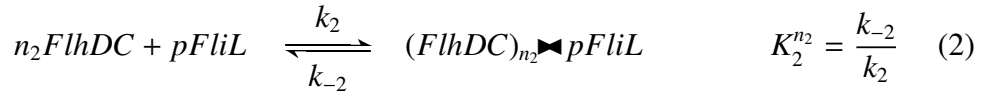
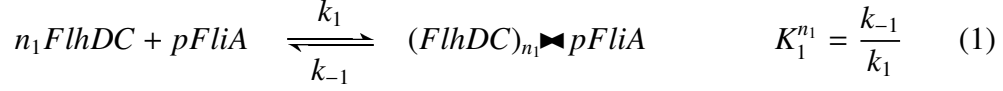


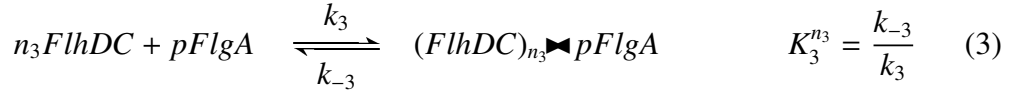
Characterization Approach :  
Equations for the  
*“Core System”*

# Complexations Reactions

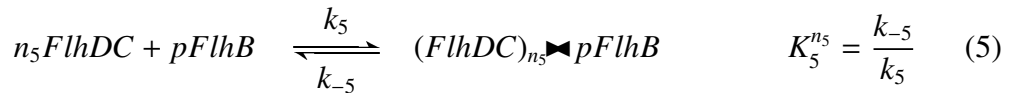
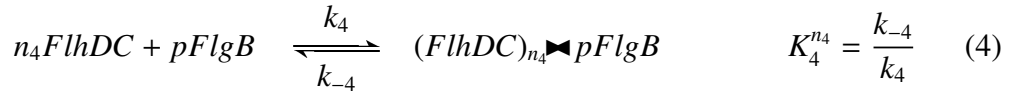
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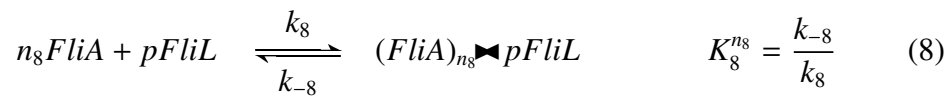
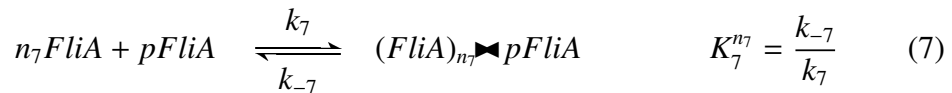
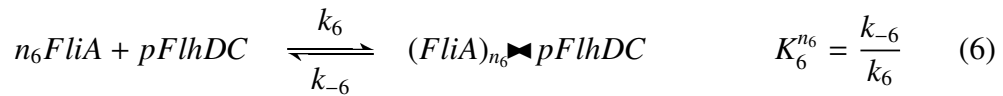
specific to pFlgA-circuit



specific to pFlgB-circuit

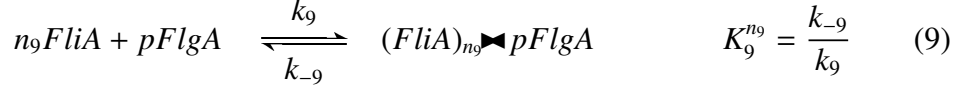


specific to pFlhDC-circuit

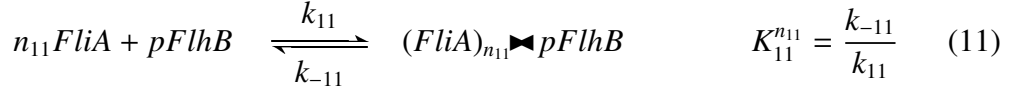
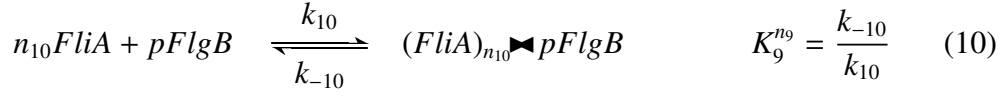


