

## SBML Model Report

**Model name: “ODea2007\_IkappaB”**



May 5, 2016

### 1 General Overview

This is a document in SBML Level 2 Version 4 format. This model was created by the following two authors: Harish Dharuri<sup>1</sup> and Hoffman Alexander<sup>2</sup> at September fourth 2007 at 10:35 a. m. and last time modified at May 26<sup>th</sup> 2014 at 11:05 p. m. Table 1 shows 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	2
species types	0	species	24
events	0	constraints	0
reactions	51	function definitions	0
global parameters	3	unit definitions	4
rules	3	initial assignments	0

### Model Notes

O’Dea, E.L., Barken, D., Peralta, R.Q., Tran K.T., Werner, S.L., Kearns, J.D., Levchenko, A., Hoffmann, A. A homeostatic model of IκB metabolism to control constitutive activity. *Molecular Systems Biology*, 3:111, pp. 1-7. 2007

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The original model was written and simulated within MathWorks MatLab 2006a using the ode15s (stiff/NDF) solver. It is highly recommended that those wanting to model this system use the MatLab version which we will freely provide upon request. As always, simulation results vary according to the numerical solver used.

Translation to SBML Level 2.1 was performed via reconstruction of the model within MathWorks SimBiology Desktop (version 2.1) followed by an Export to SBML. Please address questions about this SBML model to Jeff Kearns (jkearns@ucsd.edu).

BioModels DB curation: The model reproduces the values of different species depicted in Fig 3A and 3B (wt) of the paper corresponding to Model1.1. To depict the the total IkB alpha, beta epsilon species, three additional parameters and their corresponding assignment rules have been introduced in this model by the creator. Model succesfully tested on MathSBML.

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To cite BioModels Database, please use [Le Novre N., Bornstein B., Broicher A., Courtot M., Donizelli M., Dharuri H., Li L., Sauro H., Schilstra M., Shapiro B., Snoep J.L., Hucka M. \(2006\) BioModels Database: A Free, Centralized Database of Curated, Published, Quantitative Kinetic Models of Biochemical and Cellular Systems Nucleic Acids Res., 34: D689-D691.](#)

## 2 Unit Definitions

This is an overview of eight unit definitions of which four are predefined by SBML and not mentioned in the model.

### 2.1 Unit `substance`

**Name** micromole

**Definition**  $\mu\text{mol}$

### 2.2 Unit `uM_per_min`

**Name** `uM_per_min`

**Definition**  $\mu\text{mol} \cdot (60 \text{ s})^{-1} \cdot \text{l}^{-1}$

### 2.3 Unit `per_min`

**Name** `per_min`

**Definition**  $(60 \text{ s})^{-1}$

## 2.4 Unit `per_uM_per_min`

**Name** `per_uM_per_min`

**Definition**  $\mu\text{mol}^{-1} \cdot (60 \text{ s})^{-1} \cdot 1$

## 2.5 Unit `volume`

**Notes** Litre is the predefined SBML unit for volume.

**Definition** 1

## 2.6 Unit `area`

**Notes** Square metre is the predefined SBML unit for area since SBML Level 2 Version 1.

**Definition**  $\text{m}^2$

## 2.7 Unit `length`

**Notes** Metre is the predefined SBML unit for length since SBML Level 2 Version 1.

**Definition** m

## 2.8 Unit `time`

**Notes** Second is the predefined SBML unit for time.

**Definition** s

# 3 Compartments

This model contains two compartments.

Table 2: Properties of all compartments.

Id	Name	SBO	Spatial Dimensions	Size	Unit	Constant	Outside
cytoplasm	cytoplasm		3	1	litre	<input checked="" type="checkbox"/>	
nucleus	nucleus		3	1	litre	<input checked="" type="checkbox"/>	

## 3.1 Compartment `cytoplasm`

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

**Name** `cytoplasm`

### 3.2 Compartment `nucleus`

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

**Name** `nucleus`

## 4 Species

This model contains 24 species. Section 8 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
IkBa_mRNA	IkBat	nucleus	$\mu\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
IkBa_cytoplasm	IkBa	cytoplasm	$\mu\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
IkBa_nucleus	IkBan	nucleus	$\mu\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
IkBaIKK	IkBaIKK	cytoplasm	$\mu\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
IkBaNFkB-_cytoplasm	IkBaNFkB	cytoplasm	$\mu\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
IkBaNFkB_nucleus	IkBaNFkBn	nucleus	$\mu\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
IkBaIKKNFkB	IkBaIKKNFkB	cytoplasm	$\mu\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
NFkB_cytoplasm	NFkB	cytoplasm	$\mu\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
IKK	IKK	cytoplasm	$\mu\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
NFkB_nucleus	NFkBn	nucleus	$\mu\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
IkBbIKK	IkBbIKK	cytoplasm	$\mu\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
IkBbIKKNFkB	IkBbIKKNFkB	cytoplasm	$\mu\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
IkBbNFkB_nucleus	IkBbNFkBn	nucleus	$\mu\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
IkBbNFkB-_cytoplasm	IkBbNFkB	cytoplasm	$\mu\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
IkBb_nucleus	IkBbn	nucleus	$\mu\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
IkBb_cytoplasm	IkBb	cytoplasm	$\mu\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
IkBb_mRNA	IkBbt	nucleus	$\mu\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
IkBe_mRNA	IkBet	nucleus	$\mu\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
IkBe_cytoplasm	IkBe	cytoplasm	$\mu\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
IkBe_nucleus	IkBen	nucleus	$\mu\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$

Id	Name	Compartment	Derived Unit	Constant	Boundary Condi- tion
IkBeNFkB- _cytoplasm	IkBeNFkB	cytoplasm	$\mu\text{mol} \cdot \text{l}^{-1}$	$\boxplus$	$\boxplus$
IkBeNFkB_nucleus	IkBeNFkBn	nucleus	$\mu\text{mol} \cdot \text{l}^{-1}$	$\boxplus$	$\boxplus$
IkBeIKKNFkB	IkBeIKKNFkB	cytoplasm	$\mu\text{mol} \cdot \text{l}^{-1}$	$\boxplus$	$\boxplus$
IkBeIKK	IkBeIKK	cytoplasm	$\mu\text{mol} \cdot \text{l}^{-1}$	$\boxplus$	$\boxplus$

## 5 Parameters

This model contains three global parameters.

Table 4: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Total-IkBalpha	Total_IkBalpha		0.0		☐
Total-IkBbeta	Total_IkBbeta		0.0		☐
Total_IkBeps	Total_IkBeps		0.0		☐

## 6 Rules

This is an overview of three rules.

### 6.1 Rule Total\_IkBalpha

Rule Total\_IkBalpha is an assignment rule for parameter Total\_IkBalpha:

$$\begin{aligned} \text{Total\_IkBalpha} = & [\text{IkBa\_cytoplasm}] + [\text{IkBa\_nucleus}] + [\text{IkBaIKK}] + [\text{IkBaIKKNFkB}] \\ & + [\text{IkBaNFkB\_cytoplasm}] + [\text{IkBaNFkB\_nucleus}] \end{aligned} \quad (1)$$

**Derived unit**  $\mu\text{mol} \cdot \text{l}^{-1}$

### 6.2 Rule Total\_IkBbeta

Rule Total\_IkBbeta is an assignment rule for parameter Total\_IkBbeta:

$$\begin{aligned} \text{Total\_IkBbeta} = & [\text{IkBb\_cytoplasm}] + [\text{IkBb\_nucleus}] + [\text{IkBbIKK}] + [\text{IkBbIKKNFkB}] \\ & + [\text{IkBbNFkB\_cytoplasm}] + [\text{IkBbNFkB\_nucleus}] \end{aligned} \quad (2)$$

**Derived unit**  $\mu\text{mol} \cdot \text{l}^{-1}$

### 6.3 Rule Total\_IkBeps

Rule Total\_IkBeps is an assignment rule for parameter Total\_IkBeps:

$$\begin{aligned} \text{Total\_IkBeps} = & [\text{IkBe\_cytoplasm}] + [\text{IkBe\_nucleus}] + [\text{IkBeIKK}] + [\text{IkBeIKKNFkB}] \\ & + [\text{IkBeNFkB\_cytoplasm}] + [\text{IkBeNFkB\_nucleus}] \end{aligned} \quad (3)$$

