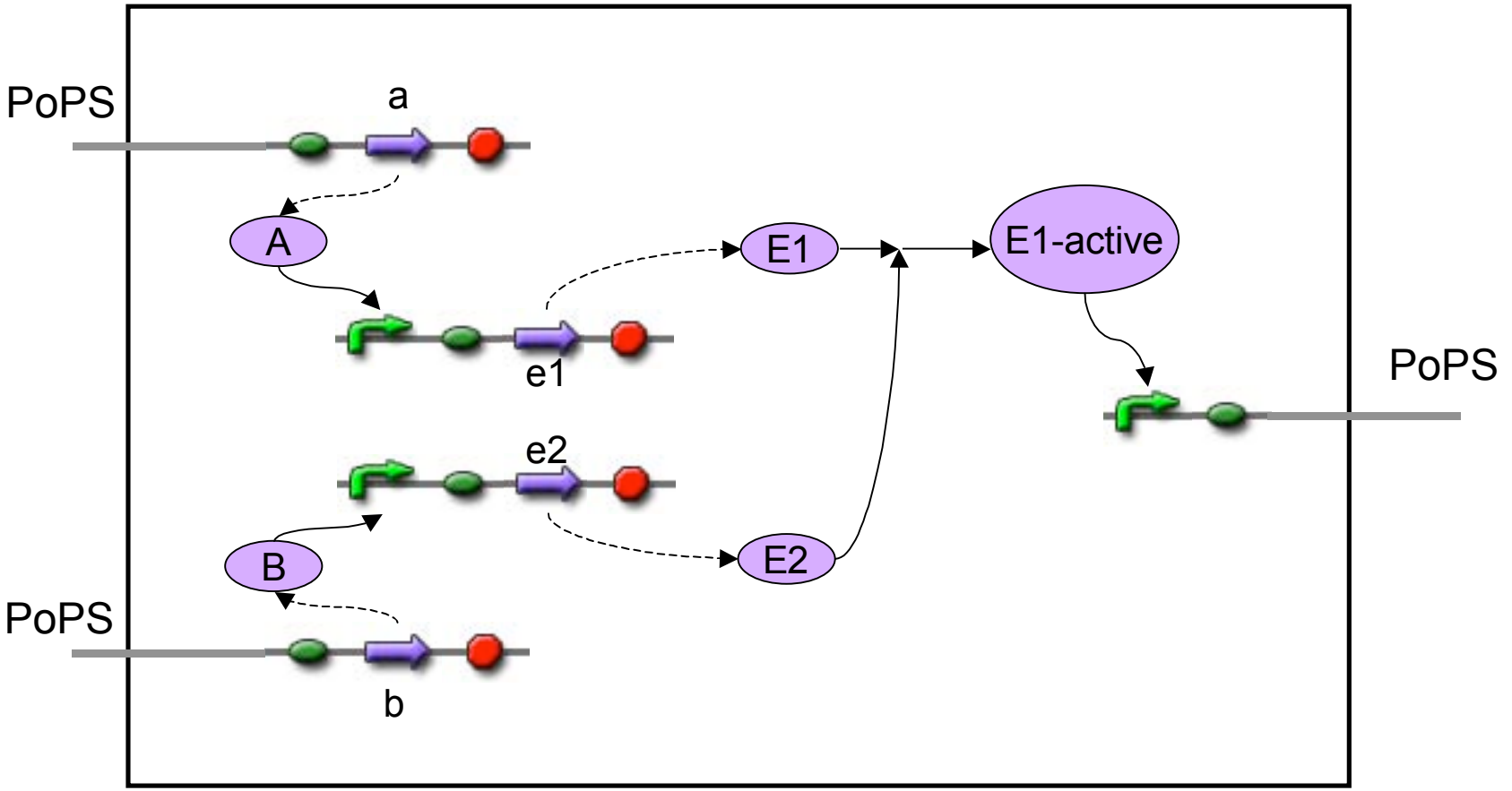
ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

