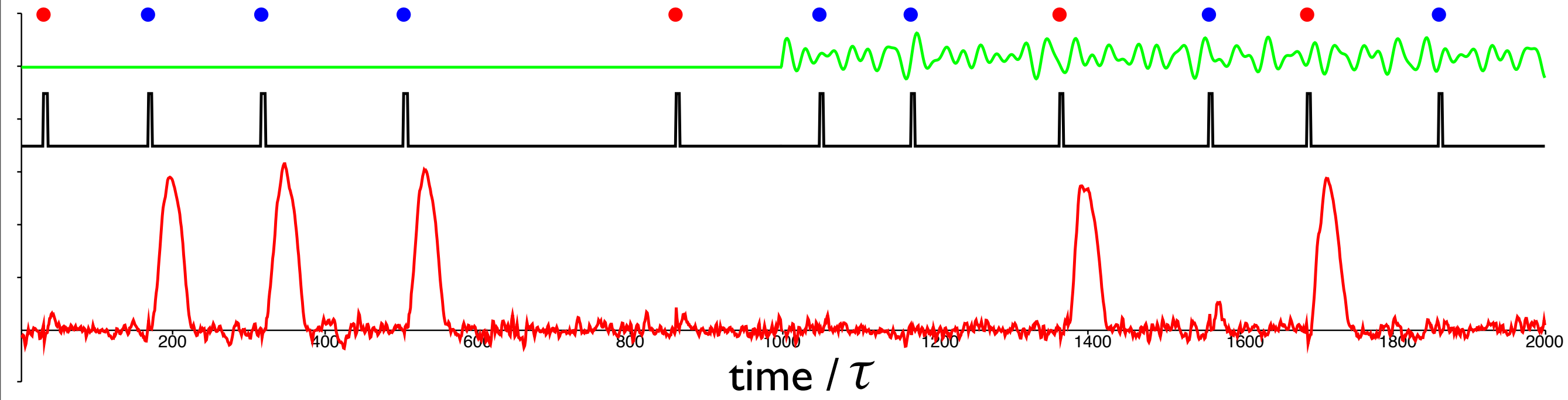


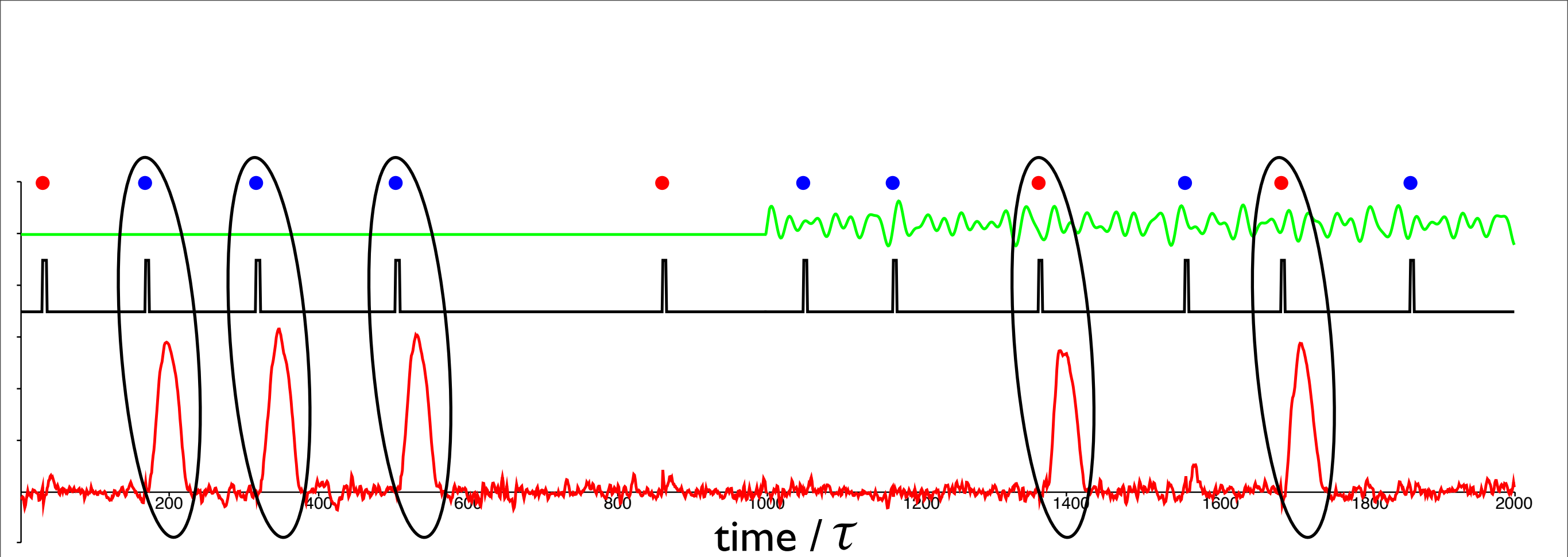


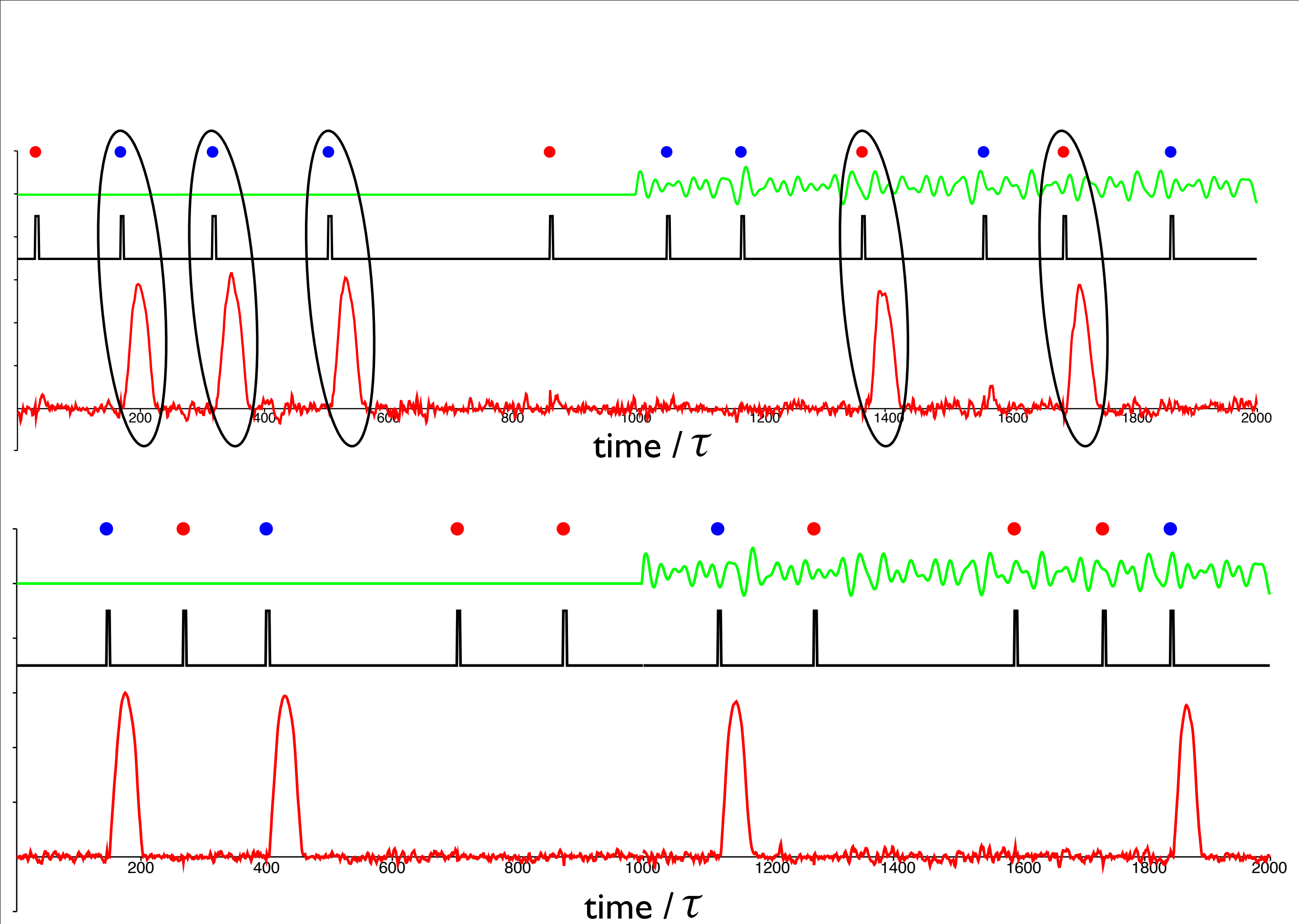


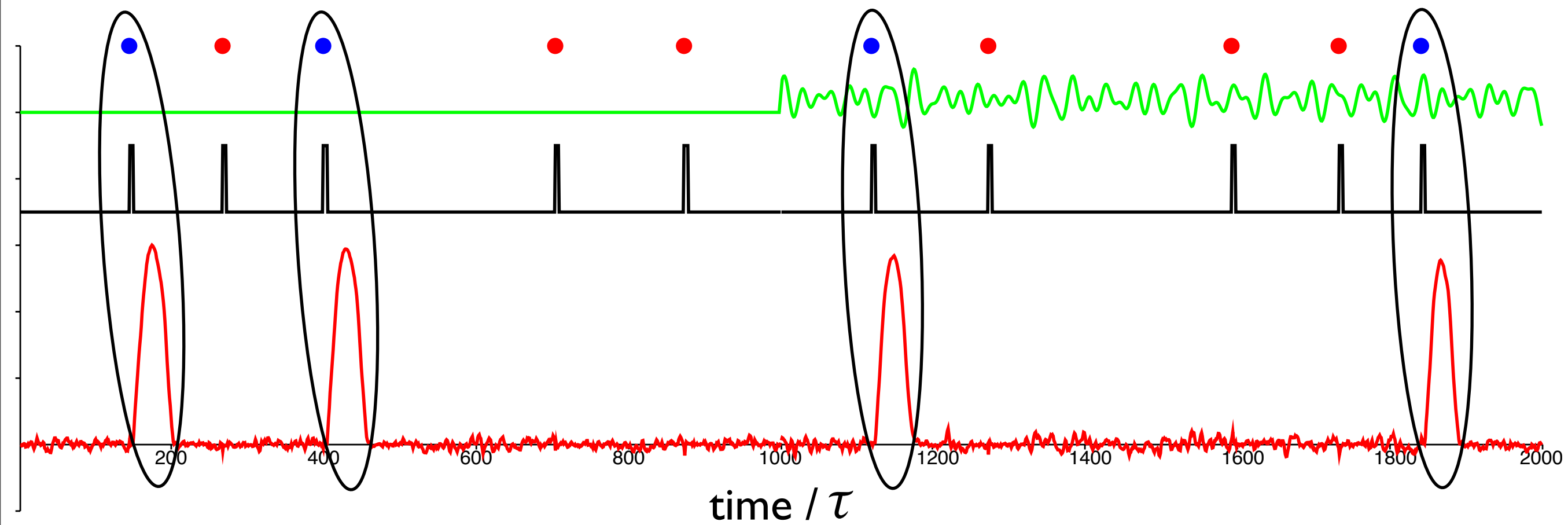
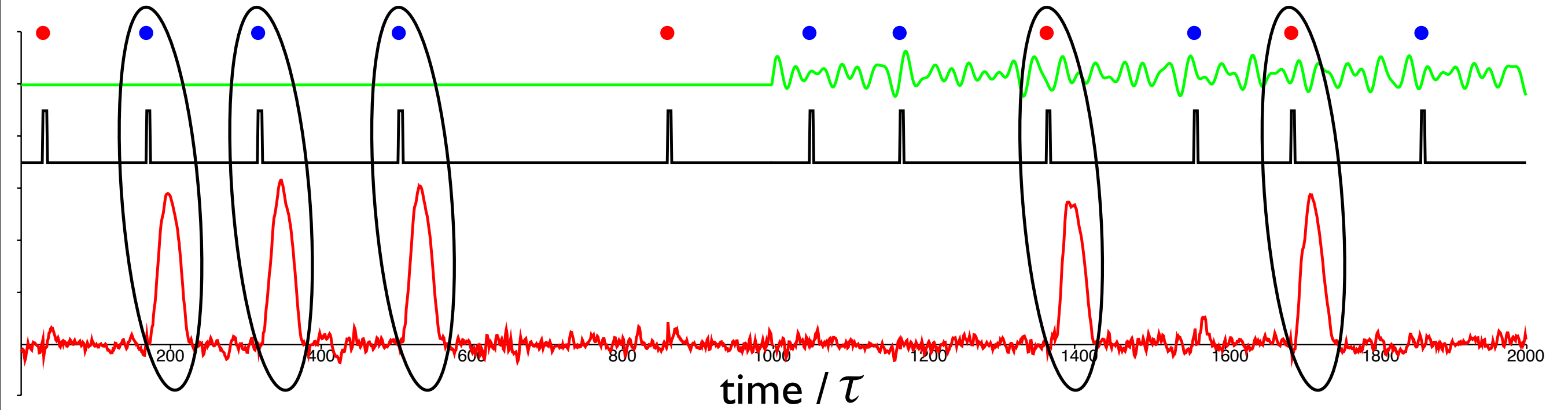


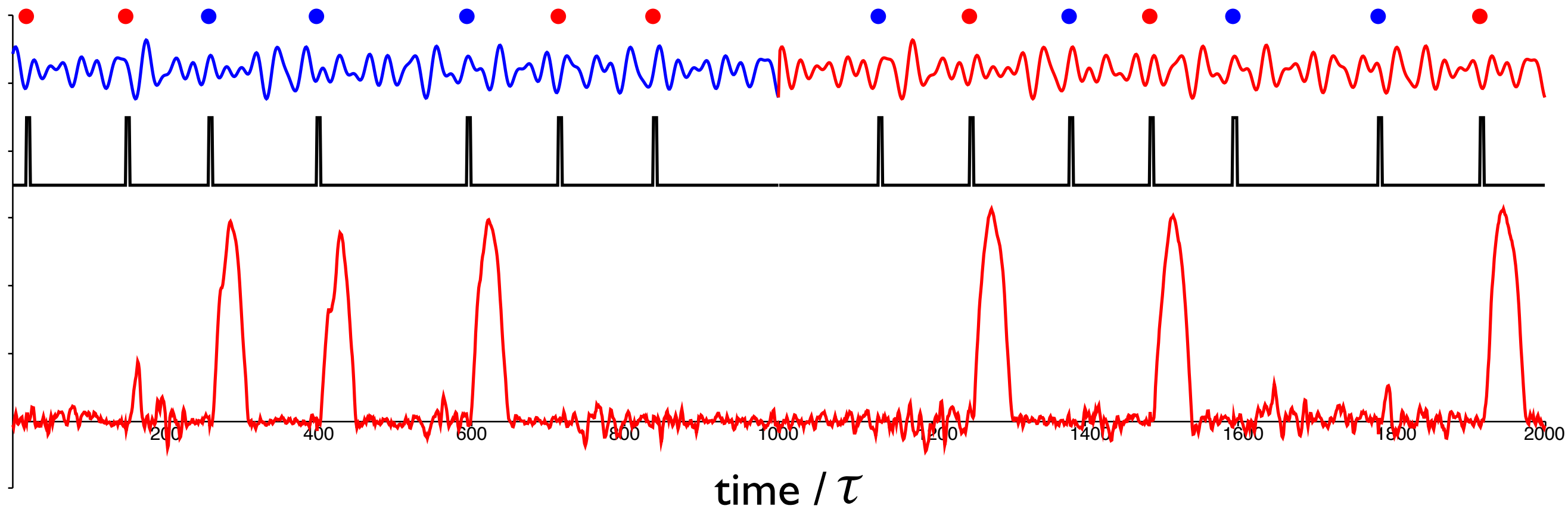


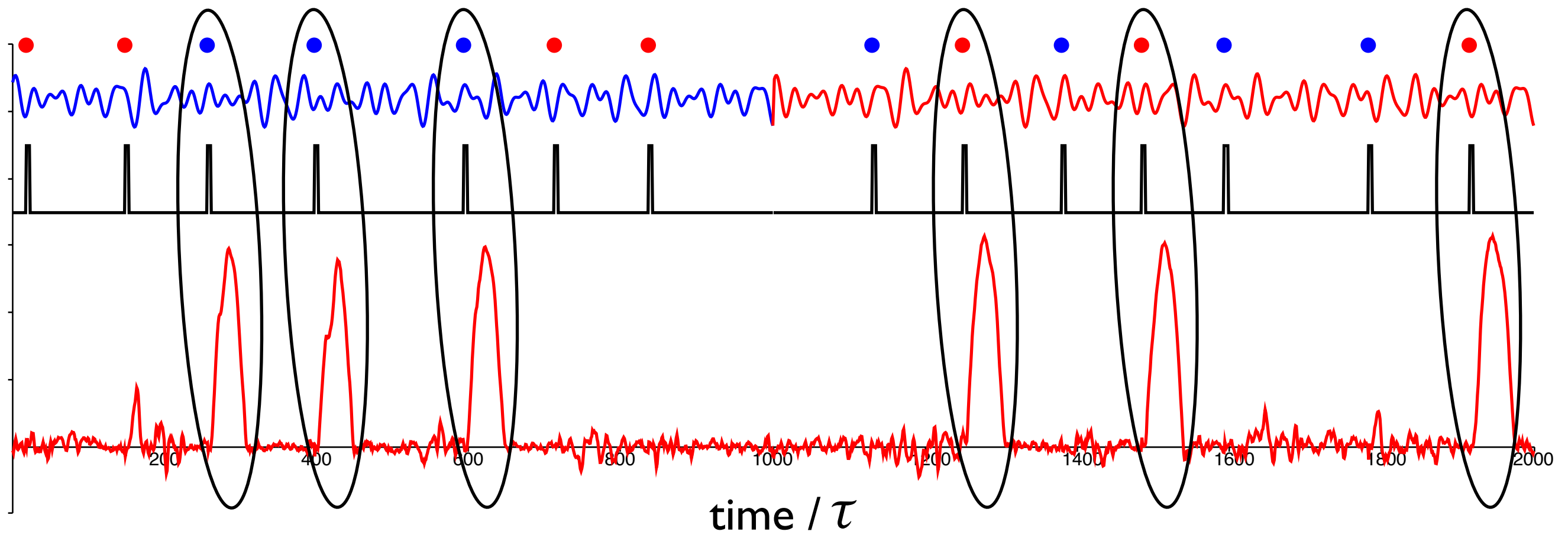


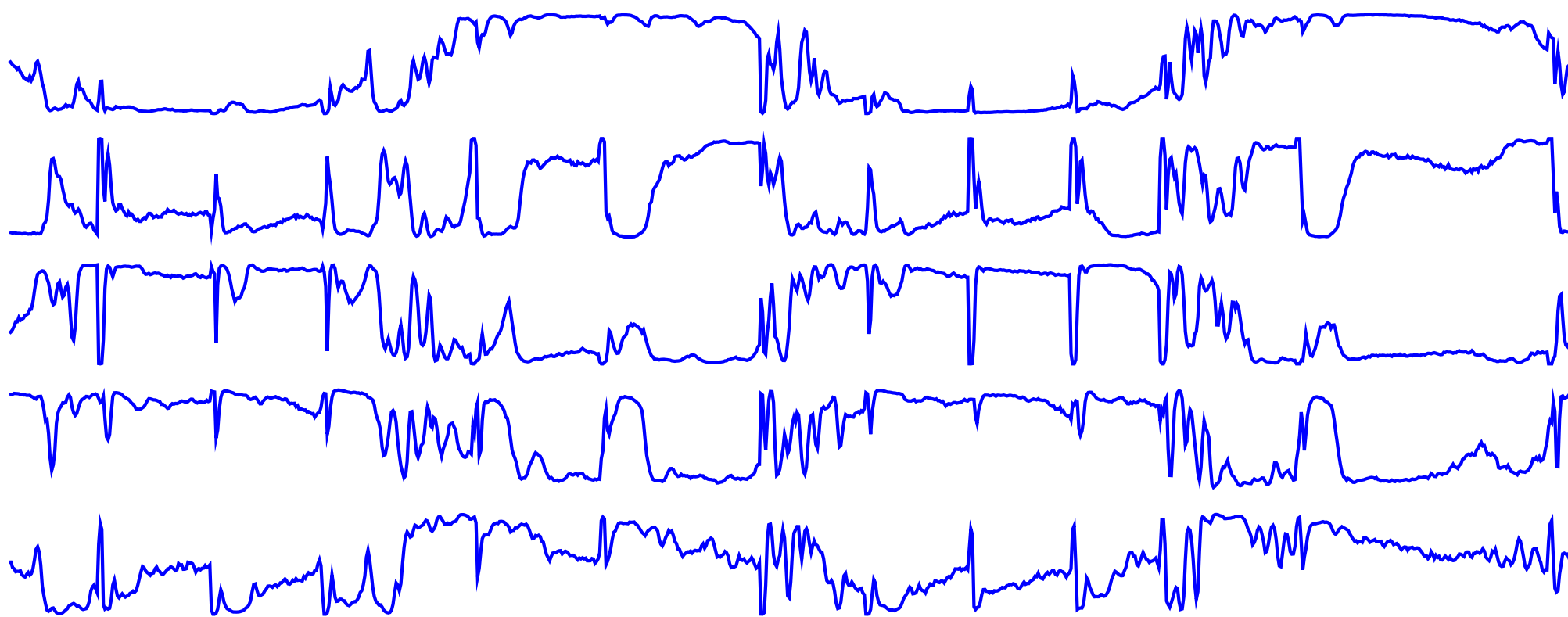
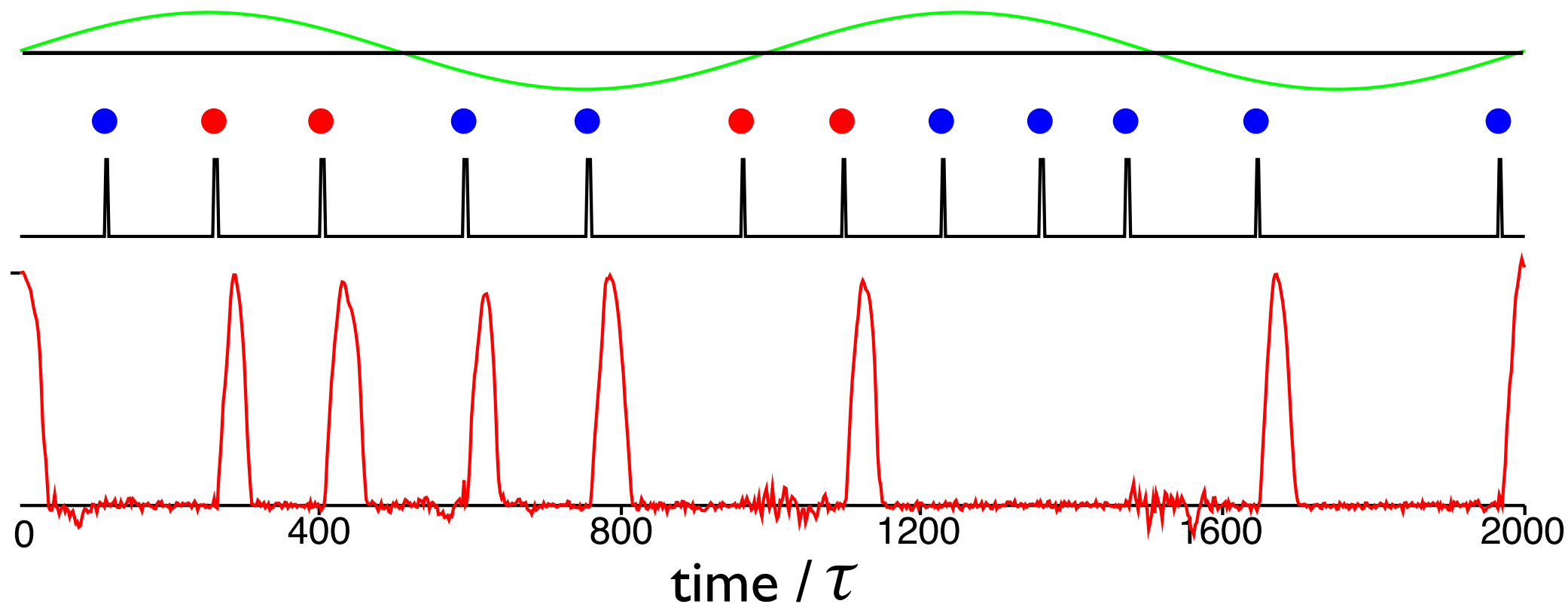


