SBML Model Report

Model name: "Caydasi2012_SPOC_HotSpotAssociation"

August 8, 2012

1 General Overview

This is a document in SBML Level 2 Version 4 format. This model was created by Maiko Lohel[1] at February nineth 2012 at 1:51 p. m. and last time modified at March sixth 2012 at 5:03 p. m. Table 1 gives an overview of the quantities of all components of this model.

Table 1: Number of components in this model, which are described in the following sections.

Element	Quantity	Element	Quantity
compartment types	0	compartments	3
species types	0	species	24
events	1	constraints	0
reactions	48	function definitions	0
global parameters	34	unit definitions	10
rules	12	initial assignments	0

Model Notes

This model is from the article:
A dynamical model of the spindle position checkpoint
Ayse Koca Caydasi, Maiko Lohel, Gerd Grnert, Peter Dittrich, Gislene Pereira & Bashar Ibrahim
Molecular Systems Biology2012; 582 PMEDID, doi: 10.1038/msb.2012.15
Abstract:

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The orientation of the mitotic spindle with respect to the polarity axis is crucial for the accuracy of asymmetric cell division. In budding yeast, a surveillance mechanism called the spindle position checkpoint (SPOC) prevents exit from mitosis when the mitotic spindle fails to align along the mother-to-daughter polarity axis. SPOC arrest relies upon inhibition of the GTPase Tem1 by the GTPase-activating protein (GAP) complex Bfa1Bub2. Importantly, reactions signaling mitotic exit take place at yeast centrosomes (named spindle pole bodies, SPBs) and the GAP complex also promotes SPB localization of Tem1. Yet, whether the regulation of Tem1 by Bfa1Bub2 takes place only at the SPBs remains elusive. Here, we present a quantitative analysis of Bfa1Bub2 and Tem1 localization at the SPBs. Based on the measured SPB-bound protein levels, we introduce a dynamical model of the SPOC that describes the regulation of Bfa1 and Tem1. Our model suggests that Bfa1 interacts with Tem1 in the cytoplasm as well as at the SPBs to provide efficient Tem1 inhibition.

To cite BioModels Database, please use: Li C, Donizelli M, Rodriguez N, Dharuri H, Endler L, Chelliah V, Li L, He E, Henry A, Stefan MI, Snoep JL, Hucka M, Le Novre N, Laibe C (2010) BioModels Database: An enhanced, curated and annotated resource for published quantitative kinetic models. BMC Syst Biol., 4:92.

2 Unit Definitions

This is an overview of ten unit definitions.

2.1 Unit `substance`

Name substance

Definition mol

2.2 Unit `volume`

Name volume

Definition l

2.3 Unit `area`

Name area

Definition m^2

2.4 Unit length

Name length

Definition m

2.5 Unit time

Name time

Definition s

2.6 Unit molar

Name molar

Definition $\mathrm{mol} \cdot \mathrm{l}^{-1}$

2.7 Unit pmps

Name per molar per second

Definition $\mathrm{mol}^{-1} \cdot \mathrm{l} \cdot \mathrm{s}^{-1}$

2.8 Unit ps

Name per second

Definition s^{-1}

2.9 Unit molecules

Name molecules

Definition dimensionless

2.10 Unit pmole

Name per mole

Definition mol^{-1}

3 Compartments

This model contains three compartments.

Table 2: Properties of all compartments.

Id	Name	SBO	Spatial Dimensions	Size	Unit	Constant	Outside
`default`			3	1		☑	
`c2`	Cytosol		3	10^{-13}		☑	`default`
`c3`	SPB		3	$3 \cdot 10^{-18}$		☑	`c2`

3.1 Compartment `default`

This is a three dimensional compartment with a constant size of one litre.

3.2 Compartment `c2`

This is a three dimensional compartment with a constant size of 10^{-13} litre, which is surrounded by `default`.

Name Cytosol

3.3 Compartment `c3`

This is a three dimensional compartment with a constant size of $3 \cdot 10^{-18}$ litre, which is surrounded by `c2` (Cytosol).

Name SPB

4 Species

This model contains 24 species. Section 9 provides further details and the derived rates of change of each species.

Table 3: Properties of each species.

Id	Name	Compartment	Derived Unit	Constant	Boundary Condition
SPB_B	B	c3	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
SPB_T	T	c3	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Bfa1	Bfa1	c2	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Bfa1P4	Bfa1P4	c2	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Bfa1P5	Bfa1P5	c2	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Tem1GTP	Tem1GTP	c2	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Tem1GDP	Tem1GDP	c2	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
B_Bfa1	B-Bfa1	c3	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
B_Bfa1P4	B-Bfa1P4	c3	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
B_Bfa1P5	B-Bfa1P5	c3	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
T_Tem1GTP	T-Tem1GTP	c3	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
T_Tem1GDP	T-Tem1GDP	c3	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
B_Bfa1_Tem1GTP	B-Bfa1-Tem1GTP	c3	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
B_Bfa1P4_Tem1GTP	B-Bfa1P4-Tem1GTP	c3	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
B_Bfa1P5_Tem1GTP	B-Bfa1P5-Tem1GTP	c3	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
B_Bfa1_Tem1GDP	B-Bfa1-Tem1GDP	c3	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
B_Bfa1P4_Tem1GDP	B-Bfa1P4-Tem1GDP	c3	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
B_Bfa1P5_Tem1GDP	B-Bfa1P5-Tem1GDP	c3	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Bfa1_Tem1GTP	Bfa1-Tem1GTP	c2	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Bfa1P4_Tem1GTP	Bfa1P4-Tem1GTP	c2	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Bfa1P5_Tem1GTP	Bfa1P5-Tem1GTP	c2	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Bfa1_Tem1GDP	Bfa1-Tem1GDP	c2	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟

Id	Name	Compartment	Derived Unit	Constant	Boundary Condition
Bfa1P4_Tem1GDP	Bfa1P4-Tem1GDP	c2	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Bfa1P5_Tem1GDP	Bfa1P5-Tem1GDP	c2	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟

5 Parameters

This model contains 34 global parameters.

Table 4: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
konB			1250000.000	$mol^{-1} \cdot l \cdot s^{-1}$	☑
koffB			0.001	s^{-1}	☑
konB4			20000.000	$mol^{-1} \cdot l \cdot s^{-1}$	☑
koffB4			0.037	s^{-1}	☑
konBT			$3.65 \cdot 10^7$	$mol^{-1} \cdot l \cdot s^{-1}$	☑
konB4T			$3.65 \cdot 10^7$	$mol^{-1} \cdot l \cdot s^{-1}$	☑
konB5T			5500000.000	$mol^{-1} \cdot l \cdot s^{-1}$	☑
koffBT			0.183	s^{-1}	☑
konT			1250000.000	$mol^{-1} \cdot l \cdot s^{-1}$	☑
koffT			0.183	s^{-1}	☑
kfKin4			1000.000	s^{-1}	☑
kfKin4Cyto			0.090	s^{-1}	☑
krKin4			0.025	s^{-1}	☑
kfCdc5			1.000	s^{-1}	☑
krCdc5			0.010	s^{-1}	☑
khyd			0.002	s^{-1}	☑
knex			0.014	s^{-1}	☑
khydBT			2.000	s^{-1}	☑
khydB4T			2.000	s^{-1}	☑
u			1.000	dimensionless	⊟
alpha	alpha		0.000	dimensionless	☑
active_Tem1_SPB	Active Tem1 at the SPB		0.000	dimensionless	⊟
active_Tem1_Cytosol	Active Tem1 in the cytosol		0.000	dimensionless	⊟
inactive_Tem1_SPB	Inactive Tem1 at the SPB		0.000	dimensionless	⊟
inactive_Tem1_Cytosol	Inactive Tem1 in the cytosol		0.000	dimensionless	⊟
active_Bfa1_SPB	Active Bfa1 at the SPB		0.000	dimensionless	⊟
active_Bfa1_Cytosol	Active Bfa1 in the cytosol		0.000	dimensionless	⊟
inactive_Bfa1_SPB	Inactive Bfa1 at the SPB		0.000	dimensionless	⊟
inactive_Bfa1_Cytosol	Inactive Bfa1 in the cytosol		0.000	dimensionless	⊟

Id	Name	SBO	Value	Unit	Constant
total_Tem1_SPB	Total Tem1 at the SPB		0.000	dimensionless	⊟
total_Tem1_Cytosol	Total Tem1 in the Cytosol		0.000	dimensionless	⊟
total_Bfa1_SPB	Total Bfa1 at the SPB		0.000	dimensionless	⊟
total_Bfa1_Cytosol	Total Bfa1 in the Cytosol		0.000	dimensionless	⊟
NA	Avogadro's number		$6.022 \cdot 10^{23}$	mol^{-1}	☑

6 Rules

This is an overview of twelve rules.