**Derived unit**  $\mu\text{mol} \cdot \text{l}^{-1}$

## 7 Reactions

This model contains 51 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

Nº	Id	Name	Reaction Equation	SBO
1	txn_a	txn_a	$\emptyset \longrightarrow \text{IkBa\_mRNA}$	
2	mdeg_a	mdeg_a	$\text{IkBa\_mRNA} \longrightarrow \emptyset$	
3	tsl_a	tsl_a	$\text{IkBa\_mRNA} \longrightarrow \text{IkBa\_mRNA} + \text{IkBa\_cytoplasm}$	
4	int_ai	int_ai	$\text{IkBa\_cytoplasm} + \text{IKK} \rightleftharpoons \text{IkBaIKK}$	
5	int_an	int_an	$\text{IkBa\_cytoplasm} + \text{NFkB\_cytoplasm} \rightleftharpoons \text{IkBaNFkB\_cytoplasm}$	
6	int_an_n	int_an_n	$\text{IkBa\_nucleus} + \text{NFkB\_nucleus} \rightleftharpoons \text{IkBaNFkB\_nucleus}$	
7	int_2ani	int_2ani	$\text{IkBaNFkB\_cytoplasm} + \text{IKK} \rightleftharpoons \text{IkBaIKKNFkB}$	
8	int_2ain	int_2ain	$\text{IkBaIKK} + \text{NFkB\_cytoplasm} \rightleftharpoons \text{IkBaIKKNFkB}$	
9	deg_a	deg_a	$\text{IkBa\_cytoplasm} \longrightarrow \emptyset$	
10	deg_a_n	deg_a_n	$\text{IkBa\_nucleus} \longrightarrow \emptyset$	
11	deg_an_n	deg_an_n	$\text{IkBaNFkB\_nucleus} \longrightarrow \text{NFkB\_nucleus}$	
12	deg_an	deg_an	$\text{IkBaNFkB\_cytoplasm} \longrightarrow \text{NFkB\_cytoplasm}$	
13	deg_ai	deg_ai	$\text{IkBaIKK} \longrightarrow \text{IKK}$	
14	deg_ain	deg_ain	$\text{IkBaIKKNFkB} \longrightarrow \text{NFkB\_cytoplasm} + \text{IKK}$	
15	loc_a	loc_a	$\text{IkBa\_cytoplasm} \rightleftharpoons \text{IkBa\_nucleus}$	
16	loc_an	loc_an	$\text{IkBaNFkB\_nucleus} \longrightarrow \text{IkBaNFkB\_cytoplasm}$	
17	loc_bn	loc_bn	$\text{IkBbNFkB\_nucleus} \longrightarrow \text{IkBbNFkB\_cytoplasm}$	
18	loc_b	loc_b	$\text{IkBb\_cytoplasm} \rightleftharpoons \text{IkBb\_nucleus}$	
19	deg_bin	deg_bin	$\text{IkBbIKKNFkB} \longrightarrow \text{NFkB\_cytoplasm} + \text{IKK}$	
20	deg_bi	deg_bi	$\text{IkBbIKK} \longrightarrow \text{IKK}$	
21	deg_bn	deg_bn	$\text{IkBbNFkB\_cytoplasm} \longrightarrow \text{NFkB\_cytoplasm}$	
22	deg_bn_n	deg_bn_n	$\text{IkBbNFkB\_nucleus} \longrightarrow \text{NFkB\_nucleus}$	
23	deg_b_n	deg_b_n	$\text{IkBb\_nucleus} \longrightarrow \emptyset$	



Nº	Id	Name	Reaction Equation	SBO
24	deg_b	deg_b	$\text{IkBb\_cytoplasm} \longrightarrow \emptyset$	
25	int_2bin	int_2bin	$\text{IkBbIKK} + \text{NFkB\_cytoplasm} \rightleftharpoons \text{IkBbIKKNFkB}$	
26	int_2bni	int_2bni	$\text{IkBbNFkB\_cytoplasm} + \text{IKK} \rightleftharpoons \text{IkBbIKKNFkB}$	
27	int_bn_n	int_bn_n	$\text{IkBb\_nucleus} + \text{NFkB\_nucleus} \rightleftharpoons \text{IkBbNFkB\_nucleus}$	
28	int_bn	int_bn	$\text{IkBb\_cytoplasm} + \text{NFkB\_cytoplasm} \rightleftharpoons \text{IkBbNFkB\_cytoplasm}$	
29	int_bi	int_bi	$\text{IkBb\_cytoplasm} + \text{IKK} \rightleftharpoons \text{IkBbIKK}$	
30	tsl_b	tsl_b	$\text{IkBb\_mRNA} \longrightarrow \text{IkBb\_mRNA} + \text{IkBb\_cytoplasm}$	
31	mdeg_b	mdeg_b	$\text{IkBb\_mRNA} \longrightarrow \emptyset$	
32	txn_b	txn_b	$\emptyset \longrightarrow \text{IkBb\_mRNA}$	
33	loc_n	loc_n	$\text{NFkB\_cytoplasm} \rightleftharpoons \text{NFkB\_nucleus}$	
34	txn_e	txn_e	$\emptyset \longrightarrow \text{IkBe\_mRNA}$	
35	mdeg_e	mdeg_e	$\text{IkBe\_mRNA} \longrightarrow \emptyset$	
36	tsl_e	tsl_e	$\text{IkBe\_mRNA} \longrightarrow \text{IkBe\_mRNA} + \text{IkBe\_cytoplasm}$	
37	int_ei	int_ei	$\text{IkBe\_cytoplasm} + \text{IKK} \rightleftharpoons \text{IkBeIKK}$	
38	int_en	int_en	$\text{IkBe\_cytoplasm} + \text{NFkB\_cytoplasm} \rightleftharpoons \text{IkBeNFkB\_cytoplasm}$	
39	int_en_n	int_en_n	$\text{IkBe\_nucleus} + \text{NFkB\_nucleus} \rightleftharpoons \text{IkBeNFkB\_nucleus}$	
40	int_2eni	int_2eni	$\text{IkBeNFkB\_cytoplasm} + \text{IKK} \rightleftharpoons \text{IkBeIKKNFkB}$	
41	int_2ein	int_2ein	$\text{IkBeIKK} + \text{NFkB\_cytoplasm} \rightleftharpoons \text{IkBeIKKNFkB}$	
42	deg_e	deg_e	$\text{IkBe\_cytoplasm} \longrightarrow \emptyset$	
43	deg_e_n	deg_e_n	$\text{IkBe\_nucleus} \longrightarrow \emptyset$	
44	deg_en_n	deg_en_n	$\text{IkBeNFkB\_nucleus} \longrightarrow \text{NFkB\_nucleus}$	
45	deg_en	deg_en	$\text{IkBeNFkB\_cytoplasm} \longrightarrow \text{NFkB\_cytoplasm}$	
46	deg_ei	deg_ei	$\text{IkBeIKK} \longrightarrow \text{IKK}$	
47	deg_ein	deg_ein	$\text{IkBeIKKNFkB} \longrightarrow \text{NFkB\_cytoplasm} + \text{IKK}$	
48	loc_e	loc_e	$\text{IkBe\_cytoplasm} \rightleftharpoons \text{IkBe\_nucleus}$	
49	loc_en	loc_en	$\text{IkBeNFkB\_nucleus} \longrightarrow \text{IkBeNFkB\_cytoplasm}$	
50	IKK_deg	IKK_deg	$\text{IKK} \longrightarrow \emptyset$	
51	itxn_a	itxn_a	$\emptyset \xrightarrow{\text{NFkB\_nucleus}} \text{IkBa\_mRNA}$	

### 7.1 Reaction `txn_a`

This is an irreversible reaction of no reactant forming one product.

**Name** `txn_a`

#### Reaction equation



#### Product

Table 6: Properties of each product.

Id	Name	SBO
IkBa_mRNA	IkBat	

#### Kinetic Law

**Derived unit**  $\mu\text{mol} \cdot (60 \text{ s})^{-1}$

$$v_1 = \text{vol}(\text{nucleus}) \cdot \text{tr2a} \quad (5)$$

Table 7: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
tr2a	tr2a		$1.848 \cdot 10^{-4}$	$\mu\text{mol} \cdot (60 \text{ s})^{-1} \cdot \text{l}^{-1}$	<input checked="" type="checkbox"/>

### 7.2 Reaction `mdeg_a`

This is an irreversible reaction of one reactant forming no product.

**Name** `mdeg_a`

#### Reaction equation



#### Reactant

Table 8: Properties of each reactant.

Id	Name	SBO
IkB <sub>a</sub> _mRNA	IkB <sub>a</sub> t	

### Kinetic Law

**Derived unit**  $(60\text{ s})^{-1} \cdot \mu\text{mol}$

$$v_2 = \text{vol}(\text{nucleus}) \cdot \text{tr3a} \cdot [\text{IkBa\_mRNA}] \quad (7)$$

Table 9: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
tr3a	tr3a		0.017	$(60\text{ s})^{-1}$	<input checked="" type="checkbox"/>

### 7.3 Reaction `tsl_a`

This is an irreversible reaction of one reactant forming two products.

**Name** `tsl_a`

### Reaction equation



### Reactant

Table 10: Properties of each reactant.

Id	Name	SBO
IkB <sub>a</sub> _mRNA	IkB <sub>a</sub> t	

### Products

Table 11: Properties of each product.

Id	Name	SBO
IkB <sub>a</sub> _mRNA	IkB <sub>a</sub> t	
IkB <sub>a</sub> _cytoplasm	IkB <sub>a</sub>	

## Kinetic Law

**Derived unit**  $(60\text{ s})^{-1} \cdot \mu\text{mol}$

$$v_3 = \text{vol}(\text{nucleus}) \cdot \text{tr1a} \cdot [\text{IkBa\_mRNA}] \quad (9)$$

Table 12: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
tr1a	tr1a		0.245	$(60\text{ s})^{-1}$	<input checked="" type="checkbox"/>

## 7.4 Reaction `int_ai`

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

**Name** `int_ai`

### Reaction equation



### Reactants

Table 13: Properties of each reactant.

Id	Name	SBO
IkBa_cytoplasm	IkBa	
IKK	IKK	

### Product

Table 14: Properties of each product.