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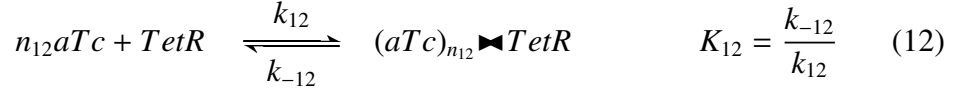
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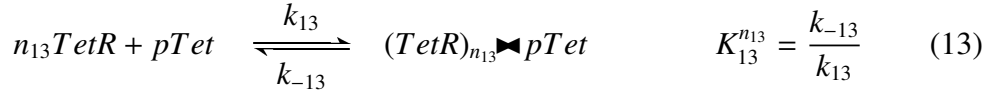
specific to pFlgB-circuit



specific to pTet-circuit



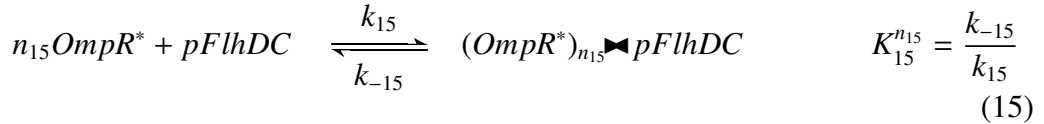
specific to pTet-circuit



specific to pFlhDC/EnvZ-circuit

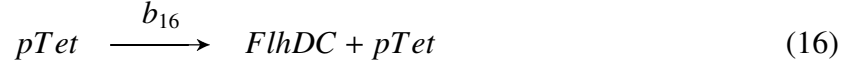


specific to pFlhDC-circuit

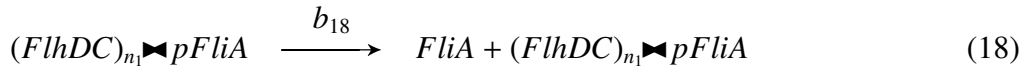
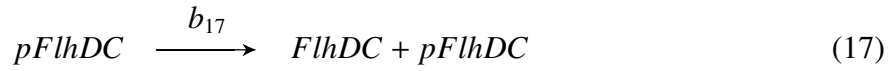


# Production Reactions

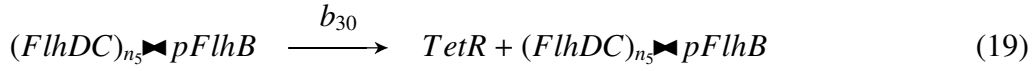
specific to pTet-circuit



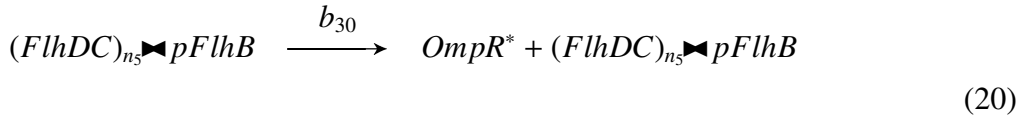
specific to pFlhDC-circuit



specific to pTet-circuit



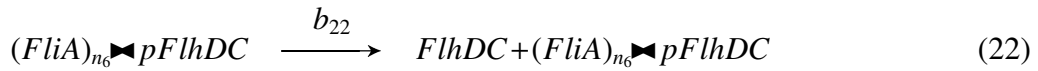
specific to pFlhDC/OmpR\*-circuit

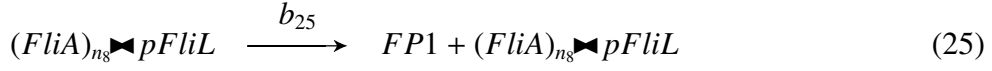
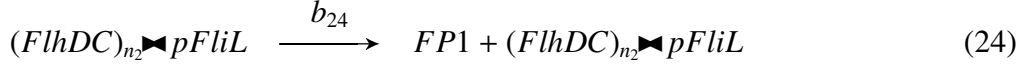
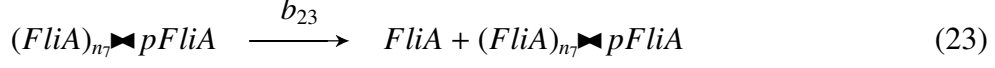