6.1 Rule active_Tem1_SPB

Rule active_Tem1_SPB is an assignment rule for parameter active_Tem1_SPB:

$$\text{active\_Tem1\_SPB} = ([\text{T\_Tem1GTP}] + [\text{B\_Bfa1\_Tem1GTP}] + [\text{B\_Bfa1P4\_Tem1GTP}] + [\text{B\_Bfa1P5\_Tem1GTP}]) \cdot \text{NA} \cdot \text{vol}(\text{c3}) \quad (1)$$

Derived unit dimensionless

6.2 Rule active_Tem1_Cytosol

Rule active_Tem1_Cytosol is an assignment rule for parameter active_Tem1_Cytosol:

$$\text{active\_Tem1\_Cytosol} = ([\text{Tem1GTP}] + [\text{Bfa1\_Tem1GTP}] + [\text{Bfa1P4\_Tem1GTP}] + [\text{Bfa1P5\_Tem1GTP}]) \cdot \text{NA} \cdot \text{vol}(\text{c2}) \quad (2)$$

Derived unit dimensionless

6.3 Rule inactive_Tem1_SPB

Rule inactive_Tem1_SPB is an assignment rule for parameter inactive_Tem1_SPB:

$$\text{inactive\_Tem1\_SPB} = ([\text{T\_Tem1GDP}] + [\text{B\_Bfa1\_Tem1GDP}] + [\text{B\_Bfa1P4\_Tem1GDP}] + [\text{B\_Bfa1P5\_Tem1GDP}]) \cdot \text{NA} \cdot \text{vol}(\text{c3}) \quad (3)$$

Derived unit dimensionless

6.4 Rule inactive_Tem1_Cytosol

Rule inactive_Tem1_Cytosol is an assignment rule for parameter inactive_Tem1_Cytosol:

$$\text{inactive\_Tem1\_Cytosol} = ([\text{Tem1GDP}] + [\text{Bfa1\_Tem1GDP}] + [\text{Bfa1P4\_Tem1GDP}] + [\text{Bfa1P5\_Tem1GDP}]) \cdot \text{NA} \cdot \text{vol}(\text{c2}) \tag{4}$$

Derived unit dimensionless

6.5 Rule active_Bfa1_SPB

Rule active_Bfa1_SPB is an assignment rule for parameter active_Bfa1_SPB:

$$\text{active\_Bfa1\_SPB} = ([\text{B\_Bfa1}] + [\text{B\_Bfa1\_Tem1GTP}] + [\text{B\_Bfa1\_Tem1GDP}] + [\text{B\_Bfa1P4}] + [\text{B\_Bfa1P4\_Tem1GTP}] + [\text{B\_Bfa1P4\_Tem1GDP}]) \cdot \text{NA} \cdot \text{vol}(\text{c3}) \tag{5}$$

Derived unit dimensionless

6.6 Rule active_Bfa1_Cytosol

Rule active_Bfa1_Cytosol is an assignment rule for parameter active_Bfa1_Cytosol:

$$\text{active\_Bfa1\_Cytosol} = ([\text{Bfa1}] + [\text{Bfa1\_Tem1GTP}] + [\text{Bfa1\_Tem1GDP}] + [\text{Bfa1P4}] + [\text{Bfa1P4\_Tem1GTP}] + [\text{Bfa1P4\_Tem1GDP}]) \cdot \text{NA} \cdot \text{vol}(\text{c2}) \tag{6}$$

Derived unit dimensionless

6.7 Rule inactive_Bfa1_SPB

Rule inactive_Bfa1_SPB is an assignment rule for parameter inactive_Bfa1_SPB:

$$\text{inactive\_Bfa1\_SPB} = ([\text{B\_Bfa1P5}] + [\text{B\_Bfa1P5\_Tem1GTP}] + [\text{B\_Bfa1P5\_Tem1GDP}]) \cdot \text{NA} \cdot \text{vol}(\text{c3}) \tag{7}$$

Derived unit dimensionless

6.8 Rule inactive_Bfa1_Cytosol

Rule inactive_Bfa1_Cytosol is an assignment rule for parameter inactive_Bfa1_Cytosol:

$$\text{inactive\_Bfa1\_Cytosol} = ([\text{Bfa1P5}] + [\text{Bfa1P5\_Tem1GTP}] + [\text{Bfa1P5\_Tem1GDP}]) \cdot \text{NA} \cdot \text{vol}(\text{c2}) \tag{8}$$

Derived unit dimensionless

6.9 Rule total_Tem1_SPB

Rule total_Tem1_SPB is an assignment rule for parameter total_Tem1_SPB:

$$\text{total\_Tem1\_SPB} = \text{active\_Tem1\_SPB} + \text{inactive\_Tem1\_SPB} \tag{9}$$

Derived unit dimensionless

6.10 Rule total_Tem1_Cytosol

Rule total_Tem1_Cytosol is an assignment rule for parameter total_Tem1_Cytosol:

$$\text{total\_Tem1\_Cytosol} = \text{active\_Tem1\_Cytosol} + \text{inactive\_Tem1\_Cytosol} \tag{10}$$

Derived unit dimensionless

6.11 Rule total_Bfa1_SPB

Rule total_Bfa1_SPB is an assignment rule for parameter total_Bfa1_SPB:

$$\text{total\_Bfa1\_SPB} = \text{active\_Bfa1\_SPB} + \text{inactive\_Bfa1\_SPB} \tag{11}$$

Derived unit dimensionless

6.12 Rule total_Bfa1_Cytosol

Rule total_Bfa1_Cytosol is an assignment rule for parameter total_Bfa1_Cytosol:

$$\text{total\_Bfa1\_Cytosol} = \text{active\_Bfa1\_Cytosol} + \text{inactive\_Bfa1\_Cytosol} \tag{12}$$

Derived unit dimensionless

7 Event

This is an overview of one event. Each event is initiated whenever its trigger condition switches from false to true. A delay function postpones the effects of an event to a later time point. At the time of execution, an event can assign values to species, parameters or compartments if these are not set to constant.

7.1 Event spindle_alignment

Name SPOC deactivation upon correct spindle alignment

Trigger condition

$$t \geq 1800 \tag{13}$$

Assignment

$$u = 0 \tag{14}$$

8 Reactions

This model contains 48 reactions. All reactions are listed in the following table and are subsequently described in detail. If a reaction is affected by a modifier, the identifier of this species is written above the reaction arrow.

Table 5: Overview of all reactions

№	Id	Name	Reaction Equation	SBO
1	R1	R1: Rev. SPB-association of Bfa1	SPB_B + Bfa1 $\rightleftharpoons$ B_Bfa1	
2	R2	R2: Rev. SPB-association of Kin4-phosphorylated Bfa1	Bfa1P4 + SPB_B $\rightleftharpoons$ B_Bfa1P4	
3	R3	R3: Rev. SPB-association of Cdc5-phosphorylated Bfa1	Bfa1P5 + SPB_B $\rightleftharpoons$ B_Bfa1P5	
4	R4	R4: Rev. SPB-association of Bfa1-Tem1GTP complex	Bfa1_Tem1GTP + SPB_B $\rightleftharpoons$ B_Bfa1_Tem1GTP	
5	R5	R5: Rev. SPB-association of Kin4-phosphorylated Bfa1-Tem1GTP complex	Bfa1P4_Tem1GTP + SPB_B $\rightleftharpoons$ B_Bfa1P4_Tem1GTP	
6	R6	R6: Rev. SPB-association of Cdc5-phosphorylated Bfa1-Tem1GTP complex	Bfa1P5_Tem1GTP + SPB_B $\rightleftharpoons$ B_Bfa1P5_Tem1GTP	
7	R7	R7: Rev. SPB-association of Bfa1-Tem1GDP complex	Bfa1_Tem1GDP + SPB_B $\rightleftharpoons$ B_Bfa1_Tem1GDP	
8	R8	R8: Rev. SPB-association of Kin4 phosphorylated Bfa1-Tem1GDP complex	Bfa1P4_Tem1GDP + SPB_B $\rightleftharpoons$ B_Bfa1P4_Tem1GDP	
9	R9	R9: Rev. SPB-association of Cdc5-phosphorylated Bfa1-Tem1GDP complex	Bfa1P5_Tem1GDP + SPB_B $\rightleftharpoons$ B_Bfa1P5_Tem1GDP	
10	R10	R10: Rev. association of Tem1GTP with SPB-bound Bfa1	Tem1GTP + B_Bfa1 $\rightleftharpoons$ B_Bfa1_Tem1GTP	
11	R11	R11: Rev. association of Tem1GTP with SPB-bound Kin4-phosphorylated Bfa1	Tem1GTP + B_Bfa1P4 $\rightleftharpoons$ B_Bfa1P4_Tem1GTP	
12	R12	R12: Rev. association of Tem1GTP with SPB-bound Cdc5-phosphorylated Bfa1	Tem1GTP + B_Bfa1P5 $\rightleftharpoons$ B_Bfa1P5_Tem1GTP	

