

## SBML Model Report

# Model name: “Coggins2014 - CXCL12 dependent recruitment of beta arrestin”



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## 1 General Overview

This is a document in SBML Level 2 Version 4 format. This model was created by the following eight authors: Nick Juty<sup>1</sup>, Vijayalakshmi Chelliah<sup>2</sup>, Ryan Gutenkunst<sup>3</sup>, Timothy Leach<sup>4</sup>, Syeda Kazmi<sup>5</sup>, Alexander McNeish<sup>6</sup>, David Byrne<sup>7</sup> and Jennifer Linderman<sup>8</sup> at April 18<sup>th</sup> 2016 at 11:39 a. m. and last time modified at April 18<sup>th</sup> 2016 at 2:58 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	1
species types	0	species	30
events	0	constraints	0
reactions	37	function definitions	14
global parameters	40	unit definitions	2
rules	5	initial assignments	6

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## 2 Unit Definitions

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

### 2.1 Unit volume

**Name** volume

**Definition** dimensionless

### 2.2 Unit substance

**Name** substance

**Definition** item

### 2.3 Unit area

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

**Definition** m<sup>2</sup>

### 2.4 Unit length

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

**Definition** m

### 2.5 Unit time

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

**Definition** s

## 3 Compartment

This model contains one compartment.

Table 2: Properties of all compartments.

Id	Name	SBO	Spatial Dimensions	Size	Unit	Constant	Outside
compartment_2	Intracellular		3	1	dimensionless	<input checked="" type="checkbox"/>	

### 3.1 Compartment `compartment_2`

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

**Name** Intracellular

## 4 Species

This model contains 30 species. Section 10 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
species_2	Be	compartment_2	item dimensionless <sup>-1</sup>	· ☐	☐
species_3	Bp	compartment_2	item dimensionless <sup>-1</sup>	· ☐	☐
species_4	C4	compartment_2	item dimensionless <sup>-1</sup>	· ☐	☐
species_5	C4Be	compartment_2	item dimensionless <sup>-1</sup>	· ☐	☐
species_6	C4Beii	compartment_2	item dimensionless <sup>-1</sup>	· ☐	☐
species_7	C4Bp	compartment_2	item dimensionless <sup>-1</sup>	· ☐	☐
species_8	C4Bpi	compartment_2	item dimensionless <sup>-1</sup>	· ☐	☐
species_9	C7	compartment_2	item dimensionless <sup>-1</sup>	· ☐	☐
species_10	C7Bei	compartment_2	item dimensionless <sup>-1</sup>	· ☐	☐
species_11	C7Beii	compartment_2	item dimensionless <sup>-1</sup>	· ☐	☐
species_12	C7Bp	compartment_2	item dimensionless <sup>-1</sup>	· ☐	☐

Id	Name	Compartment	Derived Unit	Constant	Boundary Condi- tion
species_13	C7Bpi	compartment_2	item dimensionless <sup>-1</sup>	· ☐	☐
species_14	L12i	compartment_2	item dimensionless <sup>-1</sup>	· ☐	☐
species_15	R4	compartment_2	item dimensionless <sup>-1</sup>	· ☐	☐
species_16	R4Be	compartment_2	item dimensionless <sup>-1</sup>	· ☐	☐
species_17	C7Bpii	compartment_2	item dimensionless <sup>-1</sup>	· ☐	☐
species_18	R7Bpii	compartment_2	item dimensionless <sup>-1</sup>	· ☐	☐
species_19	R7Bp	compartment_2	item dimensionless <sup>-1</sup>	· ☐	☐
species_20	R7	compartment_2	item dimensionless <sup>-1</sup>	· ☐	☐
species_21	C4Bpii	compartment_2	item dimensionless <sup>-1</sup>	· ☐	☐
species_22	C4Bei	compartment_2	item dimensionless <sup>-1</sup>	· ☐	☐
species_23	R4Bpi	compartment_2	item dimensionless <sup>-1</sup>	· ☐	☐
species_24	R4Bp	compartment_2	item dimensionless <sup>-1</sup>	· ☐	☐
species_25	R7Be	compartment_2	item dimensionless <sup>-1</sup>	· ☐	☐

Id	Name	Compartment	Derived Unit	Constant	Boundary Condi- tion
species_26	R7Bei	compartment_2	item dimensionless <sup>-1</sup>	· ☐	☐
species_27	R7Beii	compartment_2	item dimensionless <sup>-1</sup>	· ☐	☐
species_28	C7Be	compartment_2	item dimensionless <sup>-1</sup>	· ☐	☐
species_29	R4Bei	compartment_2	item dimensionless <sup>-1</sup>	· ☐	☐
species_30	R7Bpi	compartment_2	item dimensionless <sup>-1</sup>	· ☐	☐
species_1	L12	compartment_2	item dimensionless <sup>-1</sup>	· ☐	☐

## 5 Parameters

This model contains 40 global parameters.

Table 4: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
parameter_1	kf,L12,4		0.002		<input checked="" type="checkbox"/>
parameter_2	kf,L12,7		0.001		<input checked="" type="checkbox"/>
parameter_3	kf,B,4		$8.5 \cdot 10^{-9}$		<input checked="" type="checkbox"/>
parameter_4	kf,B,7		$1.4 \cdot 10^{-8}$		<input checked="" type="checkbox"/>
parameter_5	KD,R4,L12		40.000		<input checked="" type="checkbox"/>
parameter_6	KD,R7,L12		0.840		<input checked="" type="checkbox"/>
parameter_9	KD,C4,B		5100000.000		<input checked="" type="checkbox"/>
parameter_10	KD,C7,B		650000.000		<input checked="" type="checkbox"/>
parameter_11	ke,R4B		0.002		<input checked="" type="checkbox"/>
parameter_12	ke,R7B		0.004		<input checked="" type="checkbox"/>
parameter_13	ke,C7Bi		$5.5 \cdot 10^{-4}$		<input checked="" type="checkbox"/>
parameter_14	koff,B,4		$7.4 \cdot 10^{-4}$		<input checked="" type="checkbox"/>
parameter_15	koff,B,7		0.003		<input checked="" type="checkbox"/>
parameter_16	krec,R4Bi		$6.9 \cdot 10^{-5}$		<input checked="" type="checkbox"/>
parameter_17	krec,R7Bii		0.001		<input checked="" type="checkbox"/>
parameter_18	krec,C7Bii		$2.8 \cdot 10^{-4}$		<input checked="" type="checkbox"/>
parameter_19	kdeg,C4Bii		$10^{-4}$		<input checked="" type="checkbox"/>
parameter_20	kdeg,L12i		$10^{-4}$		<input checked="" type="checkbox"/>
parameter_21	KD,R4,B		7800000.000		<input checked="" type="checkbox"/>
parameter_22	KD,R7,B		2300000.000		<input checked="" type="checkbox"/>
parameter_23	ke,C4B		0.005		<input checked="" type="checkbox"/>
parameter_24	ke,C7B		0.002		<input checked="" type="checkbox"/>
parameter_25	n4		40000.000		<input checked="" type="checkbox"/>
parameter_26	n7		40000.000		<input checked="" type="checkbox"/>
parameter_27	n47		40000.000		<input checked="" type="checkbox"/>
parameter_28	Nav		$6.02 \cdot 10^{23}$		<input checked="" type="checkbox"/>
parameter_29	Vwell		$7 \cdot 10^{-5}$		<input checked="" type="checkbox"/>
parameter_30	Vcell		$8.4 \cdot 10^{-12}$		<input checked="" type="checkbox"/>
parameter_7	nmol_to_mol		$10^9$		<input checked="" type="checkbox"/>
Total4	Total4		8151.729		<input type="checkbox"/>
Total7	Total7		249192.409		<input type="checkbox"/>
_Beta	%Beta		100.000		<input type="checkbox"/>
_CXCR4	%CXCR4		100.000		<input type="checkbox"/>
_CXCR7	%CXCR7		100.000		<input type="checkbox"/>
Metabolite_1	Initial for Be		328437.241		<input checked="" type="checkbox"/>
Metabolite_3	Initial for Bp		492655.862		<input checked="" type="checkbox"/>
Metabolite_5	Initial for C4		0.000		<input checked="" type="checkbox"/>

Id	Name	SBO	Value	Unit	Constant
Metabolite- _15	Initial for C7		0.000		<input checked="" type="checkbox"/>
Metabolite- _27	Initial for R4		133539.964		<input checked="" type="checkbox"/>
Metabolite- _37	Initial for R7		509483.771		<input checked="" type="checkbox"/>

## 6 Initialassignments

This is an overview of six initialassignments.

### 6.1 Initialassignment Metabolite\_1

**Derived unit** item

**Math** [species\_2]

### 6.2 Initialassignment Metabolite\_3

**Derived unit** item

**Math** [species\_3]

### 6.3 Initialassignment Metabolite\_5

**Derived unit** item

**Math** [species\_4]

### 6.4 Initialassignment Metabolite\_15

**Derived unit** item

**Math** [species\_9]

### 6.5 Initialassignment Metabolite\_27

**Derived unit** item

**Math** [species\_15]



## 6.6 Initialassignment Metabolite\_37

**Derived unit** item

**Math** [species\_20]

## 7 Function definitions

This is an overview of 14 function definitions.