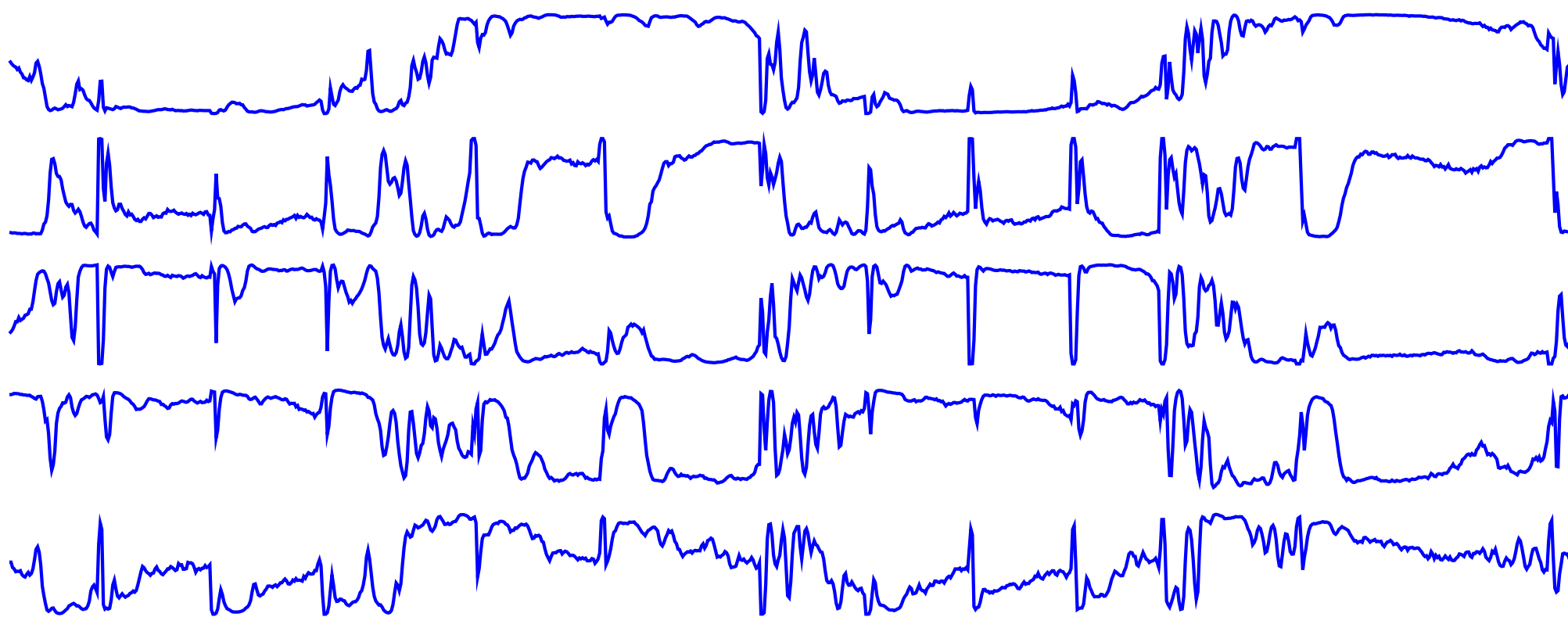
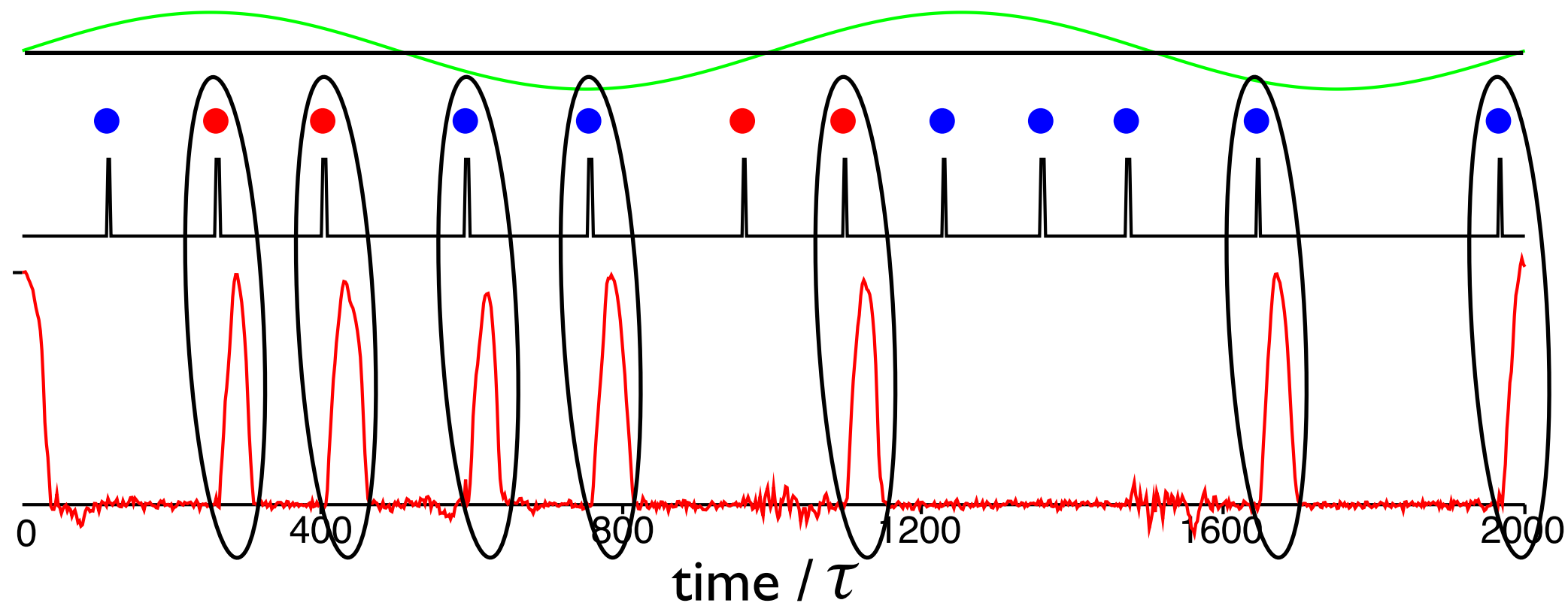


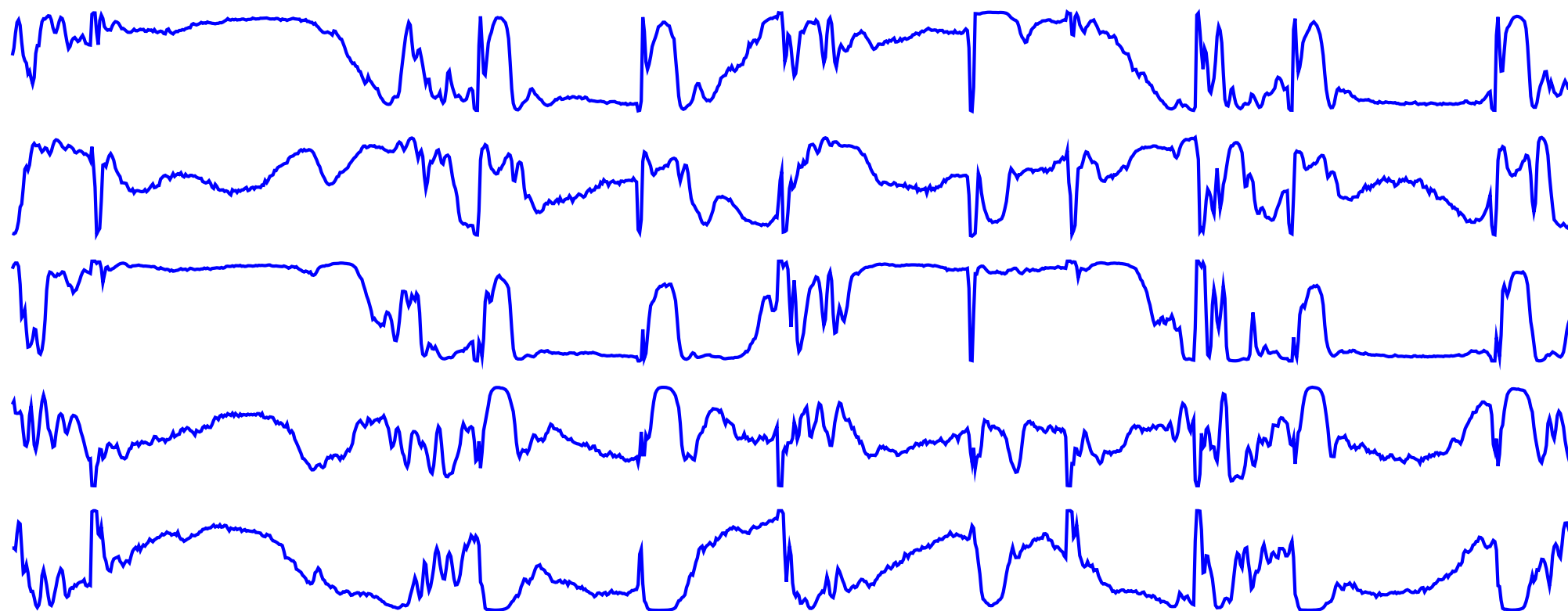
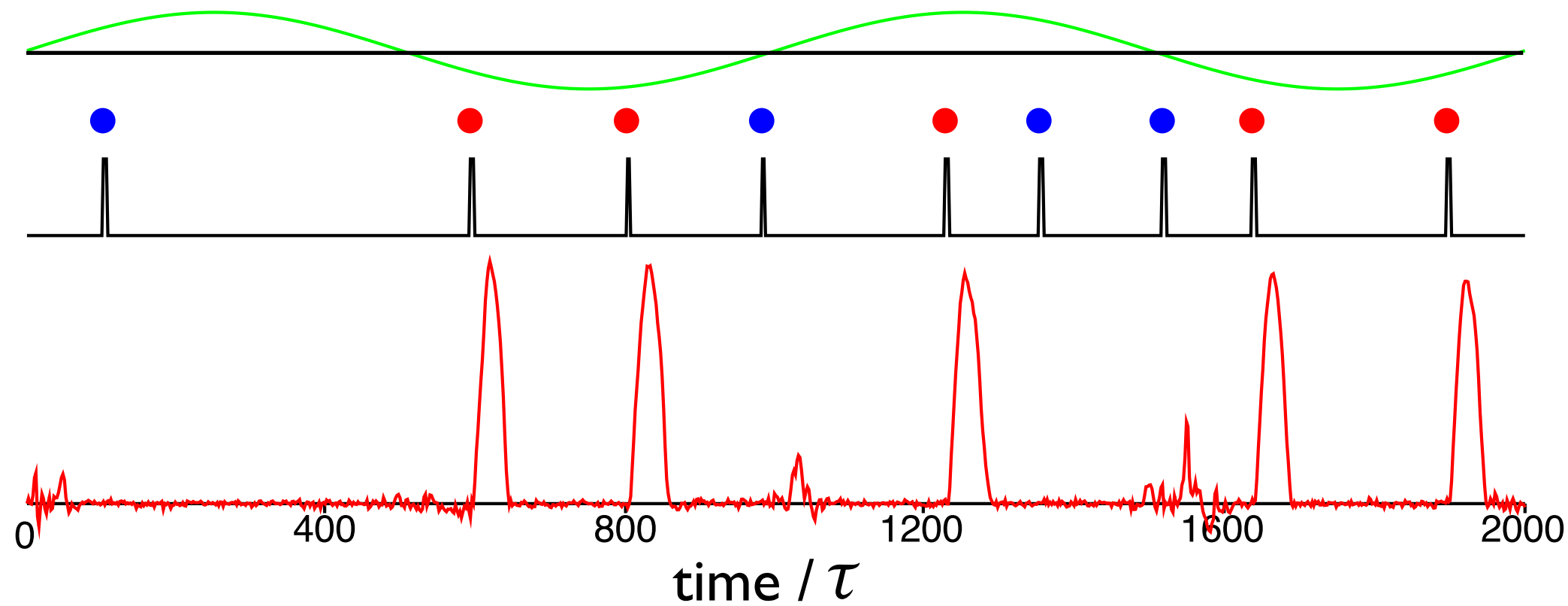


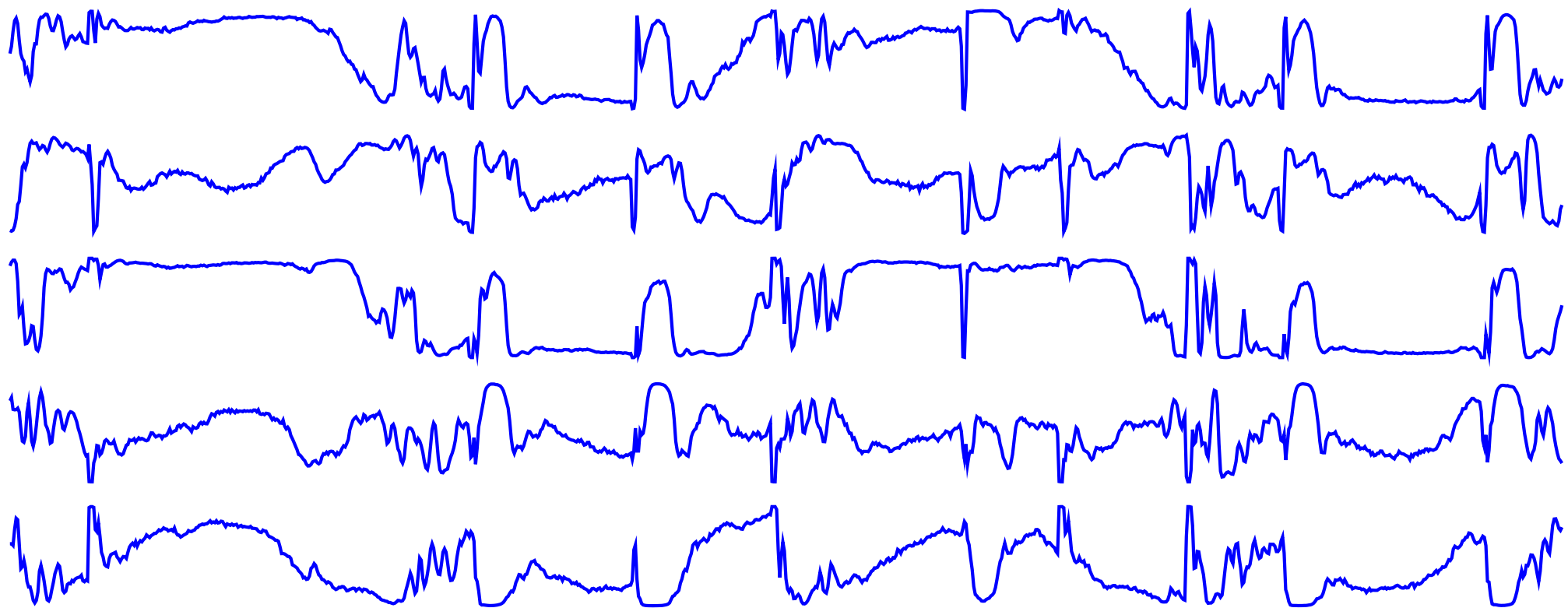
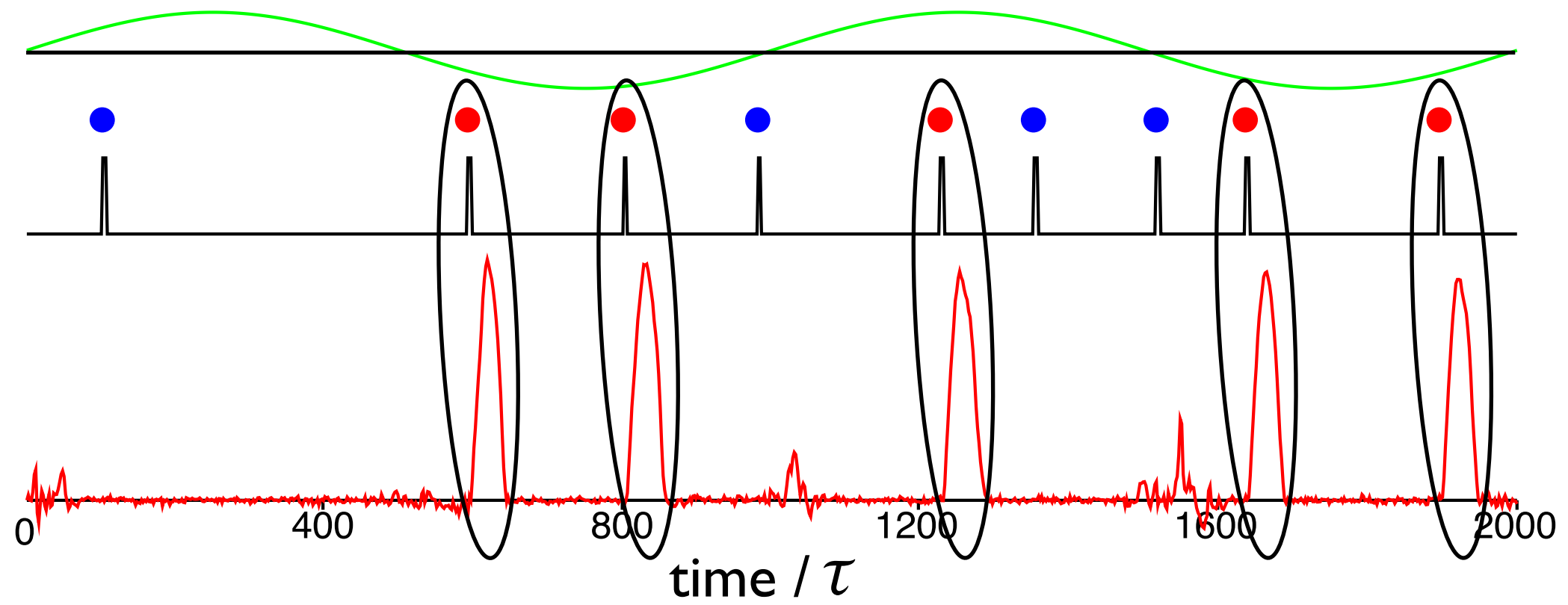