№	Id	Name	Reaction Equation	SBO
13	R13	R13: Rev. association of Tem1GDP with SPB-bound Bfa1	Tem1GDP + B_Bfa1 $\rightleftharpoons$ B_Bfa1_Tem1GDP	
14	R14	R14: Rev. association of Tem1GDP with SPB-bound Kin4-phosphorylated Bfa1	Tem1GDP + B_Bfa1P4 $\rightleftharpoons$ B_Bfa1P4_Tem1GDP	
15	R15	R15: Rev. association of Tem1GDP with SPB-bound Cdc5-phosphorylated Bfa1	Tem1GDP + B_Bfa1P5 $\rightleftharpoons$ B_Bfa1P5_Tem1GDP	
16	R16	R16: Rev. association of Tem1GTP with Bfa1	Bfa1 + Tem1GTP $\rightleftharpoons$ Bfa1_Tem1GTP	
17	R17	R17: Rev. association of Tem1GTP with Kin4-phosphorylated Bfa1	Bfa1P4 + Tem1GTP $\rightleftharpoons$ Bfa1P4_Tem1GTP	
18	R18	R18: Rev. association of Tem1GTP with Cdc5-phosphorylated Bfa1	Bfa1P5 + Tem1GTP $\rightleftharpoons$ Bfa1P5_Tem1GTP	
19	R19	R19: Rev. association of Tem1GDP with Bfa1	Bfa1 + Tem1GDP $\rightleftharpoons$ Bfa1_Tem1GDP	
20	R20	R20: Rev. association of Tem1GDP with Kin4-phosphorylated Bfa1	Bfa1P4 + Tem1GDP $\rightleftharpoons$ Bfa1P4_Tem1GDP	
21	R21	R21: Rev. association of Tem1GDP with Cdc5-phosphorylated Bfa1	Bfa1P5 + Tem1GDP $\rightleftharpoons$ Bfa1P5_Tem1GDP	
22	R22	R22: Rev. SPB-association of Tem1GTP	Tem1GTP + SPB_T $\rightleftharpoons$ T_Tem1GTP	
23	R23	R23: Rev. SPB-association of Tem1GDP	Tem1GDP + SPB_T $\rightleftharpoons$ T_Tem1GDP	
24	R24	R24: Phosphorylation of SPB-bound Bfa1 by Kin4	B_Bfa1 $\longrightarrow$ B_Bfa1P4	
25	R25	R25: Phosphorylation of SPB-bound Bfa1:Tem1GTP by Kin4	B_Bfa1_Tem1GTP $\longrightarrow$ B_Bfa1P4_Tem1GTP	
26	R26	R26: Phosphorylation of SPB-bound Bfa1:Tem1GDP by Kin4	B_Bfa1_Tem1GDP $\longrightarrow$ B_Bfa1P4_Tem1GDP	
27	R27	R27: Phosphorylation of SPB-bound Bfa1 by Cdc5	B_Bfa1 $\longrightarrow$ B_Bfa1P5	
28	R28	R28: Phosphorylation of SPB-bound Bfa1:Tem1GTP by Cdc5	B_Bfa1_Tem1GTP $\longrightarrow$ B_Bfa1P5_Tem1GTP	

№	Id	Name	Reaction Equation	SBO
29	R29	R29: Phosphorylation of SPB-bound Bfa1:Tem1GDP by Cdc5	B_Bfa1_Tem1GDP ⟶ B_Bfa1P5_Tem1GDP	
30	R47	R47: GAP-accelerated GTP-hydrolysis	B_Bfa1P4_Tem1GTP ⟶ B_Bfa1P4_Tem1GDP	
31	R46	R46: GAP-accelerated GTP-hydrolysis	B_Bfa1_Tem1GTP ⟶ B_Bfa1_Tem1GDP	
32	R48	R48: GTP-hydrolysis with intrinisc GTPase activity	B_Bfa1P5_Tem1GTP ⟶ B_Bfa1P5_Tem1GDP	
33	R30	R30: Phosphorylation of Bfa1 by cytosolic Kin4	Bfa1 ⟶ Bfa1P4	
34	R33	R33: Dephosphorylation of Bfa1 by a yet unidentified phosphatase counteracting Kin4	Bfa1P4 ⟶ Bfa1	
35	R36	R36: Dephosphorylation of Cdc5-phosphorylated Bfa1 presumably by PP2A	Bfa1P5 ⟶ Bfa1	
36	R40	R40: GDP- for GTP nucleotide exchange	Tem1GDP ⟶ Tem1GTP	
37	R39	R39: GTP-hydrolysis with intrinisc GTPase activity	Tem1GTP ⟶ Tem1GDP	
38	R42	R42: GDP- for GTP nucleotide exchange	T_Tem1GDP ⟶ T_Tem1GTP	
39	R41	R41: GTP-hydrolysis with intrinisc GTPase activity	T_Tem1GTP ⟶ T_Tem1GDP	
40	R44	R44: GAP-accelerated GTP-hydrolysis	Bfa1P4_Tem1GTP ⟶ Bfa1P4_Tem1GDP	
41	R43	R43: GAP-accelerated GTP-hydrolysis	Bfa1_Tem1GTP ⟶ Bfa1_Tem1GDP	
42	R45	R45: GTP-hydrolysis with intrinisc GTPase activity	Bfa1P5_Tem1GTP ⟶ Bfa1P5_Tem1GDP	
43	R34	R34: Dephosphorylation of Bfa1 by a yet unidentified phosphatase counteracting Kin4	Bfa1P4_Tem1GTP ⟶ Bfa1_Tem1GTP	
44	R37	R37: Dephosphorylation of Cdc5-phosphorylated Bfa1 presumably by PP2A	Bfa1P5_Tem1GTP ⟶ Bfa1_Tem1GTP	
45	R31	R31: Phosphorylation of Bfa1:Tem1GTP by cytosolic Kin4	Bfa1_Tem1GTP ⟶ Bfa1P4_Tem1GTP	

№	Id	Name	Reaction Equation	SBO
46	R35	R35: Dephosphorylation of Bfa1 by a yet unidentified phosphatase counteracting Kin4	Bfa1P4_Tem1GDP ⟶ Bfa1_Tem1GDP	
47	R38	R38: Dephosphorylation of Cdc5-phosphorylated Bfa1 presumably by PP2A	Bfa1P5_Tem1GDP ⟶ Bfa1_Tem1GDP	
48	R32	R32: Phosphorylation of Bfa1:Tem1GDP by cytosolic Kin4	Bfa1_Tem1GDP ⟶ Bfa1P4_Tem1GDP	

8.1 Reaction R1

This is a reversible reaction of two reactants forming one product.

Name R1: Rev. SPB-association of Bfa1

Reaction equation

$$\mathrm{SPB\_B} + \mathrm{Bfa1} \rightleftharpoons \mathrm{B\_Bfa1} \tag{15}$$

Reactants

Table 6: Properties of each reactant.

Id	Name	SBO
SPB_B	B	
Bfa1	Bfa1	

Product

Table 7: Properties of each product.

Id	Name	SBO
B_Bfa1	B-Bfa1	

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{mol}$

$$v_1 = \mathrm{vol}(\mathrm{c3}) \cdot (\mathrm{konB} \cdot [\mathrm{SPB\_B}] \cdot [\mathrm{Bfa1}] - \mathrm{koffB} \cdot [\mathrm{B\_Bfa1}]) \tag{16}$$

8.2 Reaction R2

This is a reversible reaction of two reactants forming one product.

Name R2: Rev. SPB-association of Kin4-phosphorylated Bfa1

Reaction equation

$$\mathrm{Bfa1P4} + \mathrm{SPB\_B} \rightleftharpoons \mathrm{B\_Bfa1P4} \tag{17}$$

Reactants

Table 8: Properties of each reactant.

Id	Name	SBO
Bfa1P4	Bfa1P4	
SPB_B	B	

Product

Table 9: Properties of each product.

Id	Name	SBO
B_Bfa1P4	B-Bfa1P4	

Kinetic Law

Derived unit $s^{-1} \cdot mol$

$$v_2 = \mathrm{vol}(c3) \cdot (\mathrm{konB4} \cdot [\mathrm{SPB\_B}] \cdot [\mathrm{Bfa1P4}] - \mathrm{koffB4} \cdot [\mathrm{B\_Bfa1P4}]) \tag{18}$$

8.3 Reaction R3

This is a reversible reaction of two reactants forming one product.

Name R3: Rev. SPB-association of Cdc5-phosphorylated Bfa1

Reaction equation

$$\mathrm{Bfa1P5} + \mathrm{SPB\_B} \rightleftharpoons \mathrm{B\_Bfa1P5} \tag{19}$$

Reactants

Table 10: Properties of each reactant.

Id	Name	SBO
Bfa1P5	Bfa1P5	
SPB_B	B	

Product

Table 11: Properties of each product.

Id	Name	SBO
B_Bfa1P5	B-Bfa1P5	

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{mol}$

$$v_3 = \mathrm{vol}(\mathrm{c3}) \cdot (\mathrm{konB} \cdot [\mathrm{SPB\_B}] \cdot [\mathrm{Bfa1P5}] - \mathrm{koffB} \cdot [\mathrm{B\_Bfa1P5}]) \tag{20}$$

8.4 Reaction R4

This is a reversible reaction of two reactants forming one product.

Name R4: Rev. SPB-association of Bfa1-Tem1GTP complex

Reaction equation

$$\mathrm{Bfa1\_Tem1GTP} + \mathrm{SPB\_B} \rightleftharpoons \mathrm{B\_Bfa1\_Tem1GTP} \tag{21}$$

Reactants

Table 12: Properties of each reactant.

Id	Name	SBO
Bfa1_Tem1GTP	Bfa1-Tem1GTP	
SPB_B	B	

Product

Table 13: Properties of each product.

Id	Name	SBO
B_Bfa1_Tem1GTP	B-Bfa1-Tem1GTP	

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{mol}$

$$v_4 = \mathrm{vol}(\mathrm{c3}) \cdot (\mathrm{konB} \cdot [\mathrm{SPB\_B}] \cdot [\mathrm{Bfa1\_Tem1GTP}] - \mathrm{koffB} \cdot [\mathrm{B\_Bfa1\_Tem1GTP}]) \tag{22}$$

8.5 Reaction R5

This is a reversible reaction of two reactants forming one product.

Name R5: Rev. SPB-association of Kin4-phosphorylated Bfa1-Tem1GTP complex

Reaction equation

$$\text{Bfa1P4\_Tem1GTP} + \text{SPB\_B} \rightleftharpoons \text{B\_Bfa1P4\_Tem1GTP} \tag{23}$$

Reactants

Table 14: Properties of each reactant.

Id	Name	SBO
Bfa1P4_Tem1GTP	Bfa1P4-Tem1GTP	
SPB_B	B	

Product

Table 15: Properties of each product.

