Appendix 1 (See website: http://www.bme.jhu.edu/ jafri/models/models.html) Cardiac Ca^{2+} Dynamics: The Roles of Ryanodine Receptor Adaptation and Sarcoplasmic Reticulum Load

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Model Equations

Ca^{2+} Subsystem

$$J_{rel} = v_1(P_{O_1} + P_{O_2})([Ca^{2+}]_{JSR} - [Ca^{2+}]_{ss}), \tag{1}$$

$$J_{leak} = v_2([Ca^{2+}]_{NSR} - [Ca^{2+}]_i), \tag{2}$$

$$J_{up} = v_3 \frac{[Ca^{2+}]_i^2}{K_{m,up}^2 + [Ca^{2+}]_i^2}, \tag{3}$$

$$J_{tr} = \frac{[Ca^{2+}]_{NSR} - [Ca^{2+}]_{JSR}}{\tau_{tr}}, \tag{4}$$

$$J_{xfer} = \frac{[Ca^{2+}]_{ss} - [Ca^{2+}]_i}{\tau_{xfer}}, \tag{5}$$

$$\begin{aligned} J_{trpn} &= k^+_{htrpn}[Ca^{2+}]_i([HTRPN]_{tot} - [HTRPNCa]) - k^-_{htrpn}[HTRPNCa] \\ &+ k^+_{ltrpn}[Ca^{2+}]_i([LTRPN]_{tot} - [LTRPNCa]) - k^-_{ltrpn}[LTRPNCa], \end{aligned} \tag{6}$$

$$B_i = \left\{1 + \frac{[CMDN]_{tot}K_m^{CMDN}}{(K_m^{CMDN} + [Ca^{2+}]_i)^2}\right\}^{-1}, \tag{7}$$

$$B_{ss} = \left\{1 + \frac{[CMDN]_{tot}K_m^{CMDN}}{(K_m^{CMDN} + [Ca^{2+}]_{ss})^2}\right\}^{-1}, \tag{8}$$

$$B_{JSR} = \left\{1 + \frac{[CSQN]_{tot}K_m^{CSQN}}{(K_m^{CSQN} + [Ca^{2+}]_{JSR})^2}\right\}^{-1}. \tag{9}$$

$$\frac{d[Ca^{2+}]_i}{dt} = B_i\Big\{J_{leak} + J_{xfer} - J_{up} - J_{trpn} - (I_{Ca,b} - 2I_{NaCa} + I_{p(Ca)})\frac{A_{cap}}{2V_{myo}F}\Big\}, \tag{10}$$

$$\frac{d[Ca^{2+}]_{ss}}{dt} = B_{ss}\Big\{J_{rel}\frac{V_{JSR}}{V_{ss}} - J_{xfer}\frac{V_{myo}}{V_{ss}} - (I_{Ca})\frac{A_{cap}}{2V_{ss}F}\Big\}. \tag{11}$$

$$\frac{d[Ca^{2+}]_{JSR}}{dt} = B_{JSR}\Big\{J_{tr} - J_{rel}\Big\}, \tag{12}$$

$$\frac{d[Ca^{2+}]_{NSR}}{dt} = \Big\{J_{up} - J_{leak}\Big\}\frac{V_{myo}}{V_{NSR}} - J_{tr}\frac{V_{JSR}}{V_{NSR}}. \tag{13}$$

