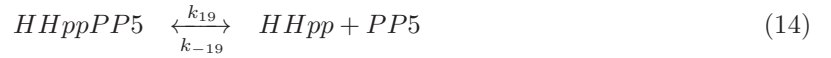
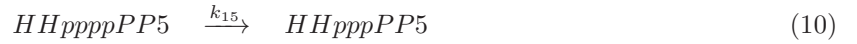
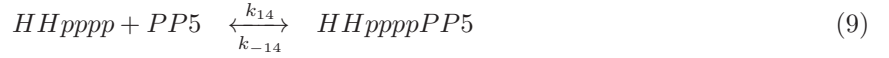
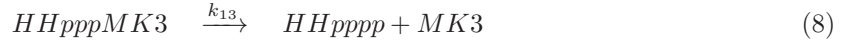
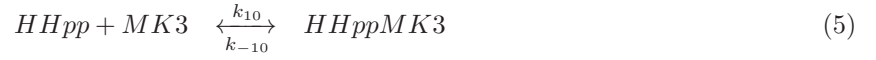
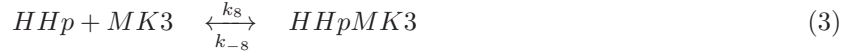


Text S2

Module 2: Kinetic equations for the phosphorylation-dephosphorylation reactions of the HSF1 trimer-HSE complex (HH)

We consider the stepwise dual phosphorylation-dephosphorylation reactions of the complex HH as module 2. The kinetic equations of the phosphorylation-dephosphorylation reactions of the complex HH by the kinase and phosphatase are given as follows:



$$R6 = k_6[HH][MK3] - k_{-6}[HHMK3] \quad (21)$$

$$R7 = k_7[HHMK3] \quad (22)$$

$$R8 = k_8[HHp][MK3] - k_{-8}[HHpMK3] \quad (23)$$

$$R9 = k_9[HHpMK3] \quad (24)$$

$$R10 = k_{10}[HHpp][MK3] - k_{-10}[HHppMK3] \quad (25)$$

$$R11 = k_{11}[HHppMK3] \quad (26)$$

$$R12 = k_{12}[HHppp][MK3] - k_{-12}[HHpppMK3] \quad (27)$$

$$R13 = k_{13}[HHpppMK3] \quad (28)$$

$$R14 = k_{14}[HHpppp][PP5] - k_{-14}[HHppppPP5] \quad (29)$$

$$R15 = k_{15}[HHppppPP5] \quad (30)$$

$$R16 = k_{16}[HHppppPP5] - k_{-16}[HHppp][PP5] \quad (31)$$

$$R17 = k_{17}[HHppp][PP5] - k_{-17}[HHpppPP5S] \quad (32)$$

$$R18 = k_{18}[HHpppPP5S] \quad (33)$$

$$R19 = k_{19}[HHppPP5] - k_{-19}[HHpp][PP5] \quad (34)$$

$$R20 = k_{23}[HHp][PP5] - h_{-23}[HHpPP5S] \quad (35)$$

$$R21 = k_{24}[HHpPP5S] \quad (36)$$

$$R22 = k_{11}[HHPP5] - h_{66}[PP5][HH] \quad (37)$$

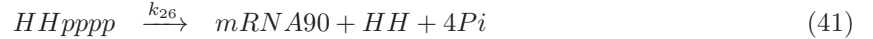
$$R23 = k_{20}[HHpp][PP5] - k_{-20}[HHppPP5S] \quad (38)$$

$$R24 = k_{21}[HHppPP5S] \quad (39)$$

$$R25 = k_{22}[HHpPP5] - k_{-22}[HHp][PP5] \quad (40)$$

In the above equations, HH is the HSF13S:HSE complex; HH_p, HH_{pp}, HH_{ppp}, and HH_{pppp} are the mono, di, tri, and tetra-phosphorylated complex; MK3 is the kinase; PP5 is a phosphatase, a co-chaperone; PP5S is the activated phosphatase formed during the dephosphorylation; and the rest of the dynamical variables are the complexes of MK3 or PP5A.

The kinetic equation for the production of mRNA90 from tetra phosphorylated HHpppp is given as follows:



The corresponding rate equation is:

$$R26 = k_{26}[HHpppp] \quad (42)$$

Rate equations for the phosphorylation-dephosphorylation reactions of trimer HSF1-HSE complex, (HH)

$$\frac{d[HH]}{dt} = R5 - R6 + R26 \quad (43)$$

$$\frac{d[HHp]}{dt} = R7 - R8 + R21 - R20 \quad (44)$$

$$\frac{d[HHpp]}{dt} = R9 - R10 - R23 + R19 \quad (45)$$

$$\frac{d[HHppp]}{dt} = R11 - R12 - R17 + R16 \quad (46)$$

$$\frac{d[HHpppp]}{dt} = R13 - R14 - R26 \quad (47)$$

$$\frac{d[HHMK3]}{dt} = R6 - R7 \quad (48)$$

$$\frac{d[HHpMK3]}{dt} = R8 - R9 \quad (49)$$

$$\frac{d[HHppMK3]}{dt} = R10 - R11 \quad (50)$$

$$\frac{d[HHpppMK3]}{dt} = R12 - R13 \quad (51)$$

$$\frac{d[HHppppPP5]}{dt} = R14 - R15 \quad (52)$$

$$\frac{d[HHppppPP5]}{dt} = R15 - R16 \quad (53)$$

$$\frac{d[HHppppPP5S]}{dt} = R17 - R18 \quad (54)$$

$$\frac{d[HHppPP5]}{dt} = R18 - R19 \quad (55)$$

$$\frac{d[HHppPP5S]}{dt} = R23 - R24 \quad (56)$$

$$\frac{d[HHpPP5]}{dt} = R24 - R25 \quad (57)$$

$$\frac{d[HHpPP5S]}{dt} = R20 - R21 \quad (58)$$

$$\frac{d[HHPP5]}{dt} = R21 - R22 \quad (59)$$