Id	Name	SBO
IkBaIKK	IkBaIKK	

## Kinetic Law

**Derived unit**  $(60\text{ s})^{-1} \cdot \mu\text{mol}$

$$v_4 = \text{vol}(\text{cytoplasm}) \cdot (a1 \cdot [\text{IkBa\_cytoplasm}] \cdot [\text{IKK}] - d1\_1 \cdot [\text{IkBaIKK}]) \quad (11)$$

Table 15: Properties of each parameter.

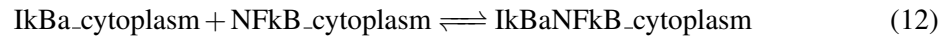
Id	Name	SBO	Value	Unit	Constant
a1	a1		1.350	$\mu\text{mol}^{-1} \cdot (60 \text{ s})^{-1} \cdot 1$	<input checked="" type="checkbox"/>
d1_1	d1_1		0.075	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>

## 7.5 Reaction `int_an`

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

**Name** `int_an`

### Reaction equation



### Reactants

Table 16: Properties of each reactant.

Id	Name	SBO
IkBa_cytoplasm	IkBa	
NFkB_cytoplasm	NFkB	

### Product

Table 17: Properties of each product.

Id	Name	SBO
IkBaNFkB_cytoplasm	IkBaNFkB	

### Kinetic Law

**Derived unit**  $(60 \text{ s})^{-1} \cdot \mu\text{mol}$

$$v_5 = \text{vol}(\text{cytoplasm}) \cdot (a4\_1 \cdot [\text{IkBa\_cytoplasm}] \cdot [\text{NFkB\_cytoplasm}] - d4\_1 \cdot [\text{IkBaNFkB\_cytoplasm}]) \quad (13)$$

Table 18: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
a4_1	a4_1		30.000	$\mu\text{mol}^{-1} \cdot (60 \text{ s})^{-1} \cdot 1$	✓
d4_1	d4_1		$6 \cdot 10^{-5}$	$(60 \text{ s})^{-1}$	✓

## 7.6 Reaction `int_an_n`

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

**Name** `int_an_n`

### Reaction equation



### Reactants

Table 19: Properties of each reactant.

Id	Name	SBO
IkBa_nucleus	IkBan	
NFkB_nucleus	NFkBn	

### Product

Table 20: Properties of each product.

Id	Name	SBO
IkBaNFkB_nucleus	IkBaNFkBn	

### Kinetic Law

**Derived unit**  $(60 \text{ s})^{-1} \cdot \mu\text{mol}$

$$v_6 = \text{vol}(\text{nucleus}) \cdot (a4\_2 \cdot [\text{IkBa\_nucleus}] \cdot [\text{NFkB\_nucleus}] - d4\_2 \cdot [\text{IkBaNFkB\_nucleus}]) \quad (15)$$

Table 21: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
a4_2	a4_2		30.000	$\mu\text{mol}^{-1} \cdot (60 \text{ s})^{-1} \cdot 1$	✓
d4_2	d4_2		$6 \cdot 10^{-5}$	$(60 \text{ s})^{-1}$	✓

## 7.7 Reaction [int\\_2ani](#)

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

**Name** [int\\_2ani](#)

### Reaction equation



### Reactants

Table 22: Properties of each reactant.

Id	Name	SBO
IkBaNFkB_cytoplasm	IkBaNFkB	
IKK	IKK	

### Product

Table 23: Properties of each product.

Id	Name	SBO
IkBaIKKNFkB	IkBaIKKNFkB	

### Kinetic Law

**Derived unit**  $(60 \text{ s})^{-1} \cdot \mu\text{mol}$

$$v_7 = \text{vol}(\text{cytoplasm}) \cdot (a_7 \cdot [\text{IkBaNFkB}_{\text{cytoplasm}}] \cdot [\text{IKK}] - d1\_2 \cdot [\text{IkBaIKKNFkB}]) \quad (17)$$

Table 24: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
a7	a7		11.100	$\mu\text{mol}^{-1} \cdot (60 \text{ s})^{-1} \cdot \text{l}$	<input checked="" type="checkbox"/>
d1_2	d1_2		0.075	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>

## 7.8 Reaction [int\\_2ain](#)

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

**Name** [int\\_2ain](#)

### Reaction equation



### Reactants

Table 25: Properties of each reactant.

Id	Name	SBO
IkBaIKK	IkBaIKK	
NFkB\_cytoplasm	NFkB	

### Product

Table 26: Properties of each product.

Id	Name	SBO
IkBaIKKNFkB	IkBaIKKNFkB	

### Kinetic Law

**Derived unit**  $(60 \text{ s})^{-1} \cdot \mu\text{mol}$

$$v_8 = \text{vol}(\text{cytoplasm}) \cdot (a4\_3 \cdot [\text{IkBaIKK}] \cdot [\text{NFkB\_cytoplasm}] - d4\_3 \cdot [\text{IkBaIKKNFkB}]) \quad (19)$$

Table 27: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
a4_3	a4_3		30.000	$\mu\text{mol}^{-1} \cdot (60 \text{ s})^{-1} \cdot 1$	<input checked="" type="checkbox"/>
d4_3	d4_3		$6 \cdot 10^{-5}$	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>

## 7.9 Reaction deg\_a

This is an irreversible reaction of one reactant forming no product.

**Name** deg\_a

### Reaction equation





## Reactant

Table 28: Properties of each reactant.

Id	Name	SBO
IkBa_cytoplasm	IkBa	

## Kinetic Law

**Derived unit**  $(60\text{ s})^{-1} \cdot \mu\text{mol}$

$$v_9 = \text{vol}(\text{cytoplasm}) \cdot \text{deg1\_c} \cdot [\text{IkBa\_cytoplasm}] \quad (21)$$

Table 29: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
deg1_c	deg1_c		0.12	$(60\text{ s})^{-1}$	<input checked="" type="checkbox"/>

## 7.10 Reaction deg\_a\_n

This is an irreversible reaction of one reactant forming no product.

**Name** deg\_a\_n

## Reaction equation



## Reactant

Table 30: Properties of each reactant.

Id	Name	SBO
IkBa_nucleus	IkBan	

## Kinetic Law

**Derived unit**  $(60\text{ s})^{-1} \cdot \mu\text{mol}$

$$v_{10} = \text{vol}(\text{nucleus}) \cdot \text{deg1\_n} \cdot [\text{IkBa\_nucleus}] \quad (23)$$

Table 31: Properties of each parameter.

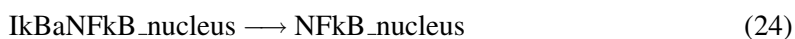
Id	Name	SBO	Value	Unit	Constant
deg1_n	deg1_n		0.12	$(60\text{ s})^{-1}$	<input checked="" type="checkbox"/>

### 7.11 Reaction `deg_an_n`

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

**Name** `deg_an_n`

#### Reaction equation



#### Reactant

Table 32: Properties of each reactant.

Id	Name	SBO
<code>IkBaNFkB_nucleus</code>	<code>IkBaNFkBn</code>	

#### Product

Table 33: Properties of each product.

Id	Name	SBO
<code>NFkB_nucleus</code>	<code>NFkBn</code>	

#### Kinetic Law

**Derived unit**  $(60\text{ s})^{-1} \cdot \mu\text{mol}$

$$v_{11} = \text{vol}(\text{nucleus}) \cdot \text{deg4\_n} \cdot [\text{IkBaNFkB\_nucleus}] \quad (25)$$

Table 34: Properties of each parameter.

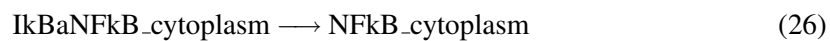
Id	Name	SBO	Value	Unit	Constant
deg4_n	deg4_n		$6 \cdot 10^{-5}$	$(60\text{ s})^{-1}$	<input checked="" type="checkbox"/>

### 7.12 Reaction `deg_an`

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

**Name** `deg_an`

#### Reaction equation



#### Reactant

Table 35: Properties of each reactant.

Id	Name	SBO
<code>IkBaNFkB\_cytoplasm</code>	<code>IkBaNFkB</code>	

#### Product

Table 36: Properties of each product.

Id	Name	SBO
<code>NFkB\_cytoplasm</code>	<code>NFkB</code>	

#### Kinetic Law

**Derived unit**  $(60 \text{ s})^{-1} \cdot \mu\text{mol}$

$$v_{12} = \text{vol}(\text{cytoplasm}) \cdot \text{deg4\_c} \cdot [\text{IkBaNFkB\_cytoplasm}] \quad (27)$$

Table 37: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
<code>deg4\_c</code>	<code>deg4\_c</code>		$6 \cdot 10^{-5}$	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>

### 7.13 Reaction `deg_ai`

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

**Name** `deg_ai`

### Reaction equation



### Reactant

Table 38: Properties of each reactant.

Id	Name	SBO
IkBaIKK	IkBaIKK	

### Product

Table 39: Properties of each product.

Id	Name	SBO
IKK	IKK	

### Kinetic Law

**Derived unit**  $(60 \text{ s})^{-1} \cdot \mu\text{mol}$

$$v_{13} = \text{vol}(\text{cytoplasm}) \cdot r1 \cdot [\text{IkBaIKK}] \quad (29)$$

Table 40: Properties of each parameter.