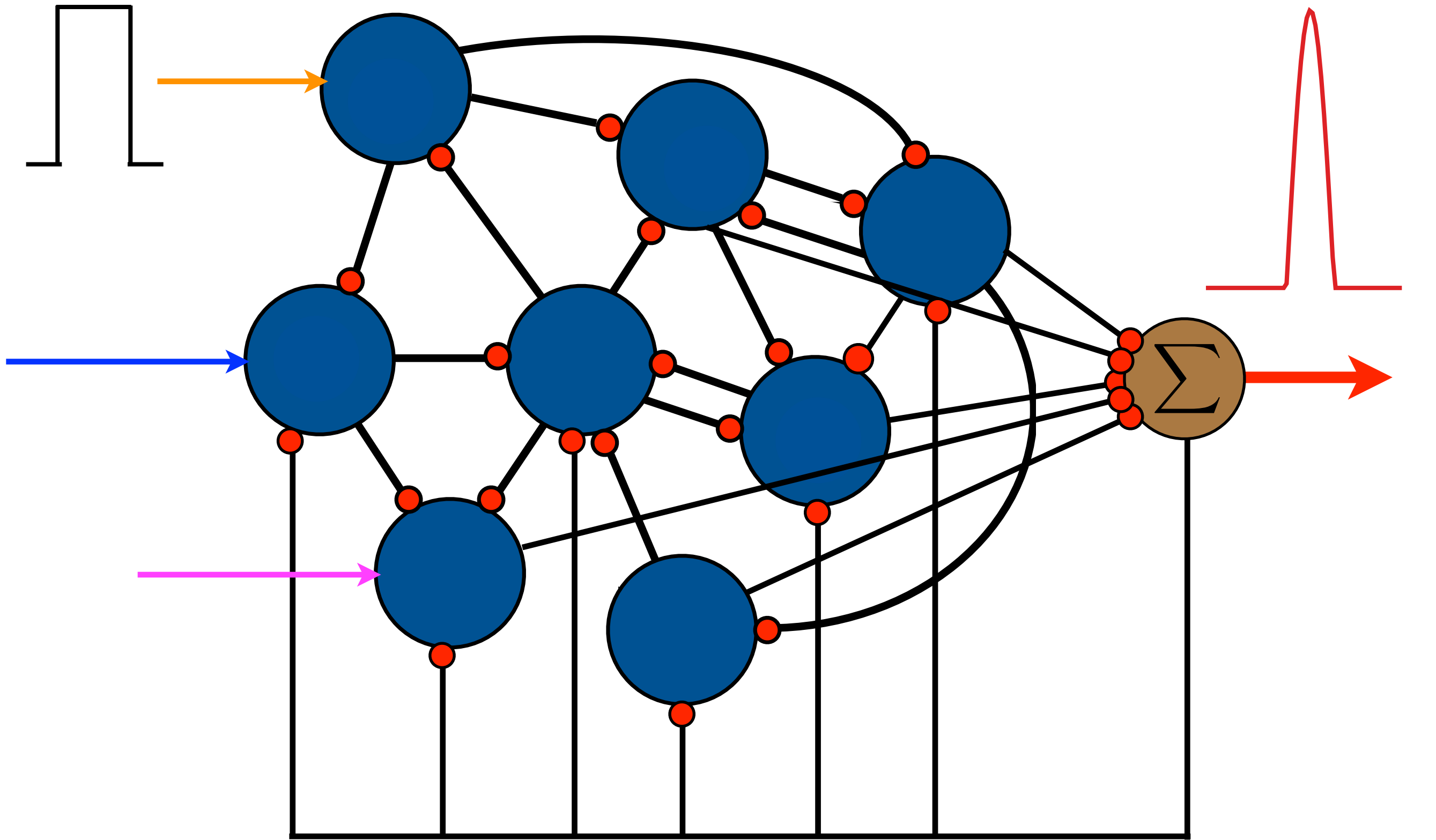


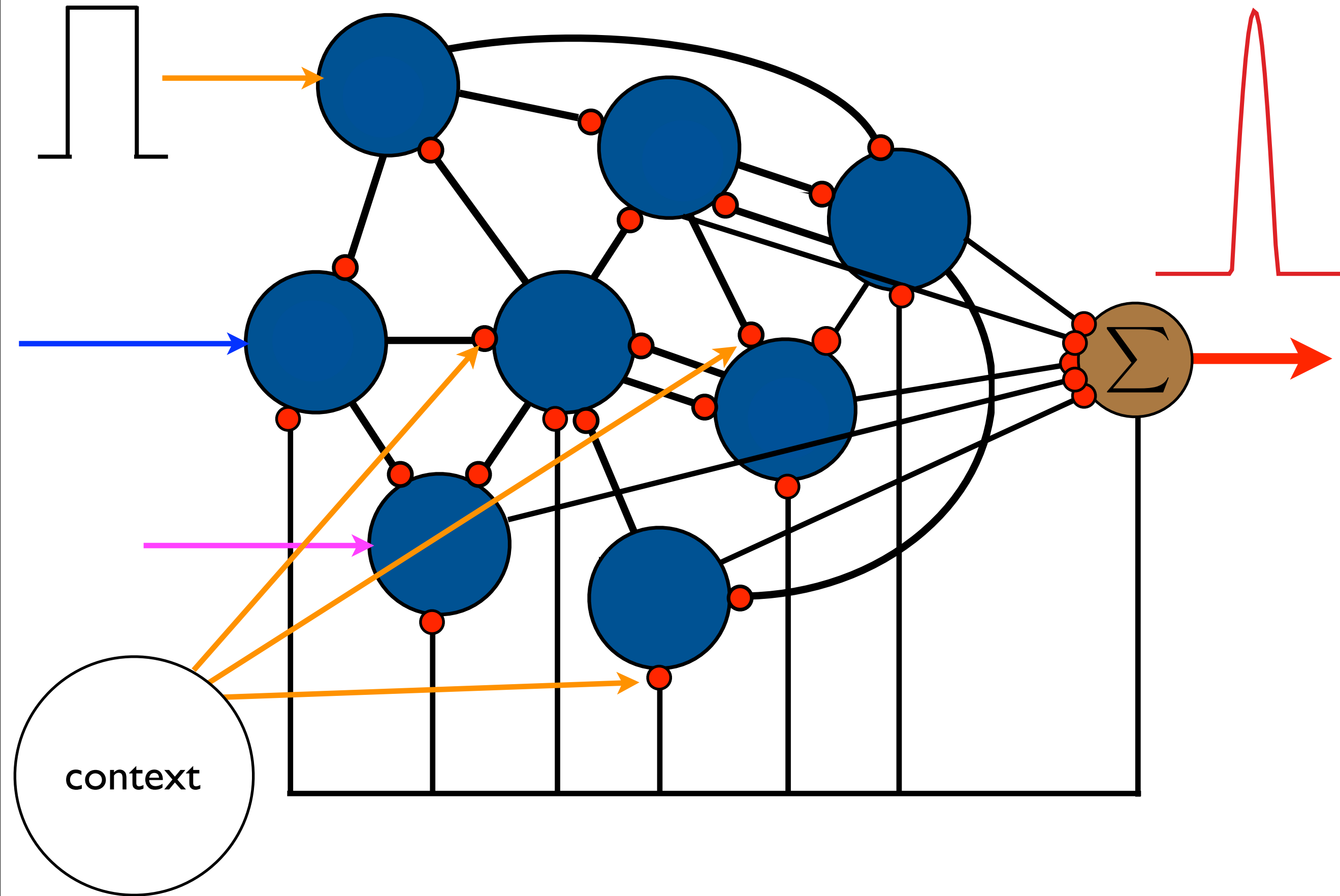


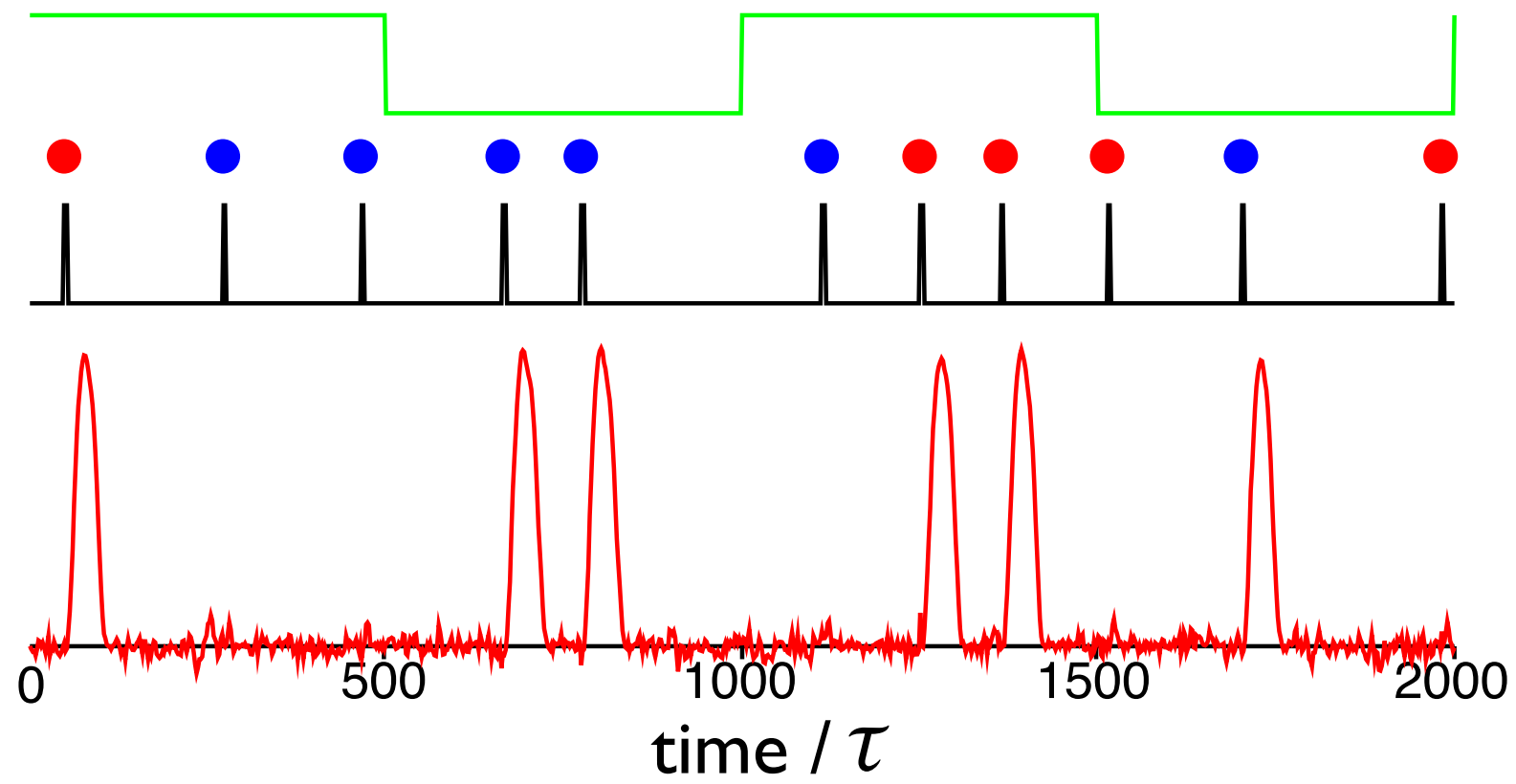


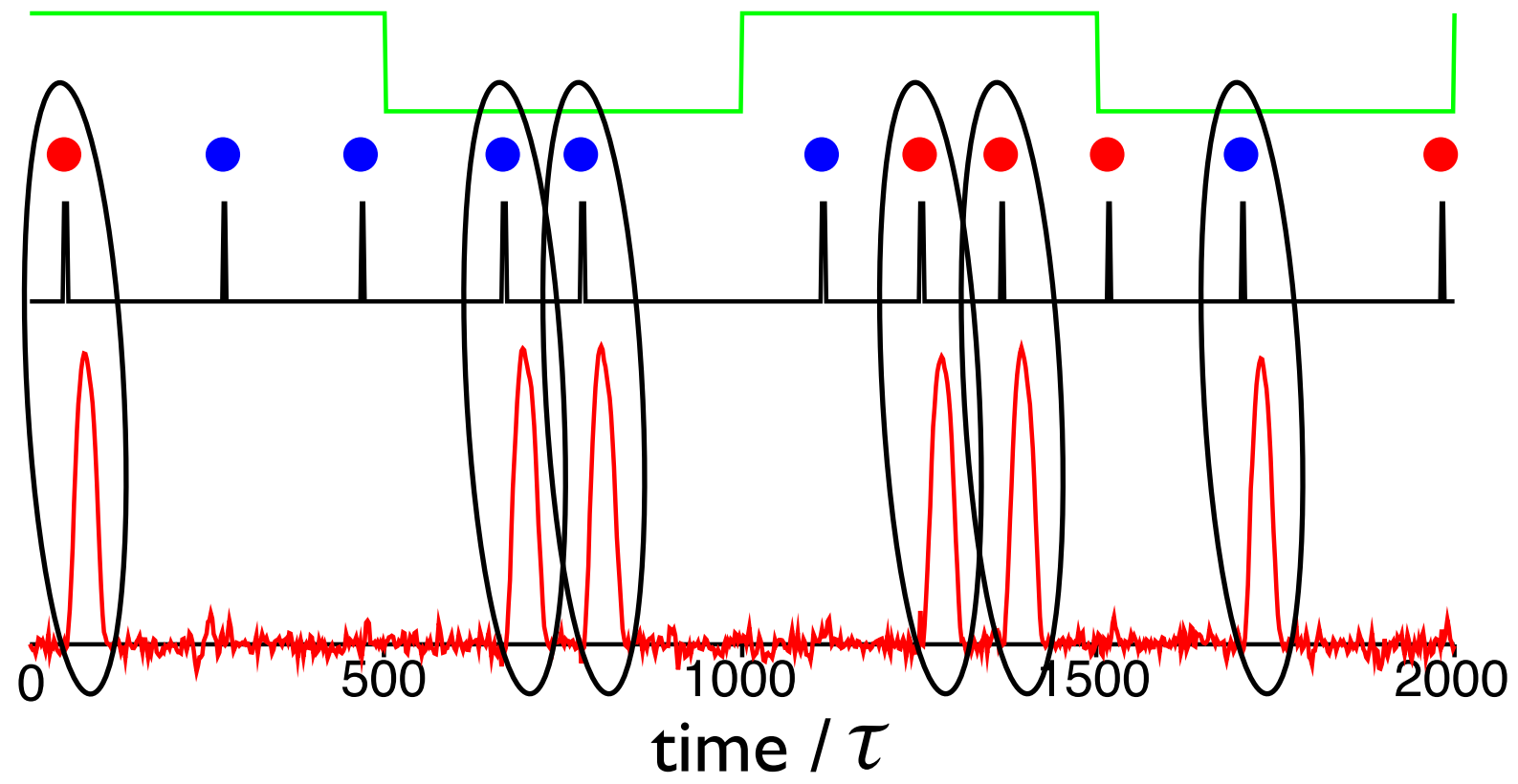


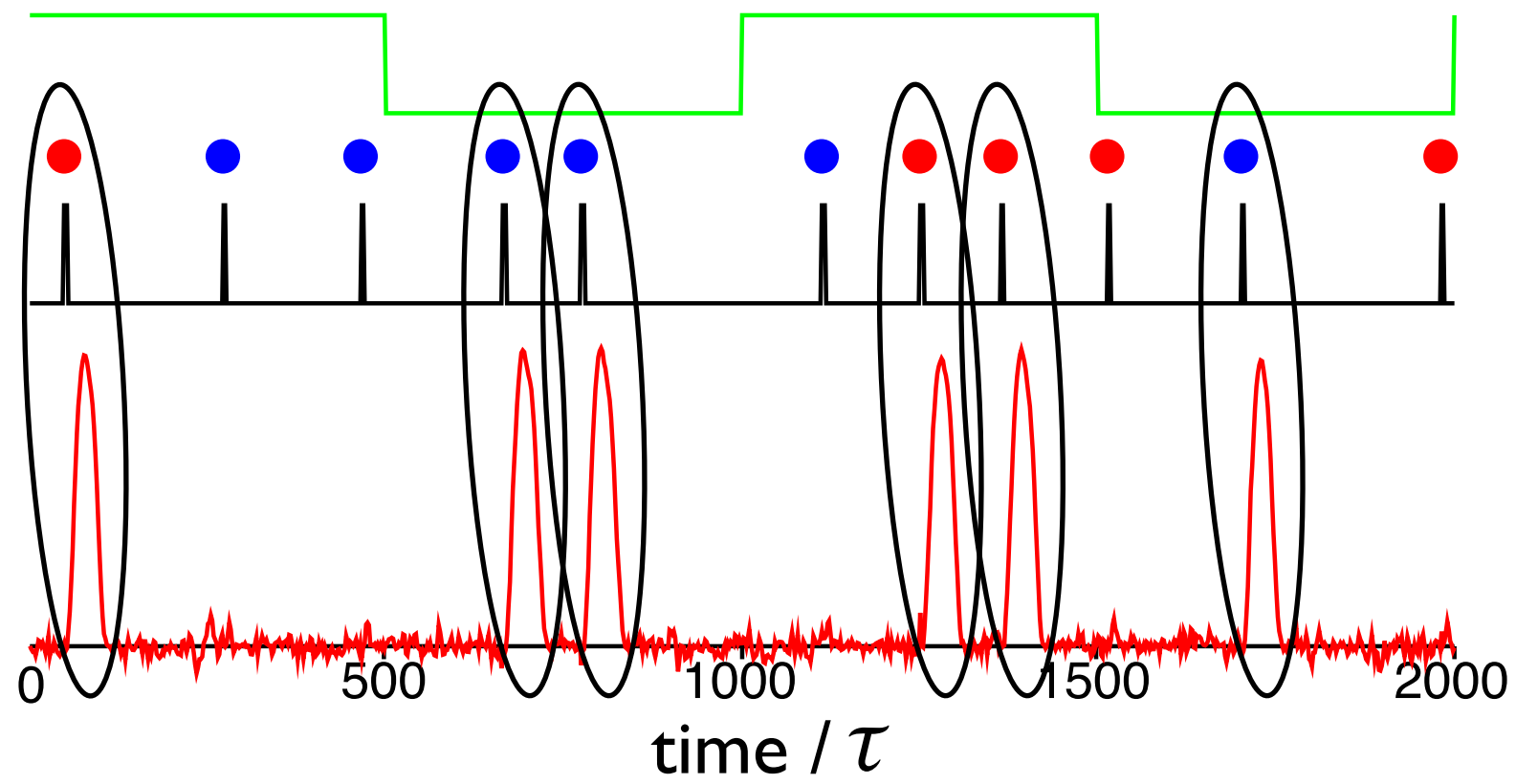