Id	Name	SBO
B_Bfa1P4_Tem1GTP	B-Bfa1P4-Tem1GTP	

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{mol}$

$$v_5 = \mathrm{vol}(\mathrm{c3}) \cdot (\mathrm{konB4} \cdot [\mathrm{Bfa1P4\_Tem1GTP}] \cdot [\mathrm{SPB\_B}] - \mathrm{koffB4} \cdot [\mathrm{B\_Bfa1P4\_Tem1GTP}]) \tag{24}$$

8.6 Reaction R6

This is a reversible reaction of two reactants forming one product.

Name R6: Rev. SPB-association of Cdc5-phosphorylated Bfa1-Tem1GTP complex

Reaction equation

$$\text{Bfa1P5\_Tem1GTP} + \text{SPB\_B} \rightleftharpoons \text{B\_Bfa1P5\_Tem1GTP} \tag{25}$$

Reactants

Table 16: Properties of each reactant.

Id	Name	SBO
Bfa1P5_Tem1GTP	Bfa1P5-Tem1GTP	
SPB_B	B	

Product

Table 17: Properties of each product.

Id	Name	SBO
B_Bfa1P5_Tem1GTP	B-Bfa1P5-Tem1GTP	

Kinetic Law

Derived unit $s^{-1} \cdot mol$

$$v_6 = \mathrm{vol}(c3) \cdot (\mathrm{konB} \cdot [\mathrm{SPB\_B}] \cdot [\mathrm{Bfa1P5\_Tem1GTP}] - \mathrm{koffB} \cdot [\mathrm{B\_Bfa1P5\_Tem1GTP}]) \quad (26)$$

8.7 Reaction R7

This is a reversible reaction of two reactants forming one product.

Name R7: Rev. SPB-association of Bfa1-Tem1GDP complex

Reaction equation

$$\mathrm{Bfa1\_Tem1GDP} + \mathrm{SPB\_B} \rightleftharpoons \mathrm{B\_Bfa1\_Tem1GDP} \quad (27)$$

Reactants

Table 18: Properties of each reactant.

Id	Name	SBO
Bfa1_Tem1GDP	Bfa1-Tem1GDP	
SPB_B	B	

Product

Table 19: Properties of each product.

Id	Name	SBO
B_Bfa1_Tem1GDP	B-Bfa1-Tem1GDP	

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{mol}$

$$v_7 = \mathrm{vol}(\mathrm{c3}) \cdot (\mathrm{konB} \cdot [\mathrm{SPB\_B}] \cdot [\mathrm{Bfa1\_Tem1GDP}] - \mathrm{koffB} \cdot [\mathrm{B\_Bfa1\_Tem1GDP}]) \quad (28)$$

8.8 Reaction R8

This is a reversible reaction of two reactants forming one product.

Name R8: Rev. SPB-association of Kin4 phosphorylated Bfa1-Tem1GDP complex

Reaction equation

$$\mathrm{Bfa1P4\_Tem1GDP} + \mathrm{SPB\_B} \rightleftharpoons \mathrm{B\_Bfa1P4\_Tem1GDP} \quad (29)$$

Reactants

Table 20: Properties of each reactant.

Id	Name	SBO
Bfa1P4_Tem1GDP	Bfa1P4-Tem1GDP	
SPB_B	B	

Product

Table 21: Properties of each product.

Id	Name	SBO
B_Bfa1P4_Tem1GDP	B-Bfa1P4-Tem1GDP	

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{mol}$

$$v_8 = \mathrm{vol}(\mathrm{c3}) \cdot (\mathrm{konB4} \cdot [\mathrm{SPB\_B}] \cdot [\mathrm{Bfa1P4\_Tem1GDP}] - \mathrm{koffB4} \cdot [\mathrm{B\_Bfa1P4\_Tem1GDP}]) \quad (30)$$

8.9 Reaction R9

This is a reversible reaction of two reactants forming one product.

Name R9: Rev. SPB-association of Cdc5-phosphorylated Bfa1-Tem1GDP complex

Reaction equation

$$\text{Bfa1P5\_Tem1GDP} + \text{SPB\_B} \rightleftharpoons \text{B\_Bfa1P5\_Tem1GDP} \tag{31}$$

Reactants

Table 22: Properties of each reactant.

Id	Name	SBO
Bfa1P5_Tem1GDP	Bfa1P5-Tem1GDP	
SPB_B	B	

Product

Table 23: Properties of each product.

Id	Name	SBO
B_Bfa1P5_Tem1GDP	B-Bfa1P5-Tem1GDP	

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{mol}$

$$v_9 = \mathrm{vol}(\mathrm{c3}) \cdot (\mathrm{konB} \cdot [\mathrm{SPB\_B}] \cdot [\mathrm{Bfa1P5\_Tem1GDP}] - \mathrm{koffB} \cdot [\mathrm{B\_Bfa1P5\_Tem1GDP}]) \tag{32}$$

8.10 Reaction R10

This is a reversible reaction of two reactants forming one product.

Name R10: Rev. association of Tem1GTP with SPB-bound Bfa1

Reaction equation

$$\text{Tem1GTP} + \text{B\_Bfa1} \rightleftharpoons \text{B\_Bfa1\_Tem1GTP} \tag{33}$$

Reactants

Table 24: Properties of each reactant.

Id	Name	SBO
Tem1GTP	Tem1GTP	
B_Bfa1	B-Bfa1	

Product

Table 25: Properties of each product.

Id	Name	SBO
B_Bfa1_Tem1GTP	B-Bfa1-Tem1GTP	

Kinetic Law

Derived unit $s^{-1} \cdot mol$

$$v_{10} = \mathrm{vol}(c3) \cdot (\mathrm{konBT} \cdot [\mathrm{B\_Bfa1}] \cdot [\mathrm{Tem1GTP}] - \mathrm{koffBT} \cdot [\mathrm{B\_Bfa1\_Tem1GTP}]) \quad (34)$$

8.11 Reaction R11

This is a reversible reaction of two reactants forming one product.

Name R11: Rev. association of Tem1GTP with SPB-bound Kin4-phosphorylated Bfa1

Reaction equation

$$\mathrm{Tem1GTP} + \mathrm{B\_Bfa1P4} \rightleftharpoons \mathrm{B\_Bfa1P4\_Tem1GTP} \quad (35)$$

Reactants

Table 26: Properties of each reactant.

Id	Name	SBO
Tem1GTP	Tem1GTP	
B_Bfa1P4	B-Bfa1P4	

Product

Table 27: Properties of each product.

Id	Name	SBO
B_Bfa1P4_Tem1GTP	B-Bfa1P4-Tem1GTP	

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{mol}$

$$v_{11} = \mathrm{vol}(\mathrm{c3}) \cdot (\mathrm{konB4T} \cdot [\mathrm{B\_Bfa1P4}] \cdot [\mathrm{Tem1GTP}] - \mathrm{koffBT} \cdot [\mathrm{B\_Bfa1P4\_Tem1GTP}]) \quad (36)$$

8.12 Reaction R12

This is a reversible reaction of two reactants forming one product.

Name R12: Rev. association of Tem1GTP with SPB-bound Cdc5-phosphorylated Bfa1

Reaction equation

$$\mathrm{Tem1GTP} + \mathrm{B\_Bfa1P5} \rightleftharpoons \mathrm{B\_Bfa1P5\_Tem1GTP} \quad (37)$$

Reactants

Table 28: Properties of each reactant.

Id	Name	SBO
Tem1GTP	Tem1GTP	
B_Bfa1P5	B-Bfa1P5	

Product

Table 29: Properties of each product.

Id	Name	SBO
B_Bfa1P5_Tem1GTP	B-Bfa1P5-Tem1GTP	

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{mol}$

$$v_{12} = \mathrm{vol}(\mathrm{c3}) \cdot (\mathrm{konB5T} \cdot [\mathrm{B\_Bfa1P5}] \cdot [\mathrm{Tem1GTP}] - \mathrm{koffBT} \cdot [\mathrm{B\_Bfa1P5\_Tem1GTP}]) \quad (38)$$

8.13 Reaction R13

This is a reversible reaction of two reactants forming one product.

Name R13: Rev. association of Tem1GDP with SPB-bound Bfa1

Reaction equation

$$\mathrm{Tem1GDP} + \mathrm{B\_Bfa1} \rightleftharpoons \mathrm{B\_Bfa1\_Tem1GDP} \tag{39}$$

Reactants

Table 30: Properties of each reactant.

Id	Name	SBO
Tem1GDP	Tem1GDP	
B_Bfa1	B-Bfa1	

Product

Table 31: Properties of each product.

Id	Name	SBO
B_Bfa1_Tem1GDP	B-Bfa1-Tem1GDP	

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{mol}$

$$v_{13} = \mathrm{vol}(\mathrm{c3}) \cdot (\mathrm{konBT} \cdot [\mathrm{B\_Bfa1}] \cdot [\mathrm{Tem1GDP}] - \mathrm{koffBT} \cdot [\mathrm{B\_Bfa1\_Tem1GDP}]) \tag{40}$$

8.14 Reaction R14

This is a reversible reaction of two reactants forming one product.

Name R14: Rev. association of Tem1GDP with SPB-bound Kin4-phosphorylated Bfa1

Reaction equation

$$\mathrm{Tem1GDP} + \mathrm{B\_Bfa1P4} \rightleftharpoons \mathrm{B\_Bfa1P4\_Tem1GDP} \tag{41}$$

Reactants

Table 32: Properties of each reactant.

Id	Name	SBO
Tem1GDP	Tem1GDP	
B_Bfa1P4	B-Bfa1P4	

Product

Table 33: Properties of each product.