L-type Ca^{2+} channel

$$\alpha = 0.4e^{(V+12)/10} \tag{14}$$

$$\beta = 0.05e^{-(V+12)/13} \tag{15}$$

$$\alpha' = \alpha a \tag{16}$$

$$\beta' = \frac{\beta}{b} \tag{17}$$

$$\gamma = 0.1875[Ca^{2+}]_{ss}, \tag{18}$$

$$\frac{dC_0}{dt} = \beta C_1 + \omega C_{Ca0} - (4\alpha + \gamma)C_0 \tag{19}$$

$$\frac{dC_1}{dt} = 4\alpha C_0 + 2\beta C_2 + \frac{\omega}{b}C_{Ca1} - (\beta + 3\alpha + \gamma a)C_1 \tag{20}$$

$$\frac{dC_2}{dt} = 3\alpha C_1 + 3\beta C_3 + \frac{\omega}{b^2}C_{Ca2} - (2\beta + 2\alpha + \gamma a^2)C_2 \tag{21}$$

$$\frac{dC_3}{dt} = 2\alpha C_2 + 4\beta C_4 + \frac{\omega}{b^3}C_{Ca3} - (3\beta + \alpha + \gamma a^3)C_3 \tag{22}$$

$$\frac{dC_4}{dt} = \alpha C_3 + gO + \frac{\omega}{b^4}C_{Ca4} - (4\beta + f + \gamma a^4)C_4 \tag{23}$$

$$\frac{dO}{dt} = fC_4 - gO \tag{24}$$

$$\frac{dC_{Ca0}}{dt} = \beta' C_{Ca1} + \gamma C_0 - (4\alpha' + \omega)C_{Ca0} \tag{25}$$

$$\frac{dC_{Ca1}}{dt} = 4\alpha' C_{Ca0} + 2\beta' C_{Ca2} + \gamma a C_1 - (\beta' + 3\alpha' + \frac{\omega}{b})C_{Ca1} \tag{26}$$

$$\frac{dC_{Ca2}}{dt} = 3\alpha' C_{Ca1} + 3\beta' C_{Ca3} + \gamma a^2 C_2 - (2\beta' + 2\alpha' + \frac{\omega}{b^2})C_{Ca2} \tag{27}$$

$$\frac{dC_{Ca3}}{dt} = 2\alpha' C_{Ca2} + 4\beta' C_{Ca4} + \gamma a^3 C_3 - (3\beta' + \alpha' + \frac{\omega}{b^3})C_{Ca3} \tag{28}$$

$$\frac{dC_{Ca4}}{dt} = \alpha' C_{Ca_3} + g' O_{Ca} + \gamma a^4 C_4 - (4\beta' + f' + \frac{\omega}{b^4})C_{Ca4} \tag{29}$$

$$\frac{dO_{Ca}}{dt} = f' C_{Ca4} - g' O_{Ca}. \tag{30}$$

$$\frac{dy}{dt} = \frac{y_\infty - y}{\tau_y}, \tag{31}$$

$$y_\infty = \frac{1}{1 + e^{(V+55)/7.5}} + \frac{0.1}{1 + e^{(-V+21)/6}}, \tag{32}$$

$$\tau_y = 20 + \frac{600}{1 + e^{(V+30)/9.5}}. \tag{33}$$

$$P_{K'} = \frac{\overline{P}_K}{1 + \frac{I_{Ca_{max}}}{I_{Ca_{half}}}}, \tag{34}$$

$$I_{Ca_{max}} = \overline{P}_{Ca} 4 \frac{VF^2}{RT} \frac{0.001 e^{2VF/RT} - 0.341[Ca]_o}{e^{2VF/RT} - 1}, \tag{35}$$

$$I_{Ca} = y\{O + O_{Ca}\} I_{Ca_{max}}, \tag{36}$$

$$I_{Ca,K} = P'_K y\{O + O_{Ca}\} \frac{VF^2}{RT} \frac{[K^+]_i e^{VF/RT} - [K^+]_o}{e^{VF/RT} - 1}. \tag{37}$$