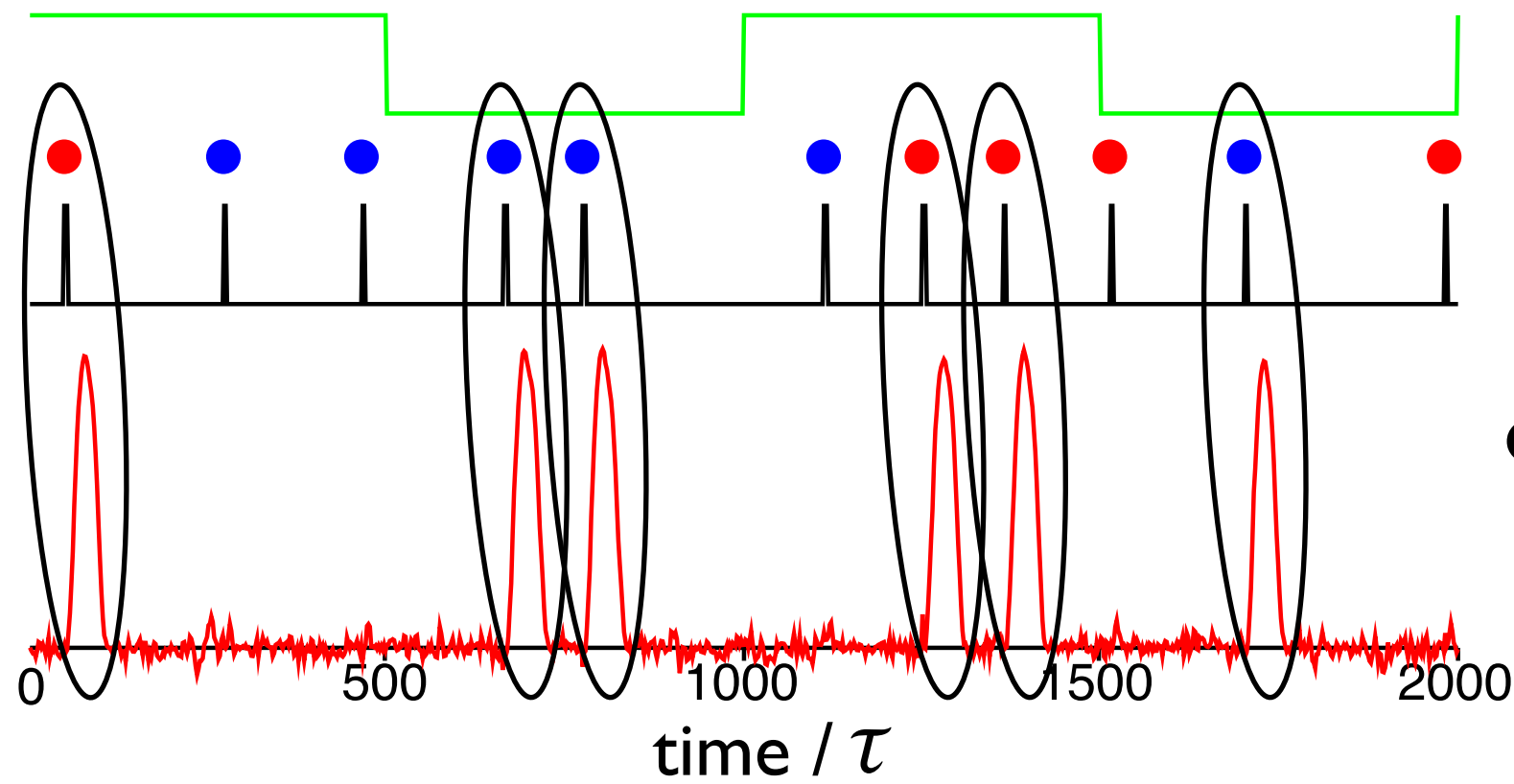






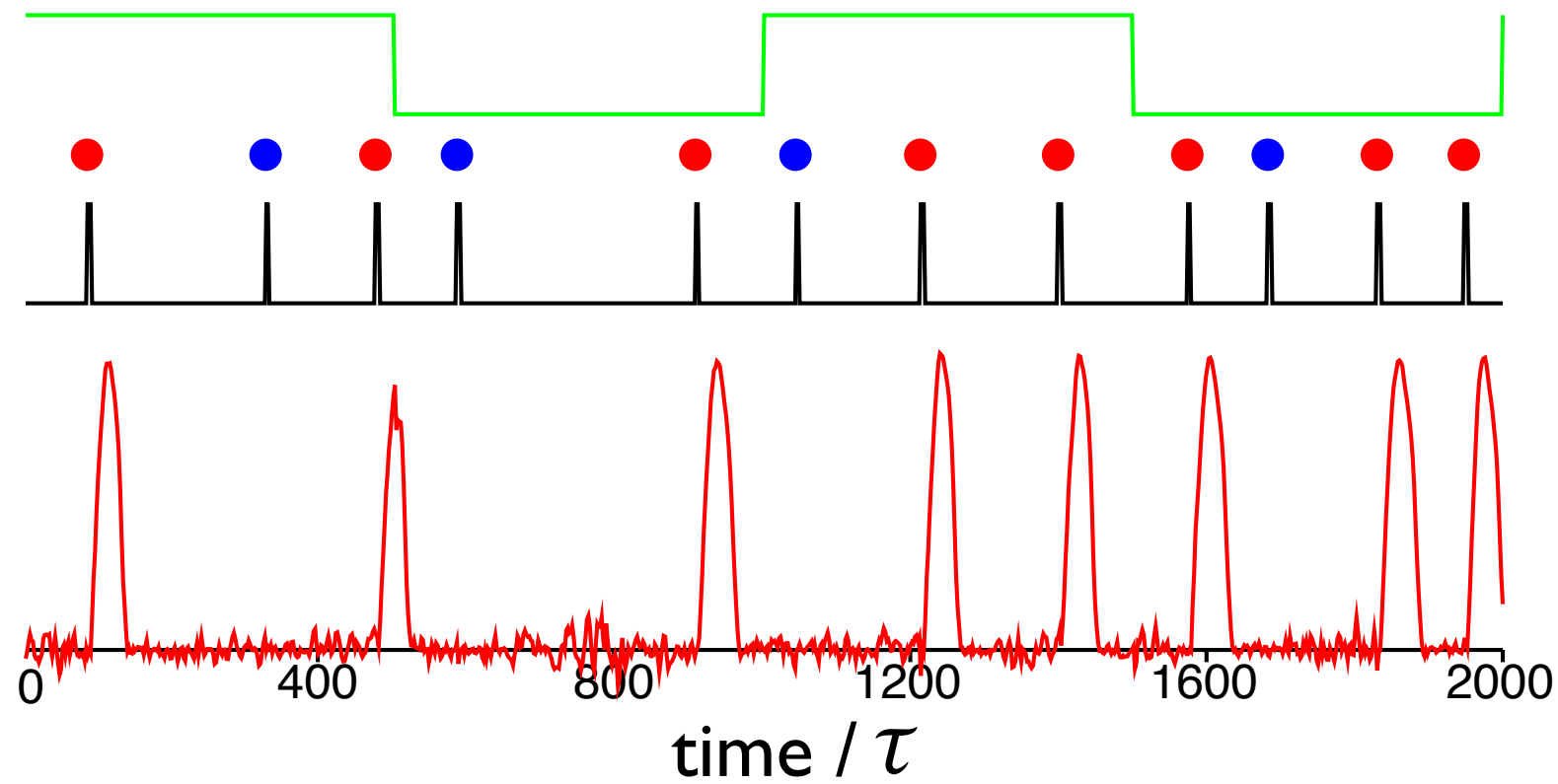
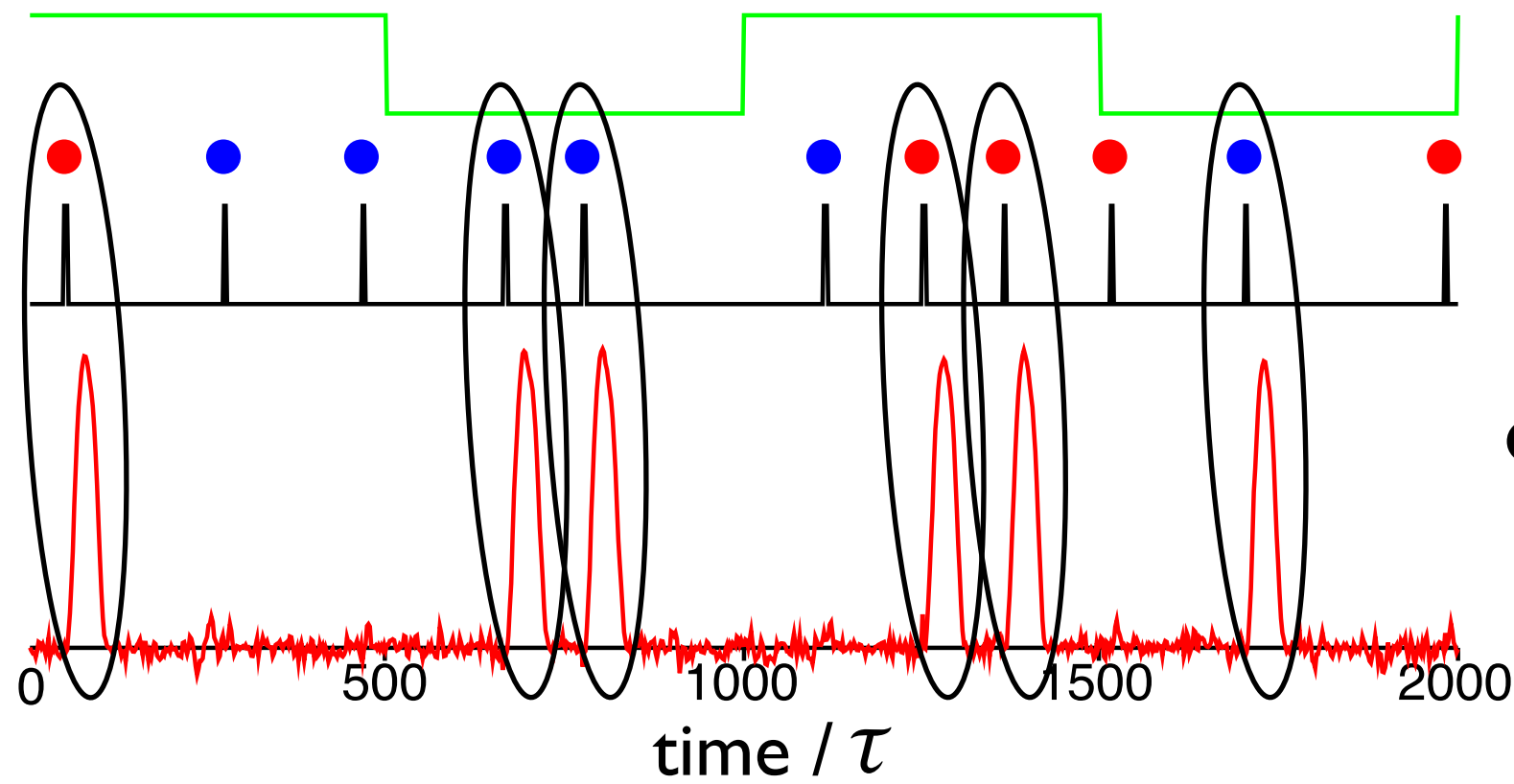


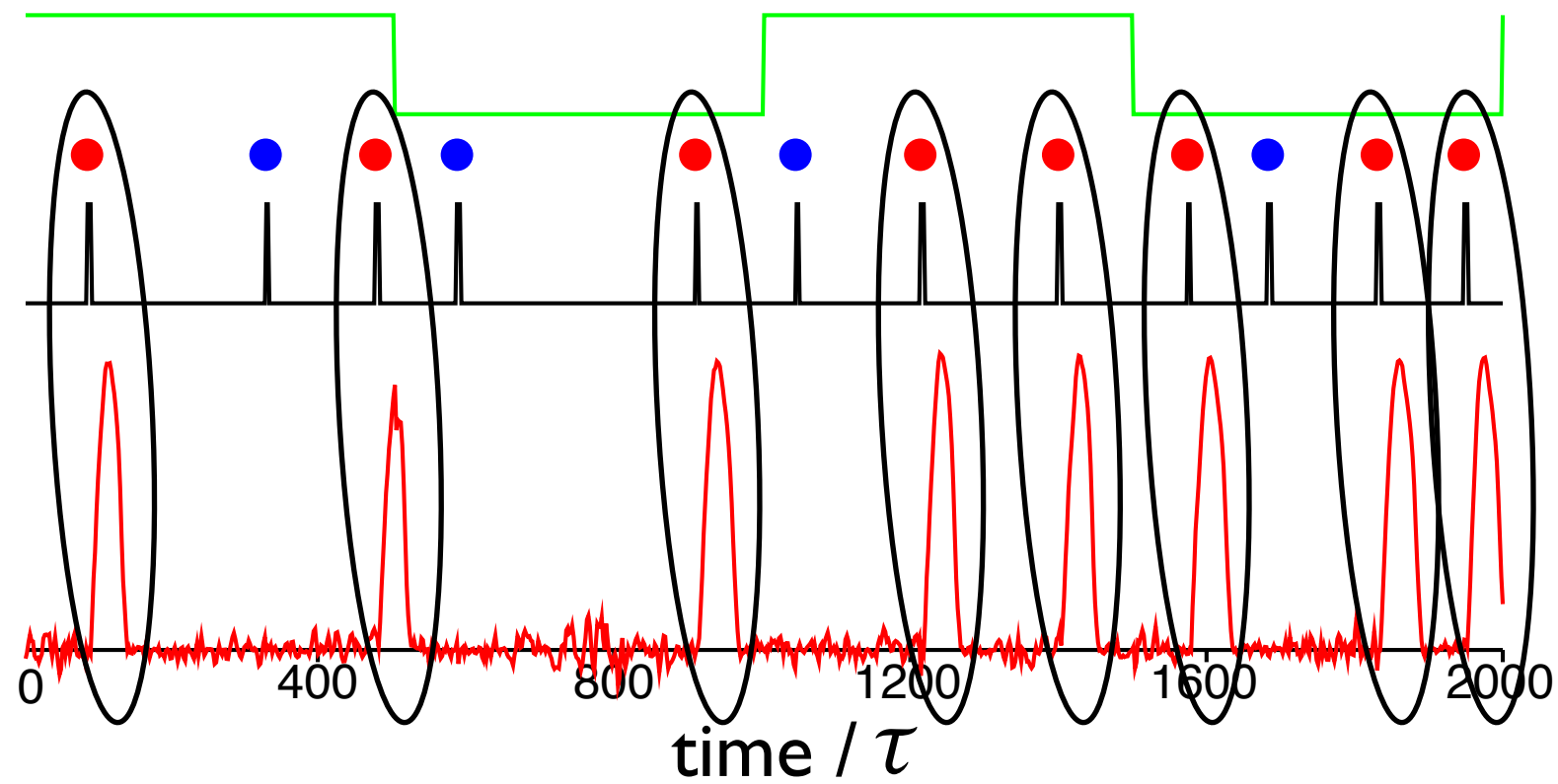
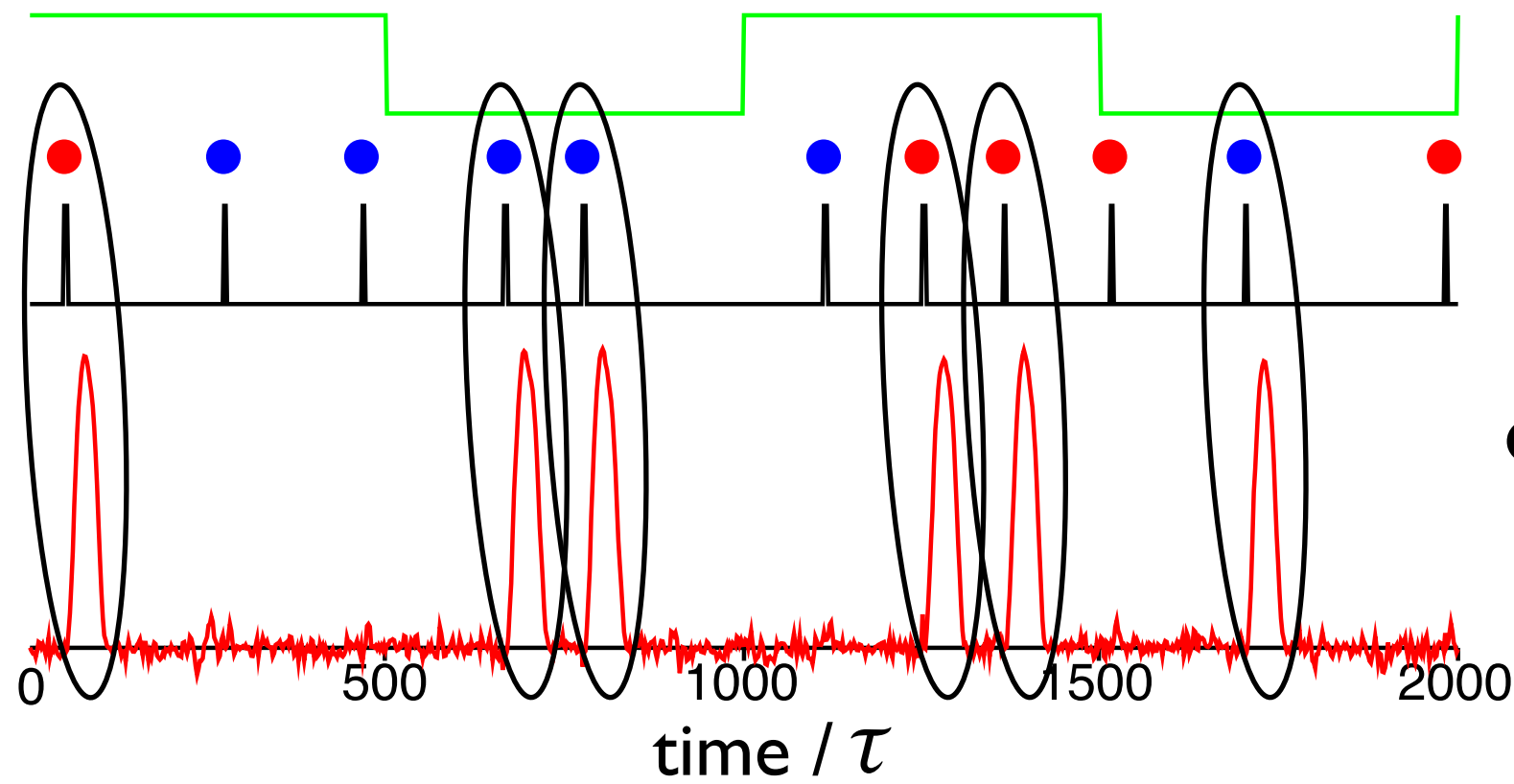
0.1%