Id	Name	SBO
B_Bfa1P4_Tem1GDP	B-Bfa1P4-Tem1GDP	

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{mol}$

$$v_{14} = \mathrm{vol}(\mathrm{c3}) \cdot (\mathrm{konB4T} \cdot [\mathrm{B\_Bfa1P4}] \cdot [\mathrm{Tem1GDP}] - \mathrm{koffBT} \cdot [\mathrm{B\_Bfa1P4\_Tem1GDP}]) \quad (42)$$

8.15 Reaction R15

This is a reversible reaction of two reactants forming one product.

Name R15: Rev. association of Tem1GDP with SPB-bound Cdc5-phosphorylated Bfa1

Reaction equation

$$\mathrm{Tem1GDP} + \mathrm{B\_Bfa1P5} \rightleftharpoons \mathrm{B\_Bfa1P5\_Tem1GDP} \quad (43)$$

Reactants

Table 34: Properties of each reactant.

Id	Name	SBO
Tem1GDP	Tem1GDP	
B_Bfa1P5	B-Bfa1P5	

Product

Table 35: Properties of each product.

Id	Name	SBO
B_Bfa1P5_Tem1GDP	B-Bfa1P5-Tem1GDP	

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{mol}$

$$v_{15} = \mathrm{vol}(\mathrm{c3}) \cdot (\mathrm{konB5T} \cdot [\mathrm{B\_Bfa1P5}] \cdot [\mathrm{Tem1GDP}] - \mathrm{koffBT} \cdot [\mathrm{B\_Bfa1P5\_Tem1GDP}]) \quad (44)$$

8.16 Reaction R16

This is a reversible reaction of two reactants forming one product.

Name R16: Rev. association of Tem1GTP with Bfa1

Reaction equation

$$\mathrm{Bfa1} + \mathrm{Tem1GTP} \rightleftharpoons \mathrm{Bfa1\_Tem1GTP} \quad (45)$$

Reactants

Table 36: Properties of each reactant.

Id	Name	SBO
Bfa1	Bfa1	
Tem1GTP	Tem1GTP	

Product

Table 37: Properties of each product.

Id	Name	SBO
Bfa1_Tem1GTP	Bfa1-Tem1GTP	

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{mol}$

$$v_{16} = \mathrm{vol}(\mathrm{c2}) \cdot (\mathrm{alpha} \cdot \mathrm{konBT} \cdot [\mathrm{Bfa1}] \cdot [\mathrm{Tem1GTP}] - \mathrm{koffBT} \cdot [\mathrm{Bfa1\_Tem1GTP}]) \quad (46)$$

8.17 Reaction R17

This is a reversible reaction of two reactants forming one product.

Name R17: Rev. association of Tem1GTP with Kin4-phosphorylated Bfa1

Reaction equation

$$\text{Bfa1P4} + \text{Tem1GTP} \rightleftharpoons \text{Bfa1P4\_Tem1GTP} \tag{47}$$

Reactants

Table 38: Properties of each reactant.

Id	Name	SBO
Bfa1P4	Bfa1P4	
Tem1GTP	Tem1GTP	

Product

Table 39: Properties of each product.

Id	Name	SBO
Bfa1P4_Tem1GTP	Bfa1P4-Tem1GTP	

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{mol}$

$$v_{17} = \mathrm{vol}(\mathrm{c2}) \cdot (\mathrm{alpha} \cdot \mathrm{konB4T} \cdot [\mathrm{Bfa1P4}] \cdot [\mathrm{Tem1GTP}] - \mathrm{koffBT} \cdot [\mathrm{Bfa1P4\_Tem1GTP}]) \tag{48}$$

8.18 Reaction R18

This is a reversible reaction of two reactants forming one product.

Name R18: Rev. association of Tem1GTP with Cdc5-phosphorylated Bfa1

Reaction equation

$$\text{Bfa1P5} + \text{Tem1GTP} \rightleftharpoons \text{Bfa1P5\_Tem1GTP} \tag{49}$$

Reactants

Table 40: Properties of each reactant.

Id	Name	SBO
Bfa1P5	Bfa1P5	
Tem1GTP	Tem1GTP	

Product

Table 41: Properties of each product.

Id	Name	SBO
Bfa1P5_Tem1GTP	Bfa1P5-Tem1GTP	

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{mol}$

$$v_{18} = \mathrm{vol}(\mathrm{c2}) \cdot (\mathrm{alpha} \cdot \mathrm{konB5T} \cdot [\mathrm{Bfa1P5}] \cdot [\mathrm{Tem1GTP}] - \mathrm{koffBT} \cdot [\mathrm{Bfa1P5\_Tem1GTP}]) \quad (50)$$

8.19 Reaction R19

This is a reversible reaction of two reactants forming one product.

Name R19: Rev. association of Tem1GDP with Bfa1

Reaction equation

$$\mathrm{Bfa1} + \mathrm{Tem1GDP} \rightleftharpoons \mathrm{Bfa1\_Tem1GDP} \quad (51)$$

Reactants

Table 42: Properties of each reactant.

Id	Name	SBO
Bfa1	Bfa1	
Tem1GDP	Tem1GDP	

Product

Table 43: Properties of each product.

Id	Name	SBO
Bfa1_Tem1GDP	Bfa1-Tem1GDP	

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{mol}$

$$v_{19} = \mathrm{vol}(\mathrm{c2}) \cdot (\mathrm{alpha} \cdot \mathrm{konBT} \cdot [\mathrm{Bfa1}] \cdot [\mathrm{Tem1GDP}] - \mathrm{koffBT} \cdot [\mathrm{Bfa1\_Tem1GDP}]) \quad (52)$$

8.20 Reaction R20

This is a reversible reaction of two reactants forming one product.

Name R20: Rev. association of Tem1GDP with Kin4-phosphorylated Bfa1

Reaction equation

$$\mathrm{Bfa1P4} + \mathrm{Tem1GDP} \rightleftharpoons \mathrm{Bfa1P4\_Tem1GDP} \quad (53)$$

Reactants

Table 44: Properties of each reactant.

Id	Name	SBO
Bfa1P4	Bfa1P4	
Tem1GDP	Tem1GDP	

Product

Table 45: Properties of each product.

Id	Name	SBO
Bfa1P4_Tem1GDP	Bfa1P4-Tem1GDP	

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{mol}$

$$v_{20} = \mathrm{vol}(\mathrm{c2}) \cdot (\mathrm{alpha} \cdot \mathrm{konB4T} \cdot [\mathrm{Bfa1P4}] \cdot [\mathrm{Tem1GDP}] - \mathrm{koffBT} \cdot [\mathrm{Bfa1P4\_Tem1GDP}]) \quad (54)$$

8.21 Reaction R21

This is a reversible reaction of two reactants forming one product.

Name R21: Rev. association of Tem1GDP with Cdc5-phosphorylated Bfa1

Reaction equation

$$\text{Bfa1P5} + \text{Tem1GDP} \rightleftharpoons \text{Bfa1P5\_Tem1GDP} \tag{55}$$

Reactants

Table 46: Properties of each reactant.

Id	Name	SBO
Bfa1P5	Bfa1P5	
Tem1GDP	Tem1GDP	

Product

Table 47: Properties of each product.

Id	Name	SBO
Bfa1P5_Tem1GDP	Bfa1P5-Tem1GDP	

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{mol}$

$$v_{21} = \mathrm{vol}(\mathrm{c2}) \cdot (\mathrm{alpha} \cdot \mathrm{konB5T} \cdot [\mathrm{Bfa1P5}] \cdot [\mathrm{Tem1GDP}] - \mathrm{koffBT} \cdot [\mathrm{Bfa1P5\_Tem1GDP}]) \tag{56}$$

8.22 Reaction R22

This is a reversible reaction of two reactants forming one product.

Name R22: Rev. SPB-association of Tem1GTP

Reaction equation

$$\text{Tem1GTP} + \text{SPB\_T} \rightleftharpoons \text{T\_Tem1GTP} \tag{57}$$

Reactants

Table 48: Properties of each reactant.

Id	Name	SBO
Tem1GTP	Tem1GTP	
SPB_T	T	

Product

Table 49: Properties of each product.

Id	Name	SBO
T_Tem1GTP	T-Tem1GTP	

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{mol}$

$$v_{22} = \mathrm{vol}(\mathrm{c3}) \cdot (\mathrm{konT} \cdot [\mathrm{SPB\_T}] \cdot [\mathrm{Tem1GTP}] - \mathrm{koffT} \cdot [\mathrm{T\_Tem1GTP}]) \tag{58}$$

8.23 Reaction R23

This is a reversible reaction of two reactants forming one product.

Name R23: Rev. SPB-association of Tem1GDP

Reaction equation

$$\mathrm{Tem1GDP} + \mathrm{SPB\_T} \rightleftharpoons \mathrm{T\_Tem1GDP} \tag{59}$$

Reactants

Table 50: Properties of each reactant.

Id	Name	SBO
Tem1GDP	Tem1GDP	
SPB_T	T	

Product

Table 51: Properties of each product.

Id	Name	SBO
T_Tem1GDP	T-Tem1GDP	

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{mol}$

$$v_{23} = \mathrm{vol}(\mathrm{c3}) \cdot (\mathrm{konT} \cdot [\mathrm{SPB\_T}] \cdot [\mathrm{Tem1GDP}] - \mathrm{koffT} \cdot [\mathrm{T\_Tem1GDP}]) \tag{60}$$

8.24 Reaction R24

This is an irreversible reaction of one reactant forming one product.

Name R24: Phosphorylation of SPB-bound Bfa1 by Kin4

Reaction equation

$$\mathrm{B\_Bfa1} \longrightarrow \mathrm{B\_Bfa1P4} \tag{61}$$

Reactant

Table 52: Properties of each reactant.

Id	Name	SBO
B_Bfa1	B-Bfa1	

Product

Table 53: Properties of each product.