### 7.1 Function definition function\_8

**Name** Mass action (reversible with KD)\_12\_1

**Arguments** parameter\_22, parameter\_4, [species\_19], [species\_20], [species\_3]

**Mathematical Expression**

$$\text{parameter\_4} \cdot ([\text{species\_3}] \cdot [\text{species\_20}] - \text{parameter\_22} \cdot [\text{species\_19}]) \quad (1)$$

### 7.2 Function definition function\_5

**Name** Mass action (reversible with KD)\_10

**Arguments** parameter\_22, parameter\_4, [species\_2], [species\_20], [species\_25]

**Mathematical Expression**

$$\text{parameter\_4} \cdot ([\text{species\_2}] \cdot [\text{species\_20}] - \text{parameter\_22} \cdot [\text{species\_25}]) \quad (2)$$

### 7.3 Function definition function\_14

**Name** Mass action (reversible with KD)\_5\_4

**Arguments** parameter\_10, parameter\_2, parameter\_22, parameter\_28, parameter\_30, parameter\_6, parameter\_7, [species\_1], [species\_12], [species\_19]

**Mathematical Expression**

$$\begin{aligned} & \text{parameter\_2} \cdot \frac{\text{parameter\_7}}{\text{parameter\_28} \cdot \text{parameter\_30}} \cdot \left( [\text{species\_1}] \cdot [\text{species\_19}] \right. \\ & \left. - \frac{\text{parameter\_6} \cdot \text{parameter\_10} \cdot \frac{\text{parameter\_28} \cdot \text{parameter\_30}}{\text{parameter\_7}}}{\text{parameter\_22}} \cdot [\text{species\_12}] \right) \end{aligned} \quad (3)$$

#### 7.4 Function definition `function_13`

**Name** Mass action (reversible with KD)\_5\_3

**Arguments** `parameter_10`, `parameter_2`, `parameter_22`, `parameter_28`, `parameter_30`, `parameter_6`, `parameter_7`, `[species_1]`, `[species_25]`, `[species_28]`

**Mathematical Expression**

$$\begin{aligned} & \text{parameter\_2} \cdot \frac{\text{parameter\_7}}{\text{parameter\_28} \cdot \text{parameter\_30}} \cdot \left( [\text{species\_1}] \cdot [\text{species\_25}] \right. \\ & \left. - \frac{\text{parameter\_6} \cdot \text{parameter\_10} \cdot \frac{\text{parameter\_28} \cdot \text{parameter\_30}}{\text{parameter\_7}}}{\text{parameter\_22}} \cdot [\text{species\_28}] \right) \end{aligned} \quad (4)$$

#### 7.5 Function definition `function_9`

**Name** Mass action (reversible with KD)\_1\_1

**Arguments** `parameter_1`, `parameter_28`, `parameter_30`, `parameter_5`, `parameter_7`, `[species_1]`, `[species_15]`, `[species_4]`

**Mathematical Expression**

$$\begin{aligned} & \text{parameter\_1} \cdot \frac{\text{parameter\_7}}{\text{parameter\_28} \cdot \text{parameter\_30}} \cdot \left( [\text{species\_15}] \cdot [\text{species\_1}] \right. \\ & \left. - \text{parameter\_5} \cdot \frac{\text{parameter\_28} \cdot \text{parameter\_30}}{\text{parameter\_7}} \cdot [\text{species\_4}] \right) \end{aligned} \quad (5)$$

#### 7.6 Function definition `function_11`

**Name** Mass action (reversible with KD)\_5\_1

**Arguments** `parameter_1`, `parameter_21`, `parameter_28`, `parameter_30`, `parameter_5`, `parameter_7`, `parameter_9`, `[species_1]`, `[species_16]`, `[species_5]`

**Mathematical Expression**

$$\begin{aligned} & \text{parameter\_1} \cdot \frac{\text{parameter\_7}}{\text{parameter\_28} \cdot \text{parameter\_30}} \cdot \left( [\text{species\_1}] \cdot [\text{species\_16}] \right. \\ & \left. - \frac{\text{parameter\_5} \cdot \text{parameter\_9} \cdot \frac{\text{parameter\_28} \cdot \text{parameter\_30}}{\text{parameter\_7}}}{\text{parameter\_21}} \cdot [\text{species\_5}] \right) \end{aligned} \quad (6)$$

### 7.7 Function definition [function\\_4](#)

**Name** Mass action (reversible with KD)\_9

**Arguments** parameter\_3, parameter\_9, [species\_3], [species\_4], [species\_7]

**Mathematical Expression**

$$\text{parameter\_3} \cdot ([\text{species\_3}] \cdot [\text{species\_4}] - \text{parameter\_9} \cdot [\text{species\_7}]) \quad (7)$$

### 7.8 Function definition [function\\_2](#)

**Name** Mass action (reversible with KD)\_7

**Arguments** parameter\_21, parameter\_3, [species\_15], [species\_24], [species\_3]

**Mathematical Expression**

$$\text{parameter\_3} \cdot ([\text{species\_3}] \cdot [\text{species\_15}] - \text{parameter\_21} \cdot [\text{species\_24}]) \quad (8)$$

### 7.9 Function definition [function\\_1](#)

**Name** Mass action (reversible with KD)\_6

**Arguments** parameter\_21, parameter\_3, [species\_15], [species\_16], [species\_2]

**Mathematical Expression**

$$\text{parameter\_3} \cdot ([\text{species\_2}] \cdot [\text{species\_15}] - \text{parameter\_21} \cdot [\text{species\_16}]) \quad (9)$$

### 7.10 Function definition [function\\_10](#)

**Name** Mass action (reversible with KD)\_1\_2

**Arguments** parameter\_2, parameter\_28, parameter\_30, parameter\_6, parameter\_7, [species\_1], [species\_20], [species\_9]

**Mathematical Expression**

$$\begin{aligned} & \text{parameter\_2} \cdot \frac{\text{parameter\_7}}{\text{parameter\_28} \cdot \text{parameter\_30}} \cdot \left( [\text{species\_20}] \cdot [\text{species\_1}] \right. \\ & \left. - \text{parameter\_6} \cdot \frac{\text{parameter\_28} \cdot \text{parameter\_30}}{\text{parameter\_7}} \cdot [\text{species\_9}] \right) \end{aligned} \quad (10)$$

### 7.11 Function definition [function\\_6](#)

**Name** Mass action (reversible with KD)\_12

**Arguments** parameter\_10, parameter\_4, [species\_2], [species\_28], [species\_9]

**Mathematical Expression**

$$\text{parameter\_4} \cdot ([\text{species\_2}] \cdot [\text{species\_9}] - \text{parameter\_10} \cdot [\text{species\_28}]) \quad (11)$$

### 7.12 Function definition [function\\_3](#)

**Name** Mass action (reversible with KD)\_8

**Arguments** parameter\_3, parameter\_9, [species\_2], [species\_4], [species\_5]

**Mathematical Expression**

$$\text{parameter\_3} \cdot ([\text{species\_2}] \cdot [\text{species\_4}] - \text{parameter\_9} \cdot [\text{species\_5}]) \quad (12)$$

### 7.13 Function definition [function\\_12](#)

**Name** Mass action (reversible with KD)\_5\_2

**Arguments** parameter\_1, parameter\_21, parameter\_28, parameter\_30, parameter\_5, parameter\_7, parameter\_9, [species\_1], [species\_24], [species\_7]

**Mathematical Expression**

$$\begin{aligned} & \text{parameter\_1} \cdot \frac{\text{parameter\_7}}{\text{parameter\_28} \cdot \text{parameter\_30}} \cdot \left( [\text{species\_1}] \cdot [\text{species\_24}] \right. \\ & \left. - \frac{\text{parameter\_5} \cdot \text{parameter\_9} \cdot \frac{\text{parameter\_28} \cdot \text{parameter\_30}}{\text{parameter\_7}}}{\text{parameter\_21}} \cdot [\text{species\_7}] \right) \end{aligned} \quad (13)$$

### 7.14 Function definition [function\\_7](#)

**Name** Mass action (reversible with KD)\_13

**Arguments** parameter\_10, parameter\_4, [species\_12], [species\_3], [species\_9]

**Mathematical Expression**

$$\text{parameter\_4} \cdot ([\text{species\_3}] \cdot [\text{species\_9}] - \text{parameter\_10} \cdot [\text{species\_12}]) \quad (14)$$

## 8 Rules

This is an overview of five rules.

### 8.1 Rule Total4

Rule Total4 is an assignment rule for parameter Total4:

$$\text{Total4} = [\text{species}_7] + [\text{species}_8] + [\text{species}_{24}] \quad (15)$$

**Derived unit** item

### 8.2 Rule Total7

Rule Total7 is an assignment rule for parameter Total7:

$$\text{Total7} = [\text{species}_{12}] + [\text{species}_{13}] + [\text{species}_{17}] + [\text{species}_{19}] + [\text{species}_{30}] \quad (16)$$

**Derived unit** item

### 8.3 Rule \_Beta

Rule \_Beta is an assignment rule for parameter \_Beta:

$$\text{\_Beta} = \frac{[\text{species}_2] + [\text{species}_3]}{\text{Metabolite}_1 + \text{Metabolite}_3} \cdot 100 \quad (17)$$

### 8.4 Rule \_CXCR4

Rule \_CXCR4 is an assignment rule for parameter \_CXCR4:

$$\text{\_CXCR4} = \frac{[\text{species}_4] + [\text{species}_{15}]}{\text{Metabolite}_5 + \text{Metabolite}_{27}} \cdot 100 \quad (18)$$

### 8.5 Rule \_CXCR7

Rule \_CXCR7 is an assignment rule for parameter \_CXCR7:

$$\text{\_CXCR7} = \frac{[\text{species}_9] + [\text{species}_{20}]}{\text{Metabolite}_{15} + \text{Metabolite}_{37}} \cdot 100 \quad (19)$$

## 9 Reactions

This model contains 37 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	reaction_7	Be binding R4	$\text{species\_2} + \text{species\_15} \xrightarrow{\text{species\_15, species\_16, species\_2}} \text{species\_16}$	
2	reaction_8	Bp binding R4	$\text{species\_3} + \text{species\_15} \xrightarrow{\text{species\_15, species\_24, species\_3}} \text{species\_24}$	
3	reaction_9	Be binding C4	$\text{species\_2} + \text{species\_4} \xrightarrow{\text{species\_2, species\_4, species\_5}} \text{species\_5}$	
4	reaction_10	Bp binding C4	$\text{species\_3} + \text{species\_4} \xrightarrow{\text{species\_3, species\_4, species\_7}} \text{species\_7}$	
5	reaction_11	Be binding R7	$\text{species\_2} + \text{species\_20} \xrightarrow{\text{species\_2, species\_20, species\_25}} \text{species\_25}$	
6	reaction_12	Bp binding R7	$\text{species\_3} + \text{species\_20} \xrightarrow{\text{species\_19, species\_20, species\_3}} \text{species\_19}$	
7	reaction_13	Be binding C7	$\text{species\_2} + \text{species\_9} \xrightarrow{\text{species\_2, species\_28, species\_9}} \text{species\_28}$	
8	reaction_14	Bp binding C7	$\text{species\_3} + \text{species\_9} \xrightarrow{\text{species\_12, species\_3, species\_9}} \text{species\_12}$	
9	reaction_15	Internalization of R4Be	$\text{species\_16} \xrightarrow{\text{species\_16}} \text{species\_29} + \text{species\_2}$	
10	reaction_16	Internalization of R4Bp	$\text{species\_24} \xrightarrow{\text{species\_24}} \text{species\_23} + \text{species\_3}$	
11	reaction_17	Internalization of C4Be	$\text{species\_5} \xrightarrow{\text{species\_5}} \text{species\_22} + \text{species\_14}$	
12	reaction_18	Internalization of C4Bp	$\text{species\_7} \xrightarrow{\text{species\_7}} \text{species\_8} + \text{species\_14}$	
13	reaction_19	Internalization of R7Be	$\text{species\_25} \xrightarrow{\text{species\_25}} \text{species\_26}$	
14	reaction_20	Internalization of R7Bp	$\text{species\_19} \xrightarrow{\text{species\_19}} \text{species\_30}$	
15	reaction_21	Internalization of C7Be	$\text{species\_28} \xrightarrow{\text{species\_28}} \text{species\_10} + \text{species\_14}$	