0.1%

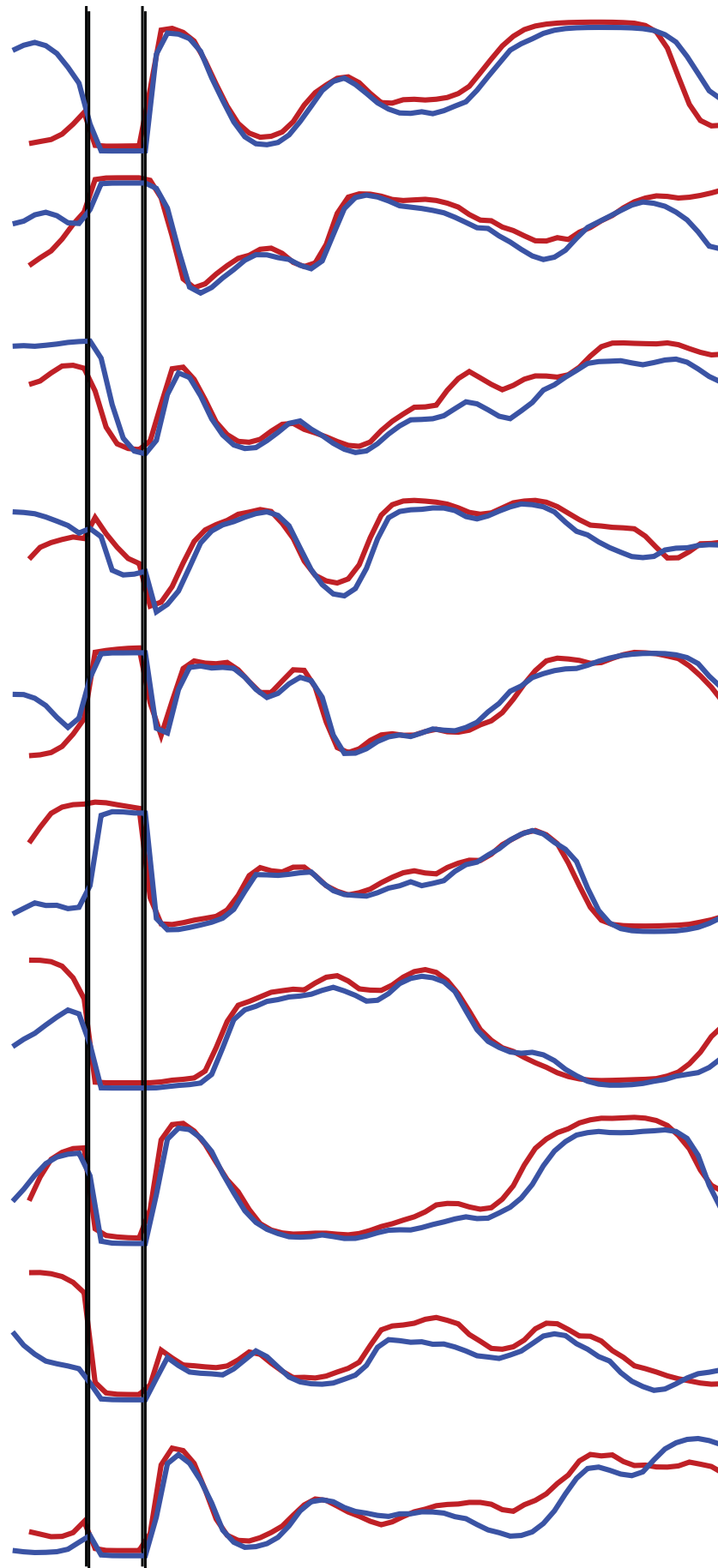
93/100,000



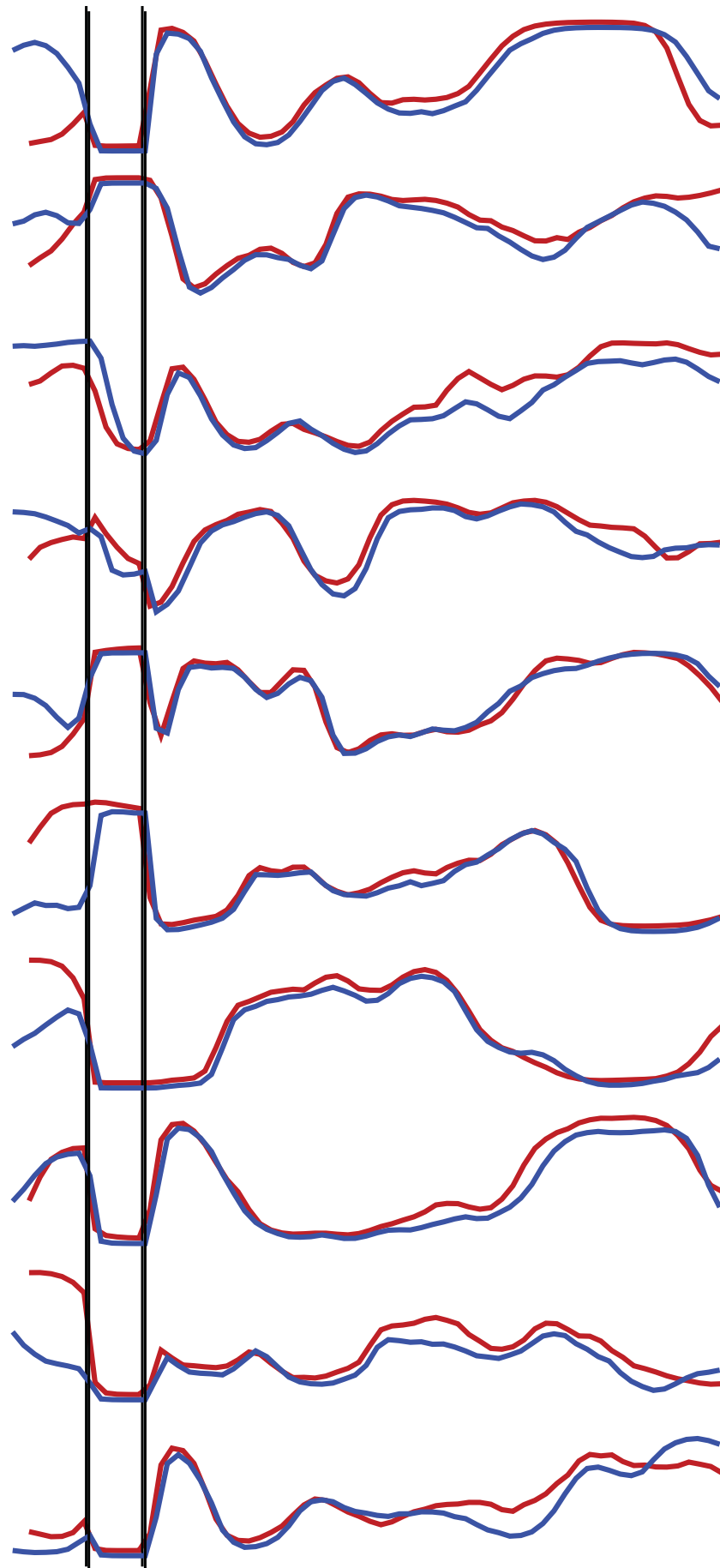


2 trials

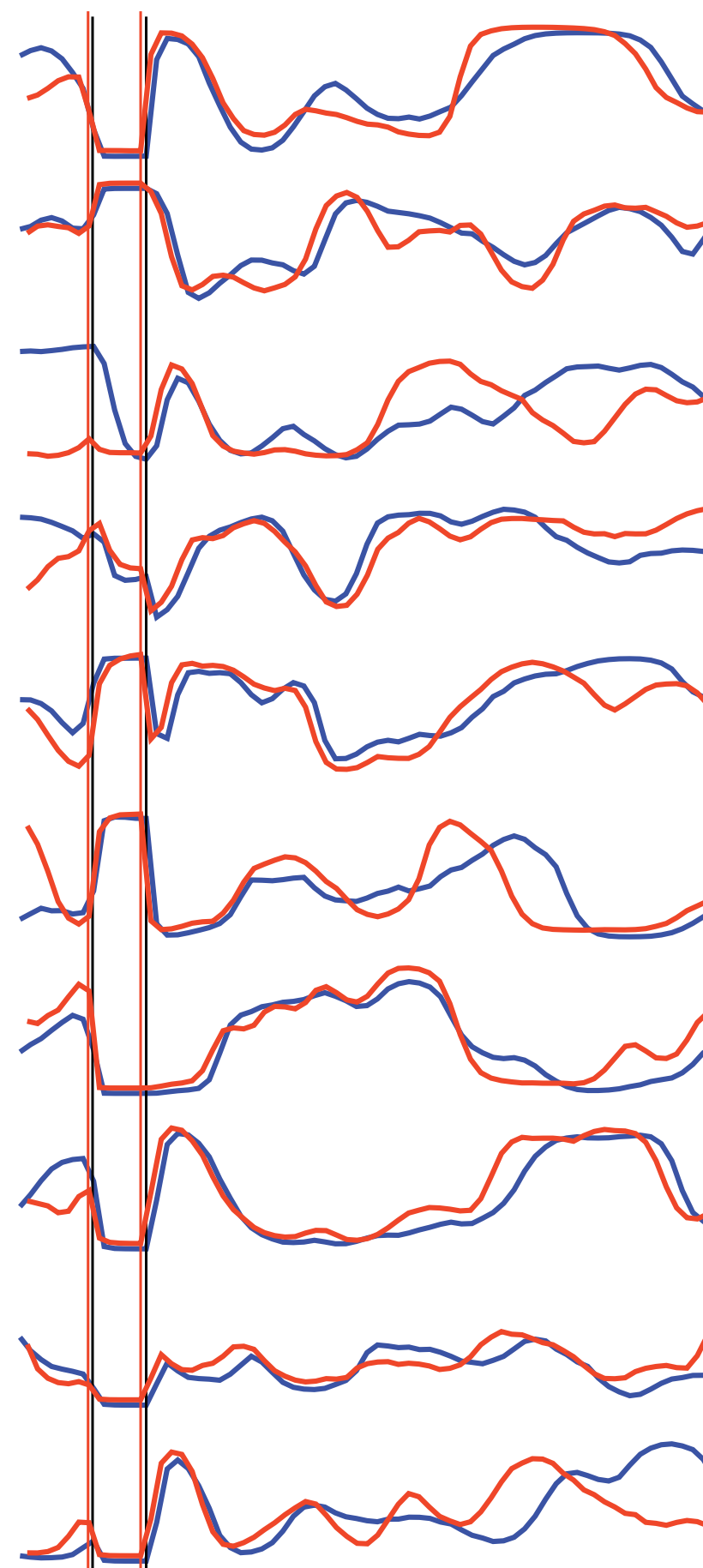
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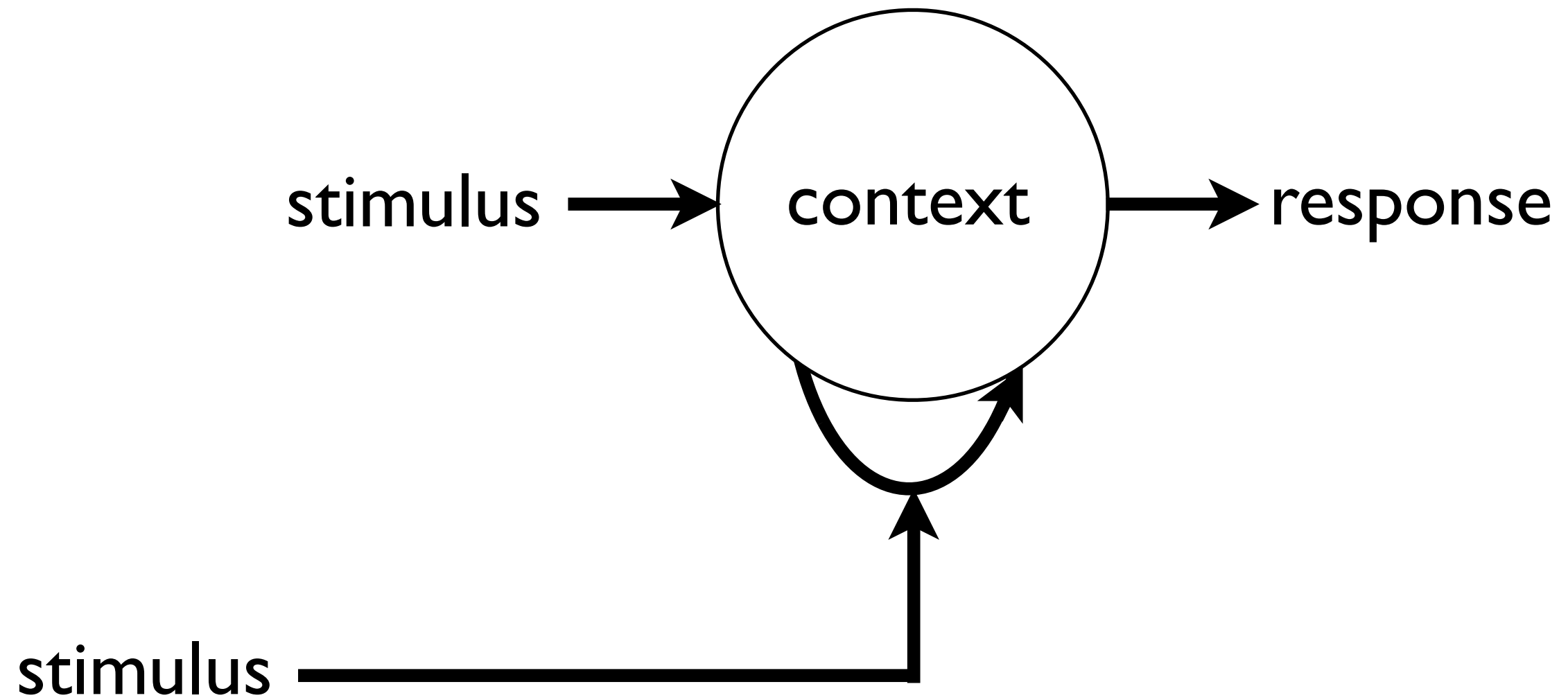
2 trials



