Table S7. Detailed *lac* operon model. $g^?$ denotes a promoter wildcard that can be on (g^*) or off (g).

Reaction number	Reaction	Propensity
1	$\rightarrow \text{mRNA}_{lacY}\,(g^*_{lacY})$	$k_m g^*_{lacY}$
2	$\rightarrow \text{mRNA}_{lacZ}\,(g^*_{lacZ})$	$k_m g^*_{lacZ}$
3	$\rightarrow \text{mRNA}_{lacI}\,(g^*_{lacI})$	$k_{mI} g^*_{lacI}$
4	$\text{mRNA} \rightarrow \varnothing$	$k_{mdeg}\text{mRNA}$
5	$\rightarrow \text{LacY}\,(\text{mRNA}_{lacY})$	$k_{tsn}\text{mRNA}_{lacY}$
6	$\rightarrow \text{LacZ}\,(\text{mRNA}_{lacZ})$	$k_{tsn}\text{mRNA}_{lacZ}$
7	$\rightarrow \text{LacI}\,(\text{mRNA}_{lacI})$	$k_{tsn}\text{mRNA}_{lacI}$
8	$\text{LacY, Z, I, I}_2,\text{I}_4 \rightarrow \varnothing$	$k_{deg}\text{LacY, Z, I, I}_2,\text{I}_4$
9	$2\,\text{LacI} \rightarrow \text{LacI}_2$	$k_{lacI}\text{LacI}\,(\text{LacI}-1)$
10	$2\,\text{LacI}_2 \rightarrow \text{LacI}_4$	$k_{lacI}\text{LacI}_2\,(\text{LacI}_2-1)$
11	$\text{LacY} \rightleftharpoons \text{LacY.lac}_e$	$k_{bl}\text{LacY}, k_{dl}\text{LacY.lac}_e$
12	$\text{LacY.lac}_e \rightarrow \text{LacY} + \text{lac}$	$k_{perm}\text{LacY.lac}_e$
13	$\text{LacZ} + \text{lac} \rightleftharpoons \text{LacZ.lac}$	$k_{bp}\text{LacZ}, k_{dp}\text{LacZ.lac}$
14	$\text{LacZ.lac} \rightleftharpoons \text{LacZ} + \text{alac}$	$k_{dp2}\text{LacZ.lac}, k_{bp2}\text{LacZ} + \text{alac}$
15	$\text{LacZ.lac} \rightarrow \text{LacZ} + \text{p}$	$k_{cat}\text{LacZ.lac}$
16	$\text{LacI}_4 + 2\,\text{alac} \rightleftharpoons \text{LacI}_4.\text{alac}_2$	$k_{ba}\text{LacI}_4 \cdot \text{alac} \cdot (\text{alac}-1), k_{da}\text{LacI}_4.\text{alac}_2$
17	$\text{LacI}_4.\text{alac}_2 + 2\,\text{alac} \rightleftharpoons \text{LacI}_4.\text{alac}_4$	$k_{ba}\text{LacI}_4 \cdot \text{alac}_2 \cdot (\text{alac}_2-1), k_{da}\text{LacI}_4.\text{alac}_4$
18	$\text{LacY.lac}_e \rightarrow \varnothing$	$k_{deg}\,\text{LacY.lac}_e$
19	$\text{LacZ.lac} \rightarrow \varnothing$	$k_{deg}\,\text{LacZ.lac}$
20	$\text{LacI}_4.\text{alac}_2 \rightarrow \varnothing$	$k_{deg}\,\text{LacI}_4.\text{alac}_2$
21	$\text{LacI}_4.\text{alac}_4 \rightarrow \varnothing$	$k_{deg}\,\text{LacI}_4.\text{alac}_4$
22	$g_{lacY} \rightleftharpoons g^*_{lacY}$	$k_{gon}g_{lacY}, k_{goff}g^*_{lacY}$
23	$g_{lacZ} \rightleftharpoons g^*_{lacZ}$	$k_{gon}g_{lacZ}, k_{goff}g^*_{lacZ}$
24	$g_{lacI} \rightleftharpoons g^*_{lacI}$	$k_{gon}g_{lacI}, k_{goff}g^*_{lacI}$
25	$g^?_{lacY} + \text{LacI}_4 \rightleftharpoons g^?_{lacY}.\text{LacI}_4$	$k_b g^?_{lacY} \cdot \text{LacI}_4, k_d g^?_{lacY}\text{LacI}_4$
26	$g^?_{lacZ} + \text{LacI}_4 \rightleftharpoons g^?_{lacZ}.\text{LacI}_4$	$k_b g^?_{lacZ} \cdot \text{LacI}_4, k_d g^?_{lacZ}\text{LacI}_4$
27	$g^?_{lacY} + \text{LacI}_4.\text{alac}_2 \rightleftharpoons g^?_{lacY}.\text{LacI}_4.\text{alac}_2$	$k_{b2} g^?_{lacY} \cdot \text{LacI}_4.\text{alac}_2, k_{d2} g^?_{lacY}\text{LacI}_4.\text{alac}_2$
28	$g^?_{lacZ} + \text{LacI}_4.\text{alac}_2 \rightleftharpoons g^?_{lacZ}.\text{LacI}_4.\text{alac}_2$	$k_{b2} g^?_{lacZ} \cdot \text{LacI}_4.\text{alac}_2, k_{d2} g^?_{lacZ}\text{LacI}_4.\text{alac}_2$
29	$g_{lacY}.\text{LacI}_4 \rightleftharpoons g^*_{lacY}.\text{LacI}_4$	$k_{gon}g_{lacY}.\text{LacI}_4, k_{goff}g^*_{lacY}.\text{LacI}_4$
30	$g_{lacZ}.\text{LacI}_4 \rightleftharpoons g^*_{lacZ}.\text{LacI}_4$	$k_{gon}g_{lacZ}.\text{LacI}_4, k_{goff}g^*_{lacZ}.\text{LacI}_4$
31	$g_{lacY}.\text{LacI}_4.\text{alac}_2 \rightleftharpoons g^*_{lacY}.\text{LacI}_4.\text{alac}_2$	$k_{gon}g_{lacY}.\text{LacI}_4.\text{alac}_2, k_{goff}g^*_{lacY}.\text{LacI}_4.\text{alac}_2$
32	$g_{lacZ}.\text{LacI}_4.\text{alac}_2 \rightleftharpoons g^*_{lacZ}.\text{LacI}_4.\text{alac}_2$	$k_{gon}g_{lacZ}.\text{LacI}_4.\text{alac}_2, k_{goff}g^*_{lacZ}.\text{LacI}_4.\text{alac}_2$
33	$\text{p} \rightarrow \varnothing$	$k_u p$