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### 1. EQUATIONS

$$\begin{aligned}
 \text{tRNA} \quad \dot{x}_1 &= k_t \frac{\left(\frac{OmpR-P}{K1}\right)^2}{\left(1+\frac{OmpR-P}{K1}\right)^2} - (\gamma_1 + k_a)x_1 + \gamma_{2p}x_2 + 2k_{7p}x_3 \left(\frac{\gamma_3}{k_{7m}}\right) \left(\frac{x_1}{\gamma_0+x_1}\right)^2 \\
 \text{Aa-tRNA} \quad \dot{x}_2 &= k_a x_1 - 2k_{7p}x_3 \left(\frac{\gamma_3}{k_{7m}}\right) \left(\frac{x_1}{\gamma_0+x_1}\right)^2 - \gamma_2 x_2 \\
 \text{T7RNAP}_{mRNA} \quad \dot{x}_3 &= k_{7m} \left(1 - \frac{\left(\frac{Y_{cgE}}{K3}\right)^2}{\left(1+\frac{Y_{cgE}}{K3}\right)^2}\right) - \gamma_3 x_3 \\
 \text{T7RNAP} \quad \dot{x}_4 &= k_{7p}x_3 \left(\frac{\gamma_3}{k_{7m}}\right) \left(\frac{x_1}{\gamma_0+x_1}\right)^2 - \gamma_4 x_4 \\
 \text{lacZ}_{mRNA} \quad \dot{x}_5 &= \alpha_M \left(1 - \frac{\left(\frac{x_4}{K5}\right)^2}{\left(1+\frac{x_4}{K5}\right)^2}\right) - \gamma_M x_5 \\
 \beta - \text{Galactosidase} \quad \dot{x}_6 &= \alpha_B x_5 - \gamma_B x_6 \\
 \text{dye} \quad \dot{x}_7 &= \alpha_A x_6
 \end{aligned}$$

### 2. PARAMETERS

Parameter	Value	Unit	Name	Source
$k_t$	$\frac{46.67}{60}$	$\frac{nM}{s}$	max transcription rate tRNA	[1]
$k_a$	$\frac{0.08}{60}$	$\frac{1}{s}$	synthesis rate Aa-tRNA	[1]
$k_{7p}$	$\frac{1.5625}{60}$	$\frac{nM}{s}$	max transcription rate T7RNAP	[1]
$k_{7m}$	$\frac{268*0.05}{60}$	$\frac{1}{s}$	max translation rate T7RNAP	[1]
$k_S$	0.3	$\frac{1}{nM}$	AND Gate rate	[1]
$\gamma_0$	1	-	threshold Aa-tRNA	guessed
$\gamma_1$	$\frac{1}{60*60}$	$\frac{1}{s}$	degradation of tRNA	[1]

Parameter	Value	Unit	Name	Source
$\gamma_2$	$\frac{1}{40*60}$	$\frac{1}{s}$	degradation of Aa-tRNA	[1]
$\gamma_3$	$\frac{1}{4.4*60}$	$\frac{1}{s}$	degradation of T7RNAP mRNA	[1]
$\gamma_4$	$\frac{46.67}{40*60}$	$\frac{1}{s}$	degradation of T7RNAP	[1]
$K1$	5	nM	response param. OmpR-P,tRNA	guessed
$K3$	600	nM	response param. YcgE,T7RNAP	guessed
$K5$	$\frac{k7p}{4*\gamma_4}$	nM	response param T7RNAP,lacZ	guessed
$\alpha_M$	$\frac{0.997}{60}$	$\frac{nM}{s}$	max transcription rate lacZ	[2]
$\alpha_B$	$\frac{1.661e-5}{60}$	$\frac{1}{s}$	max translation rate lacZ	[2]
$\alpha_A$	$\frac{20}{60}$	$\frac{1}{s}$	enzymatic reaction rate	[2]
$\gamma_M$	$\frac{0.411}{60}$	$\frac{1}{s}$	degradation lacZ mRNA	[2]
$\gamma_B$	$\frac{8.331e-4}{60}$	$\frac{1}{s}$	degradation $\beta$ -Galactosidase	[2]

### 3. INITIAL DATA

Name	Variable	Initial Value	Comment	Source
<i>tRNA</i>	$x_1$	0		
<i>Aa - tRNA</i>	$x_2$	0		
<i>T7RNAP<sub>mRNA</sub></i>	$x_3$	0		
<i>T7RNAP</i>	$x_4$	0		
<i>lacZ<sub>mRNA</sub></i>	$x_5$	0		
<i><math>\beta</math> - Galactosidase</i>	$x_6$	0		
<i>dye</i>	$x_7$	0		

### 4. SIMULATION

Since

## 5. ATTRIBUTION

The model for our AND-Gate is based on the model of the iGEM team PKU Beijing 2009 for their AND-Gate1. We modified the equations such that the change in tRNA and Aa-tRNA does not include the degradation of the mRNA which caused negativity of some concentrations in our model.[1]

The Expression of lacZ is an adaption of the model given by “Dynamics and bistability in a reduced model of the lac operon”[2]

## REFERENCES

1. PKU Beijing 2009, *And gate 1*, 2009.
2. N Yildirim, M Santillan, D Horike, and MC Mackey, *Dynamics and bistability in a reduced model of the lac operon*, *CHAOS* **14** (2004), no. 2, 279–292 (English).