1 Ionic Currents (Luo and Rudy)

1.1 Differential Equations

$$\begin{aligned}
\frac{dV}{dt} &= \frac{-1}{C_m}(I_{Na} + I_{Ca} + I_K + I_{K_1} + I_{Kp} + I_{NaCa} + I_{NaK} + I_{ns(Ca)} + I_{p(Ca)} && (38)\\
&+ I_{Ca,K} + I_{Ca,b} + I_{Na,b}) \\
\frac{dm}{dt} &= \alpha_m(1-m) - \beta_m m && (39)\\
\frac{dh}{dt} &= \alpha_h(1-h) - \beta_h h && (40)\\
\frac{dj}{dt} &= \alpha_j(1-j) - \beta_j j && (41)\\
\frac{dx}{dt} &= \alpha_x(1-x) - \beta_x x && (42)\\
\frac{d[Na^+]_i}{dt} &= -(I_{Na} + I_{Na,b} + I_{ns,Na} + 3I_{NaCa} + 3I_{NaK})\frac{A_{cap}}{V_{myo}F} && (43)\\
\frac{d[K^+]_i}{dt} &= -(I_K + I_{K_1} + I_{Kp} + I_{ns,K} - 2I_{NaK} + I_{Ca,K})\frac{A_{cap}}{V_{myo}F} && (44)\\
\frac{d[HTRPNCa]}{dt} &= k^+_{htrpn}[Ca^{2+}]_i([HTRPN]_{tot} - [HTRPNCa]) - k^-_{htrpn}[HTRPNCa] && (45)\\
\frac{d[LTRPNCa]}{dt} &= k^+_{ltrpn}[Ca^{2+}]_i([LTRPN]_{tot} - [LTRPNCa]) - k^-_{ltrpn}[LTRPNCa] && (46)
\end{aligned}$$

1.2 Fast Na^+ current

$$
\begin{aligned}
I_{Na} &= \overline{G}_{Na} m^3 hj(V - E_{Na}) && (47)\\
E_{Na} &= \frac{RT}{F} ln\Big(\frac{[Na^+]_o}{[Na^+]_i}\Big) && (48)\\
\alpha_m &= 0.32\frac{V + 47.13}{1 - e^{-0.1(V+47.13)}} && (49)\\
\beta_m &= 0.08e^{\frac{-V}{11}} && (50)
\end{aligned}
$$

For $v \geq -40\ mV$,

$$
\begin{aligned}
\alpha_h &= 0.0 && (51)\\
\alpha_j &= 0.0 && (52)\\
\beta_h &= \frac{1}{0.13(1 + e^{(V+10.66)/-11.1})} && (53)\\
\beta_j &= 0.3\frac{e^{-2.535\times10^{-7}V}}{1 + e^{-0.1(V+32)}} && (54)
\end{aligned}
$$

For $v < -40\ mV$,

$$
\begin{aligned}
\alpha_h &= 0.135e^{(80+V)/-6.8} && (55)\\
\alpha_j &= \Big(-127140e^{0.2444V} - 3.474 \times 10^{-5}e^{-0.04391V}\Big)\frac{V + 37.78}{1 + e^{0.311(V+79.23)}} && (56)\\
\beta_h &= 3.56e^{0.079V} + 3.1 \times 10^5 e^{0.35V} && (57)\\
\beta_j &= 0.1212\frac{e^{-0.01052V}}{1 + e^{-0.1378(V+40.14)}} && (58)
\end{aligned}
$$

1.3 Time-dependent K^+ current I_K

$$
\begin{aligned}
I_K &= \overline{G}_K X_i x^2 (V - E_K) && (59)\\
E_K &= \frac{RT}{F} ln\Big(\frac{[K^+]_o + P_{Na,K}[Na^+]_o}{[K^+]_i + P_{Na,K}[Na^+]_i}\Big) && (60)\\
\overline{G}_K &= 0.1128\sqrt{\frac{[K^+]_o}{5.4}} && (61)\\
X_i &= \frac{1}{1 + e^{(V-56.26)/32.1}} && (62)\\
\alpha_X &= 7.19 \times 10^{-5}\frac{V + 30}{1 - e^{-0.148(V+30)}} && (63)\\
\beta_X &= 1.31 \times 10^{-4}\frac{V + 30}{-1 + e^{0.0687(V+30)}} && (64)
\end{aligned}
$$