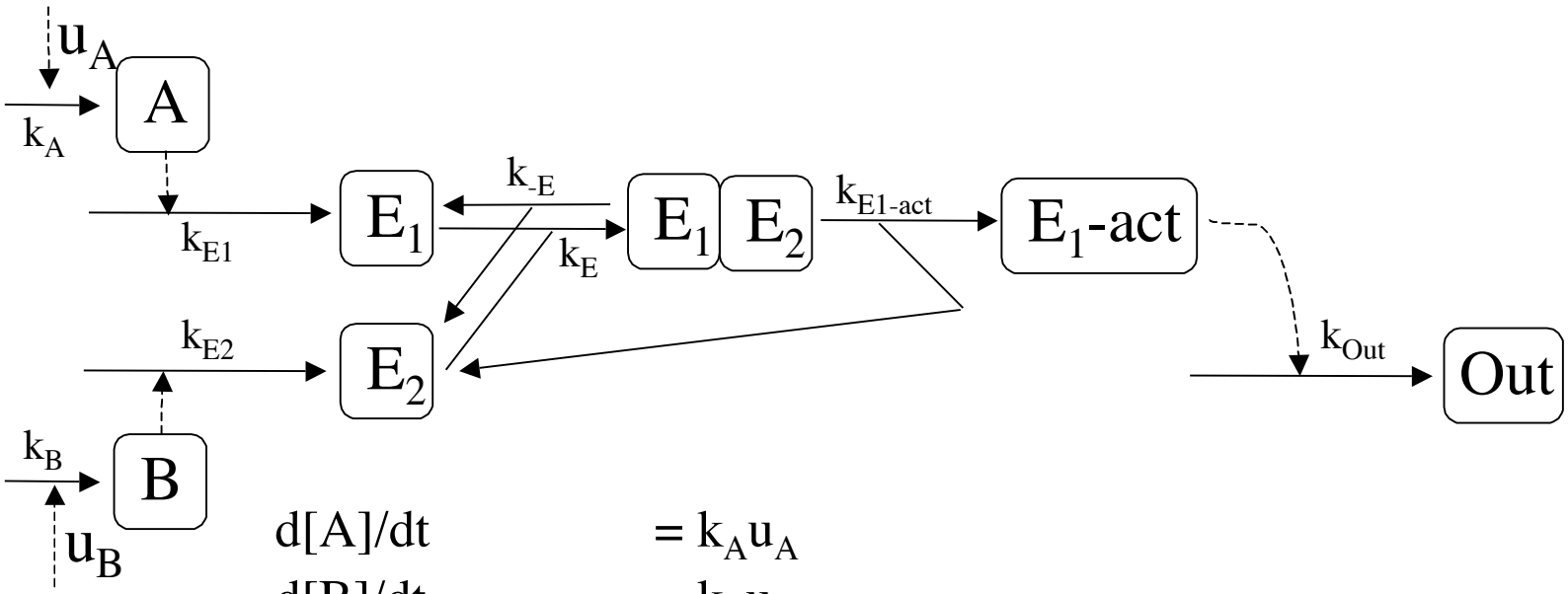
iGEM 2006

Half Adder - Modelling

AND – 1

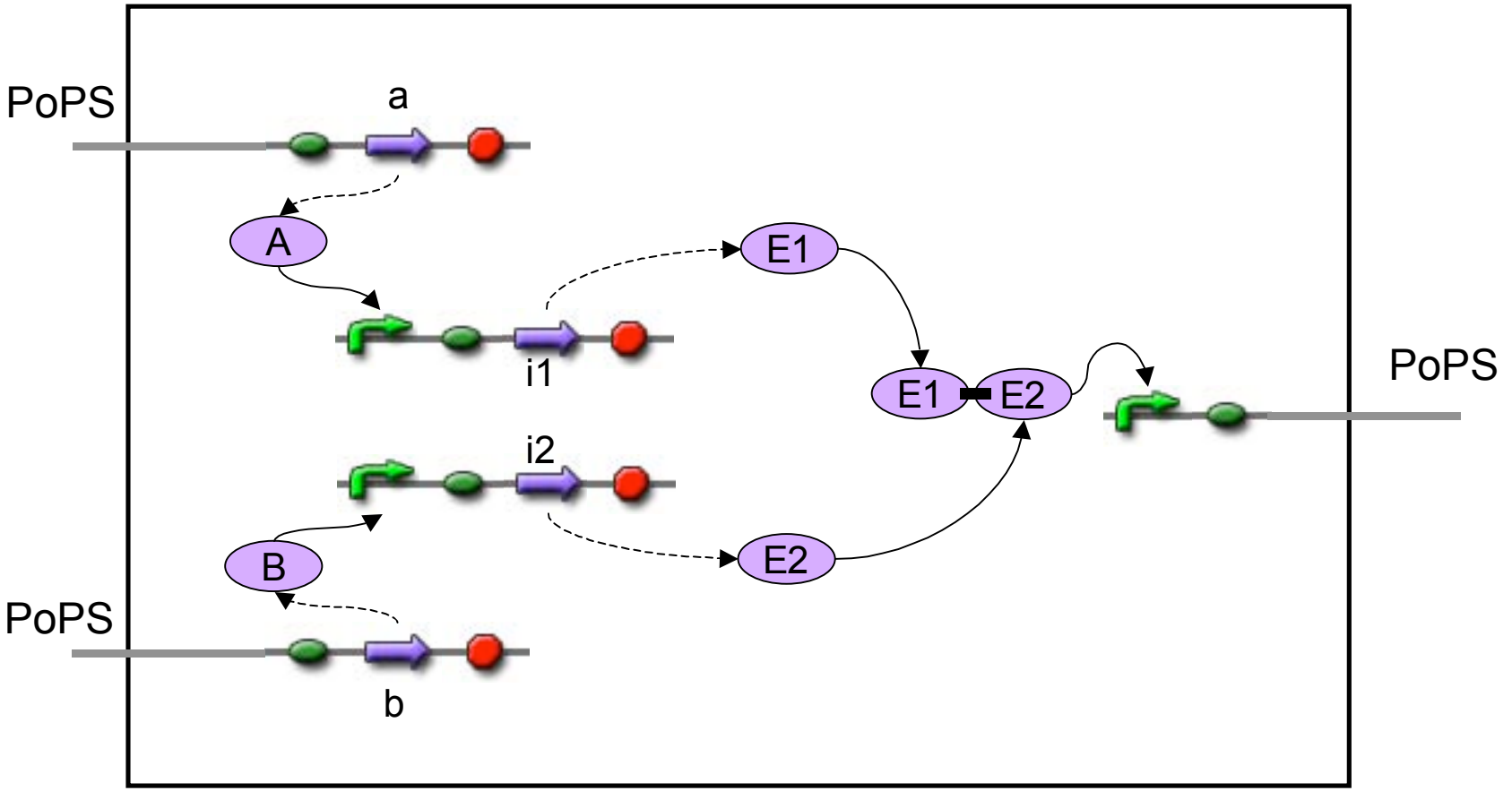


AND – 1 (ODE's)