Id	Name	SBO
B_Bfa1P4	B-Bfa1P4	

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{mol}$

$$v_{24} = \mathrm{vol}(\mathrm{c3}) \cdot \mathrm{u} \cdot \mathrm{kfKin4} \cdot [\mathrm{B\_Bfa1}] \tag{62}$$

8.25 Reaction R25

This is an irreversible reaction of one reactant forming one product.

Name R25: Phosphorylation of SPB-bound Bfa1:Tem1GTP by Kin4

Reaction equation

$$\text{B\_Bfa1\_Tem1GTP} \longrightarrow \text{B\_Bfa1P4\_Tem1GTP} \tag{63}$$

Reactant

Table 54: Properties of each reactant.

Id	Name	SBO
B_Bfa1_Tem1GTP	B-Bfa1-Tem1GTP	

Product

Table 55: Properties of each product.

Id	Name	SBO
B_Bfa1P4_Tem1GTP	B-Bfa1P4-Tem1GTP	

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{mol}$

$$v_{25} = \mathrm{vol}(\mathrm{c3}) \cdot \mathrm{u} \cdot \mathrm{kfKin4} \cdot [\text{B\_Bfa1\_Tem1GTP}] \tag{64}$$

8.26 Reaction R26

This is an irreversible reaction of one reactant forming one product.

Name R26: Phosphorylation of SPB-bound Bfa1:Tem1GDP by Kin4

Reaction equation

$$\text{B\_Bfa1\_Tem1GDP} \longrightarrow \text{B\_Bfa1P4\_Tem1GDP} \tag{65}$$

Reactant

Table 56: Properties of each reactant.

Id	Name	SBO
B_Bfa1_Tem1GDP	B-Bfa1-Tem1GDP	

Product

Table 57: Properties of each product.

Id	Name	SBO
B_Bfa1P4_Tem1GDP	B-Bfa1P4-Tem1GDP	

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{mol}$

$$v_{26} = \mathrm{vol}\,(\mathrm{c3}) \cdot \mathrm{u} \cdot \mathrm{kfKin4} \cdot [\mathrm{B\_Bfa1\_Tem1GDP}] \tag{66}$$

8.27 Reaction R27

This is an irreversible reaction of one reactant forming one product.

Name R27: Phosphorylation of SPB-bound Bfa1 by Cdc5

Reaction equation

$$\mathrm{B\_Bfa1} \longrightarrow \mathrm{B\_Bfa1P5} \tag{67}$$

Reactant

Table 58: Properties of each reactant.

Id	Name	SBO
B_Bfa1	B-Bfa1	

Product

Table 59: Properties of each product.

Id	Name	SBO
B_Bfa1P5	B-Bfa1P5	

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{mol}$

$$v_{27} = \mathrm{vol}\,(\mathrm{c3}) \cdot \mathrm{kfCdc5} \cdot [\mathrm{B\_Bfa1}] \tag{68}$$

8.28 Reaction R28

This is an irreversible reaction of one reactant forming one product.

Name R28: Phosphorylation of SPB-bound Bfa1:Tem1GTP by Cdc5

Reaction equation

$$\mathrm{B\_Bfa1\_Tem1GTP} \longrightarrow \mathrm{B\_Bfa1P5\_Tem1GTP} \tag{69}$$

Reactant

Table 60: Properties of each reactant.

Id	Name	SBO
B_Bfa1_Tem1GTP	B-Bfa1-Tem1GTP	

Product

Table 61: Properties of each product.

Id	Name	SBO
B_Bfa1P5_Tem1GTP	B-Bfa1P5-Tem1GTP	

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{mol}$

$$v_{28} = \mathrm{vol}\,(\mathrm{c3}) \cdot \mathrm{kfCdc5} \cdot [\mathrm{B\_Bfa1\_Tem1GTP}] \tag{70}$$

8.29 Reaction R29

This is an irreversible reaction of one reactant forming one product.

Name R29: Phosphorylation of SPB-bound Bfa1:Tem1GDP by Cdc5

Reaction equation

$$\mathrm{B\_Bfa1\_Tem1GDP} \longrightarrow \mathrm{B\_Bfa1P5\_Tem1GDP} \tag{71}$$

Reactant

Table 62: Properties of each reactant.

Id	Name	SBO
B_Bfa1_Tem1GDP	B-Bfa1-Tem1GDP	

Product

Table 63: Properties of each product.

Id	Name	SBO
B_Bfa1P5_Tem1GDP	B-Bfa1P5-Tem1GDP	

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{mol}$

$$v_{29} = \mathrm{vol}(\mathrm{c3}) \cdot \mathrm{kfCdc5} \cdot [\mathrm{B\_Bfa1\_Tem1GDP}] \tag{72}$$

8.30 Reaction R47

This is an irreversible reaction of one reactant forming one product.

Name R47: GAP-accelerated GTP-hydrolysis

Reaction equation

$$\mathrm{B\_Bfa1P4\_Tem1GTP} \longrightarrow \mathrm{B\_Bfa1P4\_Tem1GDP} \tag{73}$$

Reactant

Table 64: Properties of each reactant.

Id	Name	SBO
B_Bfa1P4_Tem1GTP	B-Bfa1P4-Tem1GTP	

Product

Table 65: Properties of each product.

Id	Name	SBO
B_Bfa1P4_Tem1GDP	B-Bfa1P4-Tem1GDP	

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{mol}$

$$v_{30} = \mathrm{vol}(\mathrm{c3}) \cdot \mathrm{khydB4T} \cdot [\mathrm{B\_Bfa1P4\_Tem1GTP}] \tag{74}$$

8.31 Reaction R46

This is an irreversible reaction of one reactant forming one product.

Name R46: GAP-accelerated GTP-hydrolysis

Reaction equation

$$\mathrm{B\_Bfa1\_Tem1GTP} \longrightarrow \mathrm{B\_Bfa1\_Tem1GDP} \tag{75}$$

Reactant

Table 66: Properties of each reactant.

Id	Name	SBO
B_Bfa1_Tem1GTP	B-Bfa1-Tem1GTP	

Product

Table 67: Properties of each product.

Id	Name	SBO
B_Bfa1_Tem1GDP	B-Bfa1-Tem1GDP	

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{mol}$

$$v_{31} = \mathrm{vol}(\mathrm{c3}) \cdot \mathrm{khydBT} \cdot [\mathrm{B\_Bfa1\_Tem1GTP}] \tag{76}$$

8.32 Reaction R48

This is an irreversible reaction of one reactant forming one product.

Name R48: GTP-hydrolysis with intrinisc GTPase activity

Reaction equation

$$\text{B\_Bfa1P5\_Tem1GTP} \longrightarrow \text{B\_Bfa1P5\_Tem1GDP} \tag{77}$$

Reactant

Table 68: Properties of each reactant.

Id	Name	SBO
B_Bfa1P5_Tem1GTP	B-Bfa1P5-Tem1GTP	

Product

Table 69: Properties of each product.

Id	Name	SBO
B_Bfa1P5_Tem1GDP	B-Bfa1P5-Tem1GDP	

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{mol}$

$$v_{32} = \mathrm{vol}(\mathrm{c3}) \cdot \mathrm{khyd} \cdot [\text{B\_Bfa1P5\_Tem1GTP}] \tag{78}$$

8.33 Reaction R30

This is an irreversible reaction of one reactant forming one product.

Name R30: Phosphorylation of Bfa1 by cytosolic Kin4

Reaction equation

$$\text{Bfa1} \longrightarrow \text{Bfa1P4} \tag{79}$$

Reactant

Table 70: Properties of each reactant.

Id	Name	SBO
Bfa1	Bfa1	

Product

Table 71: Properties of each product.

Id	Name	SBO
Bfa1P4	Bfa1P4	

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{mol}$

$$v_{33} = \mathrm{vol}\,(\mathrm{c2}) \cdot \mathrm{u} \cdot \mathrm{kfKin4Cyto} \cdot [\mathrm{Bfa1}] \tag{80}$$

8.34 Reaction R33

This is an irreversible reaction of one reactant forming one product.

Name R33: Dephosphorylation of Bfa1 by a yet unidentified phosphatase counteracting Kin4

Reaction equation

$$\mathrm{Bfa1P4} \longrightarrow \mathrm{Bfa1} \tag{81}$$

Reactant

Table 72: Properties of each reactant.

Id	Name	SBO
Bfa1P4	Bfa1P4	

Product

Table 73: Properties of each product.

Id	Name	SBO
Bfa1	Bfa1	

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{mol}$

$$v_{34} = \mathrm{vol}\,(\mathrm{c2}) \cdot \mathrm{krKin4} \cdot [\mathrm{Bfa1P4}] \tag{82}$$

8.35 Reaction R36

This is an irreversible reaction of one reactant forming one product.

Name R36: Dephosphorylation of Cdc5-phosphorylated Bfa1 presumably by PP2A

Reaction equation

$$\mathrm{Bfa1P5} \longrightarrow \mathrm{Bfa1} \tag{83}$$

Reactant

Table 74: Properties of each reactant.

Id	Name	SBO
Bfa1P5	Bfa1P5	

Product

Table 75: Properties of each product.

Id	Name	SBO
Bfa1	Bfa1	

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{mol}$

$$v_{35} = \mathrm{vol}\,(\mathrm{c2}) \cdot \mathrm{u} \cdot \mathrm{krCdc5} \cdot [\mathrm{Bfa1P5}] \tag{84}$$

8.36 Reaction R40

This is an irreversible reaction of one reactant forming one product.

Name R40: GDP- for GTP nucleotide exchange

Reaction equation

$$\mathrm{Tem1GDP} \longrightarrow \mathrm{Tem1GTP} \tag{85}$$

Reactant

Table 76: Properties of each reactant.