1.4 Time-independent K^+ current I_{K_1}

$$
I_{K_1} = \overline{G}_{K_1} K_{1_\infty}(V - E_{K_1}) \quad (65)
$$

$$E_{K_1} = \frac{RT}{F} ln\left(\frac{[K^+]_o}{[K^+]_i}\right) \quad (66)$$

$$\overline{G}_{K_1} = 0.75\sqrt{\frac{[K^+]_o}{5.4}} \quad (67)$$

$$K_{1_\infty} = \frac{\alpha_{K_1}}{\alpha_{K_1} + \beta_{K_1}} \quad (68)$$

$$\alpha_{K_1} = \frac{1.02}{1 + e^{0.2385(V - E_{K_1} - 59.215)}} \quad (69)$$

$$\beta_{K_1} = \frac{0.4912e^{0.08032(V - E_{K_1} + 5.476)} + e^{0.06175(V - E_{K_1} - 594.31)}}{1 + e^{-0.5143(V - E_{K_1} + 4.753)}} \quad (70)$$

1.5 Plateau K^+ current I_{Kp}

$$I_{Kp} = \overline{G}_{Kp} K_p (V - E_{Kp}) \quad (71)$$

$$E_{Kp} = E_{K_1} \quad (72)$$

$$K_p = \frac{1}{1 + e^{(7.488 - V)/5.98}} \quad (73)$$

1.6 Na^{2+}-Ca^{2+} exchanger current I_{NaCa}

$$I_{NaCa} = k_{NaCa} \frac{1}{K^3_{m,Na} + [Na^+]^3_o} \frac{1}{K_{m,Ca} + [Ca^{2+}]_o} \frac{1}{1 + k_{sat} e^{(\eta - 1)VF/RT}} \left(e^{\eta VF/RT} \cdot [Na^+]^3_i [Ca^{2+}]_o - e^{(\eta - 1)VF/RT} [Na^+]^3_o [Ca^{2+}]_i\right) \quad (74)$$

1.7 Na^{2+}-K^+ pump

$$I_{NaK} = \overline{I}_{NaK} f_{NaK} \frac{1}{1 + (\frac{K_{m,Nai}}{[Na^+]_i})^{1.5}} \frac{[K^+]_o}{[K^+]_o + K_{m,Ko}} \quad (75)$$

$$f_{NaK} = \frac{1}{1 + 0.1245e^{-0.1VF/RT} + 0.0365\sigma e^{-VF/RT}} \quad (76)$$

$$\sigma = \frac{1}{7}\left(e^{\frac{[Na^+]_o}{67.3}} - 1\right) \quad (77)$$

1.8 Nonspecific Ca^{2+}-activated current $I_{ns(Ca)}$

$$I_{ns(Ca)} = I_{ns,Na} + I_{ns,K} \quad (78)$$

$$I_{ns,Na} = \overline{I}_{ns,Na} \frac{1}{1 + \left(\frac{K_{m,ns(Ca)}}{[Ca^{2+}]_i}\right)^3} \quad (79)$$

$$\overline{I}_{ns,Na} = P_{ns(Ca)} \frac{VF^2}{RT} \frac{0.75[Na^+]_i e^{VF/(RT)} - 0.75[Na^+]_o}{e^{VF/(RT)} - 1} \quad (80)$$

$$I_{ns,K} = \overline{I}_{ns,K} \frac{1}{1 + \left(\frac{K_{m,ns(Ca)}}{[Ca_{2+}]_i}\right)^3} \quad (81)$$

$$\overline{I}_{ns,K} = P_{ns(Ca)} \frac{VF^2}{RT} \frac{0.75[K^+]_i e^{VF/(RT)} - 0.75[K^+]_o}{e^{VF/(RT)} - 1} \quad (82)$$