2 contexts



0.1%



echo-state

liquid-state

Busing, Schrauwen, Legenstein

echo-state

rate models

liquid-state

spiking models

Busing, Schrauwen, Legenstein

echo-state

rate models

$$\tau_{\text{task}} > \tau_{\text{intrinsic}}$$

liquid-state

spiking models

$$\tau_{\text{task}} \sim \tau_{\text{intrinsic}}$$

echo-state

rate models

$$\tau_{\text{task}} > \tau_{\text{intrinsic}}$$

network slowness

liquid-state

spiking models

$$\tau_{\text{task}} \sim \tau_{\text{intrinsic}}$$

intrinsic slowness

echo-state

rate models

$$\tau_{\text{task}} > \tau_{\text{intrinsic}}$$

network slowness

Jaeger

Ganguli, Huh, Sompolinsky

Sussillo, Abbott

liquid-state

spiking models

$$\tau_{\text{task}} \sim \tau_{\text{intrinsic}}$$

intrinsic slowness

Buonomano

Mauk

Maass

Busing, Schrauwen, Legenstein

echo-state

rate models

$$\tau_{\text{task}} > \tau_{\text{intrinsic}}$$

network slowness

Jaeger

Ganguli, Huh, Sompolinsky

Sussillo, Abbott

liquid-state

spiking models

$$\tau_{\text{task}} \sim \tau_{\text{intrinsic}}$$

intrinsic slowness

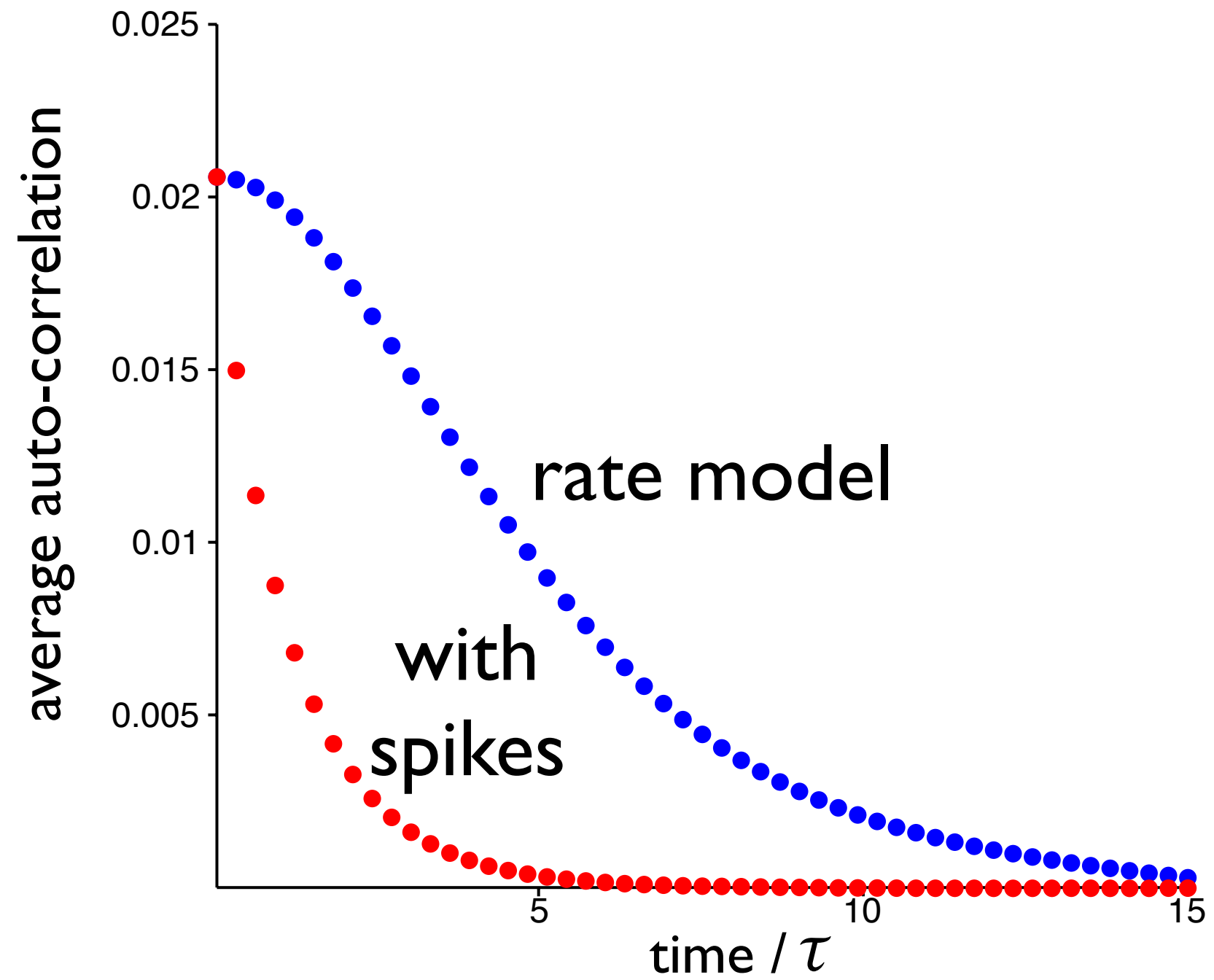
Buonomano

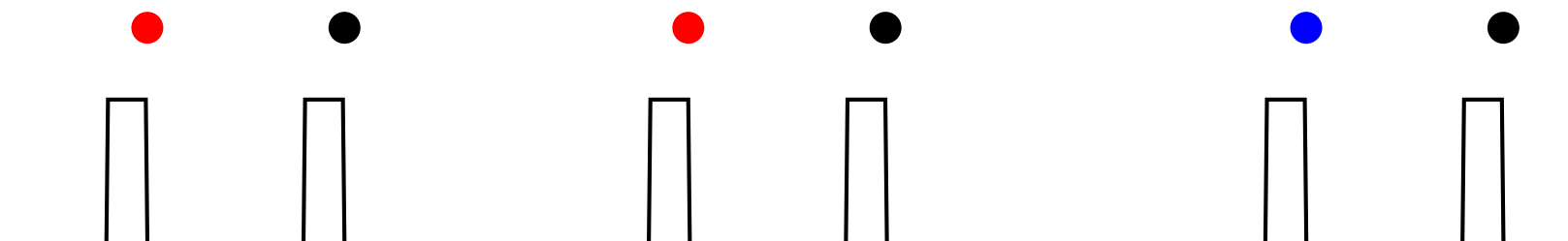
Mauk

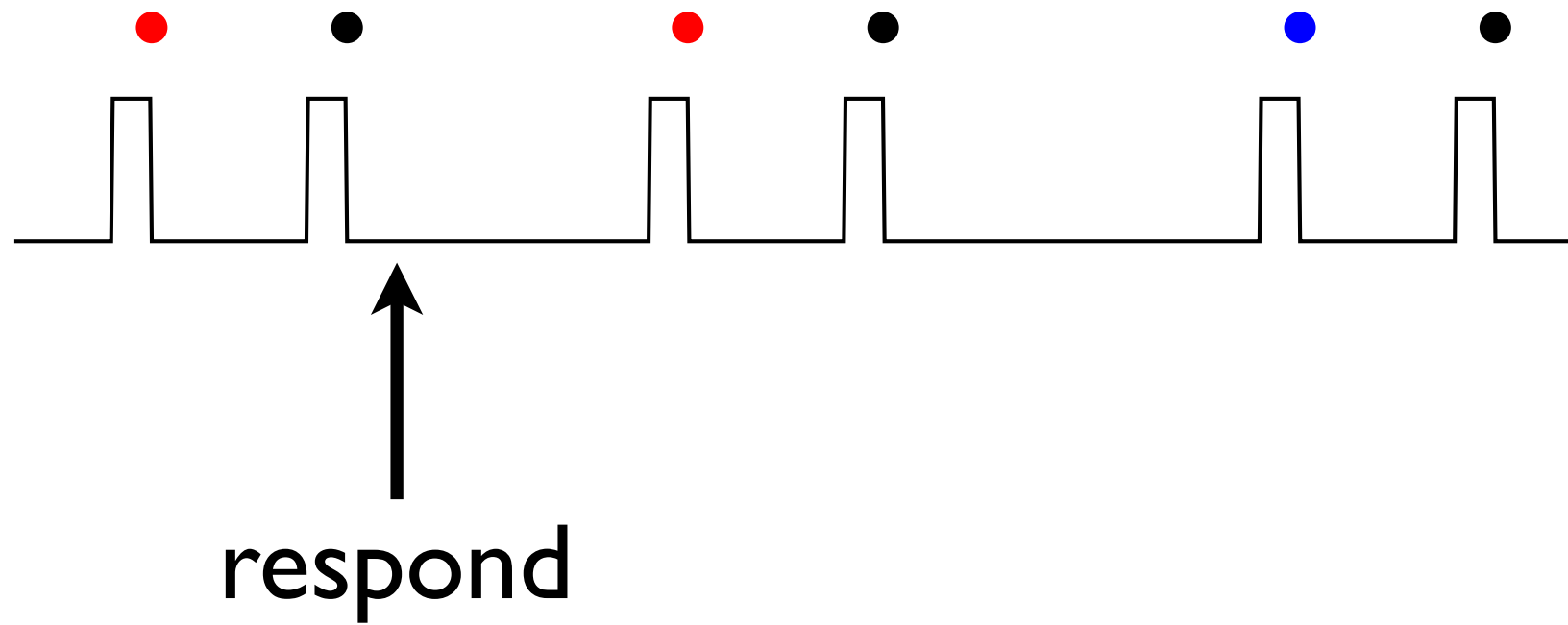
Maass

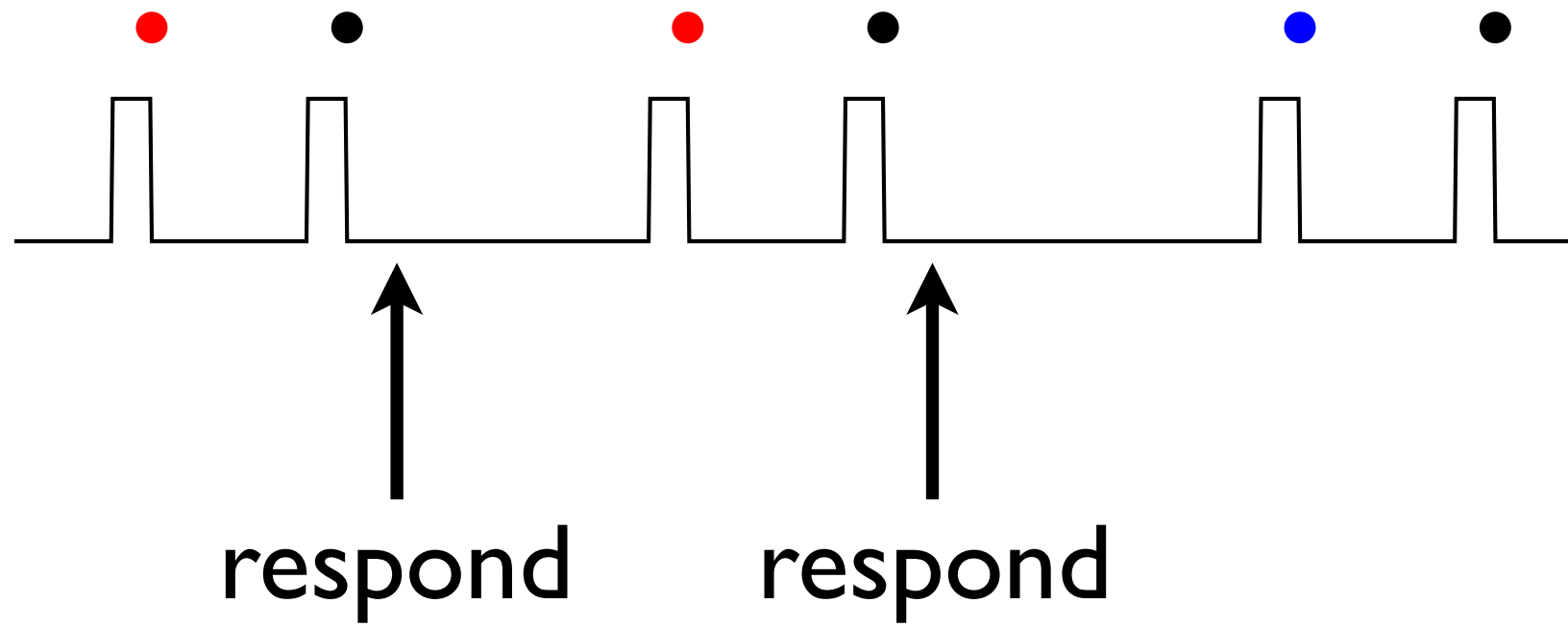


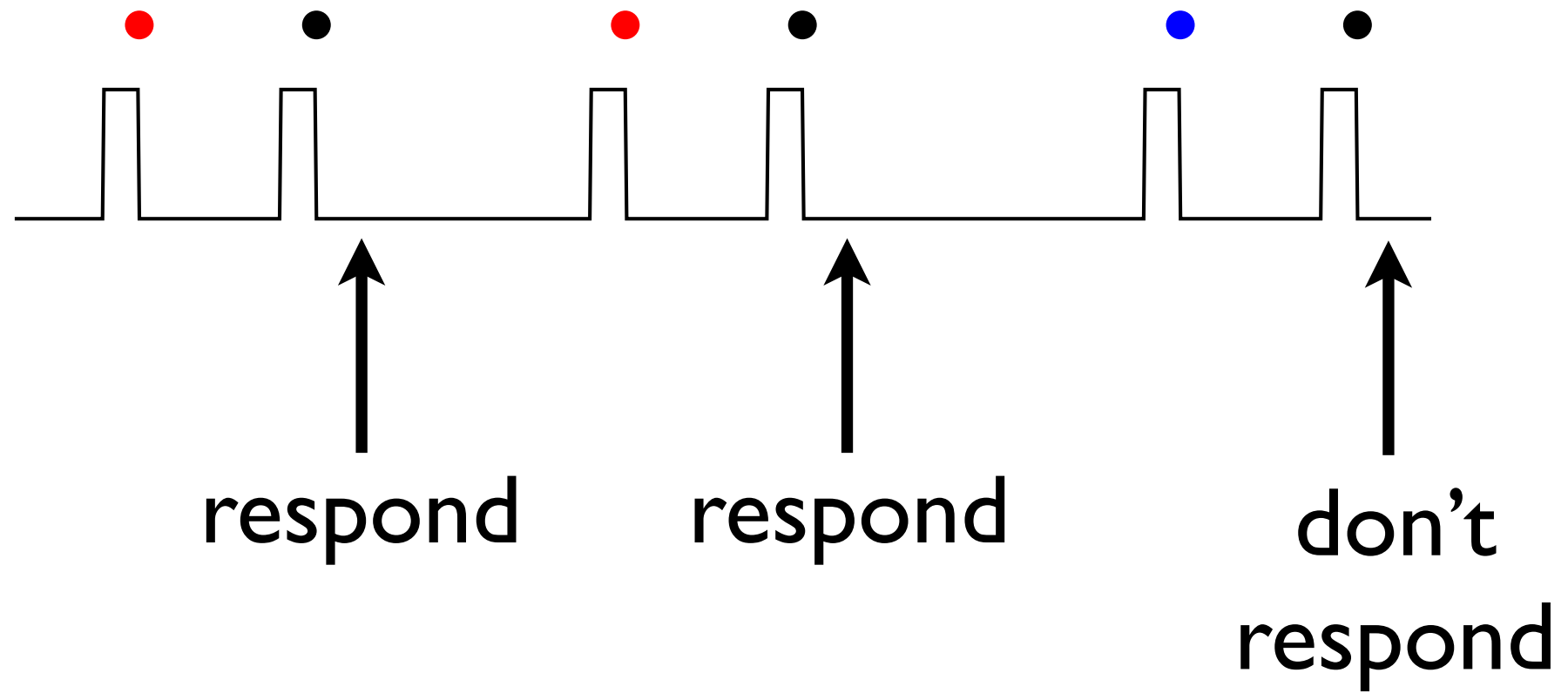
Busing, Schrauwen, Legenstein

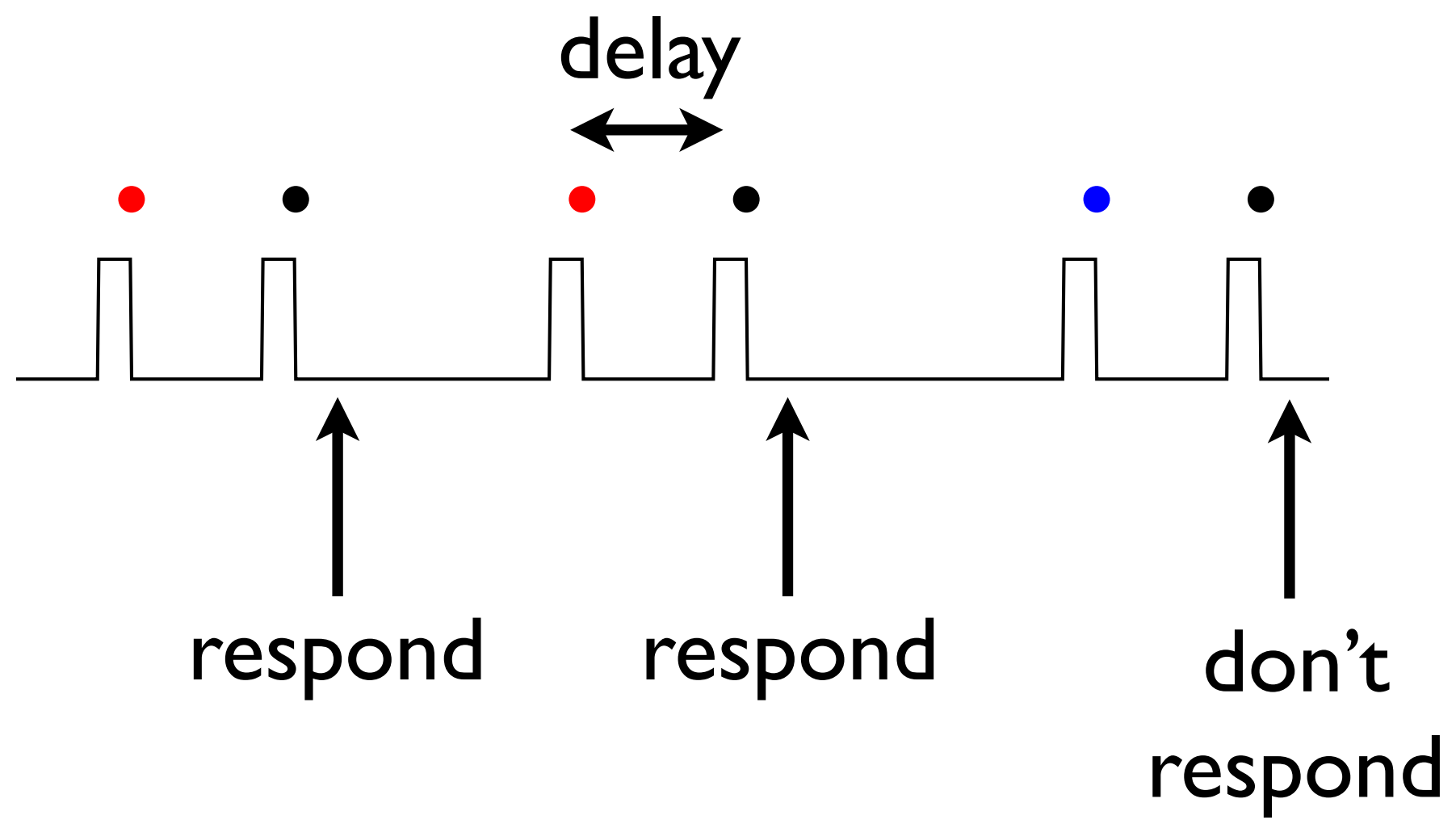


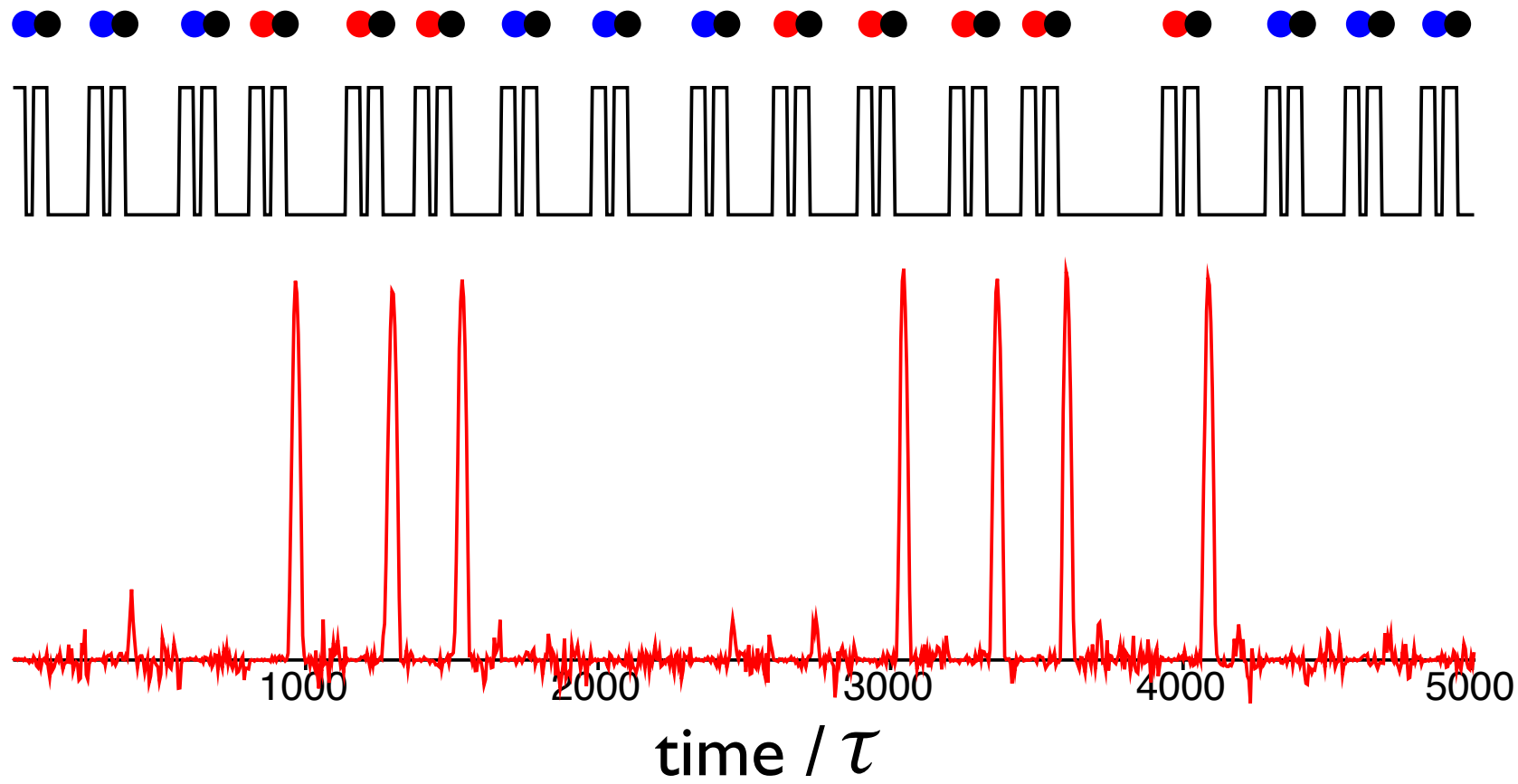


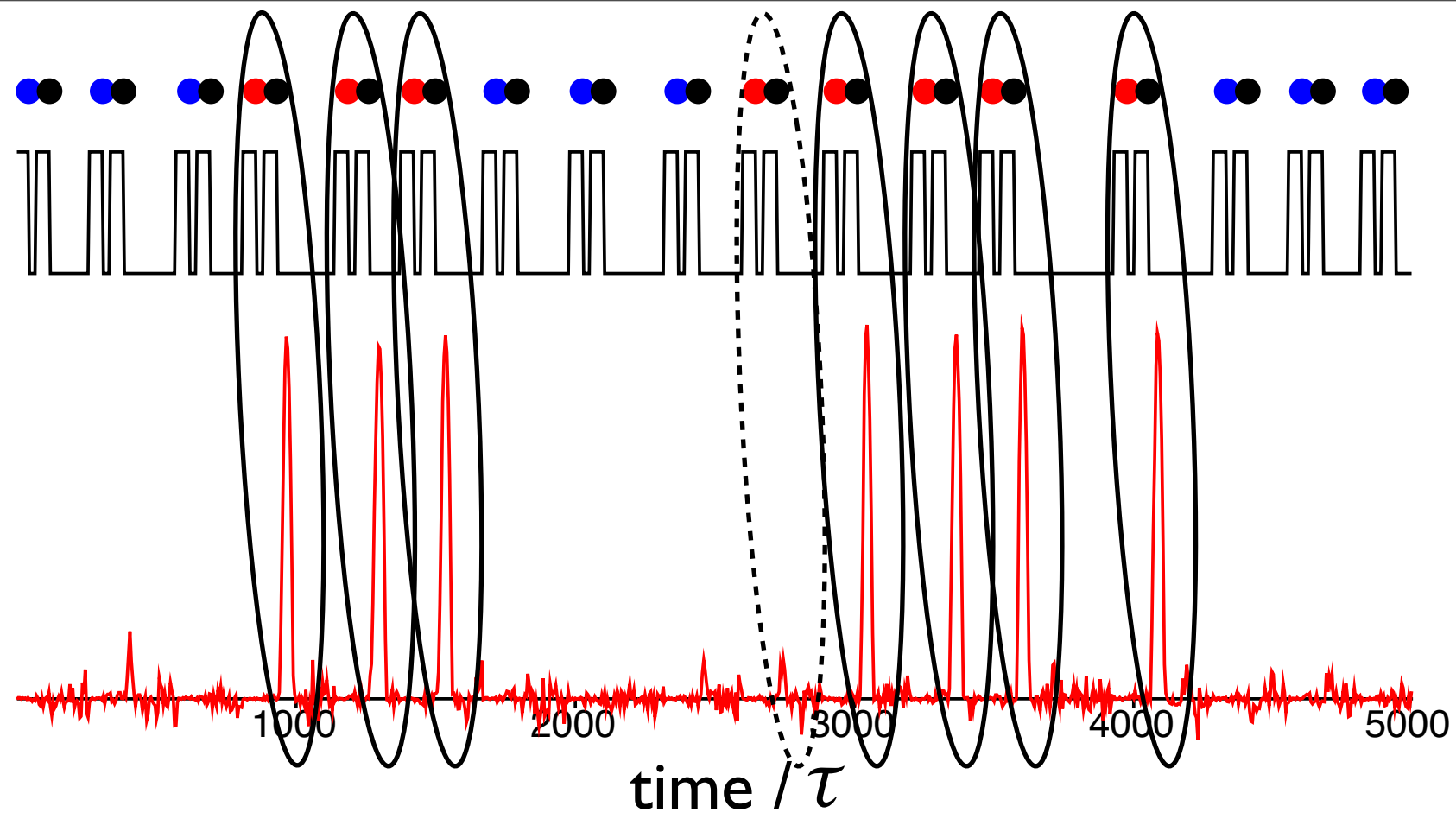


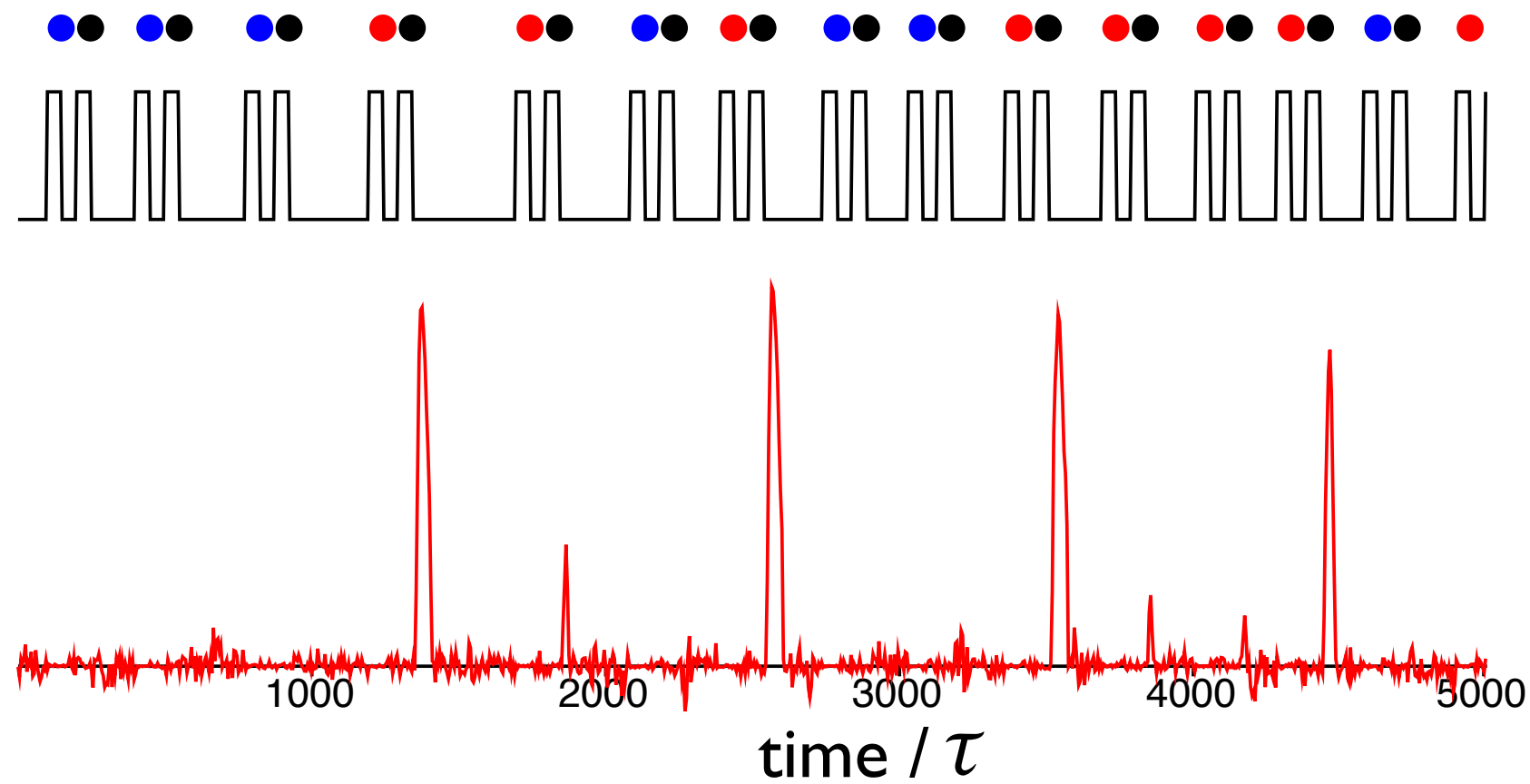
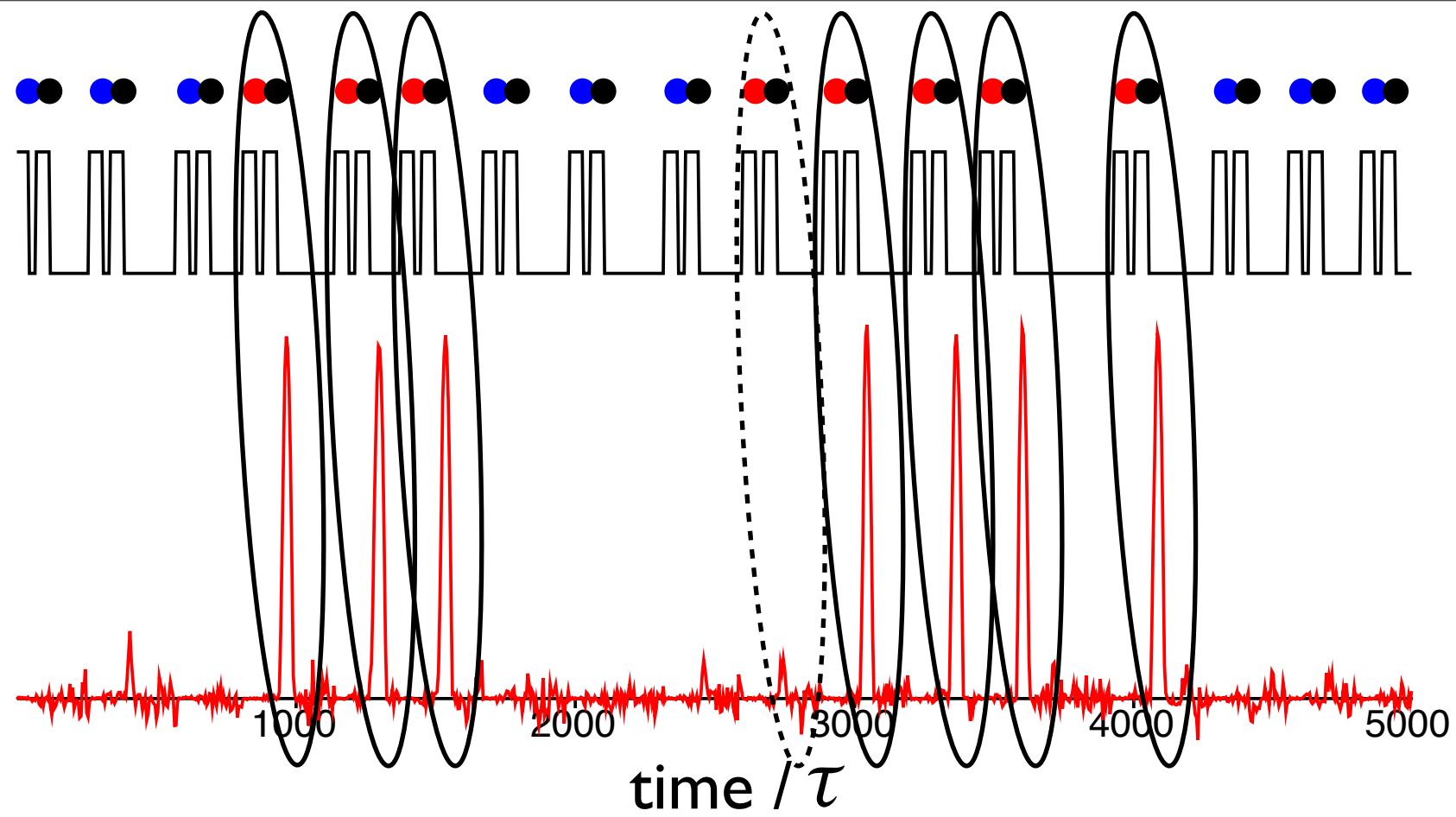