Nº	Id	Name	Reaction Equation	SBO
16	reaction_22	Internalization of C7Bp	$\text{species\_12} \xrightarrow{\text{species\_12}} \text{species\_13} + \text{species\_14}$	
17	reaction_23	Dissocation of Be from C4Bei	$\text{species\_22} \xrightarrow{\text{species\_22}} \text{species\_6} + \text{species\_2}$	
18	reaction_24	Dissociation of Bp from C4Bpi	$\text{species\_8} \xrightarrow{\text{species\_8}} \text{species\_21} + \text{species\_3}$	
19	reaction_25	Dissociation of Be from R7Bei	$\text{species\_26} \xrightarrow{\text{species\_26}} \text{species\_27} + \text{species\_2}$	
20	reaction_26	Dissociation of Bp from R7Bpi	$\text{species\_30} \xrightarrow{\text{species\_30}} \text{species\_18} + \text{species\_3}$	
21	reaction_27	Trafficking of C7Bei to late endosomes	$\text{species\_10} \xrightarrow{\text{species\_10}} \text{species\_11}$	
22	reaction_28	Trafficking of C7Bpi to late endosomes	$\text{species\_13} \xrightarrow{\text{species\_13}} \text{species\_17}$	
23	reaction_29	Recycling of R4Bei	$\text{species\_29} \xrightarrow{\text{species\_29}} \text{species\_15}$	
24	reaction_30	Recycling of R4Bpi	$\text{species\_23} \xrightarrow{\text{species\_23}} \text{species\_15}$	
25	reaction_31	Recycling of R7Bei	$\text{species\_27} \xrightarrow{\text{species\_27}} \text{species\_20}$	
26	reaction_32	Recycling of R7Bpii	$\text{species\_18} \xrightarrow{\text{species\_18}} \text{species\_20}$	
27	reaction_33	Recycling of C7Bei	$\text{species\_11} \xrightarrow{\text{species\_11}} \text{species\_20} + \text{species\_2}$	
28	reaction_34	Recycling of C7Bpii	$\text{species\_17} \xrightarrow{\text{species\_17}} \text{species\_20} + \text{species\_3}$	
29	reaction_35	Degradation of C4Bei	$\text{species\_6} \xrightarrow{\text{species\_6}} \emptyset$	
30	reaction_36	Degradation of C4Bpii	$\text{species\_21} \xrightarrow{\text{species\_21}} \emptyset$	
31	reaction_37	Degradation of L12i	$\text{species\_14} \xrightarrow{\text{species\_14}} \emptyset$	
32	reaction_1	L12 binding R4	$\text{species\_1} + \text{species\_15} \xrightleftharpoons{\text{species\_1, species\_15, species\_4}} \text{species\_4}$	
33	reaction_2	L12 binding R7	$\text{species\_1} + \text{species\_20} \xrightleftharpoons{\text{species\_1, species\_20, species\_9}} \text{species\_9}$	
34	reaction_3	L12 binding R4Be	$\text{species\_1} + \text{species\_16} \xrightleftharpoons{\text{species\_1, species\_16, species\_5}} \text{species\_5}$	

Nº	Id	Name	Reaction Equation	SBO
35	reaction_4	L12 binding R4Bp	$\text{species\_1} + \text{species\_24} \xrightleftharpoons{\text{species\_1, species\_24, species\_7}} \text{species\_7}$	
36	reaction_5	L12 binding R7Be	$\text{species\_1} + \text{species\_25} \xrightleftharpoons{\text{species\_1, species\_25, species\_28}} \text{species\_28}$	
37	reaction_6	L12 binding R7Bp	$\text{species\_1} + \text{species\_19} \xrightleftharpoons{\text{species\_1, species\_12, species\_19}} \text{species\_12}$	



## 9.1 Reaction `reaction_7`

This is a reversible reaction of two reactants forming one product influenced by three modifiers.

**Name** Be binding R4

### Reaction equation



### Reactants

Table 6: Properties of each reactant.

Id	Name	SBO
species_2	Be	
species_15	R4	

### Modifiers

Table 7: Properties of each modifier.

Id	Name	SBO
species_15	R4	
species_16	R4Be	
species_2	Be	

### Product

Table 8: Properties of each product.

Id	Name	SBO
species_16	R4Be	

### Kinetic Law

**Derived unit** contains undeclared units

$$v_1 = \text{vol}(\text{compartment\_2}) \cdot \text{function\_1}(\text{parameter\_21}, \text{parameter\_3}, [\text{species\_15}], [\text{species\_16}], [\text{species\_2}]) \quad (21)$$

$$\begin{aligned} &\text{function\_1}(\text{parameter\_21}, \text{parameter\_3}, [\text{species\_15}], [\text{species\_16}], [\text{species\_2}]) \\ &= \text{parameter\_3} \cdot ([\text{species\_2}] \cdot [\text{species\_15}] - \text{parameter\_21} \cdot [\text{species\_16}]) \end{aligned} \quad (22)$$

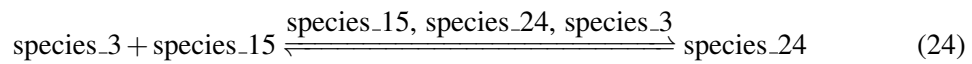
$$\begin{aligned} &\text{function\_1}(\text{parameter\_21}, \text{parameter\_3}, [\text{species\_15}], [\text{species\_16}], [\text{species\_2}]) \\ &= \text{parameter\_3} \cdot ([\text{species\_2}] \cdot [\text{species\_15}] - \text{parameter\_21} \cdot [\text{species\_16}]) \end{aligned} \quad (23)$$

## 9.2 Reaction `reaction_8`

This is a reversible reaction of two reactants forming one product influenced by three modifiers.

**Name** Bp binding R4

### Reaction equation



### Reactants

Table 9: Properties of each reactant.

Id	Name	SBO
<code>species_3</code>	Bp	
<code>species_15</code>	R4	

### Modifiers

Table 10: Properties of each modifier.

Id	Name	SBO
<code>species_15</code>	R4	
<code>species_24</code>	R4Bp	
<code>species_3</code>	Bp	

### Product

Table 11: Properties of each product.

Id	Name	SBO
<code>species_24</code>	R4Bp	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_2 = \text{vol}(\text{compartment\_2}) \cdot \text{function\_2}(\text{parameter\_21}, \text{parameter\_3}, [\text{species\_15}], [\text{species\_24}], [\text{species\_3}]) \quad (25)$$

$$\begin{aligned} &\text{function\_2}(\text{parameter\_21}, \text{parameter\_3}, [\text{species\_15}], [\text{species\_24}], [\text{species\_3}]) \\ &= \text{parameter\_3} \cdot ([\text{species\_3}] \cdot [\text{species\_15}] - \text{parameter\_21} \cdot [\text{species\_24}]) \end{aligned} \quad (26)$$

$$\begin{aligned} &\text{function\_2}(\text{parameter\_21}, \text{parameter\_3}, [\text{species\_15}], [\text{species\_24}], [\text{species\_3}]) \\ &= \text{parameter\_3} \cdot ([\text{species\_3}] \cdot [\text{species\_15}] - \text{parameter\_21} \cdot [\text{species\_24}]) \end{aligned} \quad (27)$$

## 9.3 Reaction `reaction_9`

This is a reversible reaction of two reactants forming one product influenced by three modifiers.

**Name** Be binding C4

### Reaction equation



### Reactants

Table 12: Properties of each reactant.

Id	Name	SBO
<code>species_2</code>	Be	
<code>species_4</code>	C4	

### Modifiers

Table 13: Properties of each modifier.

Id	Name	SBO
<code>species_2</code>	Be	
<code>species_4</code>	C4	
<code>species_5</code>	C4Be	

## Product

Table 14: Properties of each product.

Id	Name	SBO
species_5	C4Be	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_3 = \text{vol}(\text{compartment}_2) \cdot \text{function\_3}(\text{parameter\_3}, \text{parameter\_9}, [\text{species\_2}], [\text{species\_4}], [\text{species\_5}]) \quad (29)$$

$$\begin{aligned} &\text{function\_3}(\text{parameter\_3}, \text{parameter\_9}, [\text{species\_2}], [\text{species\_4}], [\text{species\_5}]) \\ &= \text{parameter\_3} \cdot ([\text{species\_2}] \cdot [\text{species\_4}] - \text{parameter\_9} \cdot [\text{species\_5}]) \end{aligned} \quad (30)$$

$$\begin{aligned} &\text{function\_3}(\text{parameter\_3}, \text{parameter\_9}, [\text{species\_2}], [\text{species\_4}], [\text{species\_5}]) \\ &= \text{parameter\_3} \cdot ([\text{species\_2}] \cdot [\text{species\_4}] - \text{parameter\_9} \cdot [\text{species\_5}]) \end{aligned} \quad (31)$$

## 9.4 Reaction `reaction_10`

This is a reversible reaction of two reactants forming one product influenced by three modifiers.

**Name** Bp binding C4

### Reaction equation



## Reactants

Table 15: Properties of each reactant.

Id	Name	SBO
species_3	Bp	
species_4	C4	

## Modifiers

Table 16: Properties of each modifier.

Id	Name	SBO
species_3	Bp	
species_4	C4	
species_7	C4Bp	

## Product

Table 17: Properties of each product.

Id	Name	SBO
species_7	C4Bp	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_4 = \text{vol}(\text{compartment}_2) \cdot \text{function}_4(\text{parameter}_3, \text{parameter}_9, [\text{species}_3], [\text{species}_4], [\text{species}_7]) \quad (33)$$

$$\begin{aligned} &\text{function}_4(\text{parameter}_3, \text{parameter}_9, [\text{species}_3], [\text{species}_4], [\text{species}_7]) \\ &= \text{parameter}_3 \cdot ([\text{species}_3] \cdot [\text{species}_4] - \text{parameter}_9 \cdot [\text{species}_7]) \end{aligned} \quad (34)$$

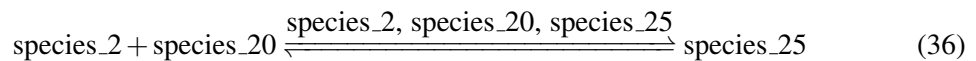
$$\begin{aligned} &\text{function}_4(\text{parameter}_3, \text{parameter}_9, [\text{species}_3], [\text{species}_4], [\text{species}_7]) \\ &= \text{parameter}_3 \cdot ([\text{species}_3] \cdot [\text{species}_4] - \text{parameter}_9 \cdot [\text{species}_7]) \end{aligned} \quad (35)$$

## 9.5 Reaction [reaction\\_11](#)

This is a reversible reaction of two reactants forming one product influenced by three modifiers.