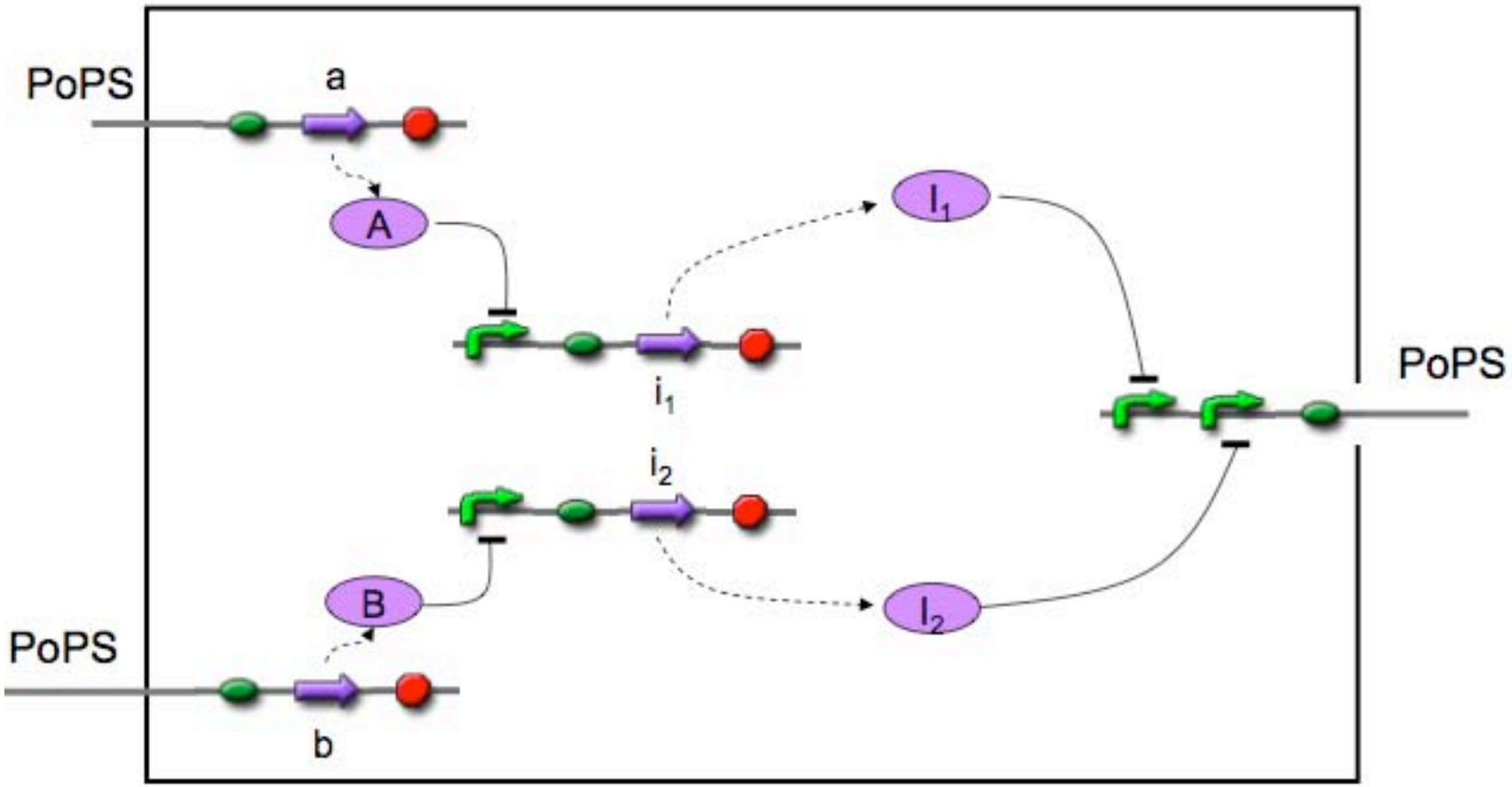


$$
\begin{aligned}
d[A]/dt &= k_A u_A \\
d[B]/dt &= k_B u_B \\
d[E_1]/dt &= k_{E1}[A] - k_E[E_1][E_2] + k_{-E}[E_1E_2] \\
d[E_2]/dt &= k_{E2}[B] - k_E[E_1][E_2] + k_{-E}[E_1E_2] + k_{E1\text{-}act}[E_1E_2] \\
d[E_1E_2]/dt &= k_E[E_1][E_2] - k_{-E}[E_1E_2] - k_{E1\text{-}act}[E_1E_2] \\
d[E_1\text{-act}]/dt &= k_{E1\text{-}act}[E_1E_2] \\
d[Out]/dt &= k_{out}[E_1\text{-act}]
\end{aligned}
$$