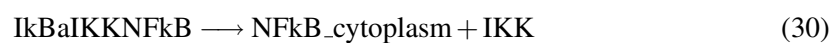
Id	Name	SBO	Value	Unit	Constant
r1	r1		0.072	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>

## 7.14 Reaction `deg_ain`

This is an irreversible reaction of one reactant forming two products.

**Name** `deg_ain`

### Reaction equation



### Reactant

Table 41: Properties of each reactant.

Id	Name	SBO
IkBaIKKNFkB	IkBaIKKNFkB	

## Products

Table 42: Properties of each product.

Id	Name	SBO
NFkB_cytoplasm	NFkB	
IKK	IKK	

## Kinetic Law

**Derived unit**  $(60\text{ s})^{-1} \cdot \mu\text{mol}$

$$v_{14} = \text{vol}(\text{cytoplasm}) \cdot r_4 \cdot [\text{IkBaIKKNFkB}] \quad (31)$$

Table 43: Properties of each parameter.

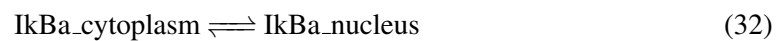
Id	Name	SBO	Value	Unit	Constant
r4	r4		0.36	$(60\text{ s})^{-1}$	<input checked="" type="checkbox"/>

### 7.15 Reaction `loc_a`

This is a reversible reaction of one reactant forming one product.

**Name** `loc_a`

#### Reaction equation



## Reactant

Table 44: Properties of each reactant.

Id	Name	SBO
IkBa_cytoplasm	IkBa	

## Product

Table 45: Properties of each product.

Id	Name	SBO
IkBaNfkb_nucleus	IkBaN	

## Kinetic Law

**Derived unit**  $(60\text{ s})^{-1} \cdot \mu\text{mol}$

$$v_{15} = \text{vol}(\text{cytoplasm}) \cdot \text{tp1a} \cdot [\text{IkBa}_{\text{cytoplasm}}] - \text{vol}(\text{nucleus}) \cdot \text{tp2a} \cdot [\text{IkBa}_{\text{nucleus}}] \quad (33)$$

Table 46: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
tp1a	tp1a		0.018	$(60\text{ s})^{-1}$	<input checked="" type="checkbox"/>
tp2a	tp2a		0.012	$(60\text{ s})^{-1}$	<input checked="" type="checkbox"/>

### 7.16 Reaction `loc_an`

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

**Name** `loc_an`

## Reaction equation



## Reactant

Table 47: Properties of each reactant.

Id	Name	SBO
IkBaNfkb_nucleus	IkBaNfkb	

## Product

Table 48: Properties of each product.

Id	Name	SBO
IkBaNFkB_cytoplasm	IkBaNFkB	

### Kinetic Law

**Derived unit**  $(60\text{ s})^{-1} \cdot \mu\text{mol}$

$$v_{16} = \text{vol}(\text{nucleus}) \cdot k2\_a \cdot [\text{IkBaNFkB\_nucleus}] \quad (35)$$

Table 49: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k2_a	k2_a		0.828	$(60\text{ s})^{-1}$	<input checked="" type="checkbox"/>

### 7.17 Reaction `loc_bn`

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

**Name** `loc_bn`

### Reaction equation



### Reactant

Table 50: Properties of each reactant.

Id	Name	SBO
IkBbNFkB_nucleus	IkBbNFkBn	

### Product

Table 51: Properties of each product.

Id	Name	SBO
IkBbNFkB_cytoplasm	IkBbNFkB	

## Kinetic Law

**Derived unit**  $(60\text{ s})^{-1} \cdot \mu\text{mol}$

$$v_{17} = \text{vol}(\text{nucleus}) \cdot k2\_b \cdot [\text{IkBbNFkB\_nucleus}] \quad (37)$$

Table 52: Properties of each parameter.

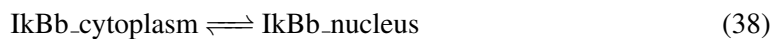
Id	Name	SBO	Value	Unit	Constant
k2_b	k2_b		0.414	$(60\text{ s})^{-1}$	<input checked="" type="checkbox"/>

## 7.18 Reaction loc\_b

This is a reversible reaction of one reactant forming one product.

**Name** loc\_b

### Reaction equation



### Reactant

Table 53: Properties of each reactant.

Id	Name	SBO
IkBb\_cytoplasm	IkBb	

### Product

Table 54: Properties of each product.

Id	Name	SBO
IkBb\_nucleus	IkBbn	

## Kinetic Law

**Derived unit**  $(60\text{ s})^{-1} \cdot \mu\text{mol}$

$$v_{18} = \text{vol}(\text{cytoplasm}) \cdot \text{tp1b} \cdot [\text{IkBb\_cytoplasm}] - \text{vol}(\text{nucleus}) \cdot \text{tp2b} \cdot [\text{IkBb\_nucleus}] \quad (39)$$



Table 55: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
tp1b	tp1b		0.018	$(60\text{ s})^{-1}$	<input checked="" type="checkbox"/>
tp2b	tp2b		0.012	$(60\text{ s})^{-1}$	<input checked="" type="checkbox"/>

### 7.19 Reaction deg\_bin

This is an irreversible reaction of one reactant forming two products.

**Name** deg\_bin

#### Reaction equation



#### Reactant

Table 56: Properties of each reactant.

Id	Name	SBO
IkBbIKKNFkB	IkBbIKKNFkB	

#### Products

Table 57: Properties of each product.

Id	Name	SBO
NFkB\_cytoplasm	NFkB	
IKK	IKK	

#### Kinetic Law

**Derived unit**  $(60\text{ s})^{-1} \cdot \mu\text{mol}$

$$v_{19} = \text{vol}(\text{cytoplasm}) \cdot r5 \cdot [\text{IkBbIKKNFkB}] \quad (41)$$

Table 58: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
r5	r5		0.12	$(60\text{ s})^{-1}$	<input checked="" type="checkbox"/>

## 7.20 Reaction `deg_bi`

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

**Name** `deg_bi`

### Reaction equation



### Reactant

Table 59: Properties of each reactant.

Id	Name	SBO
IkBbIKK	IkBbIKK	

### Product

Table 60: Properties of each product.

Id	Name	SBO
IKK	IKK	

### Kinetic Law

**Derived unit**  $(60 \text{ s})^{-1} \cdot \mu\text{mol}$

$$v_{20} = \text{vol}(\text{cytoplasm}) \cdot r2 \cdot [\text{IkBbIKK}] \quad (43)$$

Table 61: Properties of each parameter.

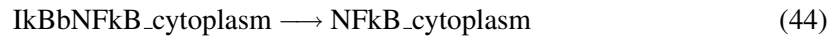
Id	Name	SBO	Value	Unit	Constant
r2	r2		0.024	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>

## 7.21 Reaction `deg_bn`

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

**Name** `deg_bn`

### Reaction equation



### Reactant

Table 62: Properties of each reactant.

Id	Name	SBO
IkBbNFkB\_cytoplasm	IkBbNFkB	

### Product

Table 63: Properties of each product.

Id	Name	SBO
NFkB\_cytoplasm	NFkB	

### Kinetic Law

**Derived unit**  $(60 \text{ s})^{-1} \cdot \mu\text{mol}$

$$v_{21} = \text{vol}(\text{cytoplasm}) \cdot \text{deg5\_c} \cdot [\text{IkBbNFkB\_cytoplasm}] \quad (45)$$

Table 64: Properties of each parameter.

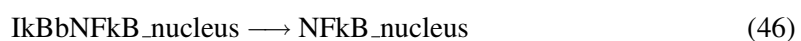
Id	Name	SBO	Value	Unit	Constant
deg5\_c	deg5\_c		$6 \cdot 10^{-5}$	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>

## 7.22 Reaction deg\_bn\_n

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

**Name** deg\_bn\_n

### Reaction equation



### Reactant

Table 65: Properties of each reactant.

Id	Name	SBO
IkBbNFkB_nucleus	IkBbNFkBn	

## Product

Table 66: Properties of each product.

Id	Name	SBO
NFkB_nucleus	NFkBn	

## Kinetic Law

**Derived unit**  $(60\text{ s})^{-1} \cdot \mu\text{mol}$

$$v_{22} = \text{vol}(\text{nucleus}) \cdot \text{deg5\_n} \cdot [\text{IkBbNFkB\_nucleus}] \quad (47)$$

Table 67: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
deg5_n	deg5_n		$6 \cdot 10^{-5}$	$(60\text{ s})^{-1}$	<input checked="" type="checkbox"/>

## 7.23 Reaction deg\_b\_n

This is an irreversible reaction of one reactant forming no product.

**Name** deg\_b\_n

## Reaction equation



## Reactant

Table 68: Properties of each reactant.

Id	Name	SBO
IkBb_nucleus	IkBbn	

## Kinetic Law

**Derived unit**  $(60\text{ s})^{-1} \cdot \mu\text{mol}$

$$v_{23} = \text{vol}(\text{nucleus}) \cdot \text{deg2\_n} \cdot [\text{IkBb\_nucleus}] \quad (49)$$

Table 69: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
deg2_n	deg2_n		0.18	$(60\text{ s})^{-1}$	<input checked="" type="checkbox"/>

## 7.24 Reaction deg\_b

This is an irreversible reaction of one reactant forming no product.