**Name** Be binding R7

### Reaction equation



## Reactants

Table 18: Properties of each reactant.

Id	Name	SBO
species_2	Be	
species_20	R7	

## Modifiers

Table 19: Properties of each modifier.

Id	Name	SBO
species_2	Be	
species_20	R7	
species_25	R7Be	

## Product

Table 20: Properties of each product.

Id	Name	SBO
species_25	R7Be	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_5 = \text{vol}(\text{compartment}_2) \cdot \text{function}_5(\text{parameter}_{22}, \text{parameter}_4, [\text{species}_2], [\text{species}_{20}], [\text{species}_{25}]) \quad (37)$$

$$\begin{aligned} &\text{function}_5(\text{parameter}_{22}, \text{parameter}_4, [\text{species}_2], [\text{species}_{20}], [\text{species}_{25}]) \\ &= \text{parameter}_4 \cdot ([\text{species}_2] \cdot [\text{species}_{20}] - \text{parameter}_{22} \cdot [\text{species}_{25}]) \end{aligned} \quad (38)$$

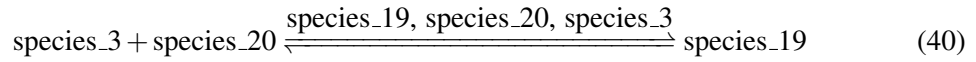
$$\begin{aligned} &\text{function}_5(\text{parameter}_{22}, \text{parameter}_4, [\text{species}_2], [\text{species}_{20}], [\text{species}_{25}]) \\ &= \text{parameter}_4 \cdot ([\text{species}_2] \cdot [\text{species}_{20}] - \text{parameter}_{22} \cdot [\text{species}_{25}]) \end{aligned} \quad (39)$$

## 9.6 Reaction `reaction_12`

This is a reversible reaction of two reactants forming one product influenced by three modifiers.

**Name** Bp binding R7

## Reaction equation



## Reactants

Table 21: Properties of each reactant.

Id	Name	SBO
species_3	Bp	
species_20	R7	

## Modifiers

Table 22: Properties of each modifier.

Id	Name	SBO
species_19	R7Bp	
species_20	R7	
species_3	Bp	

## Product

Table 23: Properties of each product.

Id	Name	SBO
species_19	R7Bp	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_6 = \text{vol}(\text{compartment\_2}) \cdot \text{function\_8}(\text{parameter\_22}, \text{parameter\_4}, [\text{species\_19}], [\text{species\_20}], [\text{species\_3}]) \quad (41)$$

$$\begin{aligned} & \text{function\_8}(\text{parameter\_22}, \text{parameter\_4}, [\text{species\_19}], [\text{species\_20}], [\text{species\_3}]) \\ &= \text{parameter\_4} \cdot ([\text{species\_3}] \cdot [\text{species\_20}] - \text{parameter\_22} \cdot [\text{species\_19}]) \end{aligned} \quad (42)$$

$$\begin{aligned} & \text{function\_8}(\text{parameter\_22}, \text{parameter\_4}, [\text{species\_19}], [\text{species\_20}], [\text{species\_3}]) \\ &= \text{parameter\_4} \cdot ([\text{species\_3}] \cdot [\text{species\_20}] - \text{parameter\_22} \cdot [\text{species\_19}]) \end{aligned} \quad (43)$$

## 9.7 Reaction `reaction_13`

This is a reversible reaction of two reactants forming one product influenced by three modifiers.

**Name** Be binding C7

### Reaction equation



### Reactants

Table 24: Properties of each reactant.

Id	Name	SBO
species_2	Be	
species_9	C7	

### Modifiers

Table 25: Properties of each modifier.

Id	Name	SBO
species_2	Be	
species_28	C7Be	
species_9	C7	

### Product

Table 26: Properties of each product.

Id	Name	SBO
species_28	C7Be	

### Kinetic Law

**Derived unit** contains undeclared units

$$v_7 = \text{vol}(\text{compartment\_2}) \cdot \text{function\_6}(\text{parameter\_10}, \text{parameter\_4}, [\text{species\_2}], [\text{species\_28}], [\text{species\_9}]) \quad (45)$$



$$\begin{aligned} &\text{function\_6}(\text{parameter\_10}, \text{parameter\_4}, [\text{species\_2}], [\text{species\_28}], [\text{species\_9}]) \\ &= \text{parameter\_4} \cdot ([\text{species\_2}] \cdot [\text{species\_9}] - \text{parameter\_10} \cdot [\text{species\_28}]) \end{aligned} \quad (46)$$

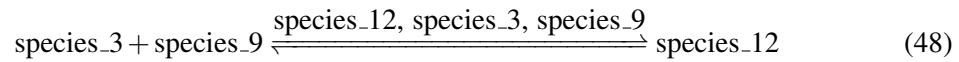
$$\begin{aligned} &\text{function\_6}(\text{parameter\_10}, \text{parameter\_4}, [\text{species\_2}], [\text{species\_28}], [\text{species\_9}]) \\ &= \text{parameter\_4} \cdot ([\text{species\_2}] \cdot [\text{species\_9}] - \text{parameter\_10} \cdot [\text{species\_28}]) \end{aligned} \quad (47)$$

## 9.8 Reaction `reaction_14`

This is a reversible reaction of two reactants forming one product influenced by three modifiers.

**Name** Bp binding C7

### Reaction equation



### Reactants

Table 27: Properties of each reactant.

Id	Name	SBO
<code>species_3</code>	Bp	
<code>species_9</code>	C7	

### Modifiers

Table 28: Properties of each modifier.

Id	Name	SBO
<code>species_12</code>	C7Bp	
<code>species_3</code>	Bp	
<code>species_9</code>	C7	

### Product

Table 29: Properties of each product.

Id	Name	SBO
<code>species_12</code>	C7Bp	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_8 = \text{vol}(\text{compartment\_2}) \cdot \text{function\_7}(\text{parameter\_10}, \text{parameter\_4}, [\text{species\_12}], [\text{species\_3}], [\text{species\_9}]) \quad (49)$$

$$\begin{aligned} &\text{function\_7}(\text{parameter\_10}, \text{parameter\_4}, [\text{species\_12}], [\text{species\_3}], [\text{species\_9}]) \\ &= \text{parameter\_4} \cdot ([\text{species\_3}] \cdot [\text{species\_9}] - \text{parameter\_10} \cdot [\text{species\_12}]) \end{aligned} \quad (50)$$

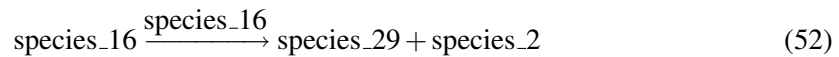
$$\begin{aligned} &\text{function\_7}(\text{parameter\_10}, \text{parameter\_4}, [\text{species\_12}], [\text{species\_3}], [\text{species\_9}]) \\ &= \text{parameter\_4} \cdot ([\text{species\_3}] \cdot [\text{species\_9}] - \text{parameter\_10} \cdot [\text{species\_12}]) \end{aligned} \quad (51)$$

## 9.9 Reaction `reaction_15`

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

**Name** Internalization of R4Be

### Reaction equation



### Reactant

Table 30: Properties of each reactant.

Id	Name	SBO
<code>species_16</code>	R4Be	

### Modifier

Table 31: Properties of each modifier.

Id	Name	SBO
<code>species_16</code>	R4Be	

### Products

Table 32: Properties of each product.

Id	Name	SBO
species_29	R4Bei	
species_2	Be	

## Kinetic Law

**Derived unit** contains undeclared units

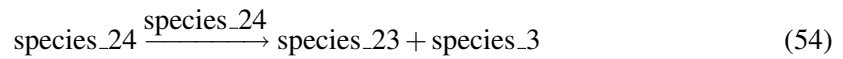
$$v_9 = \text{vol}(\text{compartment}_2) \cdot \text{parameter}_{11} \cdot [\text{species}_{16}] \quad (53)$$

## 9.10 Reaction `reaction_16`

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

**Name** Internalization of R4Bp

## Reaction equation



## Reactant

Table 33: Properties of each reactant.

Id	Name	SBO
species_24	R4Bp	

## Modifier

Table 34: Properties of each modifier.

Id	Name	SBO
species_24	R4Bp	

## Products

Table 35: Properties of each product.

Id	Name	SBO
species_23	R4Bpi	
species_3	Bp	

## Kinetic Law

**Derived unit** contains undeclared units

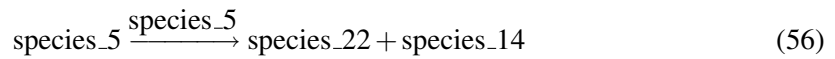
$$v_{10} = \text{vol}(\text{compartment\_2}) \cdot \text{parameter\_11} \cdot [\text{species\_24}] \quad (55)$$

## 9.11 Reaction `reaction_17`

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

**Name** Internalization of C4Be

## Reaction equation



## Reactant

Table 36: Properties of each reactant.

Id	Name	SBO
species_5	C4Be	

## Modifier

Table 37: Properties of each modifier.

Id	Name	SBO
species_5	C4Be	

## Products

Table 38: Properties of each product.

Id	Name	SBO
species_22	C4Bei	
species_14	L12i	

## Kinetic Law

**Derived unit** contains undeclared units

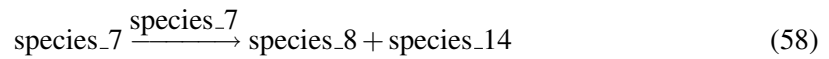
$$v_{11} = \text{vol}(\text{compartment\_2}) \cdot \text{parameter\_23} \cdot [\text{species\_5}] \quad (57)$$

## 9.12 Reaction reaction\_18

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

**Name** Internalization of C4Bp

## Reaction equation



## Reactant

Table 39: Properties of each reactant.

Id	Name	SBO
species_7	C4Bp	

## Modifier

Table 40: Properties of each modifier.

Id	Name	SBO
species_7	C4Bp	

## Products

Table 41: Properties of each product.