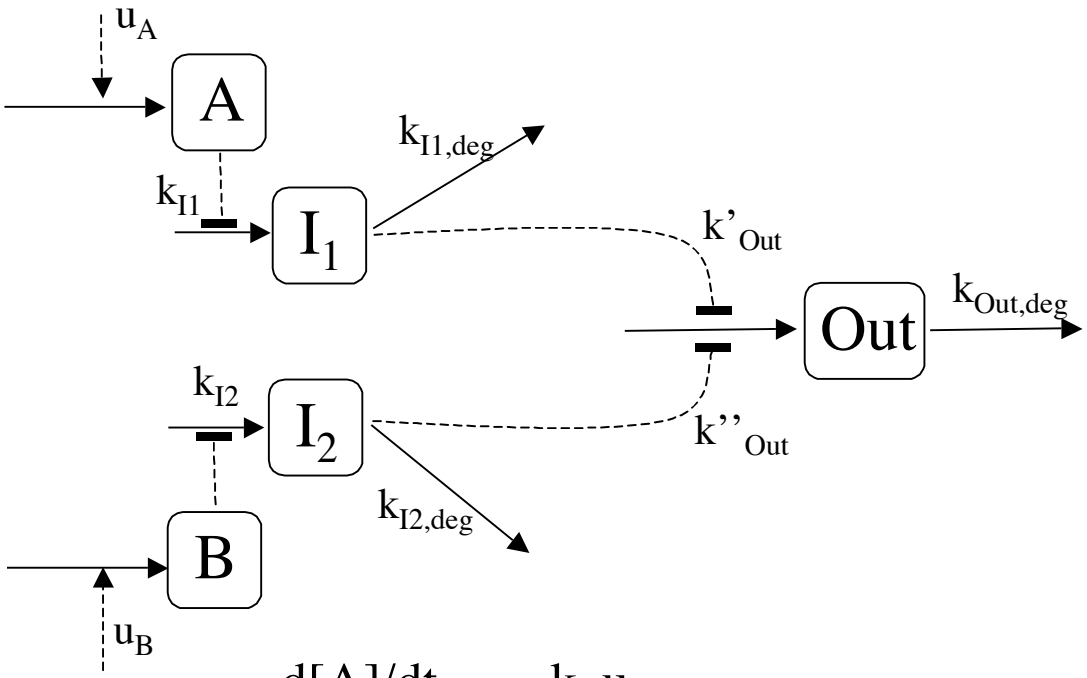
AND – 2

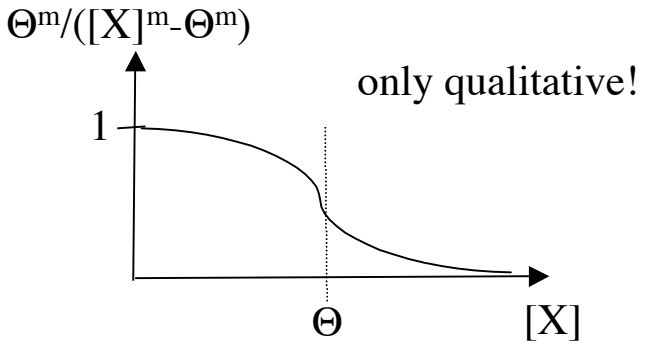