**Name** deg\_b

## Reaction equation



## Reactant

Table 70: Properties of each reactant.

Id	Name	SBO
IkBb\_cytoplasm	IkBb	

## Kinetic Law

**Derived unit**  $(60\text{ s})^{-1} \cdot \mu\text{mol}$

$$v_{24} = \text{vol}(\text{cytoplasm}) \cdot \text{deg2\_c} \cdot [\text{IkBb\_cytoplasm}] \quad (51)$$

Table 71: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
deg2_c	deg2_c		0.18	$(60\text{ s})^{-1}$	<input checked="" type="checkbox"/>

## 7.25 Reaction `int_2bin`

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

**Name** `int_2bin`

### Reaction equation



### Reactants

Table 72: Properties of each reactant.

Id	Name	SBO
IkBbIKK	IkBbIKK	
NFkB_cytoplasm	NFkB	

### Product

Table 73: Properties of each product.

Id	Name	SBO
IkBbIKKNFkB	IkBbIKKNFkB	

### Kinetic Law

**Derived unit**  $(60 \text{ s})^{-1} \cdot \mu\text{mol}$

$$v_{25} = \text{vol}(\text{cytoplasm}) \cdot (a5\_3 \cdot [\text{IkBbIKK}] \cdot [\text{NFkB\_cytoplasm}] - d5\_3 \cdot [\text{IkBbIKKNFkB}]) \quad (53)$$

Table 74: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
a5_3	a5_3		30.000	$\mu\text{mol}^{-1} \cdot (60 \text{ s})^{-1} \cdot 1$	<input checked="" type="checkbox"/>
d5_3	d5_3		$6 \cdot 10^{-5}$	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>

## 7.26 Reaction `int_2bni`

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

**Name** `int_2bni`

### Reaction equation



### Reactants

Table 75: Properties of each reactant.

Id	Name	SBO
IkBbNFkB\_cytoplasm	IkBbNFkB	
IKK	IKK	

### Product

Table 76: Properties of each product.

Id	Name	SBO
IkBbIKKNFkB	IkBbIKKNFkB	

### Kinetic Law

**Derived unit**  $(60 \text{ s})^{-1} \cdot \mu\text{mol}$

$$v_{26} = \text{vol}(\text{cytoplasm}) \cdot (a8 \cdot [\text{IkBbNFkB\_cytoplasm}] \cdot [\text{IKK}] - d2\_2 \cdot [\text{IkBbIKKNFkB}]) \quad (55)$$

Table 77: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
a8	a8		2.880	$\mu\text{mol}^{-1} \cdot (60 \text{ s})^{-1} \cdot 1$	<input checked="" type="checkbox"/>
d2_2	d2_2		0.105	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>

### 7.27 Reaction `int_bn_n`

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

**Name** `int_bn_n`

### Reaction equation



## Reactants

Table 78: Properties of each reactant.

Id	Name	SBO
IkBb_nucleus	IkBbn	
NFkB_nucleus	NFkBn	

## Product

Table 79: Properties of each product.

Id	Name	SBO
IkBbNFkB_nucleus	IkBbNFkBn	

## Kinetic Law

**Derived unit**  $(60 \text{ s})^{-1} \cdot \mu\text{mol}$

$$v_{27} = \text{vol}(\text{nucleus}) \cdot (a5\_2 \cdot [\text{IkBb\_nucleus}] \cdot [\text{NFkB\_nucleus}] - d5\_2 \cdot [\text{IkBbNFkB\_nucleus}]) \quad (57)$$

Table 80: Properties of each parameter.

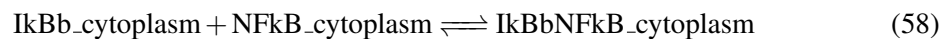
Id	Name	SBO	Value	Unit	Constant
a5_2	a5_2		30.000	$\mu\text{mol}^{-1} \cdot (60 \text{ s})^{-1} \cdot 1$	<input checked="" type="checkbox"/>
d5_2	d5_2		$6 \cdot 10^{-5}$	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>

## 7.28 Reaction int\_bn

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

**Name** int\_bn

## Reaction equation



## Reactants



Table 81: Properties of each reactant.

Id	Name	SBO
IkBb_cytoplasm	IkBb	
NFkB_cytoplasm	NFkB	

## Product

Table 82: Properties of each product.

Id	Name	SBO
IkBbNFkB_cytoplasm	IkBbNFkB	

## Kinetic Law

**Derived unit**  $(60\text{ s})^{-1} \cdot \mu\text{mol}$

$$v_{28} = \text{vol}(\text{cytoplasm}) \cdot (a5\_1 \cdot [\text{IkBb\_cytoplasm}] \cdot [\text{NFkB\_cytoplasm}] - d5\_1 \cdot [\text{IkBbNFkB\_cytoplasm}]) \quad (59)$$

Table 83: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
a5_1	a5_1		30.000	$\mu\text{mol}^{-1} \cdot (60\text{ s})^{-1} \cdot 1$	<input checked="" type="checkbox"/>
d5_1	d5_1		$6 \cdot 10^{-5}$	$(60\text{ s})^{-1}$	<input checked="" type="checkbox"/>

## 7.29 Reaction `int_bi`

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

**Name** `int_bi`

## Reaction equation



## Reactants

Table 84: Properties of each reactant.

Id	Name	SBO
IkBb_cytoplasm	IkBb	
IKK	IKK	

## Product

Table 85: Properties of each product.

Id	Name	SBO
IkBbIKK	IkBbIKK	

## Kinetic Law

**Derived unit**  $(60\text{ s})^{-1} \cdot \mu\text{mol}$

$$v_{29} = \text{vol}(\text{cytoplasm}) \cdot (a2 \cdot [\text{IkBb\_cytoplasm}] \cdot [\text{IKK}] - d2\_1 \cdot [\text{IkBbIKK}]) \quad (61)$$

Table 86: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
a2	a2		0.360	$\mu\text{mol}^{-1} \cdot (60\text{ s})^{-1} \cdot 1$	<input checked="" type="checkbox"/>
d2_1	d2_1		0.105	$(60\text{ s})^{-1}$	<input checked="" type="checkbox"/>

## 7.30 Reaction `tsl_b`

This is an irreversible reaction of one reactant forming two products.

**Name** `tsl_b`

## Reaction equation



## Reactant

Table 87: Properties of each reactant.

Id	Name	SBO
IkBb_mRNA	IkBbt	

## Products

Table 88: Properties of each product.

Id	Name	SBO
IkBb_mRNA	IkBbt	
IkBb_cytoplasm	IkBb	

## Kinetic Law

**Derived unit**  $(60\text{ s})^{-1} \cdot \mu\text{mol}$

$$v_{30} = \text{vol}(\text{nucleus}) \cdot \text{tr1b} \cdot [\text{IkBb\_mRNA}] \quad (63)$$

Table 89: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
tr1b	tr1b		0.245	$(60\text{ s})^{-1}$	<input checked="" type="checkbox"/>

### 7.31 Reaction mdeg\_b

This is an irreversible reaction of one reactant forming no product.

**Name** mdeg\_b

## Reaction equation



## Reactant

Table 90: Properties of each reactant.

Id	Name	SBO
IkBb_mRNA	IkBbt	

## Kinetic Law

**Derived unit**  $(60\text{ s})^{-1} \cdot \mu\text{mol}$

$$v_{31} = \text{vol}(\text{nucleus}) \cdot \text{tr3b} \cdot [\text{IkBb\_mRNA}] \quad (65)$$

Table 91: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
tr3b	tr3b		0.017	$(60\text{ s})^{-1}$	<input checked="" type="checkbox"/>

### 7.32 Reaction `txn_b`

This is an irreversible reaction of no reactant forming one product.

**Name** `txn_b`

#### Reaction equation



#### Product

Table 92: Properties of each product.

Id	Name	SBO
IkBb_mRNA	IkBbt	

#### Kinetic Law

**Derived unit**  $\mu\text{mol} \cdot (60\text{ s})^{-1}$

$$v_{32} = \text{vol}(\text{nucleus}) \cdot \text{tr2b} \quad (67)$$

Table 93: Properties of each parameter.

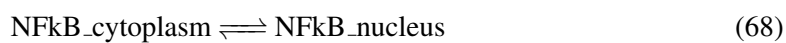
Id	Name	SBO	Value	Unit	Constant
tr2b	tr2b		$4.272 \cdot 10^{-5}$	$\mu\text{mol} \cdot (60\text{ s})^{-1} \cdot \text{l}^{-1}$	<input checked="" type="checkbox"/>

### 7.33 Reaction `loc_n`

This is a reversible reaction of one reactant forming one product.

**Name** `loc_n`

#### Reaction equation



Reactant

Table 94: Properties of each reactant.

Id	Name	SBO
NFkB_cytoplasm	NFkB	

Product

Table 95: Properties of each product.