1.9 Sarcolemmal Ca^{2+} pump current $I_{p(Ca)}$

$$I_{p(Ca)} = \overline{I}_{p(Ca)} \frac{[Ca^{2+}]_i}{K_{m,p(Ca)} + [Ca^{2+}]_i} \quad (83)$$

1.10 Ca^{2+} background current $I_{Ca,b}$

$$I_{Ca,b} = \overline{G}_{Ca,b}(V - E_{Ca,N}) \quad (84)$$

$$E_{Ca,N} = \frac{RT}{2F} ln\left(\frac{[Ca^{2+}]_o}{[Ca^{2+}]_i}\right) \quad (85)$$

1.11 Na^+ background current $I_{Na,b}$

$$I_{Na,b} = \overline{G}_{Na,b}(V - E_{Na,N}) \quad (86)$$

$$E_{Na,N} = E_{Na} \quad (87)$$

2 RyR Channel States (Keizer and Levine)

$$\frac{dP_{C_1}}{dt} = -k_a^+ [Ca^{2+}]_{SS}^n P_{C_1} + k_a^- P_{O_1} \quad (88)$$

$$\frac{dP_{O_1}}{dt} = k_a^+ [Ca^{2+}]_{SS}^n P_{C_1} - k_a^- P_{O_1} - k_b^+ [Ca^{2+}]_{SS}^m P_{O_1} + k_b^- P_{O_2} - k_c^+ P_{O_1} + k_c^- P_{C_2} \quad (89)$$

$$\frac{dP_{O_2}}{dt} = k_b^+ [Ca^{2+}]_{SS}^m P_{O_1} - k_b^- P_{O_2} \quad (90)$$

$$\frac{dP_{C_2}}{dt} = k_c^+ P_{O_1} - k_c^- P_{C_2} \quad (91)$$

3 Tables

3.1 Table 1 - Cell Geometry Parameters

Parameter	Definition	Value
A_{cap}	capacative membrane area	$1.534 \times 10^{-4}\ cm^2$
V_{myo}	myoplasmic volume	$25.84 \times 10^{-6}\ \mu L$
V_{JSR}	junctional SR volume	$0.12 \times 10^{-6}\ \mu L$
V_{NSR}	network SR volume	$2.098 \times 10^{-6}\ \mu L$
V_{SS}	subspace volume	$1.485 \times 10^{-9}\ \mu L$

3.2 Table 2 - Standard Ionic Concentrations

Parameter	Definition	Value
$[K^+]_o$	extracellular K^+concentration	5.4 mM
$[Na^+]_o$	extracellular Na^{2+} concentration	140.0 mM
$[Ca^{2+}]_o$	extracellular Ca^{2+} concentration	1.8 mM

3.3 Table 3 - SR Parameters

Parameter	Definition	Value
v_1	maximum RyR channel Ca^{2+} permeability	1.8 ms^{-1}
v_2	Ca^{2+} leak rate constant from the NSR	5.80×10^{-5} ms^{-1}
v_3	SR Ca^{2+}-ATPase maximaum pump rate	1.8 $\mu M ms^{-1}$
$K_{m,up}$	half saturation constant for SR Ca^{2+}-ATPase pump	0.5 μM
τ_{tr}	time constant for transfer from NSR to JSR	34.48 ms
τ_{xfer}	time constant for transfer from subspace to myoplasm	3.125 ms
k_a^+	RyR $P_{C_1} - P_{O_1}$ rate constant	0.01215 $\mu M^{-4} ms^{-1}$
k_a^-	RyR $P_{O_1} - P_{C_1}$ rate constant	0.1425 ms^{-1}
k_b^+	RyR $P_{O_1} - P_{O_2}$ rate constant	0.00405 $\mu M^{-3} ms^{-1}$
k_b^-	RyR $P_{O_2} - P_{O_1}$ rate constant	1.930 ms^{-1}
k_c^+	RyR $P_{O_1} - P_{C_2}$ rate constant	0.018 ms^{-1}
k_c^-	RyR $P_{C_2} - P_{O_1}$ rate constant	0.0008 ms^{-1}
n	RyR Ca^{2+} cooperativity parameter $P_{C_1} - P_{O_1}$	4
m	RyR Ca^{2+} cooperativity parameter $P_{O_1} - P_{O_2}$	3