specific to pFlhDC/EnvZ-circuit

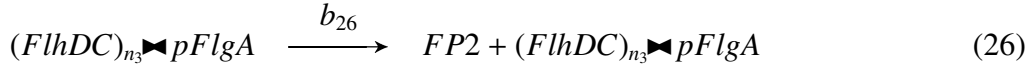


specific to pFlhDC-circuit

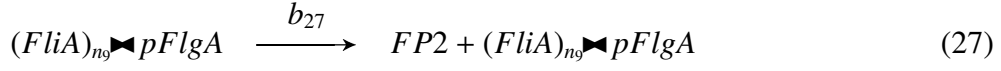




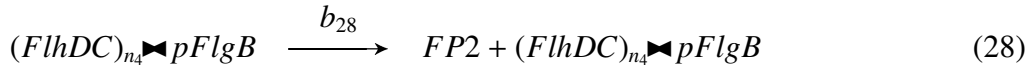
specific to pFlgA-circuit



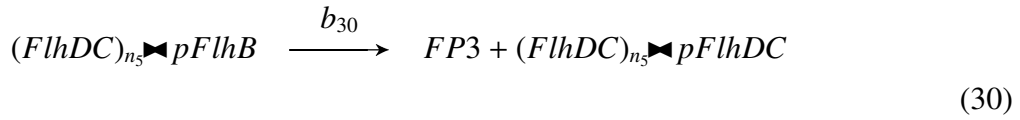
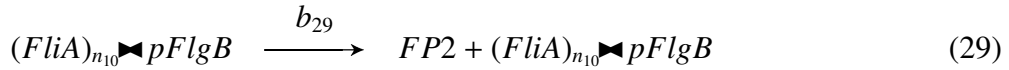
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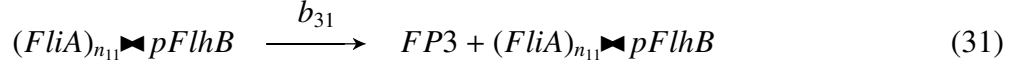


specific to pFlgB-circuit



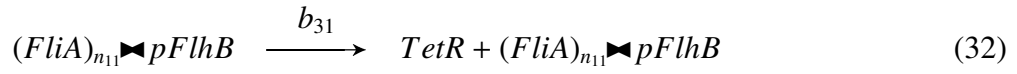
specific to pFlgB-circuit






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specific to pTet-circuit



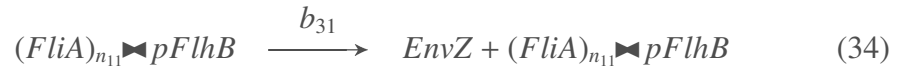

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specific to pFlhDC/OmpR\* -circuit




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specific to pFlhDC/EnvZ-circuit



# Degradation/Dilution Reactions

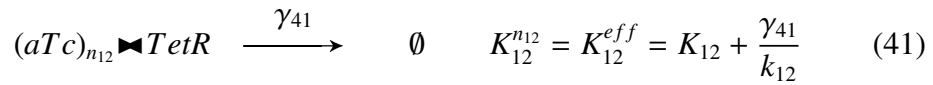
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specific to pTet-circuit



specific to pTet-circuit



specific to pFlhDC/EnvZ-circuit



specific to pFlhDC-circuit



## Equations due to Complexations, according to our Model

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$$(1) \Rightarrow [(FlhDC)_{n_1} \blacktriangleright pFliA]_{eq} = \frac{[FlhDC]^{n_1}}{K_1^{n_1} + [FlhDC]^{n_1}} \cdot [pFliA^{total}] \quad (44)$$


---

$$(7) \Rightarrow [(FliA)_{n_7} \blacktriangleright pFliA]_{eq} = \frac{[FliA]^{n_7}}{K_7^{n_7} + [FliA]^{n_7}} \cdot [pFliA^{total}] \quad (45)$$


---

$$(2) \Rightarrow [(FlhDC)_{n_2} \blacktriangleright pFliL]_{eq} = \frac{[FlhDC]^{n_2}}{K_2^{n_2} + [FlhDC]^{n_2}} \cdot [pFliL^{total}] \quad (46)$$


---

$$(8) \Rightarrow [(FliA)_{n_8} \blacktriangleright pFliL]_{eq} = \frac{[FliA]^{n_8}}{K_8^{n_8} + [FliA]^{n_8}} \cdot [pFliL^{total}] \quad (47)$$