Id	Name	SBO
NFkB_nucleus	NFkBn	

Kinetic Law

**Derived unit**  $(60\text{ s})^{-1} \cdot \mu\text{mol}$

$v_{33} = \text{vol}(\text{cytoplasm}) \cdot k1\_2 \cdot [\text{NFkB\_cytoplasm}] - \text{vol}(\text{nucleus}) \cdot k1\_1 \cdot [\text{NFkB\_nucleus}] \quad (69)$

Table 96: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1_2	k1_2		5.400	$(60\text{ s})^{-1}$	<input checked="" type="checkbox"/>
k1_1	k1_1		0.005	$(60\text{ s})^{-1}$	<input checked="" type="checkbox"/>

7.34 Reaction `txn_e`

This is an irreversible reaction of no reactant forming one product.

**Name** `txn_e`

Reaction equation



Product

Table 97: Properties of each product.

Id	Name	SBO
IkBe_mRNA	IkBet	

**Kinetic Law****Derived unit**  $\mu\text{mol} \cdot (60 \text{ s})^{-1}$ 

$$v_{34} = \text{vol}(\text{nucleus}) \cdot \text{tr2e} \quad (71)$$

Table 98: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
tr2e	tr2e		$3.048 \cdot 10^{-5}$	$\mu\text{mol} \cdot (60 \text{ s})^{-1} \cdot \text{l}^{-1}$	<input checked="" type="checkbox"/>

**7.35 Reaction mdeg\_e**

This is an irreversible reaction of one reactant forming no product.

**Name** mdeg\_e**Reaction equation****Reactant**

Table 99: Properties of each reactant.

Id	Name	SBO
IkBe_mRNA	IkBet	

**Kinetic Law****Derived unit**  $(60 \text{ s})^{-1} \cdot \mu\text{mol}$ 

$$v_{35} = \text{vol}(\text{nucleus}) \cdot \text{tr3e} \cdot [\text{IkBe\_mRNA}] \quad (73)$$

Table 100: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
tr3e	tr3e		0.017	$(60\text{ s})^{-1}$	<input checked="" type="checkbox"/>

### 7.36 Reaction `tsl_e`

This is an irreversible reaction of one reactant forming two products.

**Name** `tsl_e`

#### Reaction equation



#### Reactant

Table 101: Properties of each reactant.

Id	Name	SBO
IkBe_mRNA	IkBet	

#### Products

Table 102: Properties of each product.

Id	Name	SBO
IkBe_mRNA	IkBet	
IkBe_cytoplasm	IkBe	

#### Kinetic Law

**Derived unit**  $(60\text{ s})^{-1} \cdot \mu\text{mol}$

$$v_{36} = \text{vol}(\text{nucleus}) \cdot \text{tr1e} \cdot [\text{IkBe\_mRNA}] \quad (75)$$

Table 103: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
tr1e	tr1e		0.245	$(60\text{ s})^{-1}$	<input checked="" type="checkbox"/>

### 7.37 Reaction `int_ei`

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

**Name** `int_ei`

#### Reaction equation



#### Reactants

Table 104: Properties of each reactant.

Id	Name	SBO
<code>IkBe_cytoplasm</code>	<code>IkBe</code>	
<code>IKK</code>	<code>IKK</code>	

#### Product

Table 105: Properties of each product.

Id	Name	SBO
<code>IkBeIKK</code>	<code>IkBeIKK</code>	

#### Kinetic Law

**Derived unit**  $(60 \text{ s})^{-1} \cdot \mu\text{mol}$

$$v_{37} = \text{vol}(\text{cytoplasm}) \cdot (a3 \cdot [\text{IkBe}_{\text{cytoplasm}}] \cdot [\text{IKK}] - d3\_1 \cdot [\text{IkBeIKK}]) \quad (77)$$

Table 106: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
<code>a3</code>	<code>a3</code>		0.540	$\mu\text{mol}^{-1} \cdot (60 \text{ s})^{-1} \cdot 1$	<input checked="" type="checkbox"/>
<code>d3_1</code>	<code>d3_1</code>		0.105	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>

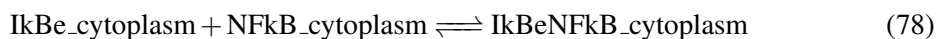
### 7.38 Reaction `int_en`

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

**Name** `int_en`



### Reaction equation



### Reactants

Table 107: Properties of each reactant.

Id	Name	SBO
IkBe_cytoplasm	IkBe	
NFkB_cytoplasm	NFkB	

### Product

Table 108: Properties of each product.

Id	Name	SBO
IkBeNFkB_cytoplasm	IkBeNFkB	

### Kinetic Law

**Derived unit**  $(60\text{ s})^{-1} \cdot \mu\text{mol}$

$$v_{38} = \text{vol}(\text{cytoplasm}) \cdot (a6\_1 \cdot [\text{IkBe\_cytoplasm}] \cdot [\text{NFkB\_cytoplasm}] - d6\_1 \cdot [\text{IkBeNFkB\_cytoplasm}]) \quad (79)$$

Table 109: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
a6_1	a6_1		30.000	$\mu\text{mol}^{-1} \cdot (60\text{ s})^{-1} \cdot 1$	<input checked="" type="checkbox"/>
d6_1	d6_1		$6 \cdot 10^{-5}$	$(60\text{ s})^{-1}$	<input checked="" type="checkbox"/>

### 7.39 Reaction `int_en_n`

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

**Name** `int_en_n`

### Reaction equation



## Reactants

Table 110: Properties of each reactant.

Id	Name	SBO
IkBe_nucleus	IkBen	
NFkB_nucleus	NFkBn	

## Product

Table 111: Properties of each product.

Id	Name	SBO
IkBeNFkB_nucleus	IkBeNFkBn	

## Kinetic Law

**Derived unit**  $(60 \text{ s})^{-1} \cdot \mu\text{mol}$

$$v_{39} = \text{vol}(\text{nucleus}) \cdot (a6\_2 \cdot [\text{IkBe\_nucleus}] \cdot [\text{NFkB\_nucleus}] - d6\_2 \cdot [\text{IkBeNFkB\_nucleus}]) \quad (81)$$

Table 112: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
a6_2	a6_2		30.000	$\mu\text{mol}^{-1} \cdot (60 \text{ s})^{-1} \cdot 1$	<input checked="" type="checkbox"/>
d6_2	d6_2		$6 \cdot 10^{-5}$	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>

### 7.40 Reaction `int_2eni`

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

**Name** `int_2eni`

### Reaction equation



## Reactants

Table 113: Properties of each reactant.

Id	Name	SBO
IkBeNFkB_cytoplasm	IkBeNFkB	
IKK	IKK	

## Product

Table 114: Properties of each product.

Id	Name	SBO
IkBeIKKNFkB	IkBeIKKNFkB	

## Kinetic Law

**Derived unit**  $(60\text{ s})^{-1} \cdot \mu\text{mol}$

$$v_{40} = \text{vol}(\text{cytoplasm}) \cdot (a9 \cdot [\text{IkBeNFkB\_cytoplasm}] \cdot [\text{IKK}] - d3\_2 \cdot [\text{IkBeIKKNFkB}]) \quad (83)$$

Table 115: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
a9	a9		4.200	$\mu\text{mol}^{-1} \cdot (60\text{ s})^{-1} \cdot 1$	<input checked="" type="checkbox"/>
d3_2	d3_2		0.105	$(60\text{ s})^{-1}$	<input checked="" type="checkbox"/>

## 7.41 Reaction `int_2ein`

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

**Name** `int_2ein`

## Reaction equation



## Reactants

Table 116: Properties of each reactant.

Id	Name	SBO
IkBeIKK	IkBeIKK	

Id	Name	SBO
NFkB_cytoplasm	NFkB	

## Product

Table 117: Properties of each product.

Id	Name	SBO
IkBeIKKNFkB	IkBeIKKNFkB	

## Kinetic Law

**Derived unit**  $(60\text{ s})^{-1} \cdot \mu\text{mol}$

$$v_{41} = \text{vol}(\text{cytoplasm}) \cdot (a6\_3 \cdot [\text{IkBeIKK}] \cdot [\text{NFkB\_cytoplasm}] - d6\_3 \cdot [\text{IkBeIKKNFkB}]) \quad (85)$$

Table 118: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
a6_3	a6_3		30.000	$\mu\text{mol}^{-1} \cdot (60\text{ s})^{-1} \cdot 1$	<input checked="" type="checkbox"/>
d6_3	d6_3		$6 \cdot 10^{-5}$	$(60\text{ s})^{-1}$	<input checked="" type="checkbox"/>

## 7.42 Reaction deg\_e

This is an irreversible reaction of one reactant forming no product.

**Name** deg\_e

## Reaction equation



## Reactant

Table 119: Properties of each reactant.

Id	Name	SBO
IkBe_cytoplasm	IkBe	

### Kinetic Law

**Derived unit**  $(60\text{ s})^{-1} \cdot \mu\text{mol}$

$$v_{42} = \text{vol}(\text{cytoplasm}) \cdot \text{deg3\_c} \cdot [\text{IkBe\_cytoplasm}] \quad (87)$$

Table 120: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
deg3_c	deg3_c		0.18	$(60\text{ s})^{-1}$	<input checked="" type="checkbox"/>

### 7.43 Reaction `deg_e_n`

This is an irreversible reaction of one reactant forming no product.

**Name** `deg_e_n`

### Reaction equation



### Reactant

Table 121: Properties of each reactant.