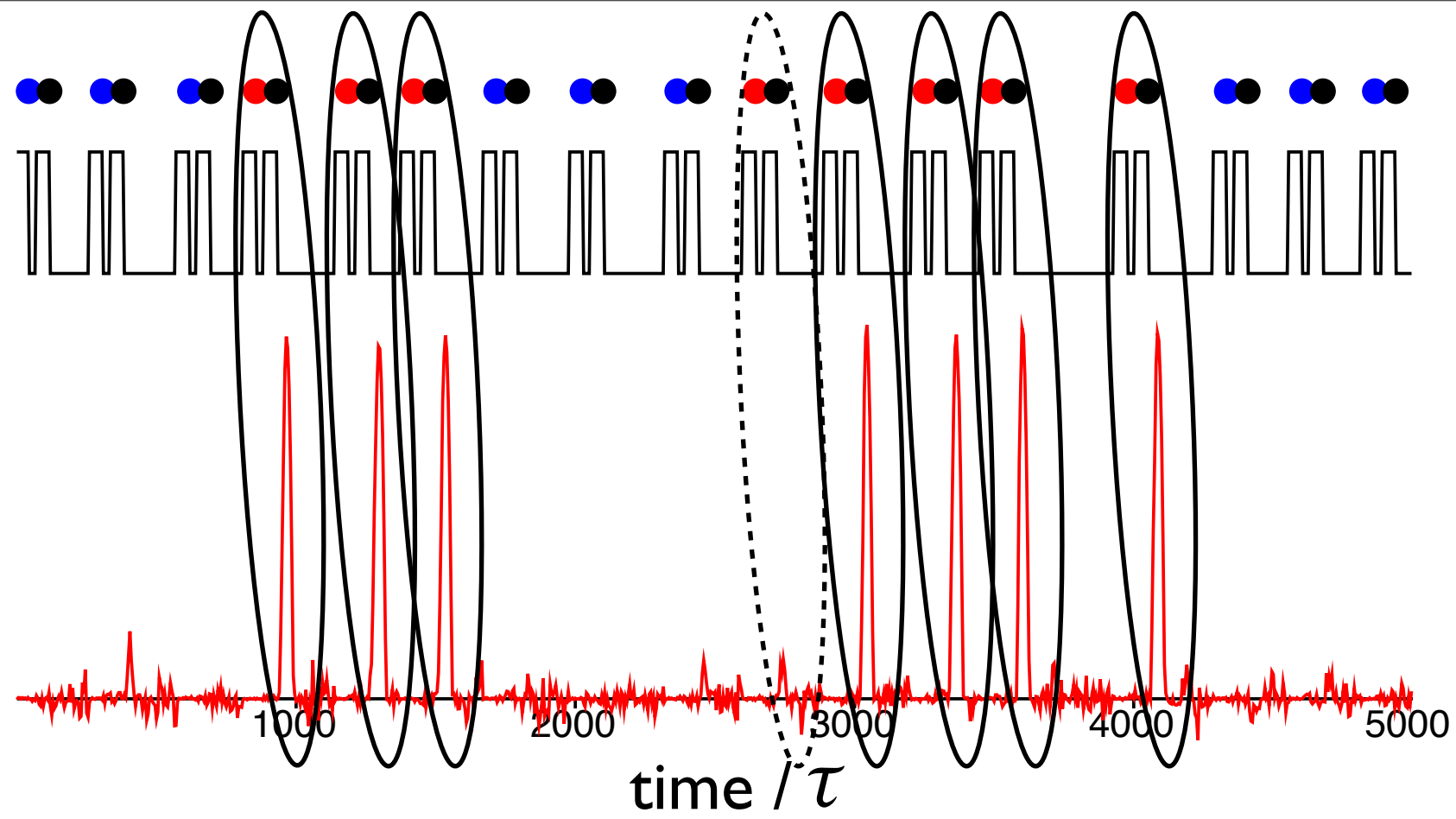




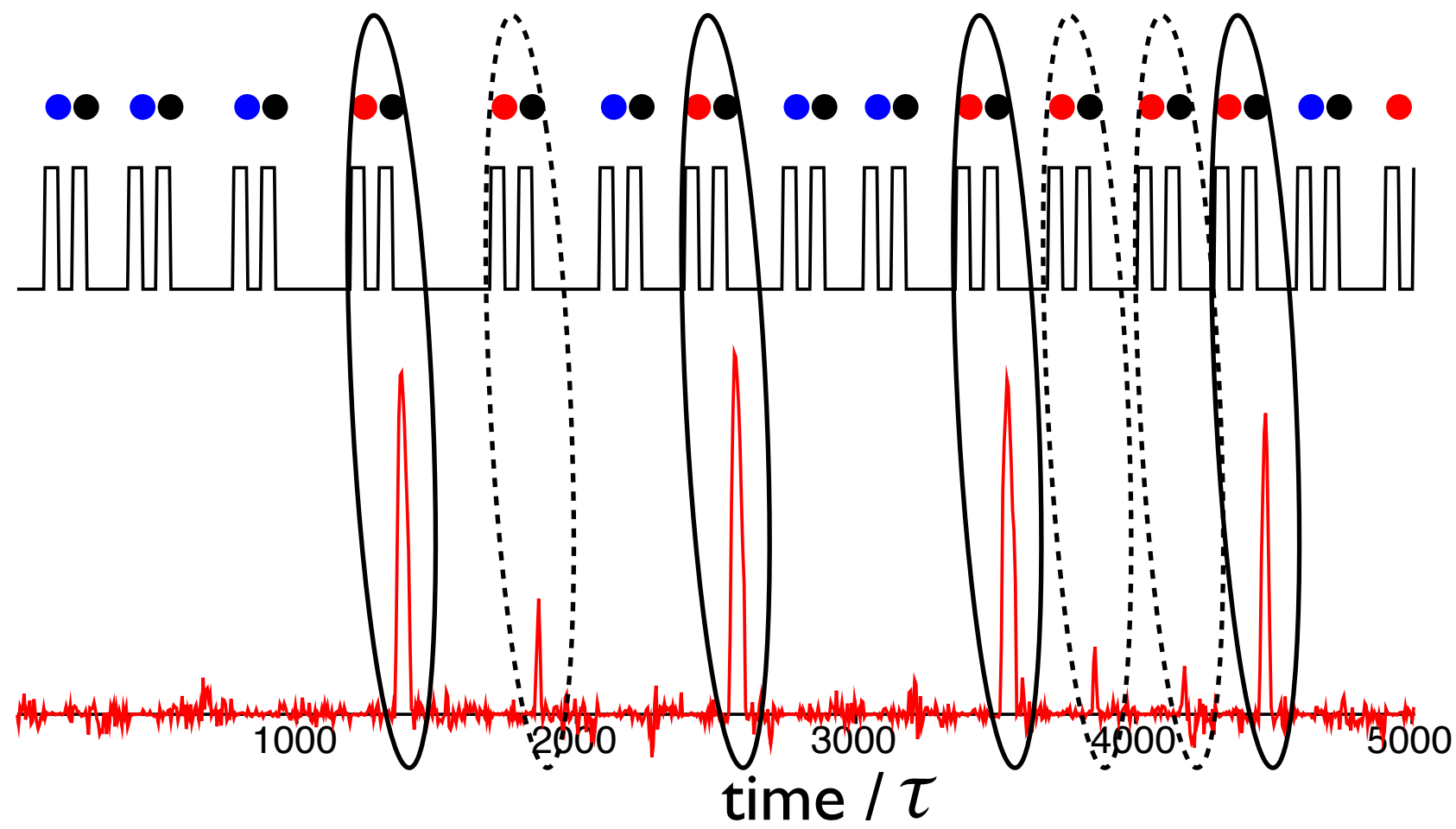




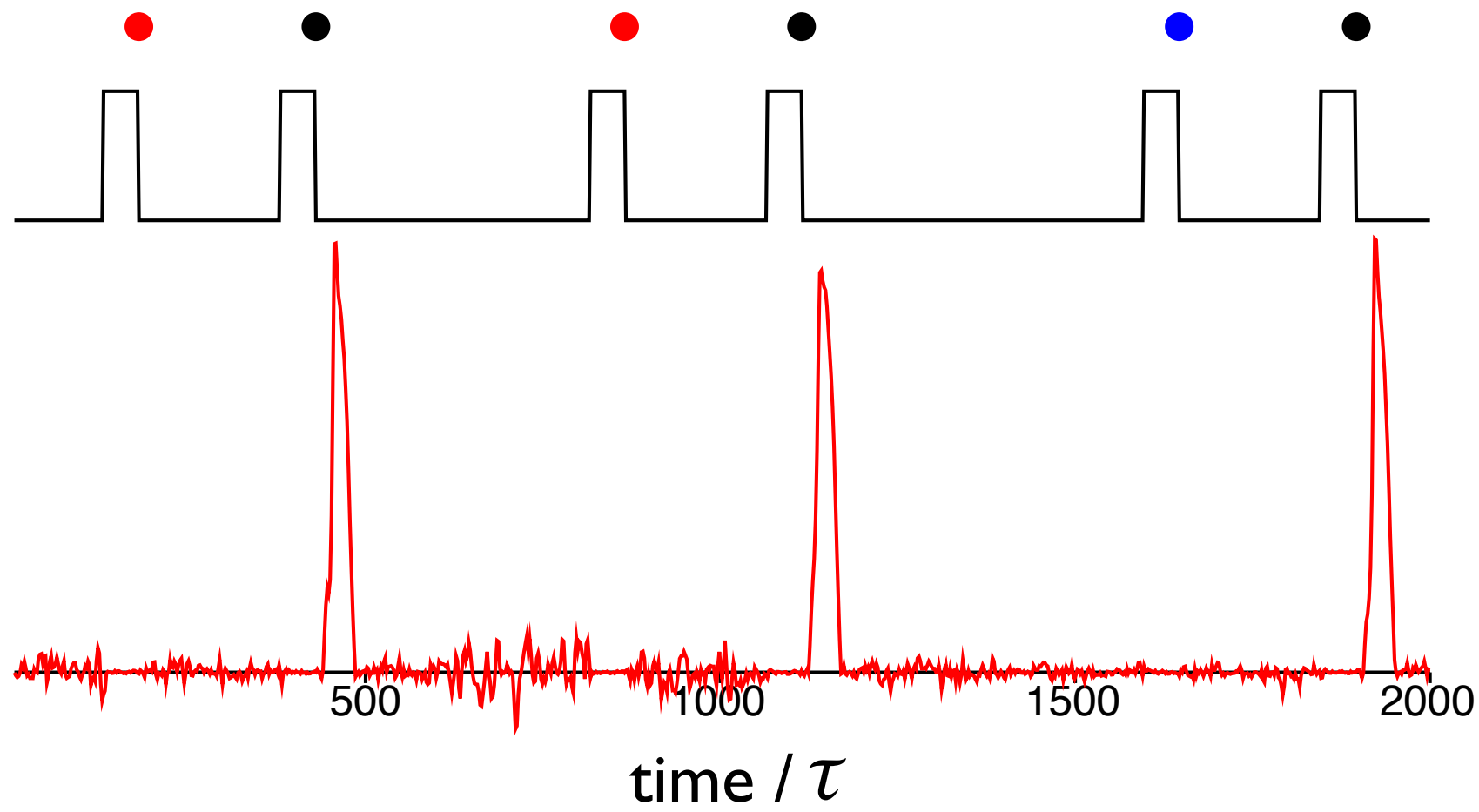




delay = 25τ



delay = 50τ



delay = 200τ

$$\tau \frac{dx_i}{dt} = -x_i + \sum_{j=1}^N J_{ij} \tanh(x_j)$$

$$\tau \frac{dx_i}{dt} = -x_i + \sum_{j=1}^N J_{ij} \tanh(x_j)$$



$$\tau \frac{dx_i}{dt} = -x_i - \alpha_i y_i + \sum_{j=1}^N J_{ij} \tanh(x_j)$$

$$\tau \frac{dx_i}{dt} = -x_i + \sum_{j=1}^N J_{ij} \tanh(x_j)$$



$$\tau \frac{dx_i}{dt} = -x_i - \alpha_i y_i + \sum_{j=1}^N J_{ij} \tanh(x_j)$$

$$\tau_i^a \frac{dy_i}{dt} = r_i - y_i$$

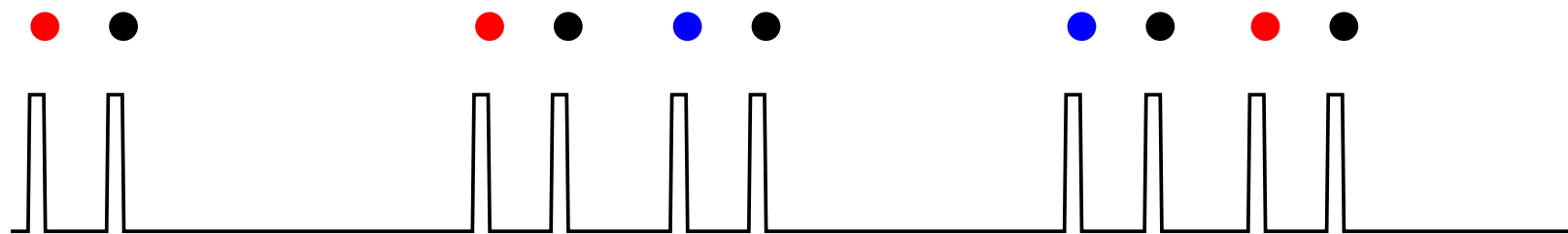
$$\tau \frac{dx_i}{dt} = -x_i + \sum_{j=1}^N J_{ij} \tanh(x_j)$$



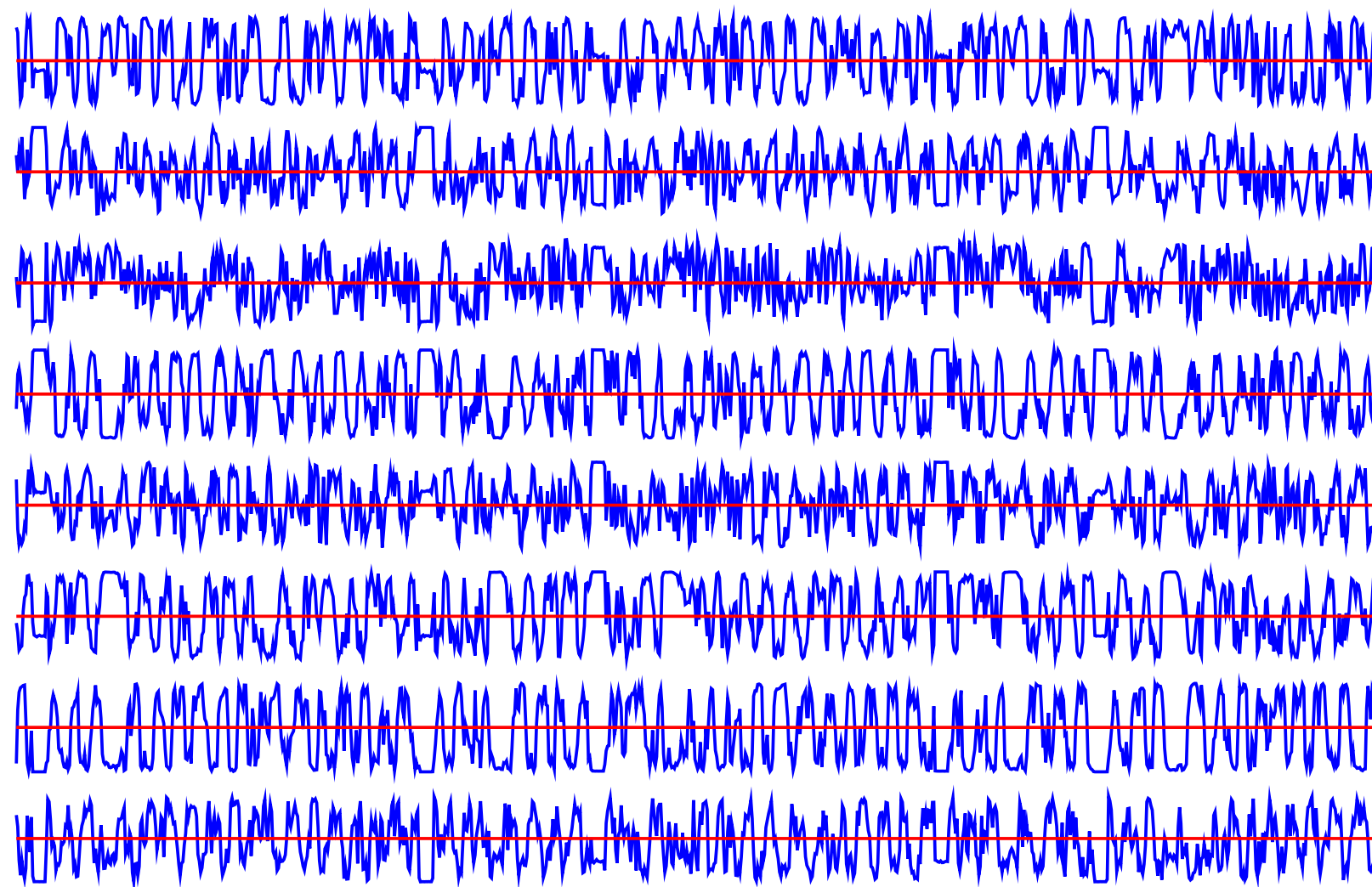
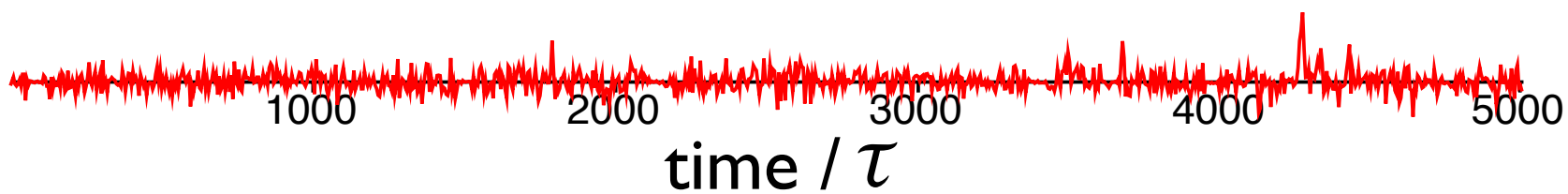
$$\tau \frac{dx_i}{dt} = -x_i - \alpha_i y_i + \sum_{j=1}^N J_{ij} \tanh(x_j)$$

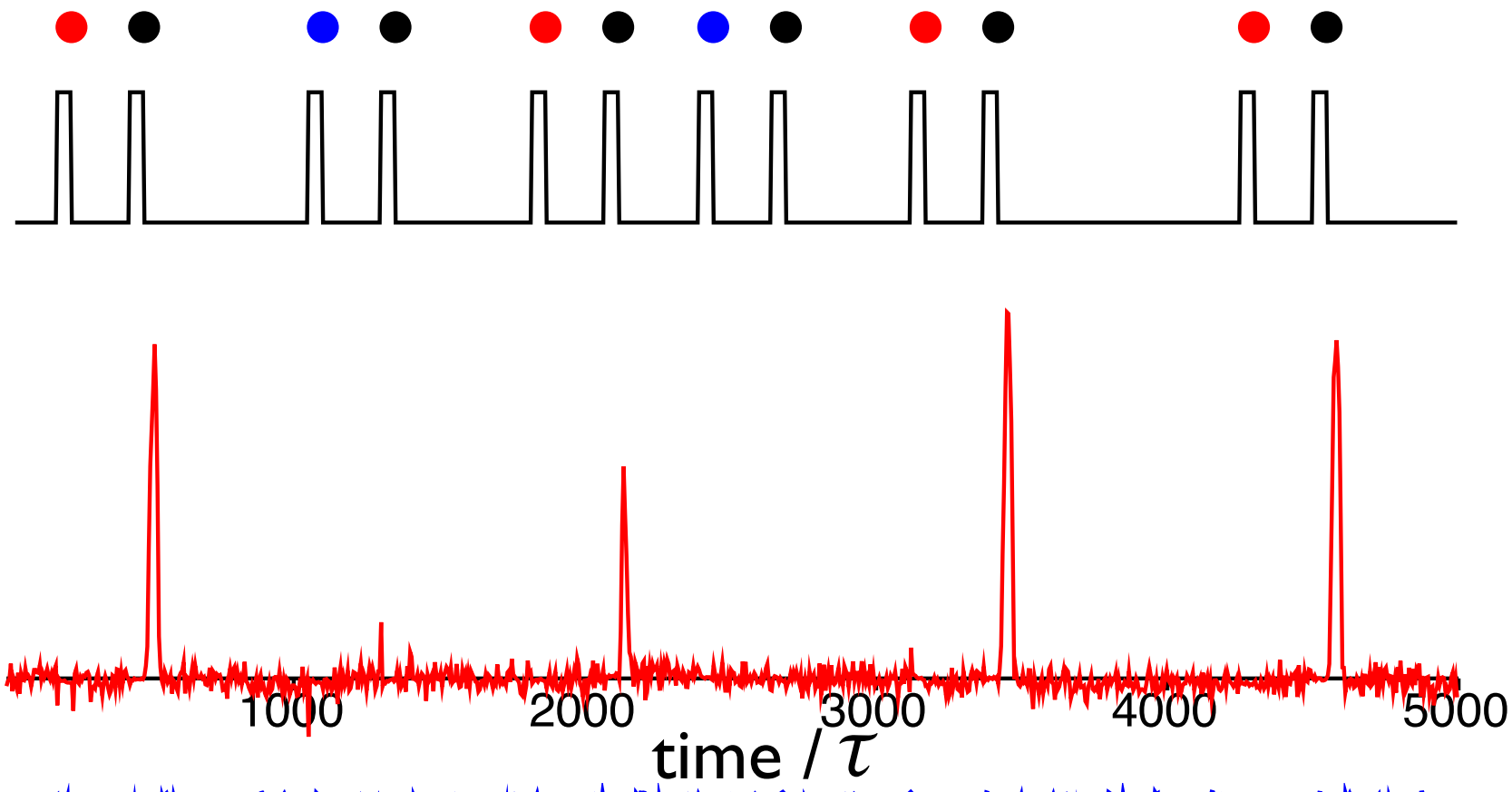
$$\tau_i^a \frac{dy_i}{dt} = r_i - y_i$$

