Appendix 1. Model Equations

Terms are color coded as transcription (green), translation (blue), nuclear transport (purple), and binding/unbinding (brown). For complexes in the nucleus of the cell, an n appears after every molecule in the complex (e.g., PopCn in the text is written here as PopnCn)

L = Light Level (e.g. Lon)

$dG/dt = bin*Rn*(1 - G) - unbin*G$

$dGRv/dt = binRv*RvnRvn*(1 - GRv) - unbinRv*GRv$

$dMnRo/dt = trRo*(1 - G)*(1 - GRv)^3 - tmc*MnRo$

$dMcRo/dt = tmc*MnRo - umR*McRo$

$dMnRt/dt = trRt*(1 - G) - tmc*MnRt$

$dMcRt/dt = tmc*MnRt - umR*McRt$

$dMnPo/dt = trPo*(1 - G)^5 + L - tmc*MnPo$

$dMcPo/dt = tmc*MnPo - umPo*McPo$

$dMnPt/dt = trPt*(1 - G)^5 + L - tmc*MnPt$

$dMcPt/dt = tmc*MnPt - umPt*McPt$

$dMnRv/dt = trRv*(1 - G)^3 - tmc*MnRv$

$dMcRv/dt = tmc*MnRv - umRv*McRv$

$dRv/dt = tlrv*McRv - 2*arv*Rv*Rv + 2*drv*RvRv - nl*Rv + ne*Rvn - uRv*Rv$

$dRvn/dt = - 2*Nf*arv*Rvn*Rvn + 2*drv*RvnRvn + nl*Rv - ne*Rvn - uRv*Rvn$

$dRvRv/dt = arv*Rv*Rv - drv*RvRv - nl*RvRv + ne*RvnRvn - 2*uRv*RvRv$

$dRvnRvn/dt = Nf*arv*Rvn*Rvn - drv*RvnRvn + nl*RvRv - ne*RvnRvn - 2*uRv*RvnRvn$

$dPo/dt = tlp*McPo - ac*Po*C + dc*PoC - upu*Po$

$dPt/dt = tlp*McPt - ac*Pt*C + dc*PtC - upu*Po$

dPoC/dt = ac*Po*C - dc*PoC - hoo*PoC - upu*PoC

dPtC/dt = ac*Pt*C - dc*PtC - hot*PtC - upu*PtC

dPopC/dt = hoo*PoC + ac*Pop*C - dc*PopC - up*PopC - ht*PopC - nl*PopC + ne*PonpCn - ar*PopC*Ro + dr*PopCRo - ar*PopC*Rt + dr*PopCRt

dPtpC/dt = hot*PtC + ac*Ptp*C - dc*PtpC - up*PtpC - ht*PtpC - nl*PtpC + ne*PtnpCn - ar*PtpC*Ro + dr*PtpCRo - ar*PtpC*Rt + dr*PtpCRt

dPop/dt = - ac*Pop*C+ dc*PopC - up*Pop - ar*Pop*Ro + dr*PopRo - ar*Pop*Rt + dr*PopRt - nl*Pop + ne*Ponp

dPtp/dt = - ac*Ptp*C+ dc*PtpC - up*Ptp - ar*Ptp*Ro + dr*PtpRo - ar*Ptp*Rt + dr*PtpRt - nl*Ptp + ne*Ptnp

dPoppC/dt = hto*PopC - up*PoppC + ac*Popp*C- dc*PoppC + ne*PonppCn - ar*PoppC*Ro + dr*PoppCRo - ar*PoppC*Rt + dr*PoppCRt

dPtppC/dt = ht*PtpC - up*PtppC + ac*Ptpp*C- dc*PtppC + ne*PtnppCn - ar*PtppC*Ro + dr*PtppCRo - ar*PtppC*Rt + dr*PtppCRt

dPopRo/dt = ar*Pop*Ro - dr*PopRo - ac*PopRo*C + dc*PopCRo - nl*PopRo + ne*PonpRon

dPtpRo/dt = ar*Ptp*Ro - dr*PtpRo - ac*PtpRo*C+ dc*PtpCRo - nl*PtpRo + ne*PtnpRon

dPopRt/dt = ar*Pop*Rt - dr*PopRt - ac*PopRt*C+ dc*PopCRt - nl*PopRt + ne*PonpRtn

dPtpRt/dt = ar*Ptp*Rt - dr*PtpRt - ac*PtpRt*C + dc*PtpCRt - nl*PtpRt + ne*PtnpRtn