Id	Name	SBO
IkBe_nucleus	IkBen	

### Kinetic Law

**Derived unit**  $(60\text{ s})^{-1} \cdot \mu\text{mol}$

$$v_{43} = \text{vol}(\text{nucleus}) \cdot \text{deg3\_n} \cdot [\text{IkBe\_nucleus}] \quad (89)$$

Table 122: Properties of each parameter.

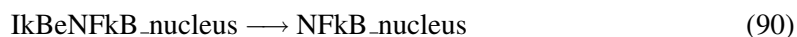
Id	Name	SBO	Value	Unit	Constant
deg3_n	deg3_n		0.18	$(60\text{ s})^{-1}$	<input checked="" type="checkbox"/>

#### 7.44 Reaction `deg_en_n`

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

**Name** `deg_en_n`

#### Reaction equation



#### Reactant

Table 123: Properties of each reactant.

Id	Name	SBO
<code>IkBeNFkB\_nucleus</code>	<code>IkBeNFkBn</code>	

#### Product

Table 124: Properties of each product.

Id	Name	SBO
<code>NFkB\_nucleus</code>	<code>NFkBn</code>	

#### Kinetic Law

**Derived unit**  $(60\text{ s})^{-1} \cdot \mu\text{mol}$

$$v_{44} = \text{vol}(\text{nucleus}) \cdot \text{deg6\_n} \cdot [\text{IkBeNFkB\_nucleus}] \quad (91)$$

Table 125: Properties of each parameter.

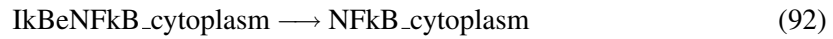
Id	Name	SBO	Value	Unit	Constant
<code>deg6_n</code>	<code>deg6_n</code>		$6 \cdot 10^{-5}$	$(60\text{ s})^{-1}$	<input checked="" type="checkbox"/>

#### 7.45 Reaction `deg_en`

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

**Name** `deg_en`

### Reaction equation



### Reactant

Table 126: Properties of each reactant.

Id	Name	SBO
IkBeNFkB\_cytoplasm	IkBeNFkB	

### Product

Table 127: Properties of each product.

Id	Name	SBO
NFkB\_cytoplasm	NFkB	

### Kinetic Law

**Derived unit**  $(60 \text{ s})^{-1} \cdot \mu\text{mol}$

$$v_{45} = \text{vol}(\text{cytoplasm}) \cdot \text{deg6\_c} \cdot [\text{IkBeNFkB\_cytoplasm}] \quad (93)$$

Table 128: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
deg6_c	deg6_c		$6 \cdot 10^{-5}$	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>

### 7.46 Reaction [deg\\_ei](#)

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

**Name** [deg\\_ei](#)

### Reaction equation



### Reactant

Table 129: Properties of each reactant.

Id	Name	SBO
IkBeIKK	IkBeIKK	

## Product

Table 130: Properties of each product.

Id	Name	SBO
IKK	IKK	

## Kinetic Law

**Derived unit**  $(60\text{ s})^{-1} \cdot \mu\text{mol}$

$$v_{46} = \text{vol}(\text{cytoplasm}) \cdot r_3 \cdot [\text{IkBeIKK}] \quad (95)$$

Table 131: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
r3	r3		0.036	$(60\text{ s})^{-1}$	<input checked="" type="checkbox"/>

## 7.47 Reaction `deg_ein`

This is an irreversible reaction of one reactant forming two products.

**Name** `deg_ein`

## Reaction equation



## Reactant

Table 132: Properties of each reactant.

Id	Name	SBO
IkBeIKKNFkB	IkBeIKKNFkB	



## Products

Table 133: Properties of each product.

Id	Name	SBO
NFkB_cytoplasm	NFkB	
IKK	IKK	

## Kinetic Law

**Derived unit**  $(60\text{ s})^{-1} \cdot \mu\text{mol}$

$$v_{47} = \text{vol}(\text{cytoplasm}) \cdot r6 \cdot [\text{IkBeIKKNFkB}] \quad (97)$$

Table 134: Properties of each parameter.

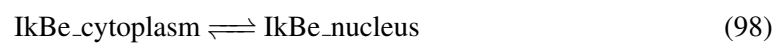
Id	Name	SBO	Value	Unit	Constant
r6	r6		0.18	$(60\text{ s})^{-1}$	<input checked="" type="checkbox"/>

## 7.48 Reaction loc\_e

This is a reversible reaction of one reactant forming one product.

**Name** loc\_e

## Reaction equation



## Reactant

Table 135: Properties of each reactant.

Id	Name	SBO
IkBe_cytoplasm	IkBe	

## Product

Table 136: Properties of each product.

Id	Name	SBO
IkBe_nucleus	IkBen	

### Kinetic Law

**Derived unit**  $(60\text{ s})^{-1} \cdot \mu\text{mol}$

$$v_{48} = \text{vol}(\text{cytoplasm}) \cdot \text{tp1e} \cdot [\text{IkBe\_cytoplasm}] - \text{vol}(\text{nucleus}) \cdot \text{tp2e} \cdot [\text{IkBe\_nucleus}] \quad (99)$$

Table 137: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
tp1e	tp1e		0.018	$(60\text{ s})^{-1}$	<input checked="" type="checkbox"/>
tp2e	tp2e		0.012	$(60\text{ s})^{-1}$	<input checked="" type="checkbox"/>

### 7.49 Reaction loc\_en

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

**Name** loc\_en

### Reaction equation



### Reactant

Table 138: Properties of each reactant.

Id	Name	SBO
IkBeNFkB_nucleus	IkBeNFkBn	

### Product

Table 139: Properties of each product.

Id	Name	SBO
IkBeNFkB_cytoplasm	IkBeNFkB	

## Kinetic Law

**Derived unit**  $(60\text{ s})^{-1} \cdot \mu\text{mol}$

$$v_{49} = \text{vol}(\text{nucleus}) \cdot k2\_e \cdot [\text{IkBeNFkB\_nucleus}] \quad (101)$$

Table 140: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k2_e	k2_e		0.414	$(60\text{ s})^{-1}$	<input checked="" type="checkbox"/>

## 7.50 Reaction IKK\_deg

This is an irreversible reaction of one reactant forming no product.

**Name** IKK\_deg

### Reaction equation



## Reactant

Table 141: Properties of each reactant.

Id	Name	SBO
IKK	IKK	

## Kinetic Law

**Derived unit**  $(60\text{ s})^{-1} \cdot \mu\text{mol}$

$$v_{50} = \text{vol}(\text{cytoplasm}) \cdot k\_IKK\_deg \cdot [\text{IKK}] \quad (103)$$

Table 142: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k_IKK_deg	IKK_deg		0.0	$(60\text{ s})^{-1}$	<input checked="" type="checkbox"/>

### 7.51 Reaction `itxn_a`

This is an irreversible reaction of no reactant forming one product influenced by one modifier.

**Name** `itxn_a`

#### Reaction equation



#### Modifier

Table 143: Properties of each modifier.

Id	Name	SBO
NFkB_nucleus	NFkBn	

#### Product

Table 144: Properties of each product.

Id	Name	SBO
IkBa_mRNA	IkBat	

#### Kinetic Law

**Derived unit**  $10^{-6} \text{ mol} \cdot (60 \text{ s})^{-1}$

$$v_{51} = \text{vol}(\text{nucleus}) \cdot \text{tr2a\_i} \cdot [\text{NFkB\_nucleus}]^2 \quad (105)$$

Table 145: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
tr2a_i	tr2a_i		1.98	$\mu\text{mol}^{-1} \cdot (60 \text{ s})^{-1} \cdot 1$	<input checked="" type="checkbox"/>

## 8 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.

### 8.1 Species IkBa\_mRNA

**Name** IkBat

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

This species takes part in five reactions (as a reactant in [mdeg\\_a](#), [tsl\\_a](#) and as a product in [txn\\_a](#), [tsl\\_a](#), [itxn\\_a](#)).

$$\frac{d}{dt}\text{IkBa\_mRNA} = v_1 + v_3 + v_{51} - v_2 - v_3 \quad (106)$$

### 8.2 Species IkBa\_cytoplasm

**Name** IkBa

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

This species takes part in five reactions (as a reactant in [int\\_ai](#), [int\\_an](#), [deg\\_a](#), [loc\\_a](#) and as a product in [tsl\\_a](#)).

$$\frac{d}{dt}\text{IkBa\_cytoplasm} = v_3 - v_4 - v_5 - v_9 - v_{15} \quad (107)$$

### 8.3 Species IkBa\_nucleus

**Name** IkBan

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

This species takes part in three reactions (as a reactant in [int\\_an\\_n](#), [deg\\_a\\_n](#) and as a product in [loc\\_a](#)).

$$\frac{d}{dt}\text{IkBa\_nucleus} = v_{15} - v_6 - v_{10} \quad (108)$$

### 8.4 Species IkBaIKK

**Name** IkBaIKK

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

This species takes part in three reactions (as a reactant in [int\\_2ain](#), [deg\\_ai](#) and as a product in [int\\_ai](#)).

$$\frac{d}{dt}\text{IkBaIKK} = v_4 - v_8 - v_{13} \quad (109)$$

### 8.5 Species IkBaNFkB\_cytoplasm

**Name** IkBaNFkB

**Initial concentration**  $0.06 \mu\text{mol} \cdot \text{l}^{-1}$

This species takes part in four reactions (as a reactant in [int\\_2ani](#), [deg\\_an](#) and as a product in [int\\_an](#), [loc\\_an](#)).