---

specific to pFlgA-circuit

$$(3) \Rightarrow [(FlhDC)_{n_3} \blacktriangleright pFlgA]_{eq} = \frac{[FlhDC]^{n_3}}{K_3^{n_3} + [FlhDC]^{n_3}} \cdot [pFlgA^{total}] \quad (48)$$


---

specific to pFlgA-circuit

$$(9) \Rightarrow [(FliA)_{n_9} \blacktriangleright pFlgA]_{eq} = \frac{[FliA]^{n_9}}{K_9^{n_9} + [FliA]^{n_9}} \cdot [pFlgA^{total}] \quad (49)$$


---

specific to pFlgB-circuit

$$(4) \Rightarrow [(FlhDC)_{n_4} \blacktriangleright pFlgB]_{eq} = \frac{[FlhDC]^{n_4}}{K_4^{n_4} + [FlhDC]^{n_4}} \cdot [pFlgB^{total}] \quad (50)$$


---



specific to pFlgB-circuit

$$(10) \Rightarrow [(FliA)_{n_{10}} \blacktriangleright pFlgB]_{eq} = \frac{[FliA]^{n_{10}}}{K_{10}^{n_{10}} + [FliA]^{n_{10}}} \cdot [pFlgB^{total}] \quad (51)$$


---

$$(5) \Rightarrow [(FlhDC)_{n_5} \blacktriangleright pFlhB]_{eq} = \frac{[FlhDC]^{n_5}}{K_5^{n_5} + [FlhDC]^{n_5}} \cdot [pFlhB^{total}] \quad (52)$$


---

$$(11) \Rightarrow [(FliA)_{n_{11}} \blacktriangleright pFlhB]_{eq} = \frac{[FliA]^{n_{11}}}{K_{11}^{n_{11}} + [FliA]^{n_{11}}} \cdot [pFlhB^{total}] \quad (53)$$


---

specific to pFlhDC-circuit

$$(6) \Rightarrow [(FliA)_{n_6} \blacktriangleright pFlhDC]_{eq} = \frac{[FliA]^{n_6}}{K_6^{n_6} + [FliA]^{n_6}} \cdot [pFlhDC^{total}] \quad (54)$$


---

specific to pTet-circuit

$$(12) \Rightarrow [TetR^{free}] = \frac{K_{12}^{n_{aTc}}}{K_{12}^{n_{aTc}} + [aTc]_i^{n_{aTc}}} \cdot [TetR^{total}] \quad (55)$$


---

specific to pTet-circuit

$$(13) \Rightarrow [pTet]_{eq} = \frac{K_{13}^{n_{13}}}{K_{13}^{n_{13}} + [TetR^{free}]^{n_{13}}} \cdot [pTet^{total}] \quad (56)$$


---

specific to pFlhDC/EnvZ-circuit

$$(14) \Rightarrow \begin{cases} ([EnvZ^{total}] - n_{14} OmpR_{eq}^*)^{n_{14}} ([OmpR^{total}] - OmpR_{eq}^*) - K_{14}^{eff} OmpR_{eq}^* = 0 \\ 0 < n_{14} OmpR_{eq}^* \quad ; \quad 0 < OmpR_{eq}^* < [OmpR^{total}] \end{cases} \quad (57)$$


---

specific to pFlhDC-circuit

$$(15) \Rightarrow [pFlhDC]_{eq} = \frac{K_{15}^{n_{15}}}{K_{15}^{n_{15}} + [OmpR^*]^{n_{15}}} \cdot [pFlhDC^{total}] \quad (58)$$

# Resulting Temporal ODEs with the needed parameters

specific to pTet-circuit

$$(16) \Rightarrow \frac{d[FlhDC]}{dt} = b_{16}[pTet]_{eq} - \gamma_{35}[FlhDC] \quad (59a)$$

$$(55) \Rightarrow \frac{d[FlhDC]}{dt} = \beta_{16} \cdot \frac{K_{13}^{n_{13}}}{K_{13}^{n_{13}} + \left( \frac{K_{12}^{n_{atc}}}{K_{12}^{n_{atc}} + [atc]_i^{n_{atc}}} \cdot [TetR] \right)^{n_{13}}} - \gamma_{35}[FlhDC] \quad (59)$$