dPoppRo/dt = ar*Popp*Ro - dr*PoppRo - ac*PoppRo*C + dc*PoppCRo + ne*PonppRon

dPoppRt/dt = ar*Popp*Rt - dr*PoppRt - ac*PoppRt*C + dc*PoppCRt + ne*PonppRtn

dPtppRo/dt = ar*Ptpp*Ro - dr*PtppRo - ac*PtppRo*C + dc*PtppCRo + ne*PtnppRon

dPtppRt/dt = ar*Ptpp*Rt - dr*PtppRt - ac*PtppRt*C + dc*PtppCRt + ne*PtnppRtn

dPopp/dt = - ac*Popp*C + dc*PoppC + ne*Ponpp - ar*Popp*Ro + dr*PoppRo – ar*Popp*Rt + dr*PoppRt - up*Popp

dPtpp/dt = - ac*Ptpp*C+ dc*PtppC + ne*Ptnpp - ar*Ptpp*Ro + dr*PtppRo - ar*Ptpp*Rt + dr*PtppRt - up*Ptpp

dPopCRo/dt = ar*PopC*Ro - dr*PopCRo + ac*PopRo*C- dc*PopCRo - nl*PopCRo + ne*PonpCnRon - hto*PopCRo

dPtpCRo/dt = ar*PtpC*Ro - dr*PtpCRo + ac*PtpRo*C - dc*PtpCRo - nl*PtpCRo + ne*PtnpCnRon - ht*PtpCRo

dPopCRt/dt = ar*PopC*Rt - dr*PopCRt + ac*PopRt*C- dc*PopCRt - nl*PopCRt + ne*PonpCnRtn - hto*PopCRt

dPtpCRt/dt = ar*PtpC*Rt - dr*PtpCRt + ac*PtpRt*C - dc*PtpCRt - nl*PtpCRt + ne*PtnpCnRtn - ht*PtpCRt

dPoppCRo/dt = ar*PoppC*Ro - dr*PoppCRo + ac*PoppRo*C- dc*PoppCRo + ne*PonppCnRon + hto*PopCRo

dPtppCRo/dt = ar*PtppC*Ro - dr*PtppCRo + ac*PtppRo*C - dc*PtppCRo + ne*PtnppCnRon + ht*PtpCRo

dPoppCRt/dt = ar*PoppC*Rt - dr*PoppCRt + ac*PoppRt*C - dc*PoppCRt + ne*PonppCnRtn + hot*PopCRt

dPtppCRt/dt = ar*PtppC*Rt - dr*PtppCRt + ac*PtppRt*C - dc*PtppCRt + ne*PtnppCnRtn + ht*PtpCRt

dRo/dt = - ar*Ro*Pop - ar*Ro*Popp - ar*Ro*PopC - ar*Ro*PoppC + dr*PopRo + dr*PoppRo + dr*PopCRo + dr*PoppCRo - ar*Ro*Ptp - ar*Ro*Ptpp - ar*Ro*PtpC - ar*Ro*PtppC + dr*PtpRo + dr*PtppRo + dr*PtpCRo + dr*PtppCRo + tlr*McRo - uro*Ro

dRt/dt = - ar*Rt*Pop - ar*Rt*Popp - ar*Rt*PopC - ar*Rt*PoppC + dr*PopRt + dr*PoppRt + dr*PopCRt + dr*PoppCRt - ar*Rt*Ptp - ar*Rt*Ptpp - ar*Rt*PtpC - ar*Rt*PtppC + dr*PtpRt + dr*PtppRt + dr*PtpCRt + dr*PtppCRt + tlr*McRt - urt*Rt

dPonpCn/dt = ac*Nf*Ponp*Cn - dc*PonpCn - hto*PonpCn + nl*PopC - ne*PonpCn - ar*Nf*PonpCn*Ron + dr*PonpCnRon - ar*Nf*PonpCn*Rtn + dr*PonpCnRtn - up*PonpCn

dPtnpCn/dt = ac*Nf*Ptnp*Cn - dc*PtnpCn - ht*PtnpCn + nl*PtpC - ne*PtnpCn - ar*Nf*PtnpCn*Ron + dr*PtnpCnRon - ar*Nf*PtnpCn*Rtn + dr*PtnpCnRtn - up*PtnpCn