AND – 3



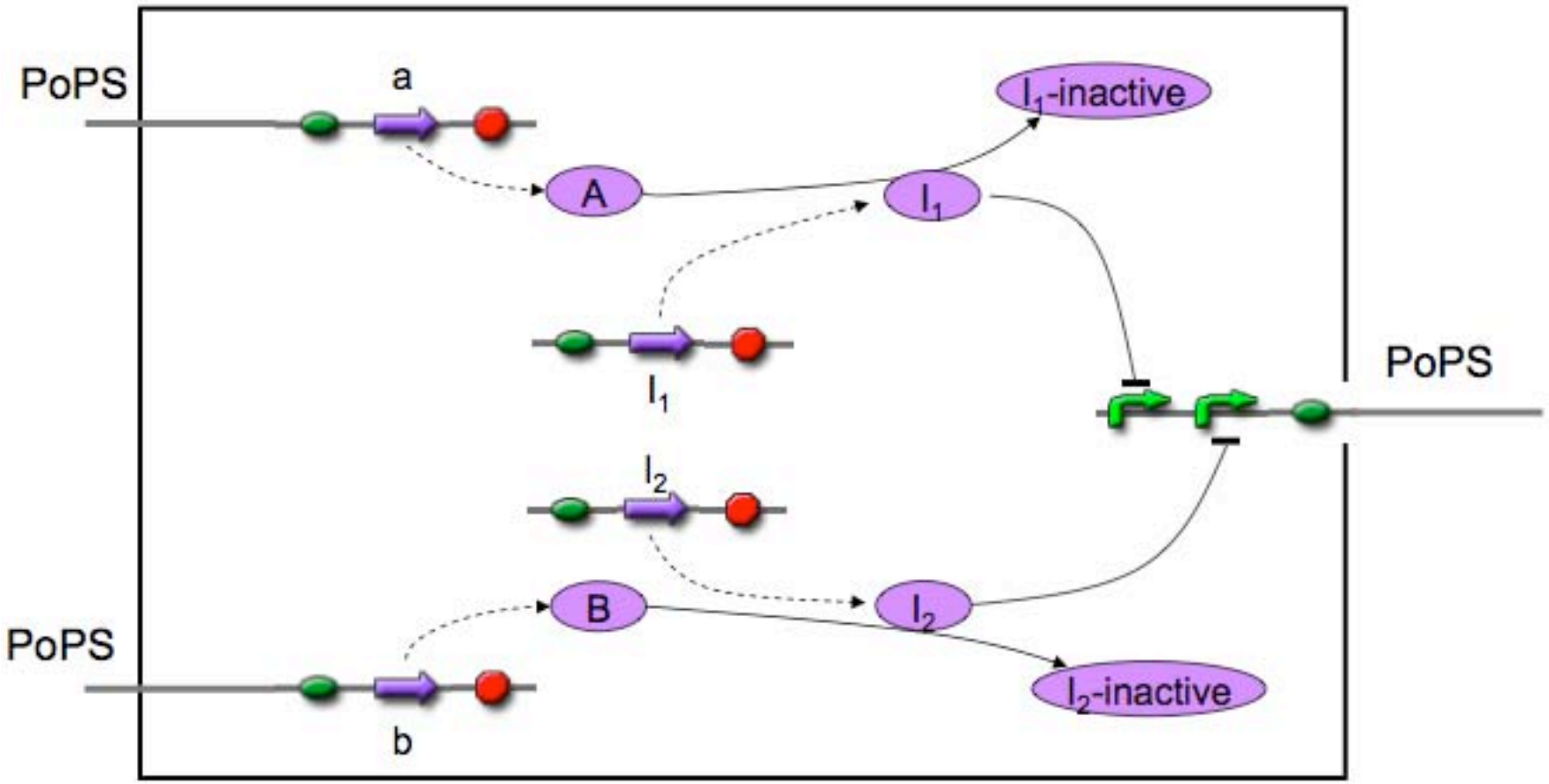
AND – 3 (ODE's)