specific to pFlhDC-circuit

$$(17) \Rightarrow \frac{d[FlhDC]}{dt} = b_{17}[pFlhDC^{free}]_{eq} + b_{22}[(FliA)_{n_6} \blacktriangleright pFlhDC]_{eq} - \gamma_{35}[FlhDC] \quad (60a)$$

$$(54) \Rightarrow \frac{d[FlhDC]}{dt} = \frac{K_{15}^{n_{15}}}{K_{15}^{n_{15}} + [OmpR^*]^{n_{15}}} \left( \beta_{17} \cdot \frac{K_6^{n_6}}{K_6^{n_6} + [FliA]^{n_6}} + \beta_{22} \cdot \frac{[FliA]^{n_6}}{K_6^{n_6} + [FliA]^{n_6}} \right) - \gamma_{35}[FlhDC] \quad (60)$$

$$(18) \Rightarrow \frac{d[FliA]}{dt} = b_{18}[(FlhDC)_{n_1} \blacktriangleright pFliA]_{eq} + b_{23}[(FliA)_{n_7} \blacktriangleright pFliA]_{eq} - \gamma_{36}[FliA] \quad (61a)$$

$$(44) \Rightarrow \frac{d[FliA]}{dt} = \beta_{18} \cdot \frac{[FlhDC]^{n_1}}{K_1^{n_1} + [FlhDC]^{n_1}} + \beta_{23} \cdot \frac{[FliA]^{n_7}}{K_7^{n_7} + [FliA]^{n_7}} - \gamma_{36}[FliA] \quad (61)$$

$$(24) \Rightarrow \frac{d[FP1]}{dt} = b_{24}[(FlhDC)_{n_2} \blacktriangleright pFliL]_{eq} + b_{25}[(FliA)_{n_8} \blacktriangleright pFliL]_{eq} - \gamma_{37}[FP1] \quad (62a)$$

$$(46) \Rightarrow \frac{d[FP1]}{dt} = \beta_{24} \cdot \frac{[FlhDC]^{n_2}}{K_2^{n_2} + [FlhDC]^{n_2}} + \beta_{25} \cdot \frac{[FliA]^{n_8}}{K_8^{n_8} + [FliA]^{n_8}} - \gamma_{37}[FP1] \quad (62)$$

specific to pFlgA-circuit

$$(26) \Rightarrow \frac{d[FP2]}{dt} = b_{26}[(FlhDC)_{n_3} \blacktriangleright pFlgA]_{eq} + b_{27}[(FliA)_{n_9} \blacktriangleright pFlgA]_{eq} - \gamma_{38}[FP2] \quad (63a)$$

$$(48) \Rightarrow \frac{d[FP2]}{dt} = \beta_{26} \cdot \frac{[FlhDC]^{n_3}}{K_3^{n_3} + [FlhDC]^{n_3}} + \beta_{27} \cdot \frac{[FliA]^{n_9}}{K_9^{n_9} + [FliA]^{n_9}} - \gamma_{38}[FP2] \quad (63)$$

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$$(28) \Rightarrow \frac{d[FP2]}{dt} = b_{28}[(FlhDC)_{n_4} \blacktriangleright pFlgB]_{eq} + b_{29}[(FliA)_{n_{10}} \blacktriangleright pFlgB]_{eq} - \gamma_{38}[FP2] \quad (64a)$$

$$(50) \Rightarrow \frac{d[FP2]}{dt} = \beta_{28} \cdot \frac{[FlhDC]^{n_4}}{K_4^{n_4} + [FlhDC]^{n_4}} + \beta_{29} \cdot \frac{[FliA]^{n_{10}}}{K_{10}^{n_{10}} + [FliA]^{n_{10}}} - \gamma_{38}[FP2] \quad (64)$$