3.4 Table 4 - L-type Ca^{2+} Channel Parameters

Parameter	Definition	Value
f	transition rate into open state	0.3 ms^{-1}
g	transition rate out of open state	2.0 ms^{-1}
f'	transition rate into open state for modeCa	0.0 ms^{-1}
g'	transition rate out of open state	0.0 ms^{-1}
a	mode transition parameter	2.0
b	mode transition parameter	2.0
ω	mode transition parameter	0.01 ms^{-1}
$\overline{P}_{Ca}$	L-type Ca^{2+} channel permeability to Ca^{2+}	33.75×10^{-4} $cm\,s^{-1}$
$\overline{P}_K$	L-type Ca^{2+} channel permeability to K^+	1.0×10^{-7} $cm\,s^{-1}$
$I_{Ca_{half}}$	I_{Ca} level that reduces $\overline{P}_K$ by half	-0.458 $\mu A \mu F^{-1}$

3.5 Table 5 - Buffering Parameters

Parameter	Definition	Value
$[LTRPN]_{tot}$	total myoplasmic troponin low affinity site concentration	70.0 μM
$[HTRPN]_{tot}$	total myoplasmic troponin high affinity site concentration	140.0 μM
k^+_{htrpn}	Ca^{2+} on rate constant for troponin high affinity sites	2.0×10^7 $M^{-1}s^{-1}$
k^-_{htrpn}	Ca^{2+} off rate constant for troponin high affinity sites	0.066 s^{-1}
k^+_{ltrpn}	Ca^{2+} on rate constant for troponin low affinity sites	4.0×10^7 $M^{-1}s^{-1}$
k^-_{ltrpn}	Ca^{2+} on rate constant for troponin low affinity sites	40.0 s^{-1}
$[CMDN]_{tot}$	total myoplasmic calmodulin concentration	50.0 μM
$[CSQN]_{tot}$	total network SR calsequestrin concentration	15.0 mM
K_m^{CMDN}	Ca^{2+} half saturation constant for calmodulin	2.38 μM
K_m^{CSQN}	Ca^{2+} half saturation constant for calsequestrin	0.8 mM

3.6 Table 6 - Membrane Current Parameters

Parameter	Definition	Value
C_m	unit membrane capacitance	1.0 $\mu F\, cm^{-2}$
F	Faraday's constant	96.5 $coul\, mmol^{-1}$
T	absolute temperature	310 K
R	ideal gas constant	8.314 $Jmol^{-1}K^{-1}$
$\overline{G}_{Na}$	maximum Na^+ channel conductance	12.8 $mS\mu F^{-1}$ (16.0)
$\overline{G}_{Kp}$	maximum plateau K^+ channel conductance	0.00828 $mS\mu F^{-1}$ (0.0183)
$P_{Na,K}$	Na^+ permeability of K^+ channel	0.01833
k_{NaCa}	scaling factor of Na^+-Ca^{2+} exchange	5000 $\mu A\, \mu F^{-1}$ (2000)
$K_{m,Na}$	Na^+ half saturation constant for Na^+-Ca^{2+} exchange	87.5 mM
$K_{m,Ca}$	Ca^{2+} half saturation constant for Na^+-Ca^{2+} exchange	1.38 mM
k_{sat}	Na^+-Ca^{2+} exchange saturation factor at very negative potentials	0.1
η	controls voltage dependence of Na^+-Ca^{2+} exchange	0.35
$\overline{I}_{NaK}$	maximum Na^+-K^+ pump curent	1.3 $\mu A\, \mu F^{-1}$ (1.5)
$K_{m,Nai}$	Na^+ half saturation constant for Na^+-K^+ pump	10.0 mM
$K_{m,Ko}$	K^+ half saturation constant for Na^+-K^+ pump	1.5 mM
$P_{ns(Ca)}$	nonspecific current channel permeability	0.0 cms^{-1} (1.75×10^{-7})
$K_{m,ns(Ca)}$	Ca^{2+} half saturation constant for nonspecific current	1.2 μM
$\overline{I}_{p(Ca)}$	maximum sarcolemmal Ca^{2+} pump current	1.15 $\mu A\, \mu F^{-1}$
$K_{m,p(Ca)}$	Ca^{2+} half saturation constant for sarcolemmal Ca^{2+} pump	0.5 μM
$\overline{G}_{Ca,b}$	maximum background Ca^{2+} current conductance	0.006032 $mS\mu F^{-1}$ (0.003016)
$\overline{G}_{Na,b}$	maximum background Na^+ current conductance	0.00141 $mS\mu F^{-1}$