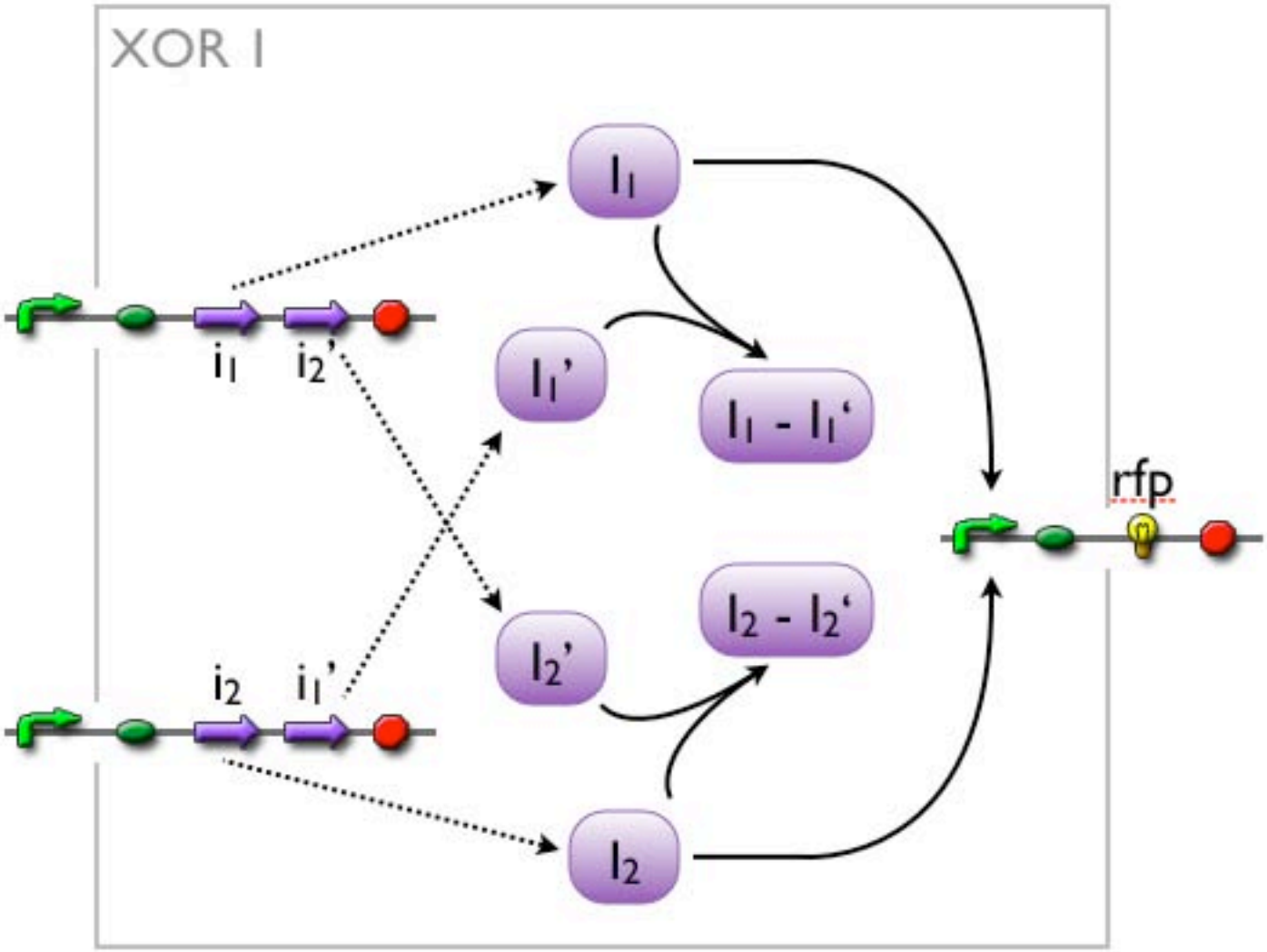




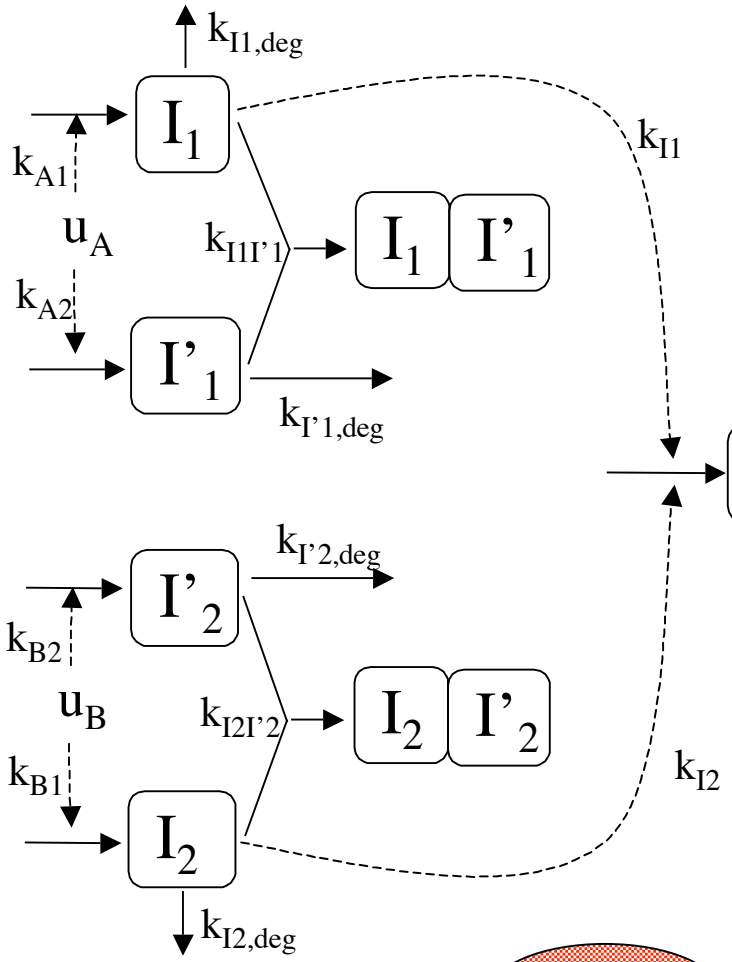
$$d[A]/dt = k_A u_A$$
$$d[B]/dt = k_B u_B$$
$$d[I_1]/dt = k_{I1}\,\Theta^{m1}/([A]^{m1}-\Theta^{m1}) - k_{I1,deg}[I_1]$$
$$d[I_2]/dt = k_{I2}\,\Theta^{m1}/([B]^{m1}-\Theta^{m1}) - k_{I2,deg}[I_1]$$
$$d[Out]/dt = k'_{Out}\Theta^{m3}/([I_1]^{m3}-\Theta^{m3})\; k''_{Out}\Theta^{m4}/([I_2]^{m4}-\Theta^{m4}) - k_{Out,deg}[Out]$$