---


$$(30) \Rightarrow \frac{d[FP3]}{dt} = b_{30}[(FlhDC)_{n_5} \blacktriangleright pFlhB]_{eq} + b_{31}[(FliA)_{n_{11}} \blacktriangleright pFlhB]_{eq} - \gamma_{39}[FP3] \quad (65a)$$

$$(52) \Rightarrow \frac{d[FP3]}{dt} = \beta_{30} \cdot \frac{[FlhDC]^{n_5}}{K_5^{n_5} + [FlhDC]^{n_5}} + \beta_{31} \cdot \frac{[FliA]^{n_{11}}}{K_{11}^{n_{11}} + [FliA]^{n_{11}}} - \gamma_{39}[FP3] \quad (65)$$

specific to pTet-circuit

$$(19) \Rightarrow \frac{d[TetR]}{dt} = b_{30}[(FlhDC)_{n_5} \blacktriangleright pFlhB]_{eq} + b_{31}[(FliA)_{n_{11}} \blacktriangleright pFlhB]_{eq} - \gamma_{40}[TetR] \quad (66a)$$

$$(52) \Rightarrow \frac{d[TetR]}{dt} = \beta_{30} \cdot \frac{[FlhDC]^{n_5}}{K_5^{n_5} + [FlhDC]^{n_5}} + \beta_{31} \cdot \frac{[FliA]^{n_{11}}}{K_{11}^{n_{11}} + [FliA]^{n_{11}}} - \gamma_{40}[TetR] \quad (66)$$

eqn.(55) gives then  $[TetR^{free}]$  in function of  $[TetR^{total}] := [TetR]$

specific to pFlhDC/EnvZ-circuit

$$(21) \Rightarrow \frac{d[EnvZ]}{dt} = b_{30}[(FlhDC)_{n_5} \blacktriangleright pFlhB]_{eq} + b_{31}[(FliA)_{n_{11}} \blacktriangleright pFlhB]_{eq} - \gamma_{42}[EnvZ] \quad (67a)$$

$$(52) \Rightarrow \frac{d[EnvZ]}{dt} = \beta_{30} \cdot \frac{[FlhDC]^{n_5}}{K_5^{n_5} + [FlhDC]^{n_5}} + \beta_{31} \cdot \frac{[FliA]^{n_{11}}}{K_{11}^{n_{11}} + [FliA]^{n_{11}}} - \gamma_{42}[EnvZ]$$

$$(53) \Rightarrow \frac{d[EnvZ]}{dt} = \beta_{30} \cdot \frac{[FlhDC]^{n_5}}{K_5^{n_5} + [FlhDC]^{n_5}} + \beta_{31} \cdot \frac{[FliA]^{n_{11}}}{K_{11}^{n_{11}} + [FliA]^{n_{11}}} - \gamma_{42}[EnvZ] \quad (67b)$$

$$[EnvZ^{total}] = [EnvZ_b] + [EnvZ] \quad (67)$$

Solve then eqn.(57) to get  $[OmpR^*]$  in function of  $[OmpR^{total}] := [OmpR_b]$

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specific to pFlhDC/OmpR\*-circuit

$$(20) \Rightarrow \frac{d[OmpR^*]}{dt} = b_{30}[(FlhDC)_{n_5} \blacktriangleright pFlhB]_{eq} + b_{31}[(FliA)_{n_{11}} \blacktriangleright pFlhB]_{eq} - \gamma_{43}[OmpR^*]$$

$$(33) \Rightarrow \frac{d[OmpR^*]}{dt} = b_{30}[(FlhDC)_{n_5} \blacktriangleright pFlhB]_{eq} + b_{31}[(FliA)_{n_{11}} \blacktriangleright pFlhB]_{eq} - \gamma_{43}[OmpR^*] \quad (68a)$$

$$(43) \Rightarrow \frac{d[OmpR^*]}{dt} = b_{30}[(FlhDC)_{n_5} \blacktriangleright pFlhB]_{eq} + b_{31}[(FliA)_{n_{11}} \blacktriangleright pFlhB]_{eq} - \gamma_{43}[OmpR^*]$$

$$(52) \Rightarrow \frac{d[OmpR^*]}{dt} = \beta_{30} \cdot \frac{[FlhDC]^{n_5}}{K_5^{n_5} + [FlhDC]^{n_5}} + \beta_{31} \cdot \frac{[FliA]^{n_{11}}}{K_{11}^{n_{11}} + [FliA]^{n_{11}}} - \gamma_{43}[OmpR^*]$$

$$(53) \Rightarrow \frac{d[OmpR^*]}{dt} = \beta_{30} \cdot \frac{[FlhDC]^{n_5}}{K_5^{n_5} + [FlhDC]^{n_5}} + \beta_{31} \cdot \frac{[FliA]^{n_{11}}}{K_{11}^{n_{11}} + [FliA]^{n_{11}}} - \gamma_{43}[OmpR^*] \quad (68)$$


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