Id	Name	SBO
species_8	C4Bpi	
species_14	L12i	

### Kinetic Law

**Derived unit** contains undeclared units

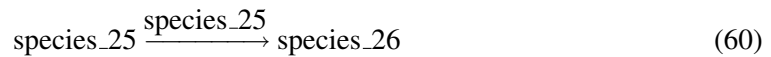
$$v_{12} = \text{vol}(\text{compartment\_2}) \cdot \text{parameter\_23} \cdot [\text{species\_7}] \quad (59)$$

### 9.13 Reaction `reaction_19`

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

**Name** Internalization of R7Be

### Reaction equation



### Reactant

Table 42: Properties of each reactant.

Id	Name	SBO
species_25	R7Be	

### Modifier

Table 43: Properties of each modifier.

Id	Name	SBO
species_25	R7Be	

### Product

Table 44: Properties of each product.

Id	Name	SBO
species_26	R7Bei	

### Kinetic Law

**Derived unit** contains undeclared units

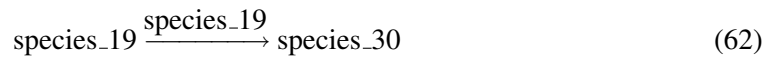
$$v_{13} = \text{vol}(\text{compartment\_2}) \cdot \text{parameter\_12} \cdot [\text{species\_25}] \quad (61)$$

### 9.14 Reaction reaction\_20

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

**Name** Internalization of R7Bp

### Reaction equation



### Reactant

Table 45: Properties of each reactant.

Id	Name	SBO
species_19	R7Bp	

### Modifier

Table 46: Properties of each modifier.

Id	Name	SBO
species_19	R7Bp	

### Product

Table 47: Properties of each product.

Id	Name	SBO
species_30	R7Bpi	

## Kinetic Law

**Derived unit** contains undeclared units

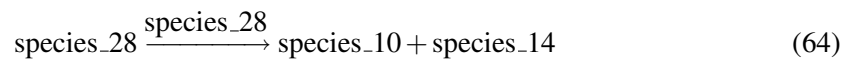
$$v_{14} = \text{vol}(\text{compartment\_2}) \cdot \text{parameter\_12} \cdot [\text{species\_19}] \quad (63)$$

## 9.15 Reaction `reaction_21`

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

**Name** Internalization of C7Be

### Reaction equation



### Reactant

Table 48: Properties of each reactant.

Id	Name	SBO
species_28	C7Be	

### Modifier

Table 49: Properties of each modifier.

Id	Name	SBO
species_28	C7Be	

### Products

Table 50: Properties of each product.

Id	Name	SBO
species_10	C7Bei	
species_14	L12i	

## Kinetic Law

**Derived unit** contains undeclared units



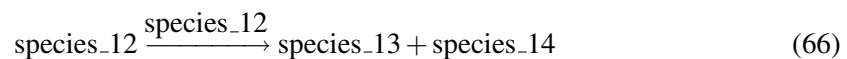
$$v_{15} = \text{vol}(\text{compartment\_2}) \cdot \text{parameter\_24} \cdot [\text{species\_28}] \quad (65)$$

### 9.16 Reaction [reaction\\_22](#)

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

**Name** Internalization of C7Bp

#### Reaction equation



#### Reactant

Table 51: Properties of each reactant.

Id	Name	SBO
species_12	C7Bp	

#### Modifier

Table 52: Properties of each modifier.

Id	Name	SBO
species_12	C7Bp	

#### Products

Table 53: Properties of each product.

Id	Name	SBO
species_13	C7Bpi	
species_14	L12i	

#### Kinetic Law

**Derived unit** contains undeclared units

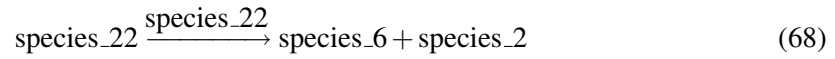
$$v_{16} = \text{vol}(\text{compartment\_2}) \cdot \text{parameter\_24} \cdot [\text{species\_12}] \quad (67)$$

### 9.17 Reaction [reaction\\_23](#)

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

**Name** Dissociation of Be from C4Bei

### Reaction equation



### Reactant

Table 54: Properties of each reactant.

Id	Name	SBO
species_22	C4Bei	

### Modifier

Table 55: Properties of each modifier.

Id	Name	SBO
species_22	C4Bei	

### Products

Table 56: Properties of each product.

Id	Name	SBO
species_6	C4Bei	
species_2	Be	

### Kinetic Law

**Derived unit** contains undeclared units

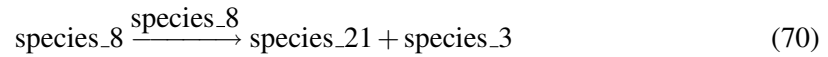
$$v_{17} = \text{vol}(\text{compartment\_2}) \cdot \text{parameter\_14} \cdot [\text{species\_22}] \quad (69)$$

## 9.18 Reaction [reaction\\_24](#)

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

**Name** Dissociation of Bp from C4Bpi

### Reaction equation



### Reactant

Table 57: Properties of each reactant.

Id	Name	SBO
species_8	C4Bpi	

### Modifier

Table 58: Properties of each modifier.

Id	Name	SBO
species_8	C4Bpi	

### Products

Table 59: Properties of each product.

Id	Name	SBO
species_21	C4Bpii	
species_3	Bp	

### Kinetic Law

**Derived unit** contains undeclared units

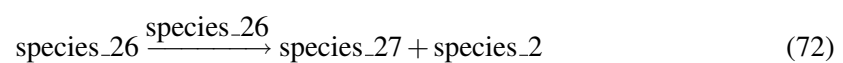
$$v_{18} = \text{vol}(\text{compartment\_2}) \cdot \text{parameter\_14} \cdot [\text{species\_8}] \quad (71)$$

### 9.19 Reaction `reaction_25`

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

**Name** Dissociation of Be from R7Bei

### Reaction equation



## Reactant

Table 60: Properties of each reactant.

Id	Name	SBO
species_26	R7Bei	

## Modifier

Table 61: Properties of each modifier.

Id	Name	SBO
species_26	R7Bei	

## Products

Table 62: Properties of each product.

Id	Name	SBO
species_27	R7Bei	
species_2	Be	

## Kinetic Law

**Derived unit** contains undeclared units

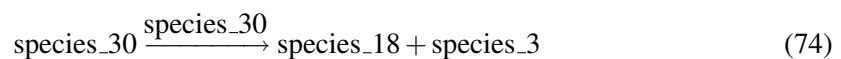
$$v_{19} = \text{vol}(\text{compartment\_2}) \cdot \text{parameter\_15} \cdot [\text{species\_26}] \quad (73)$$

### 9.20 Reaction `reaction_26`

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

**Name** Dissociation of Bp from R7Bpi

### Reaction equation



## Reactant

Table 63: Properties of each reactant.

Id	Name	SBO
species_30	R7Bpi	

Modifier

Table 64: Properties of each modifier.

Id	Name	SBO
species_30	R7Bpi	

Products

Table 65: Properties of each product.

Id	Name	SBO
species_18	R7Bpii	
species_3	Bp	

Kinetic Law

**Derived unit** contains undeclared units

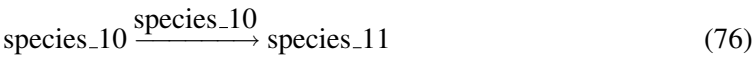
$$v_{20} = \text{vol}(\text{compartment\_2}) \cdot \text{parameter\_15} \cdot [\text{species\_30}] \tag{75}$$

9.21 Reaction `reaction_27`

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

**Name** Trafficking of C7Bei to late endosomes

Reaction equation



Reactant

Table 66: Properties of each reactant.

Id	Name	SBO
species_10	C7Bei	

## Modifier

Table 67: Properties of each modifier.

Id	Name	SBO
species_10	C7Bei	

## Product

Table 68: Properties of each product.

Id	Name	SBO
species_11	C7Bei	

## Kinetic Law

**Derived unit** contains undeclared units

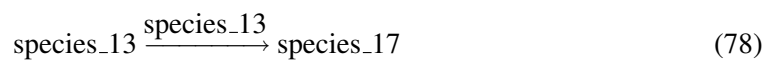
$$v_{21} = \text{vol}(\text{compartment\_2}) \cdot \text{parameter\_13} \cdot [\text{species\_10}] \quad (77)$$

## 9.22 Reaction [reaction\\_28](#)

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

**Name** Trafficking of C7Bpi to late endosomes

## Reaction equation



## Reactant

Table 69: Properties of each reactant.

Id	Name	SBO
species_13	C7Bpi	

## Modifier

Table 70: Properties of each modifier.

Id	Name	SBO
species_13	C7Bpi	

## Product

Table 71: Properties of each product.

Id	Name	SBO
species_17	C7Bpii	

## Kinetic Law

**Derived unit** contains undeclared units

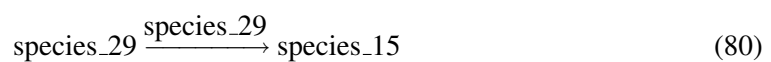
$$v_{22} = \text{vol}(\text{compartment\_2}) \cdot \text{parameter\_13} \cdot [\text{species\_13}] \quad (79)$$

### 9.23 Reaction [reaction\\_29](#)

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

**Name** Recycling of R4Bei

#### Reaction equation



## Reactant

Table 72: Properties of each reactant.

Id	Name	SBO
species_29	R4Bei	

## Modifier

Table 73: Properties of each modifier.

Id	Name	SBO
species_29	R4Bei	

## Product

Table 74: Properties of each product.

Id	Name	SBO
species_15	R4	

## Kinetic Law

**Derived unit** contains undeclared units

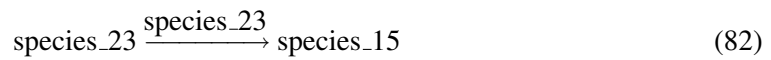
$$v_{23} = \text{vol}(\text{compartment\_2}) \cdot \text{parameter\_16} \cdot [\text{species\_29}] \quad (81)$$

## 9.24 Reaction reaction\_30

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

**Name** Recycling of R4Bpi

## Reaction equation



## Reactant

Table 75: Properties of each reactant.

Id	Name	SBO
species_23	R4Bpi	

## Modifier

Table 76: Properties of each modifier.

Id	Name	SBO
species_23	R4Bpi	



## Product

Table 77: Properties of each product.

Id	Name	SBO
species_15	R4	

## Kinetic Law

**Derived unit** contains undeclared units

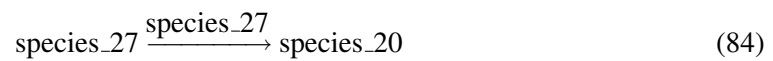
$$v_{24} = \text{vol}(\text{compartment\_2}) \cdot \text{parameter\_16} \cdot [\text{species\_23}] \quad (83)$$

## 9.25 Reaction [reaction\\_31](#)

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

**Name** Recycling of R7Beii

## Reaction equation



## Reactant

Table 78: Properties of each reactant.