Id	Name	SBO
Tem1GDP	Tem1GDP	

Product

Table 77: Properties of each product.

Id	Name	SBO
Tem1GTP	Tem1GTP	

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{mol}$

$$v_{36} = \mathrm{vol}\,(\mathrm{c2}) \cdot \mathrm{knex} \cdot [\mathrm{Tem1GDP}] \tag{86}$$

8.37 Reaction R39

This is an irreversible reaction of one reactant forming one product.

Name R39: GTP-hydrolysis with intrinisc GTPase activity

Reaction equation

$$\mathrm{Tem1GTP} \longrightarrow \mathrm{Tem1GDP} \tag{87}$$

Reactant

Table 78: Properties of each reactant.

Id	Name	SBO
Tem1GTP	Tem1GTP	

Product

Table 79: Properties of each product.

Id	Name	SBO
Tem1GDP	Tem1GDP	

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{mol}$

$$v_{37} = \mathrm{vol}(\mathrm{c2}) \cdot \mathrm{khyd} \cdot [\mathrm{Tem1GTP}] \tag{88}$$

8.38 Reaction R42

This is an irreversible reaction of one reactant forming one product.

Name R42: GDP- for GTP nucleotide exchange

Reaction equation

$$\mathrm{T\_Tem1GDP} \longrightarrow \mathrm{T\_Tem1GTP} \tag{89}$$

Reactant

Table 80: Properties of each reactant.

Id	Name	SBO
T_Tem1GDP	T-Tem1GDP	

Product

Table 81: Properties of each product.

Id	Name	SBO
T_Tem1GTP	T-Tem1GTP	

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{mol}$

$$v_{38} = \mathrm{vol}(\mathrm{c3}) \cdot \mathrm{knex} \cdot [\mathrm{T\_Tem1GDP}] \tag{90}$$

8.39 Reaction R41

This is an irreversible reaction of one reactant forming one product.

Name R41: GTP-hydrolysis with intrinisc GTPase activity

Reaction equation

$$\text{T\_Tem1GTP} \longrightarrow \text{T\_Tem1GDP} \tag{91}$$

Reactant

Table 82: Properties of each reactant.

Id	Name	SBO
T_Tem1GTP	T-Tem1GTP	

Product

Table 83: Properties of each product.

Id	Name	SBO
T_Tem1GDP	T-Tem1GDP	

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{mol}$

$$v_{39} = \mathrm{vol}(\mathrm{c3}) \cdot \mathrm{khyd} \cdot [\text{T\_Tem1GTP}] \tag{92}$$

8.40 Reaction R44

This is an irreversible reaction of one reactant forming one product.

Name R44: GAP-accelerated GTP-hydrolysis

Reaction equation

$$\text{Bfa1P4\_Tem1GTP} \longrightarrow \text{Bfa1P4\_Tem1GDP} \tag{93}$$

Reactant

Table 84: Properties of each reactant.

Id	Name	SBO
Bfa1P4_Tem1GTP	Bfa1P4-Tem1GTP	

Product

Table 85: Properties of each product.

Id	Name	SBO
Bfa1P4_Tem1GDP	Bfa1P4-Tem1GDP	

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{mol}$

$$v_{40} = \mathrm{vol}(\mathrm{c2}) \cdot \mathrm{khydB4T} \cdot [\mathrm{Bfa1P4\_Tem1GTP}] \tag{94}$$

8.41 Reaction R43

This is an irreversible reaction of one reactant forming one product.

Name R43: GAP-accelerated GTP-hydrolysis

Reaction equation

$$\mathrm{Bfa1\_Tem1GTP} \longrightarrow \mathrm{Bfa1\_Tem1GDP} \tag{95}$$

Reactant

Table 86: Properties of each reactant.

Id	Name	SBO
Bfa1_Tem1GTP	Bfa1-Tem1GTP	

Product

Table 87: Properties of each product.

Id	Name	SBO
Bfa1_Tem1GDP	Bfa1-Tem1GDP	

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{mol}$

$$v_{41} = \mathrm{vol}(\mathrm{c2}) \cdot \mathrm{khydBT} \cdot [\mathrm{Bfa1\_Tem1GTP}] \tag{96}$$

8.42 Reaction R45

This is an irreversible reaction of one reactant forming one product.

Name R45: GTP-hydrolysis with intrinisc GTPase activity

Reaction equation

$$\mathrm{Bfa1P5\_Tem1GTP} \longrightarrow \mathrm{Bfa1P5\_Tem1GDP} \tag{97}$$

Reactant

Table 88: Properties of each reactant.

Id	Name	SBO
Bfa1P5_Tem1GTP	Bfa1P5-Tem1GTP	

Product

Table 89: Properties of each product.

Id	Name	SBO
Bfa1P5_Tem1GDP	Bfa1P5-Tem1GDP	

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{mol}$

$$v_{42} = \mathrm{vol}(\mathrm{c2}) \cdot \mathrm{khyd} \cdot [\mathrm{Bfa1P5\_Tem1GTP}] \tag{98}$$

8.43 Reaction R34

This is an irreversible reaction of one reactant forming one product.

Name R34: Dephosphorylation of Bfa1 by a yet unidentified phosphatase counteracting Kin4

Reaction equation

$$\mathrm{Bfa1P4\_Tem1GTP} \longrightarrow \mathrm{Bfa1\_Tem1GTP} \tag{99}$$

Reactant

Table 90: Properties of each reactant.

Id	Name	SBO
Bfa1P4_Tem1GTP	Bfa1P4-Tem1GTP	

Product

Table 91: Properties of each product.

Id	Name	SBO
Bfa1_Tem1GTP	Bfa1-Tem1GTP	

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{mol}$

$$v_{43} = \mathrm{vol}(\mathrm{c2}) \cdot \mathrm{krKin4} \cdot [\mathrm{Bfa1P4\_Tem1GTP}] \tag{100}$$

8.44 Reaction R37

This is an irreversible reaction of one reactant forming one product.

Name R37: Dephosphorylation of Cdc5-phosphorylated Bfa1 presumably by PP2A

Reaction equation

$$\mathrm{Bfa1P5\_Tem1GTP} \longrightarrow \mathrm{Bfa1\_Tem1GTP} \tag{101}$$

Reactant

Table 92: Properties of each reactant.

Id	Name	SBO
Bfa1P5_Tem1GTP	Bfa1P5-Tem1GTP	

Product

Table 93: Properties of each product.

Id	Name	SBO
Bfa1_Tem1GTP	Bfa1-Tem1GTP	

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{mol}$

$$v_{44} = \mathrm{vol}\,(\mathrm{c2}) \cdot \mathrm{u} \cdot \mathrm{krCdc5} \cdot [\mathrm{Bfa1P5\_Tem1GTP}] \tag{102}$$

8.45 Reaction R31

This is an irreversible reaction of one reactant forming one product.

Name R31: Phosphorylation of Bfa1:Tem1GTP by cytosolic Kin4

Reaction equation

$$\mathrm{Bfa1\_Tem1GTP} \longrightarrow \mathrm{Bfa1P4\_Tem1GTP} \tag{103}$$

Reactant

Table 94: Properties of each reactant.

Id	Name	SBO
Bfa1_Tem1GTP	Bfa1-Tem1GTP	

Product

Table 95: Properties of each product.

Id	Name	SBO
Bfa1P4_Tem1GTP	Bfa1P4-Tem1GTP	

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{mol}$

$$v_{45} = \mathrm{vol}\,(\mathrm{c2}) \cdot \mathrm{u} \cdot \mathrm{kfKin4Cyto} \cdot [\mathrm{Bfa1\_Tem1GTP}] \tag{104}$$

8.46 Reaction R35

This is an irreversible reaction of one reactant forming one product.

Name R35: Dephosphorylation of Bfa1 by a yet unidentified phosphatase counteracting Kin4

Reaction equation

$$\text{Bfa1P4\_Tem1GDP} \longrightarrow \text{Bfa1\_Tem1GDP} \tag{105}$$

Reactant

Table 96: Properties of each reactant.

Id	Name	SBO
Bfa1P4_Tem1GDP	Bfa1P4-Tem1GDP	

Product

Table 97: Properties of each product.

Id	Name	SBO
Bfa1_Tem1GDP	Bfa1-Tem1GDP	

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{mol}$

$$v_{46} = \mathrm{vol}(\mathrm{c2}) \cdot \mathrm{krKin4} \cdot [\mathrm{Bfa1P4\_Tem1GDP}] \tag{106}$$

8.47 Reaction R38

This is an irreversible reaction of one reactant forming one product.

Name R38: Dephosphorylation of Cdc5-phosphorylated Bfa1 presumably by PP2A

Reaction equation

$$\text{Bfa1P5\_Tem1GDP} \longrightarrow \text{Bfa1\_Tem1GDP} \tag{107}$$

Reactant

Table 98: Properties of each reactant.

Id	Name	SBO
Bfa1P5_Tem1GDP	Bfa1P5-Tem1GDP	

Product

Table 99: Properties of each product.

Id	Name	SBO
Bfa1_Tem1GDP	Bfa1-Tem1GDP	

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{mol}$

$$v_{47} = \mathrm{vol}\,(\mathrm{c2}) \cdot \mathrm{u} \cdot \mathrm{krCdc5} \cdot [\mathrm{Bfa1P5\_Tem1GDP}] \tag{108}$$

8.48 Reaction R32

This is an irreversible reaction of one reactant forming one product.