AND – 4



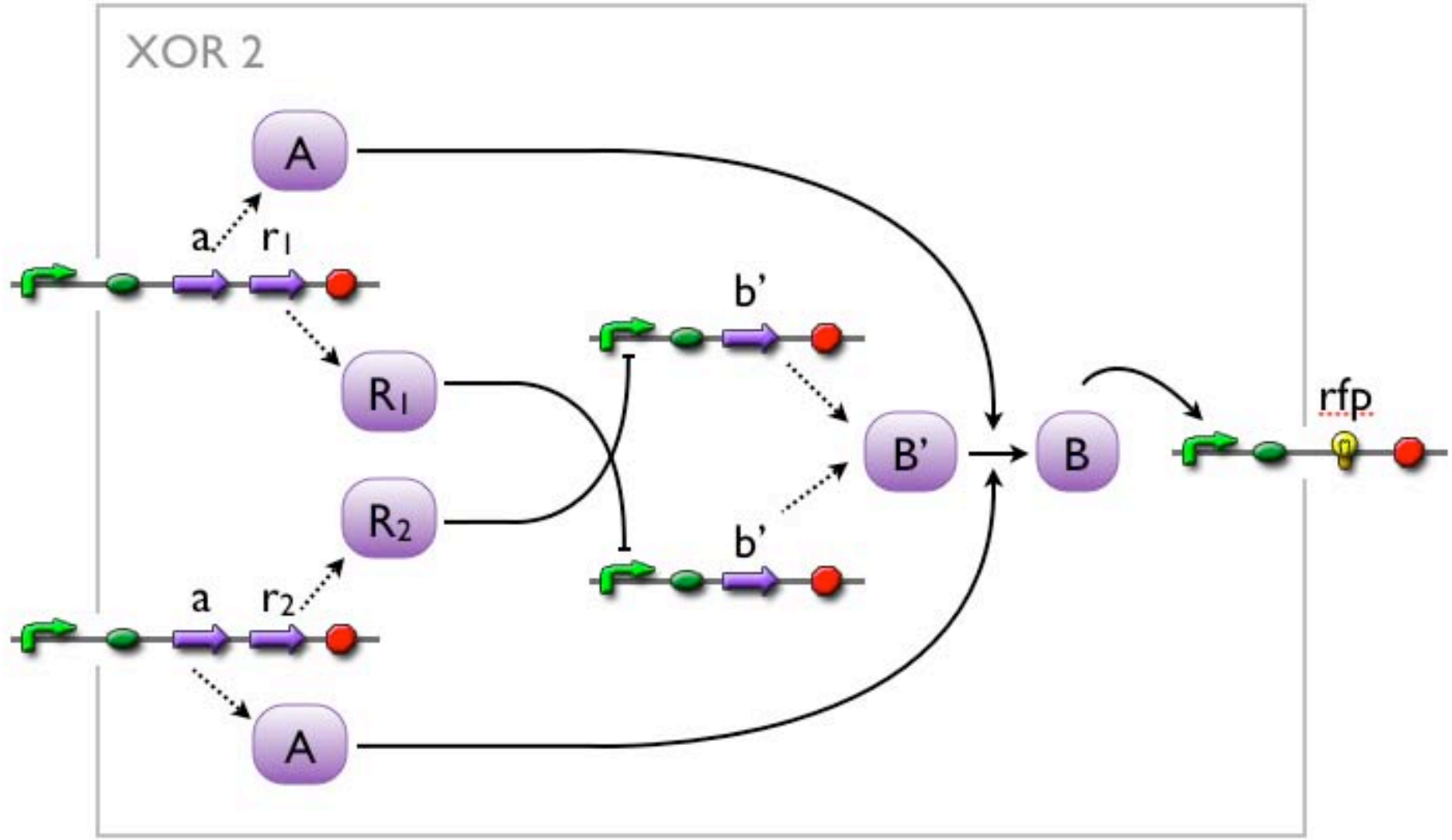

XOR I
I1
I1'
I1 - I1'
rfp
I2 - I2'
I2'
I2
i1
i2'
i2
i1'