Id	Name	SBO
species_27	R7Beii	

## Modifier

Table 79: Properties of each modifier.

Id	Name	SBO
species_27	R7Beii	

## Product

Table 80: Properties of each product.

Id	Name	SBO
species_20	R7	

### Kinetic Law

**Derived unit** contains undeclared units

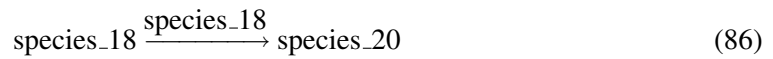
$$v_{25} = \text{vol}(\text{compartment\_2}) \cdot \text{parameter\_17} \cdot [\text{species\_27}] \quad (85)$$

### 9.26 Reaction [reaction\\_32](#)

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

**Name** Recycling of R7Bpii

### Reaction equation



### Reactant

Table 81: Properties of each reactant.

Id	Name	SBO
species_18	R7Bpii	

### Modifier

Table 82: Properties of each modifier.

Id	Name	SBO
species_18	R7Bpii	

### Product

Table 83: Properties of each product.

Id	Name	SBO
species_20	R7	

## Kinetic Law

**Derived unit** contains undeclared units

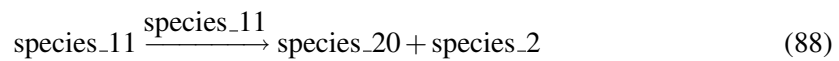
$$v_{26} = \text{vol}(\text{compartment\_2}) \cdot \text{parameter\_17} \cdot [\text{species\_18}] \quad (87)$$

## 9.27 Reaction [reaction\\_33](#)

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

**Name** Recycling of C7Beii

### Reaction equation



### Reactant

Table 84: Properties of each reactant.

Id	Name	SBO
species_11	C7Beii	

### Modifier

Table 85: Properties of each modifier.

Id	Name	SBO
species_11	C7Beii	

### Products

Table 86: Properties of each product.

Id	Name	SBO
species_20	R7	
species_2	Be	

## Kinetic Law

**Derived unit** contains undeclared units

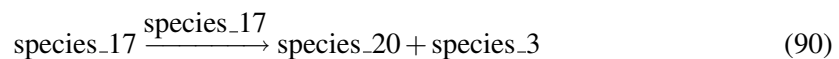
$$v_{27} = \text{vol}(\text{compartment\_2}) \cdot \text{parameter\_18} \cdot [\text{species\_11}] \quad (89)$$

### 9.28 Reaction `reaction_34`

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

**Name** Recycling of C7Bpii

#### Reaction equation



#### Reactant

Table 87: Properties of each reactant.

Id	Name	SBO
species_17	C7Bpii	

#### Modifier

Table 88: Properties of each modifier.

Id	Name	SBO
species_17	C7Bpii	

#### Products

Table 89: Properties of each product.

Id	Name	SBO
species_20	R7	
species_3	Bp	

#### Kinetic Law

**Derived unit** contains undeclared units

$$v_{28} = \text{vol}(\text{compartment\_2}) \cdot \text{parameter\_18} \cdot [\text{species\_17}] \quad (91)$$

### 9.29 Reaction `reaction_35`

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

**Name** Degradation of C4Beii

### Reaction equation



### Reactant

Table 90: Properties of each reactant.

Id	Name	SBO
species_6	C4Beii	

### Modifier

Table 91: Properties of each modifier.

Id	Name	SBO
species_6	C4Beii	

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{29} = \text{vol}(\text{compartment\_2}) \cdot \text{parameter\_19} \cdot [\text{species\_6}] \quad (93)$$

## 9.30 Reaction [reaction\\_36](#)

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

**Name** Degradation of C4Bpii

### Reaction equation



### Reactant

Table 92: Properties of each reactant.

Id	Name	SBO
species_21	C4Bpii	

## Modifier

Table 93: Properties of each modifier.

Id	Name	SBO
species_21	C4Bpii	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{30} = \text{vol}(\text{compartment\_2}) \cdot \text{parameter\_19} \cdot [\text{species\_21}] \quad (95)$$

### 9.31 Reaction [reaction\\_37](#)

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

**Name** Degradation of L12i

## Reaction equation



## Reactant

Table 94: Properties of each reactant.

Id	Name	SBO
species_14	L12i	

## Modifier

Table 95: Properties of each modifier.

Id	Name	SBO
species_14	L12i	

## Kinetic Law

**Derived unit** contains undeclared units

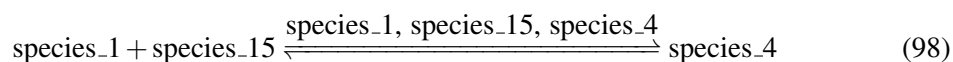
$$v_{31} = \text{vol}(\text{compartment\_2}) \cdot \text{parameter\_20} \cdot [\text{species\_14}] \quad (97)$$

### 9.32 Reaction `reaction_1`

This is a reversible reaction of two reactants forming one product influenced by three modifiers.

**Name** L12 binding R4

#### Reaction equation



#### Reactants

Table 96: Properties of each reactant.

Id	Name	SBO
species_1	L12	
species_15	R4	

#### Modifiers

Table 97: Properties of each modifier.

Id	Name	SBO
species_1	L12	
species_15	R4	
species_4	C4	

#### Product

Table 98: Properties of each product.

Id	Name	SBO
species_4	C4	

#### Kinetic Law

**Derived unit** contains undeclared units

$$v_{32} = \text{vol}(\text{compartment\_2}) \cdot \text{function\_9}(\text{parameter\_1}, \text{parameter\_28}, \text{parameter\_30}, \text{parameter\_5}, \text{parameter\_7}, [\text{species\_1}], [\text{species\_15}], [\text{species\_4}]) \quad (99)$$

$$\begin{aligned} &\text{function\_9}(\text{parameter\_1}, \text{parameter\_28}, \text{parameter\_30}, \text{parameter\_5}, \text{parameter\_7}, \\ &[\text{species\_1}], [\text{species\_15}], [\text{species\_4}]) = \text{parameter\_1} \cdot \frac{\text{parameter\_7}}{\text{parameter\_28} \cdot \text{parameter\_30}} \\ &\cdot \left( [\text{species\_15}] \cdot [\text{species\_1}] - \text{parameter\_5} \cdot \frac{\text{parameter\_28} \cdot \text{parameter\_30}}{\text{parameter\_7}} \cdot [\text{species\_4}] \right) \end{aligned} \quad (100)$$

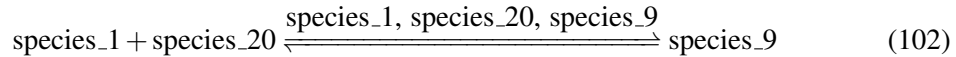
$$\begin{aligned} &\text{function\_9}(\text{parameter\_1}, \text{parameter\_28}, \text{parameter\_30}, \text{parameter\_5}, \text{parameter\_7}, \\ &[\text{species\_1}], [\text{species\_15}], [\text{species\_4}]) = \text{parameter\_1} \cdot \frac{\text{parameter\_7}}{\text{parameter\_28} \cdot \text{parameter\_30}} \\ &\cdot \left( [\text{species\_15}] \cdot [\text{species\_1}] - \text{parameter\_5} \cdot \frac{\text{parameter\_28} \cdot \text{parameter\_30}}{\text{parameter\_7}} \cdot [\text{species\_4}] \right) \end{aligned} \quad (101)$$

### 9.33 Reaction [reaction\\_2](#)

This is a reversible reaction of two reactants forming one product influenced by three modifiers.

**Name** L12 binding R7

#### Reaction equation



#### Reactants

Table 99: Properties of each reactant.

Id	Name	SBO
<code>species_1</code>	L12	
<code>species_20</code>	R7	

#### Modifiers

Table 100: Properties of each modifier.

Id	Name	SBO
<code>species_1</code>	L12	
<code>species_20</code>	R7	
<code>species_9</code>	C7	



## Product

Table 101: Properties of each product.

Id	Name	SBO
species_9	C7	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{33} = \text{vol}(\text{compartment\_2}) \cdot \text{function\_10}(\text{parameter\_2}, \text{parameter\_28}, \text{parameter\_30}, \text{parameter\_6}, \text{parameter\_7}, [\text{species\_1}], [\text{species\_20}], [\text{species\_9}]) \quad (103)$$

$$\begin{aligned} \text{function\_10}(\text{parameter\_2}, \text{parameter\_28}, \text{parameter\_30}, \text{parameter\_6}, \text{parameter\_7}, \\ [\text{species\_1}], [\text{species\_20}], [\text{species\_9}]) = \text{parameter\_2} \cdot \frac{\text{parameter\_7}}{\text{parameter\_28} \cdot \text{parameter\_30}} \\ \cdot \left( [\text{species\_20}] \cdot [\text{species\_1}] - \text{parameter\_6} \cdot \frac{\text{parameter\_28} \cdot \text{parameter\_30}}{\text{parameter\_7}} \cdot [\text{species\_9}] \right) \end{aligned} \quad (104)$$

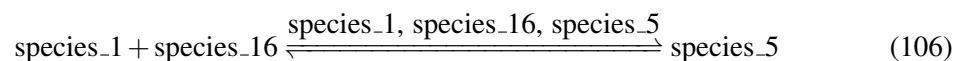
$$\begin{aligned} \text{function\_10}(\text{parameter\_2}, \text{parameter\_28}, \text{parameter\_30}, \text{parameter\_6}, \text{parameter\_7}, \\ [\text{species\_1}], [\text{species\_20}], [\text{species\_9}]) = \text{parameter\_2} \cdot \frac{\text{parameter\_7}}{\text{parameter\_28} \cdot \text{parameter\_30}} \\ \cdot \left( [\text{species\_20}] \cdot [\text{species\_1}] - \text{parameter\_6} \cdot \frac{\text{parameter\_28} \cdot \text{parameter\_30}}{\text{parameter\_7}} \cdot [\text{species\_9}] \right) \end{aligned} \quad (105)$$

### 9.34 Reaction `reaction_3`

This is a reversible reaction of two reactants forming one product influenced by three modifiers.

**Name** L12 binding R4Be

#### Reaction equation



#### Reactants

Table 102: Properties of each reactant.

Id	Name	SBO
species_1	L12	
species_16	R4Be	

## Modifiers

Table 103: Properties of each modifier.

Id	Name	SBO
species_1	L12	
species_16	R4Be	
species_5	C4Be	

## Product

Table 104: Properties of each product.