$$\frac{d}{dt}\text{IkBaNFkB\_cytoplasm} = v_5 + v_{16} - v_7 - v_{12} \quad (110)$$

### 8.6 Species IkBaNFkB\_nucleus

**Name** IkBaNFkBn

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

This species takes part in three reactions (as a reactant in [deg\\_an\\_n](#), [loc\\_an](#) and as a product in [int\\_an\\_n](#)).

$$\frac{d}{dt}\text{IkBaNFkB\_nucleus} = v_6 - v_{11} - v_{16} \quad (111)$$

### 8.7 Species IkBaIKKNFkB

**Name** IkBaIKKNFkB

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

This species takes part in three reactions (as a reactant in [deg\\_ain](#) and as a product in [int\\_2ani](#), [int\\_2ain](#)).

$$\frac{d}{dt}\text{IkBaIKKNFkB} = v_7 + v_8 - v_{14} \quad (112)$$

### 8.8 Species NFkB\_cytoplasm

**Name** NFkB

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

This species takes part in 13 reactions (as a reactant in [int\\_an](#), [int\\_2ain](#), [int\\_2bin](#), [int\\_bn](#), [loc\\_n](#), [int\\_en](#), [int\\_2ein](#) and as a product in [deg\\_an](#), [deg\\_ain](#), [deg\\_bin](#), [deg\\_bn](#), [deg\\_en](#), [deg\\_ein](#)).

$$\frac{d}{dt}\text{NFkB\_cytoplasm} = v_{12} + v_{14} + v_{19} + v_{21} + v_{45} + v_{47} - v_5 - v_8 - v_{25} - v_{28} - v_{33} - v_{38} - v_{41} \quad (113)$$

## 8.9 Species IKK

**Name** IKK

**Initial concentration**  $0.0010 \mu\text{mol} \cdot \text{l}^{-1}$

This species takes part in 13 reactions (as a reactant in [int\\_ai](#), [int\\_2ani](#), [int\\_2bni](#), [int\\_bi](#), [int\\_ei](#), [int\\_2eni](#), [IKK\\_deg](#) and as a product in [deg\\_ai](#), [deg\\_ain](#), [deg\\_bin](#), [deg\\_bi](#), [deg\\_ei](#), [deg\\_ein](#)).

$$\frac{d}{dt}\text{IKK} = v_{13} + v_{14} + v_{19} + v_{20} + v_{46} + v_{47} - v_4 - v_7 - v_{26} - v_{29} - v_{37} - v_{40} - v_{50} \quad (114)$$

## 8.10 Species NFkB\_nucleus

**Name** NFkBn

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

This species takes part in eight reactions (as a reactant in [int\\_an\\_n](#), [int\\_bn\\_n](#), [int\\_en\\_n](#) and as a product in [deg\\_an\\_n](#), [deg\\_bn\\_n](#), [loc\\_n](#), [deg\\_en\\_n](#) and as a modifier in [itxn\\_a](#)).

$$\frac{d}{dt}\text{NFkB\_nucleus} = v_{11} + v_{22} + v_{33} + v_{44} - v_6 - v_{27} - v_{39} \quad (115)$$

## 8.11 Species IkBbIKK

**Name** IkBbIKK

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

This species takes part in three reactions (as a reactant in [deg\\_bi](#), [int\\_2bin](#) and as a product in [int\\_bi](#)).

$$\frac{d}{dt}\text{IkBbIKK} = v_{29} - v_{20} - v_{25} \quad (116)$$

## 8.12 Species IkBbIKKNFkB

**Name** IkBbIKKNFkB

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

This species takes part in three reactions (as a reactant in [deg\\_bin](#) and as a product in [int\\_2bin](#), [int\\_2bni](#)).

$$\frac{d}{dt}\text{IkBbIKKNFkB} = v_{25} + v_{26} - v_{19} \quad (117)$$

### 8.13 Species IkBbNFkB\_nucleus

**Name** IkBbNFkBn

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

This species takes part in three reactions (as a reactant in [loc\\_bn](#), [deg\\_bn\\_n](#) and as a product in [int\\_bn\\_n](#)).

$$\frac{d}{dt}\text{IkBbNFkB\_nucleus} = v_{27} - v_{17} - v_{22} \quad (118)$$

### 8.14 Species IkBbNFkB\_cytoplasm

**Name** IkBbNFkB

**Initial concentration** 0.03  $\mu\text{mol} \cdot \text{l}^{-1}$

This species takes part in four reactions (as a reactant in [deg\\_bn](#), [int\\_2bni](#) and as a product in [loc\\_bn](#), [int\\_bn](#)).

$$\frac{d}{dt}\text{IkBbNFkB\_cytoplasm} = v_{17} + v_{28} - v_{21} - v_{26} \quad (119)$$

### 8.15 Species IkBb\_nucleus

**Name** IkBbn

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

This species takes part in three reactions (as a reactant in [deg\\_b\\_n](#), [int\\_bn\\_n](#) and as a product in [loc\\_b](#)).

$$\frac{d}{dt}\text{IkBb\_nucleus} = v_{18} - v_{23} - v_{27} \quad (120)$$

### 8.16 Species IkBb\_cytoplasm

**Name** IkBb

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

This species takes part in five reactions (as a reactant in [loc\\_b](#), [deg\\_b](#), [int\\_bn](#), [int\\_bi](#) and as a product in [tsl\\_b](#)).

$$\frac{d}{dt}\text{IkBb\_cytoplasm} = v_{30} - v_{18} - v_{24} - v_{28} - v_{29} \quad (121)$$



### 8.17 Species IkBb\_mRNA

**Name** IkBbt

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

This species takes part in four reactions (as a reactant in [tsl\\_b](#), [mdeg\\_b](#) and as a product in [tsl\\_b](#), [txn\\_b](#)).

$$\frac{d}{dt}\text{IkBb\_mRNA} = v_{30} + v_{32} - v_{30} - v_{31} \quad (122)$$

### 8.18 Species IkBe\_mRNA

**Name** IkBet

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

This species takes part in four reactions (as a reactant in [mdeg\\_e](#), [tsl\\_e](#) and as a product in [txn\\_e](#), [tsl\\_e](#)).

$$\frac{d}{dt}\text{IkBe\_mRNA} = v_{34} + v_{36} - v_{35} - v_{36} \quad (123)$$

### 8.19 Species IkBe\_cytoplasm

**Name** IkBe

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

This species takes part in five reactions (as a reactant in [int\\_ei](#), [int\\_en](#), [deg\\_e](#), [loc\\_e](#) and as a product in [tsl\\_e](#)).

$$\frac{d}{dt}\text{IkBe\_cytoplasm} = v_{36} - v_{37} - v_{38} - v_{42} - v_{48} \quad (124)$$

### 8.20 Species IkBe\_nucleus

**Name** IkBen

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

This species takes part in three reactions (as a reactant in [int\\_en\\_n](#), [deg\\_e\\_n](#) and as a product in [loc\\_e](#)).

$$\frac{d}{dt}\text{IkBe\_nucleus} = v_{48} - v_{39} - v_{43} \quad (125)$$

### 8.21 Species IkBeNFkB\_cytoplasm

**Name** IkBeNFkB

**Initial concentration**  $0.01 \mu\text{mol} \cdot \text{l}^{-1}$

This species takes part in four reactions (as a reactant in [int\\_2eni](#), [deg\\_en](#) and as a product in [int\\_en](#), [loc\\_en](#)).

$$\frac{d}{dt}\text{IkBeNFkB\_cytoplasm} = v_{38} + v_{49} - v_{40} - v_{45} \quad (126)$$

### 8.22 Species IkBeNFkB\_nucleus

**Name** IkBeNFkBn

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

This species takes part in three reactions (as a reactant in [deg\\_en\\_n](#), [loc\\_en](#) and as a product in [int\\_en\\_n](#)).

$$\frac{d}{dt}\text{IkBeNFkB\_nucleus} = v_{39} - v_{44} - v_{49} \quad (127)$$

### 8.23 Species IkBeIKKNFkB

**Name** IkBeIKKNFkB

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

This species takes part in three reactions (as a reactant in [deg\\_ein](#) and as a product in [int\\_2eni](#), [int\\_2ein](#)).

$$\frac{d}{dt}\text{IkBeIKKNFkB} = v_{40} + v_{41} - v_{47} \quad (128)$$

### 8.24 Species IkBeIKK

**Name** IkBeIKK

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

This species takes part in three reactions (as a reactant in [int\\_2ein](#), [deg\\_ei](#) and as a product in [int\\_ei](#)).

$$\frac{d}{dt}\text{IkBeIKK} = v_{37} - v_{41} - v_{46} \quad (129)$$

SBML<sup>2</sup>TeX was developed by Andreas Dräger<sup>a</sup>, Hannes Planatscher<sup>a</sup>, Dieudonné M Wouamba<sup>a</sup>, Adrian Schröder<sup>a</sup>, Michael Hucka<sup>b</sup>, Lukas Endler<sup>c</sup>, Martin Golebiewski<sup>d</sup> and Andreas Zell<sup>a</sup>. Please see <http://www.ra.cs.uni-tuebingen.de/software/SBML2LaTeX> for more information.

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