dPonp/dt = - ac*Nf*Ponp*Cn + dc*PonpCn - ar*Nf*Ponp*Ron + dr*PonpRon - ar*Nf*Ponp*Rtn + dr*PonpRtn + nl*Pop - ne*Ponp - up*Ponp

dPtnp/dt = - ac*Nf*Ptnp*Cn + dc*PtnpCn - ar*Nf*Ptnp*Ron + dr*PtnpRon - ar*Nf*Ptnp*Rtn + dr*PtnpRtn + nl*Ptp - ne*Ptnp - up*Ptnp

dPonppCn/dt = hto*PonpCn + ac*Nf*Ponpp*Cn - dc*PonppCn - ne*PonppCn - ar*Nf*PonppCn*Ron + dr*PonppCnRon – ar*Nf*PonppCn*Rtn + dr*PonppCnRtn - up*PonppCn

dPtnppCn/dt = ht*PtnpCn + ac*Nf*Ptnpp*Cn - dc*PtnppCn - ne*PtnppCn - ar*Nf*PtnppCn*Ron + dr*PtnppCnRon - ar*Nf*PtnppCn*Rtn + dr*PtnppCnRtn - up*PtnppCn

dPonpRon/dt = ar*Nf*Ponp*Ron - dr*PonpRon - ac*Nf*PonpRon*Cn + dc*PonpCnRon + nl*PopRo - ne*PonpRon

dPtnpRon/dt = ar*Nf*Ptnp*Ron - dr*PtnpRon - ac*Nf*PtnpRon*Cn + dc*PtnpCnRon + nl*PtpRo - ne*PtnpRon

dPonpRtn/dt = ar*Nf*Ponp*Rtn - dr*PonpRtn - ac*Nf*PonpRtn*Cn + dc*PonpCnRtn + nl*PopRt - ne*PonpRtn

dPtnpRtn/dt = ar*Nf*Ptnp*Rtn - dr*PtnpRtn - ac*Nf*PtnpRtn*Cn + dc*PtnpCnRtn + nl*PtpRt - ne*PtnpRtn

dPonppRon/dt = ar*Nf*Ponpp*Ron - dr*PonppRon - ac*Nf*PonppRon*Cn + dc*PonppCnRon - ne*PonppRon

dPtnppRon/dt = ar*Nf*Ptnpp*Ron - dr*PtnppRon - ac*Nf*PtnppRon*Cn + dc*PtnppCnRon - ne*PtnppRon

dPonppRtn/dt = ar*Nf*Ponpp*Rtn - dr*PonppRtn - ac*Nf*PonppRtn*Cn + dc*PonppCnRtn - ne*PonppRtn

dPtnppRtn/dt = ar*Nf*Ptnpp*Rtn - dr*PtnppRtn - ac*Nf*PtnppRtn*Cn + dc*PtnppCnRtn - ne*PtnppRtn

dPonpp/dt = - ac*Nf*Ponpp*Cn + dc*PonppCn - ne*Ponpp - ar*Nf*Ponpp*Ron + dr*PonppRon - ar*Nf*Ponpp*Rtn + dr*PonppRtn - up*Ponpp

dPtnpp/dt = - ac*Nf*Ptnpp*Cn + dc*PtnppCn - ne*Ptnpp - ar*Nf*Ptnpp*Ron + dr*PtnppRon - ar*Nf*Ptnpp*Rtn + dr*PtnppRtn - up*Ptnpp

dPonpCnRon/dt = ar*Nf*PonpCn*Ron - dr*PonpCnRon + ac*Nf*PonpRon*Cn - dc*PonpCnRon + nl*PopCRo - ne*PonpCnRon - hto*PonpCnRon

dPtnpCnRon/dt = ar*Nf*PtnpCn*Ron - dr*PtnpCnRon + ac*Nf*PtnpRon*Cn - dc*PtnpCnRon + nl*PtpCRo - ne*PtnpCnRon - ht*PtnpCnRon

dPonpCnRtn/dt = ar*Nf*PonpCn*Rtn - dr*PonpCnRtn + ac*Nf*PonpRtn*Cn - dc*PonpCnRtn + nl*PopCRt - ne*PonpCnRtn - hto*PonpCnRtn