Id	Name	SBO
species_5	C4Be	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{34} = \text{vol}(\text{compartment}_2) \cdot \text{function\_11}(\text{parameter}_1, \text{parameter}_{21}, \text{parameter}_{28}, \text{parameter}_{30}, \text{parameter}_5, \text{parameter}_7, \text{parameter}_9, [\text{species}_1], [\text{species}_{16}], [\text{species}_5]) \quad (107)$$

$$\begin{aligned} & \text{function\_11}(\text{parameter}_1, \text{parameter}_{21}, \text{parameter}_{28}, \text{parameter}_{30}, \text{parameter}_5, \\ & \text{parameter}_7, \text{parameter}_9, [\text{species}_1], [\text{species}_{16}], [\text{species}_5]) = \text{parameter}_1 \\ & \cdot \frac{\text{parameter}_7}{\text{parameter}_{28} \cdot \text{parameter}_{30}} \cdot \left( [\text{species}_1] \cdot [\text{species}_{16}] \right. \\ & \left. - \frac{\text{parameter}_5 \cdot \text{parameter}_9 \cdot \frac{\text{parameter}_{28} \cdot \text{parameter}_{30}}{\text{parameter}_7}}{\text{parameter}_{21}} \cdot [\text{species}_5] \right) \end{aligned} \quad (108)$$

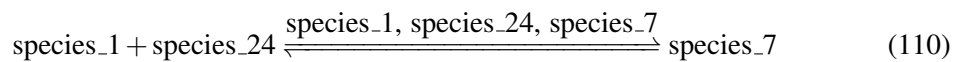
$$\begin{aligned} & \text{function\_11}(\text{parameter\_1}, \text{parameter\_21}, \text{parameter\_28}, \text{parameter\_30}, \text{parameter\_5}, \\ & \text{parameter\_7}, \text{parameter\_9}, [\text{species\_1}], [\text{species\_16}], [\text{species\_5}]) = \text{parameter\_1} \\ & \cdot \frac{\text{parameter\_7}}{\text{parameter\_28} \cdot \text{parameter\_30}} \cdot \left( [\text{species\_1}] \cdot [\text{species\_16}] \right. \\ & \left. - \frac{\text{parameter\_5} \cdot \text{parameter\_9} \cdot \frac{\text{parameter\_28} \cdot \text{parameter\_30}}{\text{parameter\_7}}}{\text{parameter\_21}} \cdot [\text{species\_5}] \right) \end{aligned} \quad (109)$$

### 9.35 Reaction `reaction_4`

This is a reversible reaction of two reactants forming one product influenced by three modifiers.

**Name** L12 binding R4Bp

#### Reaction equation



#### Reactants

Table 105: Properties of each reactant.

Id	Name	SBO
<code>species_1</code>	L12	
<code>species_24</code>	R4Bp	

#### Modifiers

Table 106: Properties of each modifier.

Id	Name	SBO
<code>species_1</code>	L12	
<code>species_24</code>	R4Bp	
<code>species_7</code>	C4Bp	

#### Product

Table 107: Properties of each product.

Id	Name	SBO
<code>species_7</code>	C4Bp	

Id	Name	SBO
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## Kinetic Law

**Derived unit** contains undeclared units

$$v_{35} = \text{vol}(\text{compartment\_2}) \cdot \text{function\_12}(\text{parameter\_1}, \text{parameter\_21}, \text{parameter\_28}, \text{parameter\_30}, \text{parameter\_5}, \text{parameter\_7}, \text{parameter\_9}, [\text{species\_1}], [\text{species\_24}], [\text{species\_7}]) \quad (111)$$

$$\begin{aligned} & \text{function\_12}(\text{parameter\_1}, \text{parameter\_21}, \text{parameter\_28}, \text{parameter\_30}, \text{parameter\_5}, \\ & \text{parameter\_7}, \text{parameter\_9}, [\text{species\_1}], [\text{species\_24}], [\text{species\_7}]) = \text{parameter\_1} \\ & \cdot \frac{\text{parameter\_7}}{\text{parameter\_28} \cdot \text{parameter\_30}} \cdot \left( [\text{species\_1}] \cdot [\text{species\_24}] \right. \\ & \left. - \frac{\text{parameter\_5} \cdot \text{parameter\_9} \cdot \frac{\text{parameter\_28} \cdot \text{parameter\_30}}{\text{parameter\_7}}}{\text{parameter\_21}} \cdot [\text{species\_7}] \right) \end{aligned} \quad (112)$$

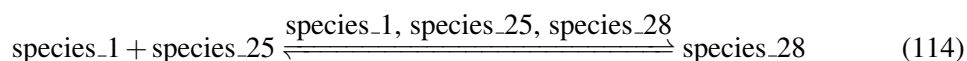
$$\begin{aligned} & \text{function\_12}(\text{parameter\_1}, \text{parameter\_21}, \text{parameter\_28}, \text{parameter\_30}, \text{parameter\_5}, \\ & \text{parameter\_7}, \text{parameter\_9}, [\text{species\_1}], [\text{species\_24}], [\text{species\_7}]) = \text{parameter\_1} \\ & \cdot \frac{\text{parameter\_7}}{\text{parameter\_28} \cdot \text{parameter\_30}} \cdot \left( [\text{species\_1}] \cdot [\text{species\_24}] \right. \\ & \left. - \frac{\text{parameter\_5} \cdot \text{parameter\_9} \cdot \frac{\text{parameter\_28} \cdot \text{parameter\_30}}{\text{parameter\_7}}}{\text{parameter\_21}} \cdot [\text{species\_7}] \right) \end{aligned} \quad (113)$$

## 9.36 Reaction reaction\_5

This is a reversible reaction of two reactants forming one product influenced by three modifiers.

**Name** L12 binding R7Be

## Reaction equation



## Reactants

Table 108: Properties of each reactant.

Id	Name	SBO
species_1	L12	
species_25	R7Be	

## Modifiers

Table 109: Properties of each modifier.

Id	Name	SBO
species_1	L12	
species_25	R7Be	
species_28	C7Be	

## Product

Table 110: Properties of each product.

Id	Name	SBO
species_28	C7Be	

## Kinetic Law

**Derived unit** contains undeclared units

$$\begin{aligned}
 v_{36} = & \text{vol}(\text{compartment}_2) \\
 & \cdot \text{function\_13}(\text{parameter\_10}, \text{parameter\_2}, \text{parameter\_22}, \text{parameter\_28}, \text{parameter\_30}, \\
 & \quad \text{parameter\_6}, \text{parameter\_7}, [\text{species\_1}], [\text{species\_25}], [\text{species\_28}])
 \end{aligned} \tag{115}$$

$$\begin{aligned}
 & \text{function\_13}(\text{parameter\_10}, \text{parameter\_2}, \text{parameter\_22}, \text{parameter\_28}, \text{parameter\_30}, \\
 & \quad \text{parameter\_6}, \text{parameter\_7}, [\text{species\_1}], [\text{species\_25}], [\text{species\_28}]) = \text{parameter\_2} \\
 & \quad \cdot \frac{\text{parameter\_7}}{\text{parameter\_28} \cdot \text{parameter\_30}} \cdot \left( [\text{species\_1}] \cdot [\text{species\_25}] \right. \\
 & \quad \left. - \frac{\text{parameter\_6} \cdot \text{parameter\_10} \cdot \frac{\text{parameter\_28} \cdot \text{parameter\_30}}{\text{parameter\_7}}}{\text{parameter\_22}} \cdot [\text{species\_28}] \right)
 \end{aligned} \tag{116}$$

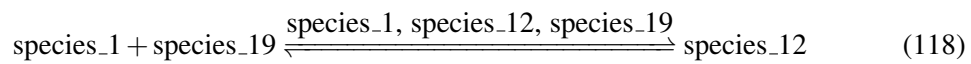
$$\begin{aligned} & \text{function\_13}(\text{parameter\_10}, \text{parameter\_2}, \text{parameter\_22}, \text{parameter\_28}, \text{parameter\_30}, \\ & \text{parameter\_6}, \text{parameter\_7}, [\text{species\_1}], [\text{species\_25}], [\text{species\_28}]) = \text{parameter\_2} \\ & \cdot \frac{\text{parameter\_7}}{\text{parameter\_28} \cdot \text{parameter\_30}} \cdot \left( [\text{species\_1}] \cdot [\text{species\_25}] \right. \\ & \left. - \frac{\text{parameter\_6} \cdot \text{parameter\_10} \cdot \frac{\text{parameter\_28} \cdot \text{parameter\_30}}{\text{parameter\_7}}}{\text{parameter\_22}} \cdot [\text{species\_28}] \right) \end{aligned} \quad (117)$$

### 9.37 Reaction `reaction_6`

This is a reversible reaction of two reactants forming one product influenced by three modifiers.

**Name** L12 binding R7Bp

#### Reaction equation



#### Reactants

Table 111: Properties of each reactant.

Id	Name	SBO
<code>species_1</code>	L12	
<code>species_19</code>	R7Bp	

#### Modifiers

Table 112: Properties of each modifier.

Id	Name	SBO
<code>species_1</code>	L12	
<code>species_12</code>	C7Bp	
<code>species_19</code>	R7Bp	

#### Product

Table 113: Properties of each product.

Id	Name	SBO
<code>species_12</code>	C7Bp	

Id	Name	SBO
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## Kinetic Law

**Derived unit** contains undeclared units

$$v_{37} = \text{vol}(\text{compartment\_2}) \cdot \text{function\_14}(\text{parameter\_10}, \text{parameter\_2}, \text{parameter\_22}, \text{parameter\_28}, \text{parameter\_30}, \text{parameter\_6}, \text{parameter\_7}, [\text{species\_1}], [\text{species\_12}], [\text{species\_19}]) \quad (119)$$

$$\begin{aligned} & \text{function\_14}(\text{parameter\_10}, \text{parameter\_2}, \text{parameter\_22}, \text{parameter\_28}, \text{parameter\_30}, \\ & \text{parameter\_6}, \text{parameter\_7}, [\text{species\_1}], [\text{species\_12}], [\text{species\_19}]) = \text{parameter\_2} \\ & \cdot \frac{\text{parameter\_7}}{\text{parameter\_28} \cdot \text{parameter\_30}} \cdot \left( [\text{species\_1}] \cdot [\text{species\_19}] \right. \\ & \left. - \frac{\text{parameter\_6} \cdot \text{parameter\_10} \cdot \frac{\text{parameter\_28} \cdot \text{parameter\_30}}{\text{parameter\_7}}}{\text{parameter\_22}} \cdot [\text{species\_12}] \right) \end{aligned} \quad (120)$$

$$\begin{aligned} & \text{function\_14}(\text{parameter\_10}, \text{parameter\_2}, \text{parameter\_22}, \text{parameter\_28}, \text{parameter\_30}, \\ & \text{parameter\_6}, \text{parameter\_7}, [\text{species\_1}], [\text{species\_12}], [\text{species\_19}]) = \text{parameter\_2} \\ & \cdot \frac{\text{parameter\_7}}{\text{parameter\_28} \cdot \text{parameter\_30}} \cdot \left( [\text{species\_1}] \cdot [\text{species\_19}] \right. \\ & \left. - \frac{\text{parameter\_6} \cdot \text{parameter\_10} \cdot \frac{\text{parameter\_28} \cdot \text{parameter\_30}}{\text{parameter\_7}}}{\text{parameter\_22}} \cdot [\text{species\_12}] \right) \end{aligned} \quad (121)$$

## 10 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.

Identifiers for kinetic laws highlighted in gray cannot be verified to evaluate to units of SBML substance per time. As a result, some SBML interpreters may not be able to verify the consistency of the units on quantities in the model. Please check if

- parameters without an unit definition are involved or
- volume correction is necessary because the `hasOnlySubstanceUnits` flag may be set to `false` and `spacialDimensions` > 0 for certain species.