The original Luo-Rudy Phase II parameters are shown in parenthesis.

3.7 Table 7 - Initial Conditions

Variable	Definition	Initial Value
t	time	0.00 ms
V	membrane potential	-86.1638 mV
m	I_{Na} activation gate	3.28302×10^{-02}
h	I_{Na} inactivation gate	0.988354
j	I_{Na} slow inactivation gate	0.992540
x	I_K activation gate	9.28836×10^{-04}
$[Na^+]_i$	intracellular Na^+ concentration	10.2042 mM
$[K^+]_i$	intracellular K^+ concentration	143.727 mM
$[Ca^{2+}]_i$	myoplasmic Ca^{2+} concentration	9.94893×10^{-05} mM
$[Ca^{2+}]_{NSR}$	network SR Ca^{2+} concentration	1.24891 mM
$[Ca^{2+}]_{ss}$	subspace SR Ca^{2+} concentration	1.36058×10^{-04} mM
$[Ca^{2+}]_{JSR}$	junctional SR Ca^{2+} concentration	1.17504 mM
P_{C_1}	fraction of channels in state P_{C_1}	0.762527
P_{0_1}	fraction of channels in state P_{0_1}	1.19168×10^{-03}
P_{0_2}	fraction of channels in state P_{0_2}	6.30613×10^{-09}
P_{C_2}	fraction of channels in state P_{C_2}	0.236283
C_0	L-type Ca^{2+} channel closed state mode normal	0.997208
C_1	L-type Ca^{2+} channel closed state mode normal	6.38897×10^{-05}
C_2	L-type Ca^{2+} channel closed state mode normal	1.53500×10^{-09}
C_3	L-type Ca^{2+} channel closed state mode normal	1.63909×10^{-14}
C_4	L-type Ca^{2+} channel closed state mode normal	6.56337×10^{-20}
O	L-type Ca^{2+} channel conducting state mode normal	9.84546×10^{-21}
C_{Ca0}	L-type Ca^{2+} channel closed state mode Ca	2.72826×10^{-03}
C_{Ca1}	L-type Ca^{2+} channel closed state mode Ca	6.99215×10^{-07}
C_{Ca2}	L-type Ca^{2+} channel closed state mode Ca	6.71989×10^{-11}
C_{Ca3}	L-type Ca^{2+} channel closed state mode Ca	2.87031×10^{-15}
C_{Ca4}	L-type Ca^{2+} channel closed state mode Ca	4.59752×10^{-20}
O_{Ca}	L-type Ca^{2+} channel conducting state mode Ca	0.0
y	I_{Ca} inactivation gate	0.998983
$[LTRPNCa]$	concentration Ca^{2+} bound low affinity troponin binding sites	6.349973 μM
$[HTRPNCa]$	concentration Ca^{2+} bound high affinity troponin binding sites	135.9813 μM