Name R32: Phosphorylation of Bfa1:Tem1GDP by cytosolic Kin4

Reaction equation

$$\mathrm{Bfa1\_Tem1GDP} \longrightarrow \mathrm{Bfa1P4\_Tem1GDP} \tag{109}$$

Reactant

Table 100: Properties of each reactant.

Id	Name	SBO
Bfa1_Tem1GDP	Bfa1-Tem1GDP	

Product

Table 101: Properties of each product.

Id	Name	SBO
Bfa1P4_Tem1GDP	Bfa1P4-Tem1GDP	

Kinetic Law

Derived unit $\mathrm{s}^{-1} \cdot \mathrm{mol}$

$$v_{48} = \mathrm{vol}(\mathrm{c2}) \cdot \mathrm{u} \cdot \mathrm{kfKin4Cyto} \cdot [\mathrm{Bfa1\_Tem1GDP}] \tag{110}$$

9 Derived Rate Equations

When interpreted as an ordinary differential equation framework, this model implies the following set of equations for the rates of change of each species.

9.1 Species SPB_B

Name B

Initial concentration $8.33 \cdot 10^{-5}\ \mathrm{mol} \cdot \mathrm{l}^{-1}$

Charge 0

This species takes part in nine reactions (as a reactant in R1, R2, R3, R4, R5, R6, R7, R8, R9).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{SPB\_B} = -v_1 - v_2 - v_3 - v_4 - v_5 - v_6 - v_7 - v_8 - v_9 \tag{111}$$

9.2 Species SPB_T

Name T

Initial concentration $1.66 \cdot 10^{-4}\ \mathrm{mol} \cdot \mathrm{l}^{-1}$

Charge 0

This species takes part in two reactions (as a reactant in R22, R23).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{SPB\_T} = -v_{22} - v_{23} \tag{112}$$

9.3 Species Bfa1

Name Bfa1

Initial concentration $2.03 \cdot 10^{-8}\ \mathrm{mol} \cdot \mathrm{l}^{-1}$

Charge 0

This species takes part in six reactions (as a reactant in R1, R16, R19, R30 and as a product in R33, R36).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Bfa1} = v_{34} + v_{35} - v_1 - v_{16} - v_{19} - v_{33} \tag{113}$$

9.4 Species Bfa1P4

Name Bfa1P4

Initial concentration $0\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

Charge 0

This species takes part in five reactions (as a reactant in R2, R17, R20, R33 and as a product in R30).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Bfa1P4} = v_{33} - v_2 - v_{17} - v_{20} - v_{34} \tag{114}$$

9.5 Species Bfa1P5

Name Bfa1P5

Initial concentration $0\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

Charge 0

This species takes part in four reactions (as a reactant in R3, R18, R21, R36).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Bfa1P5} = -v_3 - v_{18} - v_{21} - v_{35} \tag{115}$$

9.6 Species Tem1GTP

Name Tem1GTP

Initial concentration $4.91\cdot 10^{-8}\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

Charge 0

This species takes part in nine reactions (as a reactant in R10, R11, R12, R16, R17, R18, R22, R39 and as a product in R40).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Tem1GTP} = v_{36} - v_{10} - v_{11} - v_{12} - v_{16} - v_{17} - v_{18} - v_{22} - v_{37} \tag{116}$$

9.7 Species Tem1GDP

Name Tem1GDP

Initial concentration $7.99\cdot 10^{-9}\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

Charge 0

This species takes part in nine reactions (as a reactant in R13, R14, R15, R19, R20, R21, R23, R40 and as a product in R39).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Tem1GDP} = v_{37} - v_{13} - v_{14} - v_{15} - v_{19} - v_{20} - v_{21} - v_{23} - v_{36} \tag{117}$$

9.8 Species B_Bfa1

Name B-Bfa1

Initial concentration $8.33 \cdot 10^{-5}$ mol $\cdot$ l^{-1}

Charge 0

This species takes part in five reactions (as a reactant in R10, R13, R24, R27 and as a product in R1).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{B\_Bfa1} = v_1 - v_{10} - v_{13} - v_{24} - v_{27} \tag{118}$$

9.9 Species B_Bfa1P4

Name B-Bfa1P4

Initial concentration 0 mol $\cdot$ l^{-1}

Charge 0

This species takes part in four reactions (as a reactant in R11, R14 and as a product in R2, R24).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{B\_Bfa1P4} = v_2 + v_{24} - v_{11} - v_{14} \tag{119}$$

9.10 Species B_Bfa1P5

Name B-Bfa1P5

Initial concentration 0 mol $\cdot$ l^{-1}

Charge 0

This species takes part in four reactions (as a reactant in R12, R15 and as a product in R3, R27).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{B\_Bfa1P5} = v_3 + v_{27} - v_{12} - v_{15} \tag{120}$$

9.11 Species T_Tem1GTP

Name T-Tem1GTP

Initial concentration 0 mol $\cdot$ l^{-1}

Charge 0

This species takes part in three reactions (as a reactant in R41 and as a product in R22, R42).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{T\_Tem1GTP} = v_{22} + v_{38} - v_{39} \tag{121}$$

9.12 Species T_Tem1GDP

Name T-Tem1GDP

Initial concentration $0\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

Charge 0

This species takes part in three reactions (as a reactant in R42 and as a product in R23, R41).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{T\_Tem1GDP} = v_{23} + v_{39} - v_{38} \tag{122}$$

9.13 Species B_Bfa1_Tem1GTP

Name B-Bfa1-Tem1GTP

Initial concentration $0\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

Charge 0

This species takes part in five reactions (as a reactant in R25, R28, R46 and as a product in R4, R10).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{B\_Bfa1\_Tem1GTP} = v_4 + v_{10} - v_{25} - v_{28} - v_{31} \tag{123}$$

9.14 Species B_Bfa1P4_Tem1GTP

Name B-Bfa1P4-Tem1GTP

Initial concentration $0\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

Charge 0

This species takes part in four reactions (as a reactant in R47 and as a product in R5, R11, R25).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{B\_Bfa1P4\_Tem1GTP} = v_5 + v_{11} + v_{25} - v_{30} \tag{124}$$

9.15 Species B_Bfa1P5_Tem1GTP

Name B-Bfa1P5-Tem1GTP

Initial concentration $0\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

Charge 0

This species takes part in four reactions (as a reactant in R48 and as a product in R6, R12, R28).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{B\_Bfa1P5\_Tem1GTP} = v_6 + v_{12} + v_{28} - v_{32} \tag{125}$$

9.16 Species B_Bfa1_Tem1GDP

Name B-Bfa1-Tem1GDP

Initial concentration $0\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

Charge 0

This species takes part in five reactions (as a reactant in R26, R29 and as a product in R7, R13, R46).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{B\_Bfa1\_Tem1GDP} = v_7 + v_{13} + v_{31} - v_{26} - v_{29} \tag{126}$$

9.17 Species B_Bfa1P4_Tem1GDP

Name B-Bfa1P4-Tem1GDP

Initial concentration $0\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

Charge 0

This species takes part in four reactions (as a product in R8, R14, R26, R47).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{B\_Bfa1P4\_Tem1GDP} = v_8 + v_{14} + v_{26} + v_{30} \tag{127}$$

9.18 Species B_Bfa1P5_Tem1GDP

Name B-Bfa1P5-Tem1GDP

Initial concentration $0\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

Charge 0

This species takes part in four reactions (as a product in R9, R15, R29, R48).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{B\_Bfa1P5\_Tem1GDP} = v_9 + v_{15} + v_{29} + v_{32} \tag{128}$$

9.19 Species Bfa1_Tem1GTP

Name Bfa1-Tem1GTP

Initial concentration $0\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

Charge 0

This species takes part in six reactions (as a reactant in R4, R43, R31 and as a product in R16, R34, R37).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Bfa1\_Tem1GTP} = v_{16} + v_{43} + v_{44} - v_4 - v_{41} - v_{45} \tag{129}$$

9.20 Species Bfa1P4_Tem1GTP

Name Bfa1P4-Tem1GTP

Initial concentration $0\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

Charge 0

This species takes part in five reactions (as a reactant in R5, R44, R34 and as a product in R17, R31).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Bfa1P4\_Tem1GTP} = v_{17} + v_{45} - v_5 - v_{40} - v_{43} \tag{130}$$

9.21 Species Bfa1P5_Tem1GTP

Name Bfa1P5-Tem1GTP

Initial concentration $0\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

Charge 0

This species takes part in four reactions (as a reactant in R6, R45, R37 and as a product in R18).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Bfa1P5\_Tem1GTP} = v_{18} - v_6 - v_{42} - v_{44} \tag{131}$$

9.22 Species Bfa1_Tem1GDP

Name Bfa1-Tem1GDP

Initial concentration $0\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

Charge 0

This species takes part in six reactions (as a reactant in R7, R32 and as a product in R19, R43, R35, R38).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Bfa1\_Tem1GDP} = v_{19} + v_{41} + v_{46} + v_{47} - v_7 - v_{48} \tag{132}$$

9.23 Species Bfa1P4_Tem1GDP

Name Bfa1P4-Tem1GDP

Initial concentration $0\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

Charge 0

This species takes part in five reactions (as a reactant in R8, R35 and as a product in R20, R44, R32).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Bfa1P4\_Tem1GDP} = v_{20} + v_{40} + v_{48} - v_8 - v_{46} \tag{133}$$

9.24 Species Bfa1P5_Tem1GDP

Name Bfa1P5-Tem1GDP

Initial concentration $0\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

Charge 0

This species takes part in four reactions (as a reactant in R9, R38 and as a product in R21, R45).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Bfa1P5\_Tem1GDP} = v_{21} + v_{42} - v_{9} - v_{47} \tag{134}$$

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