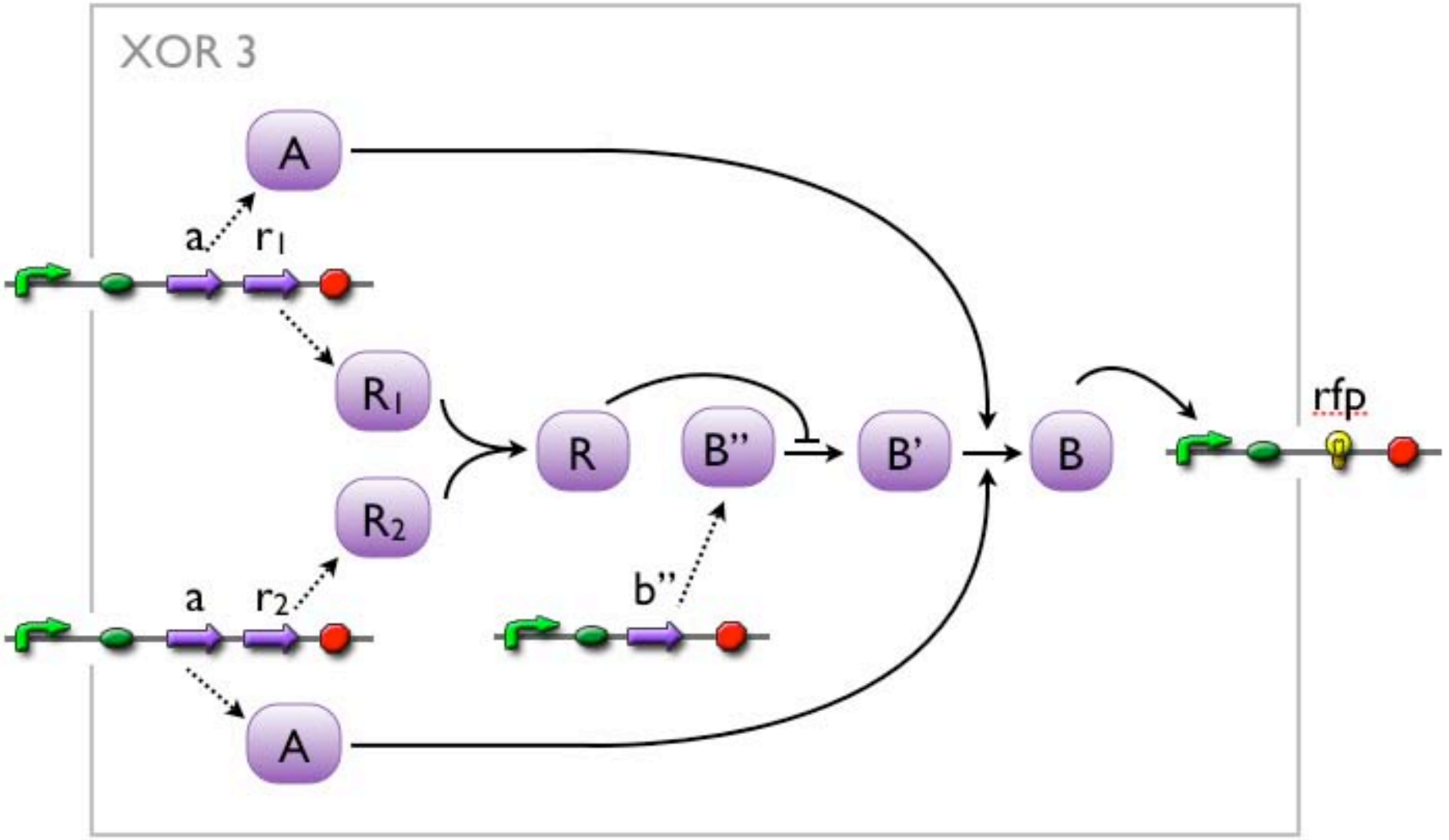
XOR – 1 (ODE's)



Question: Should $k_{I1I'1}$ and $k_{I2I'2}$ be modelled as reversible reactions?

$$
\begin{aligned}
d[I_1]/dt &= k_{A1}u_A - k_{I1I'1}[I_1][I'_1] - k_{I1,deg}[I_1] \\
d[I'_1]/dt &= k_{A2}u_A - k_{I1I'1}[I_1][I'_1] - k_{I'1,deg}[I'_1] \\
d[I_2]/dt &= k_{B1}u_B - k_{I2I'2}[I_2][I'_2] - k_{I2,deg}[I_2] \\
d[I'_2]/dt &= k_{B2}u_B - k_{I2I'2}[I_2][I'_2] - k_{I'2,deg}[I'_2] \\
d[I_1I'_1]/dt &= k_{I1I'1}[I_1][I'_1] \\
d[I_2I'_2]/dt &= k_{I2I'2}[I_2][I'_2] \\
d[Out]/dt &= k_{I1}(1 - \Theta^{m1}/([I_1]^{m1} - \Theta^{m1})) \\
&\quad + k_{I2}(1 - \Theta^{m2}/([I_2]^{m2} - \Theta^{m2})) \\
&\quad - k_{Out,deg}[Out]
\end{aligned}
$$


XOR 2
A
a
r1
R1
b'
B'
B
rfp
R2
b'
a
r2
A


XOR 3
A
a
r1
R1
R2
R
B''
B'
B
rfp
a
r2
b''
A