$$\tau_i^a = (200 - 800)\tau$$

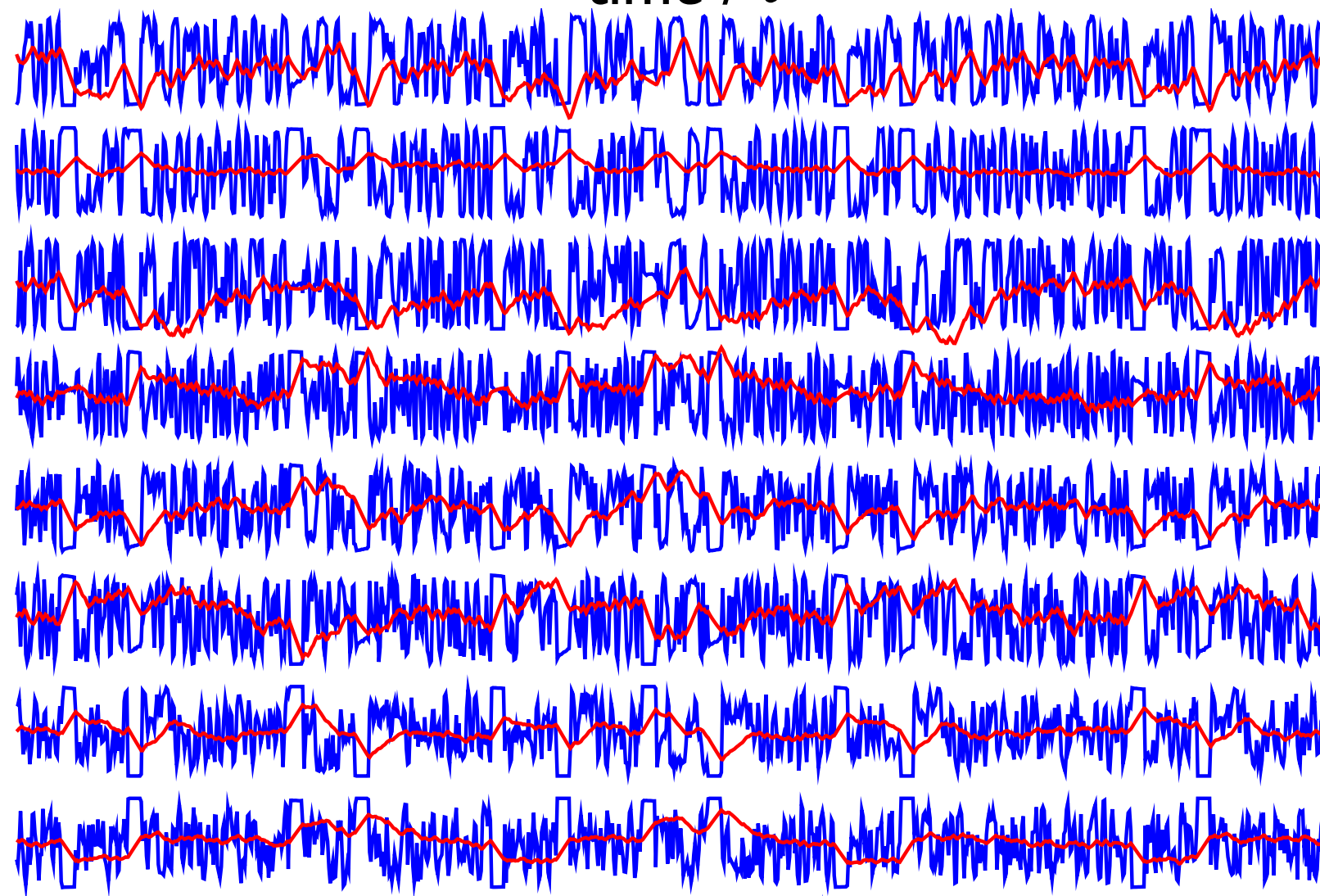


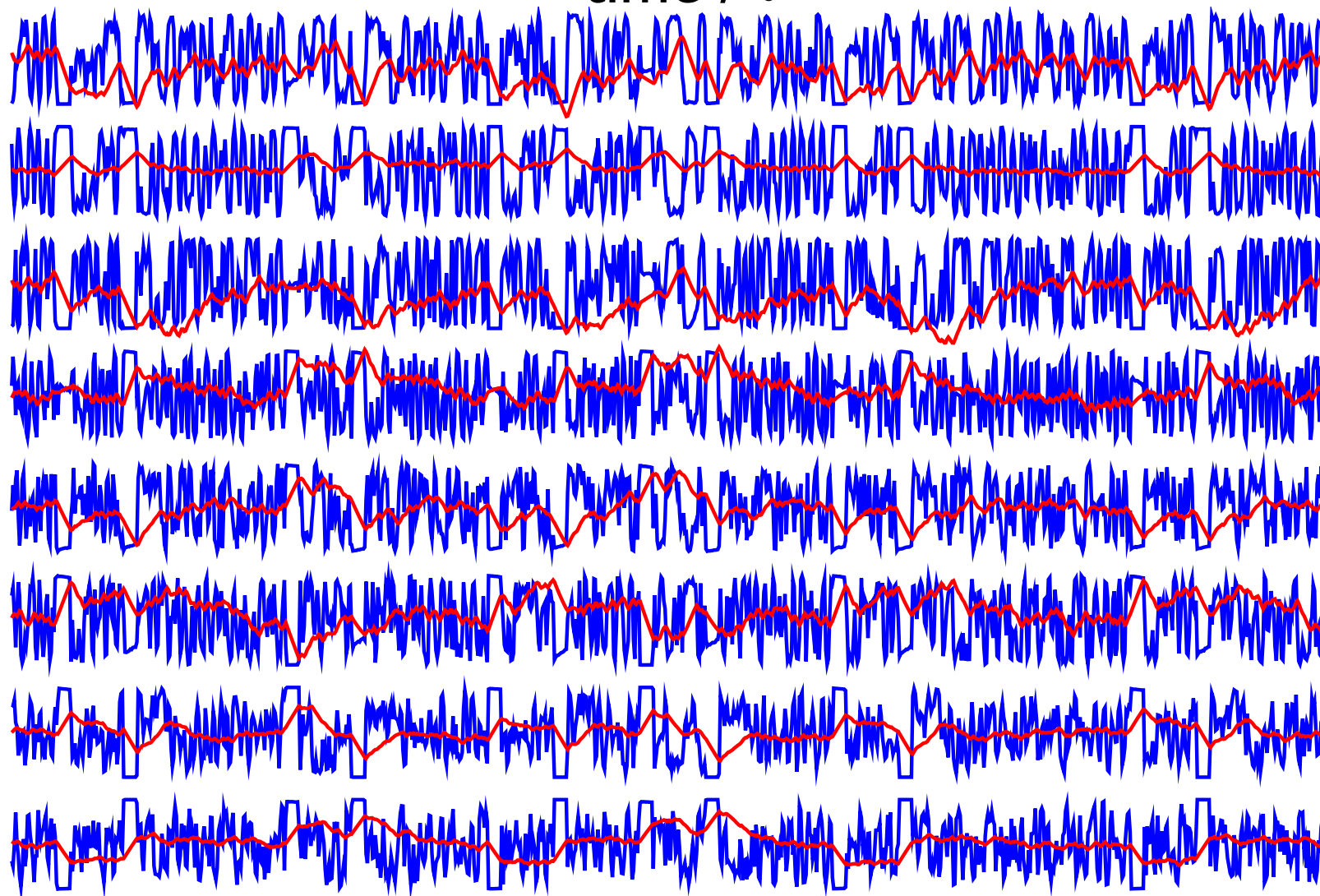
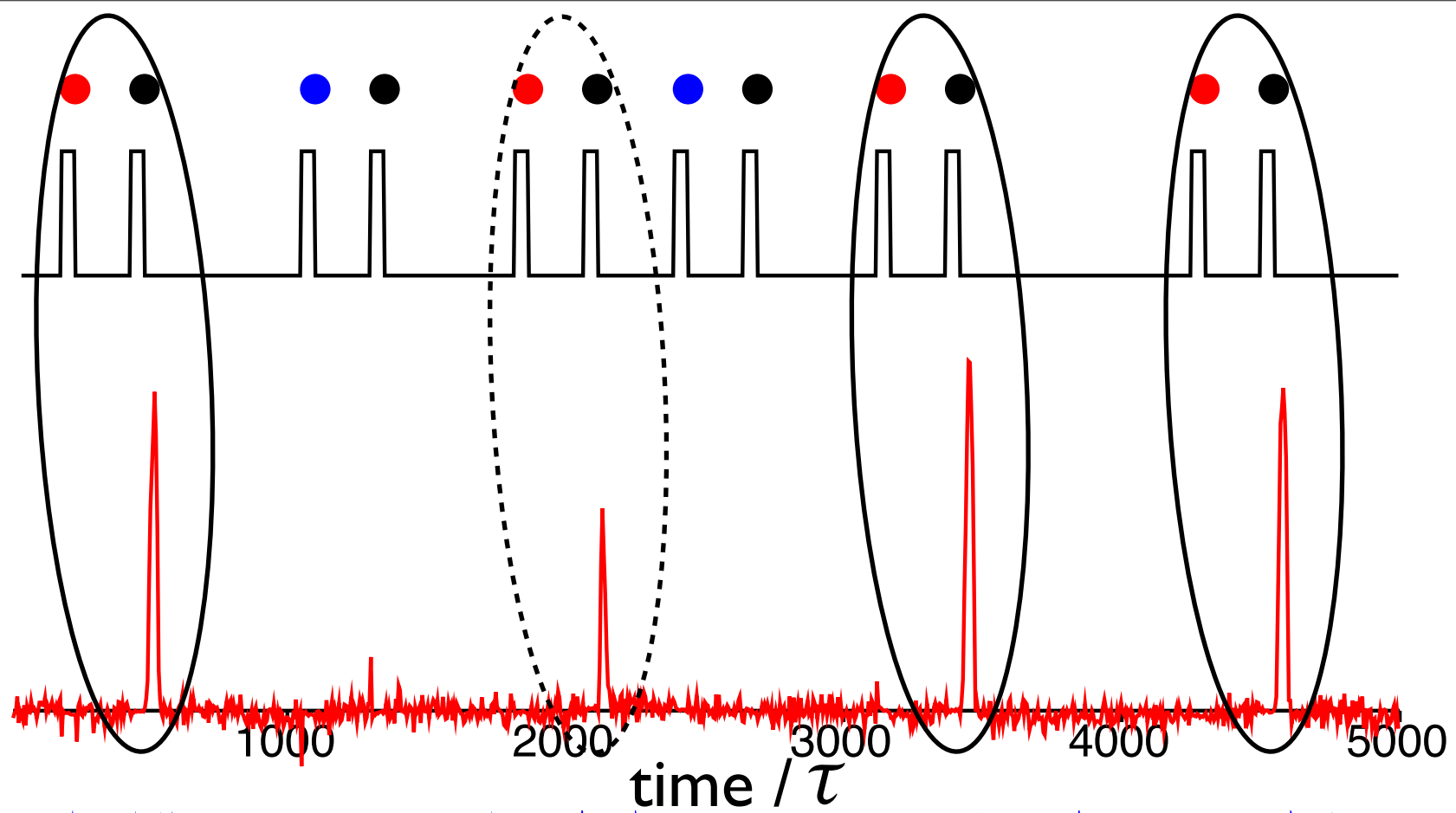
$$\text{delay} = 200\tau$$

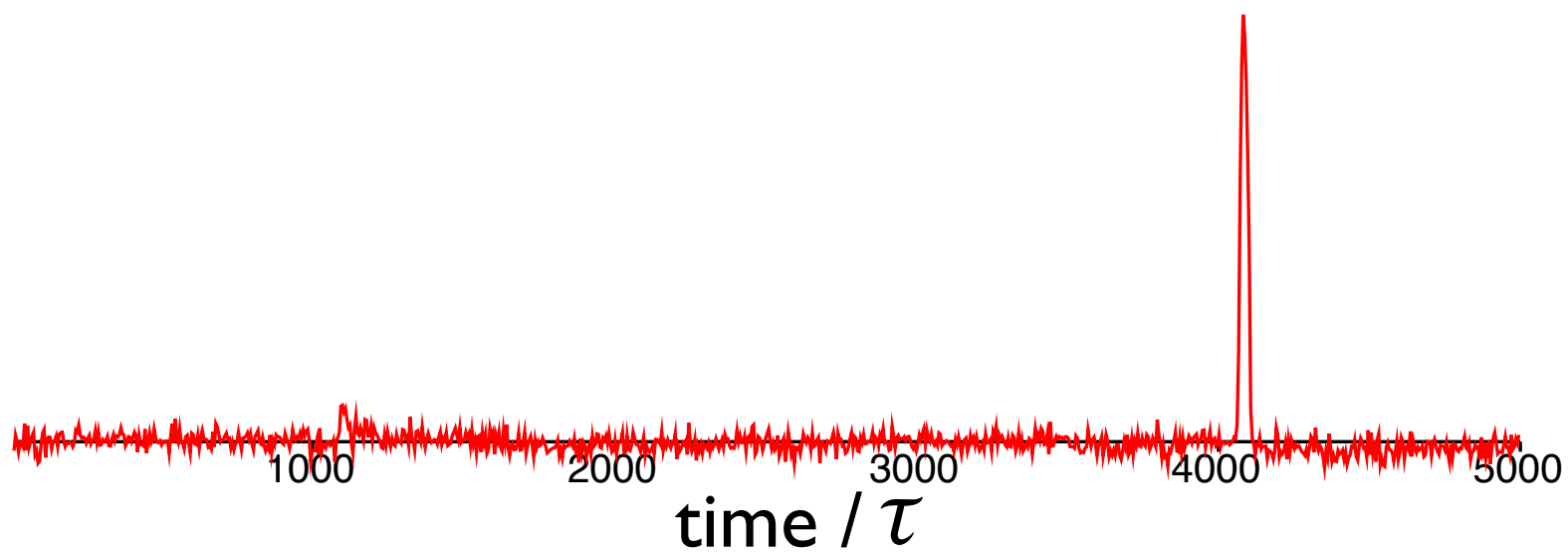




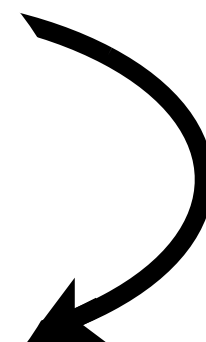
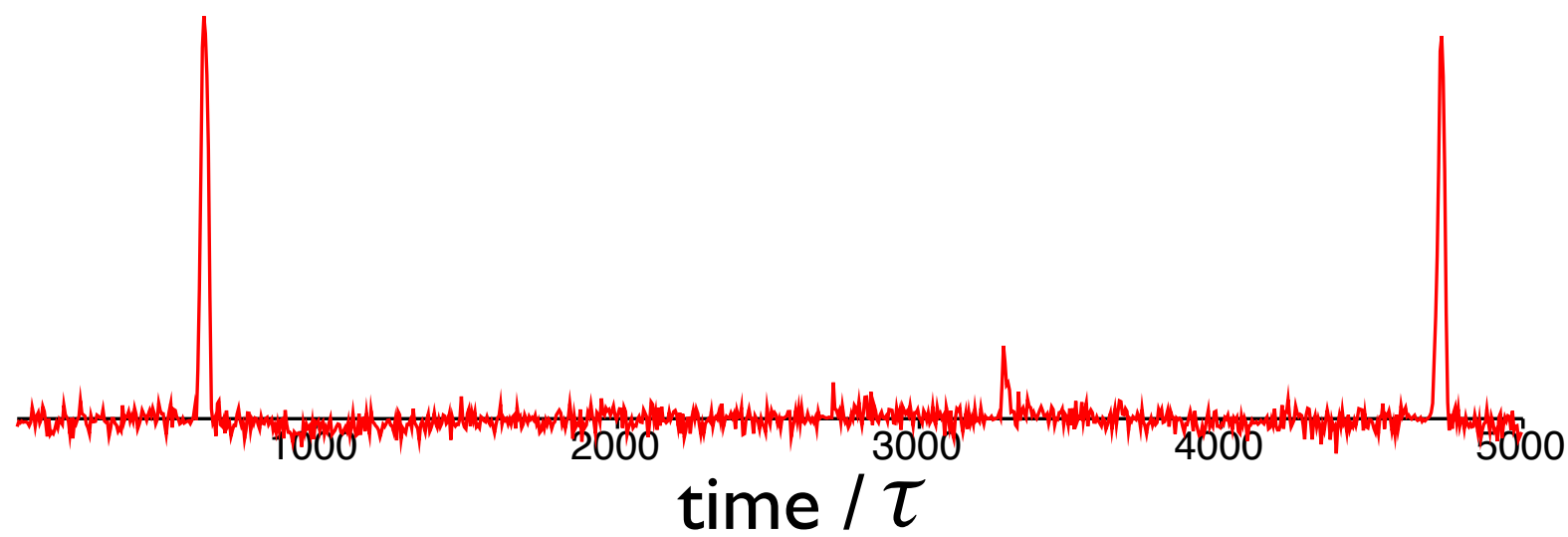
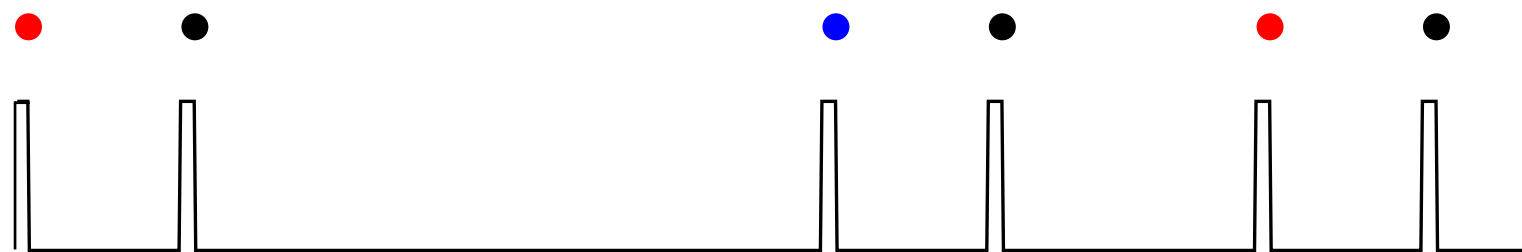
delay = 200τ

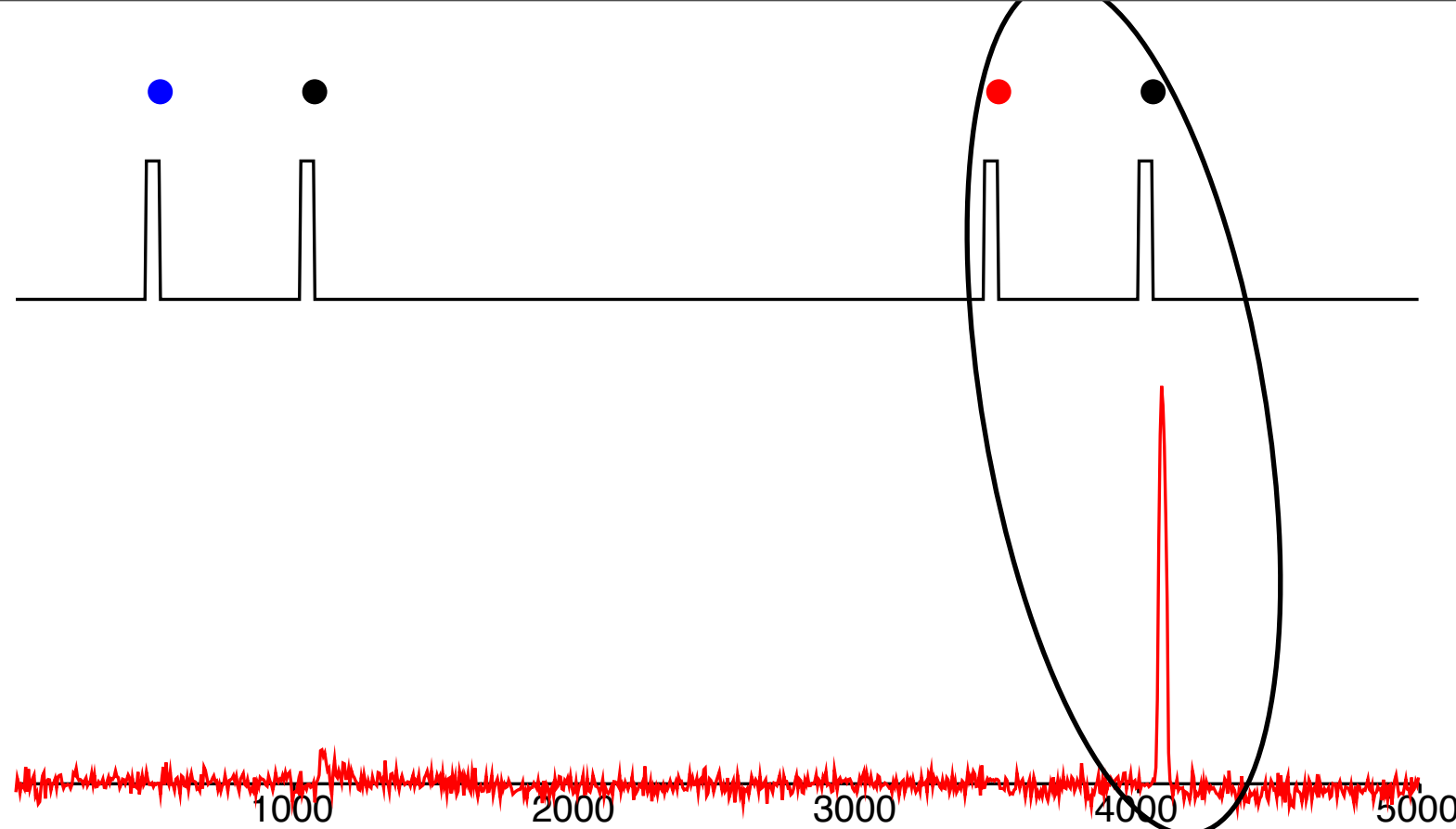




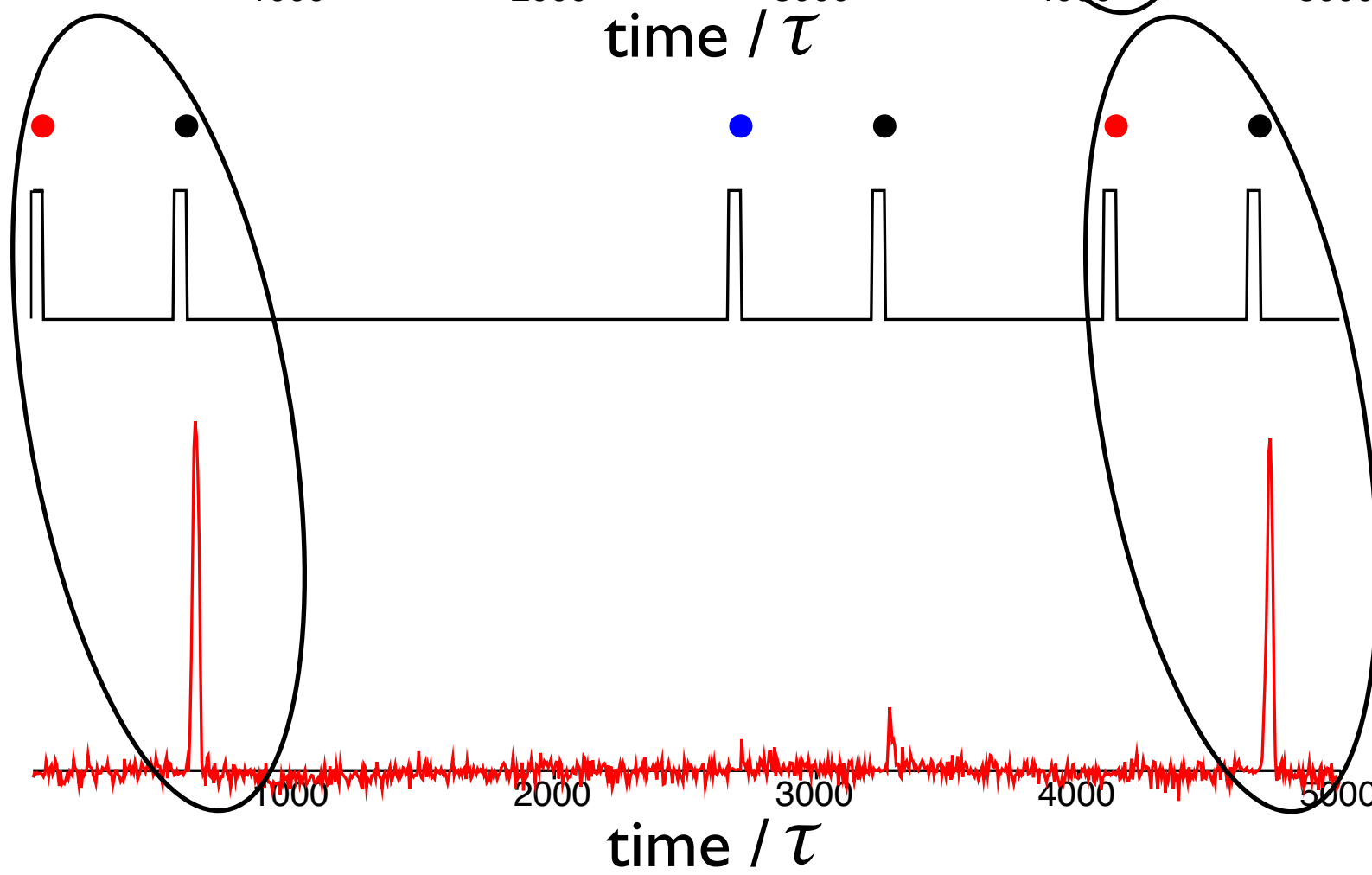
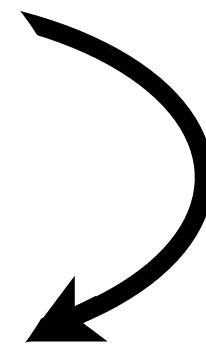


delay = 500τ





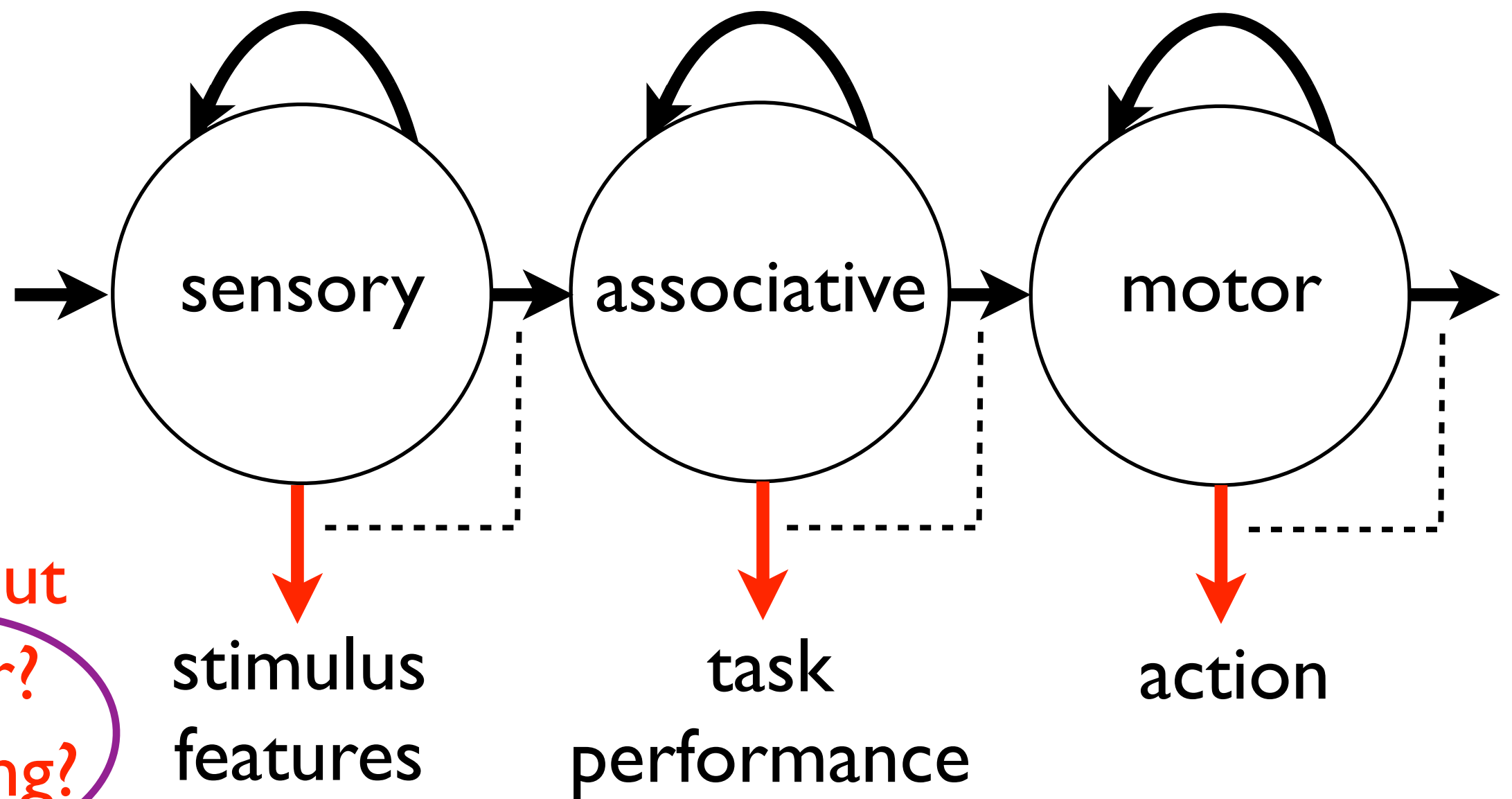
delay = 500τ



attention
completion

context
memory

dynamics



readout
linear?
learning?