dPtnpCnRtn/dt = ar*Nf*PtnpCn*Rtn - dr*PtnpCnRtn + ac*Nf*PtnpRtn*Cn - dc*PtnpCnRtn + nl*PtpCRt - ne*PtnpCnRtn - ht*PtnpCnRtn

dPonppCnRon/dt = ar*Nf*PonppCn*Ron - dr*PonppCnRon + ac*Nf*PonppRon*Cn - dc*PonppCnRon - ne*PonppCnRon + hto*PonpCnRon

dPtnppCnRon/dt = ar*Nf*PtnppCn*Ron - dr*PtnppCnRon + ac*Nf*PtnppRon*Cn - dc*PtnppCnRon - ne*PtnppCnRon + ht*PtnpCnRon

dPonppCnRtn/dt = ar*Nf*PonppCn*Rtn - dr*PonppCnRtn + ac*Nf*PonppRtn*Cn - dc*PonppCnRtn - ne*PonppCnRtn + hto*PonpCnRtn

dPtnppCnRtn/dt = ar*Nf*PtnppCn*Rtn - dr*PtnppCnRtn + ac*Nf*PtnppRtn*Cn - dc*PtnppCnRtn - ne*PtnppCnRtn + ht*PtnpCnRtn

dRon/dt = - ar*Nf*Ron*Ponp - ar*Nf*Ron*Ponpp - ar*Nf*Ron*PonpCn - ar*Nf*Ron*PonppCn + dr*PonpRon + dr*PonppRon + dr*PonpCnRon + dr*PonppCnRon - ar*Nf*Ron*Ptnp - ar*Nf*Ron*Ptnpp - ar*Nf*Ron*PtnpCn - ar*Nf*Ron*PtnppCn + dr*PtnpRon + dr*PtnppRon + dr*PtnpCnRon + dr*PtnppCnRon - uro*Ron

dRtn/dt = - ar*Nf*Rtn*Ponp - ar*Nf*Rtn*Ponpp - ar*Nf*Rtn*PonpCn - ar*Nf*Rtn*PonppCn + dr*PonpRtn + dr*PonppRtn + dr*PonpCnRtn + dr*PonppCnRtn - ar*Nf*Rtn*Ptnp - ar*Nf*Rtn*Ptnpp - ar*Nf*Rtn*PtnpCn - ar*Nf*Rtn*PtnppCn + dr*PtnpRtn + dr*PtnppRtn + dr*PtnpCnRtn + dr*PtnppCnRtn - urt*Rtn

dCn/dt = - ac*Nf*Cn*Ponp - ac*Nf*Cn*Ponpp - ac*Nf*Cn*PonpRon - ac*Nf*Cn*PonppRon + dc*PonpCn + dc*PonppCn + dc*PonpCnRon + dc*PonppCnRon - ac*Nf*Cn*Ptnp - ac*Nf*Cn*Ptnpp - ac*Nf*Cn*PtnpRon - ac*Nf*Cn*PtnppRon + dc*PtnpCn + dc*PtnppCn + dc*PtnpCnRon + dc*PtnppCnRon - ac*Nf*Cn*PonpRtn - ac*Nf*Cn*PonppRtn + dc*PonpCnRtn + dc*PonppCnRtn - ac*Nf*Cn*PtnpRtn - ac*Nf*Cn*PtnppRtn + dc*PtnpCnRtn + dc*PtnppCnRtn + up*PonpCn + up*PonppCn + up*PtnpCn + up*PtnppCn

Relations

C = Ct - (PoC + PtC + PopC + PtpC + PoppC + PtppC + PopCRo + PopCRt + PtpCRo + PtpCRt + PoppCRo + PoppCRt + PtppCRo + PtppCRt + PonpCn + PtnpCn + PonppCn + PtnppCn + PonpCnRon + PonpCnRtn + PtnpCnRon + PtnpCnRtn + PonppCnRon + PonppCnRtn + PtnppCnRon + PtnppCnRtn + Cn)

Rn = (Ron + PonpRon + PonppRon + PonpCnRon + PonppCnRon + PtnpRon + PtnppRon + PtnpCnRon + PtnppCnRon + Rtn + PonpRtn + PonppRtn + PonpCnRtn + PonppCnRtn + PtnpRtn + PtnppRtn + PtnpCnRtn + PtnppCnRtn