## 10.1 Species `species_2`

**Name** Be

**Notes** Be (is) human Beta-arrestin-2. It is not labelled. Be in the model is endogenous.

**Initial concentration** 328437.241399281 item · dimensionless<sup>-1</sup>

This species takes part in twelve reactions (as a reactant in [reaction\\_7](#), [reaction\\_9](#), [reaction\\_11](#), [reaction\\_13](#) and as a product in [reaction\\_15](#), [reaction\\_23](#), [reaction\\_25](#), [reaction\\_33](#) and as a modifier in [reaction\\_7](#), [reaction\\_9](#), [reaction\\_11](#), [reaction\\_13](#)).

$$\frac{d}{dt}\text{species\_2} = v_9 + v_{17} + v_{19} + v_{27} - v_1 - v_3 - v_5 - v_7 \quad (122)$$

## 10.2 Species `species_3`

**Name** Bp

**Notes** Bp is human Beta-arrestin-2 tagged with C-terminal of click beetle luciferase. Use

**Initial concentration** 492655.862098776 item · dimensionless<sup>-1</sup>

This species takes part in twelve reactions (as a reactant in [reaction\\_8](#), [reaction\\_10](#), [reaction\\_12](#), [reaction\\_14](#) and as a product in [reaction\\_16](#), [reaction\\_24](#), [reaction\\_26](#), [reaction\\_34](#) and as a modifier in [reaction\\_8](#), [reaction\\_10](#), [reaction\\_12](#), [reaction\\_14](#)).

$$\frac{d}{dt}\text{species\_3} = v_{10} + v_{18} + v_{20} + v_{28} - v_2 - v_4 - v_6 - v_8 \quad (123)$$

## 10.3 Species `species_4`

**Name** C4

**Notes** Complex of:

-R4 is Complementation receptor (human) CXCR4, with N-terminus of click beetle lucif

-L12 is human CXCL12, Stromal cell-derived factor-1. This is not labelled.

**Initial concentration** 0 item · dimensionless<sup>-1</sup>

This species takes part in six reactions (as a reactant in [reaction\\_9](#), [reaction\\_10](#) and as a product in [reaction\\_1](#) and as a modifier in [reaction\\_9](#), [reaction\\_10](#), [reaction\\_1](#)).

$$\frac{d}{dt}\text{species\_4} = v_{32} - v_3 - v_4 \quad (124)$$



## 10.4 Species `species_5`

**Name** C4Be

**Notes** Complex of:

- R4 is Complementation receptor (human) CXCR4, with N-terminus of click beetle luciferase.
- L12 is human CXCL12, Stromal cell-derived factor-1. This is not labelled.
- Be is human Beta-arrestin-2. It is not labelled. Be in the model is endogenous.

**Initial concentration** 0 item · dimensionless<sup>-1</sup>

This species takes part in six reactions (as a reactant in [reaction\\_17](#) and as a product in [reaction\\_9](#), [reaction\\_3](#) and as a modifier in [reaction\\_9](#), [reaction\\_17](#), [reaction\\_3](#)).

$$\frac{d}{dt}\text{species}_5 = v_3 + v_{34} - v_{11} \quad (125)$$

## 10.5 Species `species_6`

**Name** C4Beii

**Notes** Intracellular complex (after dissociation of endogenous Beta-arrestin-2) of:

- R4 is Complementation receptor (human) CXCR4, with N-terminus of click beetle luciferase.
- L12 is human CXCL12, Stromal cell-derived factor-1. This is not labelled.

**Initial concentration** 0 item · dimensionless<sup>-1</sup>

This species takes part in three reactions (as a reactant in [reaction\\_35](#) and as a product in [reaction\\_23](#) and as a modifier in [reaction\\_35](#)).

$$\frac{d}{dt}\text{species}_6 = v_{17} - v_{29} \quad (126)$$

## 10.6 Species `species_7`

**Name** C4Bp

**Notes** Complex of:

- R4 is Complementation receptor (human) CXCR4, with N-terminus of click beetle luciferase.
- L12 is human CXCL12, Stromal cell-derived factor-1. This is not labelled.
- Bp is human Beta-arrestin-2 tagged with C-terminal of click beetle luciferase.

**Initial concentration** 0 item · dimensionless<sup>-1</sup>

This species takes part in six reactions (as a reactant in [reaction\\_18](#) and as a product in [reaction\\_10](#), [reaction\\_4](#) and as a modifier in [reaction\\_10](#), [reaction\\_18](#), [reaction\\_4](#)).

$$\frac{d}{dt}\text{species}_7 = v_4 + v_{35} - v_{12} \quad (127)$$

## 10.7 Species `species_8`

**Name** C4Bpi

**Notes** Intracellular Complex of:

- R4 is Complementation receptor (human) CXCR4, with N-terminus of click beetle luciferase.
- L12 is human CXCL12, Stromal cell-derived factor-1. This is not labelled.
- Bp is human Beta-arrestin-2 tagged with C-terminal of click beetle luciferase.

**Initial concentration** 0 item · dimensionless<sup>-1</sup>

This species takes part in three reactions (as a reactant in [reaction\\_24](#) and as a product in [reaction\\_18](#) and as a modifier in [reaction\\_24](#)).

$$\frac{d}{dt}\text{species\_8} = v_{12} - v_{18} \quad (128)$$

## 10.8 Species `species_9`

**Name** C7

**Notes** Complex of:

- R7 is Complementation receptor (human) CXCR7, with N-terminus of click beetle luciferase.
- L12 is human CXCL12, Stromal cell-derived factor-1. This is not labelled.

**Initial concentration** 0 item · dimensionless<sup>-1</sup>

This species takes part in six reactions (as a reactant in [reaction\\_13](#), [reaction\\_14](#) and as a product in [reaction\\_2](#) and as a modifier in [reaction\\_13](#), [reaction\\_14](#), [reaction\\_2](#)).

$$\frac{d}{dt}\text{species\_9} = v_{33} - v_7 - v_8 \quad (129)$$

## 10.9 Species `species_10`

**Name** C7Bei

**Notes** Intracellular Complex of:

- R7 is Complementation receptor (human) CXCR7, with N-terminus of click beetle luciferase.
- L12 is human CXCL12, Stromal cell-derived factor-1. This is not labelled.
- Be is human Beta-arrestin-2. It is not labelled. Be in the model is endogenous.

**Initial concentration** 0 item · dimensionless<sup>-1</sup>

This species takes part in three reactions (as a reactant in [reaction\\_27](#) and as a product in [reaction\\_21](#) and as a modifier in [reaction\\_27](#)).

$$\frac{d}{dt}\text{species\_10} = v_{15} - v_{21} \quad (130)$$

## 10.10 Species [species\\_11](#)

**Name** C7Bei

**Notes** Intracellular Complex (after trafficking to late endosomes) of:

- R7 is Complementation receptor (human) CXCR7, with N-terminus of click beetle luciferase.
- L12 is human CXCL12, Stromal cell-derived factor-1. This is not labelled.
- Be is human Beta-arrestin-2. It is not labelled. Be in the model is endogenous.

**Initial concentration** 0 item · dimensionless<sup>-1</sup>

This species takes part in three reactions (as a reactant in [reaction\\_33](#) and as a product in [reaction\\_27](#) and as a modifier in [reaction\\_33](#)).

$$\frac{d}{dt}\text{species}_11 = v_{21} - v_{27} \quad (131)$$

## 10.11 Species [species\\_12](#)

**Name** C7Bp

**Notes** Complex of:

- R7 is Complementation receptor (human) CXCR7, with N-terminus of click beetle luciferase.
- L12 is human CXCL12, Stromal cell-derived factor-1. This is not labelled.
- Bp is human Beta-arrestin-2 tagged with C-terminal of click beetle luciferase.

**Initial concentration** 0 item · dimensionless<sup>-1</sup>

This species takes part in six reactions (as a reactant in [reaction\\_22](#) and as a product in [reaction\\_14](#), [reaction\\_6](#) and as a modifier in [reaction\\_14](#), [reaction\\_22](#), [reaction\\_6](#)).

$$\frac{d}{dt}\text{species}_12 = v_8 + v_{37} - v_{16} \quad (132)$$

## 10.12 Species [species\\_13](#)

**Name** C7Bpi

**Notes** Intracellular Complex of:

- R7 is Complementation receptor (human) CXCR7, with N-terminus of click beetle luciferase.
- L12 is human CXCL12, Stromal cell-derived factor-1. This is not labelled.
- Bp is human Beta-arrestin-2 tagged with C-terminal of click beetle luciferase.

**Initial concentration** 0 item · dimensionless<sup>-1</sup>

This species takes part in three reactions (as a reactant in [reaction\\_28](#) and as a product in [reaction\\_22](#) and as a modifier in [reaction\\_28](#)).

$$\frac{d}{dt}\text{species}_13 = v_{16} - v_{22} \quad (133)$$

### 10.13 Species [species\\_14](#)

**Name** L12i

**Notes** Intracellular

-L12 is human CXCL12, Stromal cell-derived factor-1. It is not labelled.

**Initial concentration** 0 item · dimensionless<sup>-1</sup>

This species takes part in six reactions (as a reactant in [reaction\\_37](#) and as a product in [reaction\\_17](#), [reaction\\_18](#), [reaction\\_21](#), [reaction\\_22](#) and as a modifier in [reaction\\_37](#)).

$$\frac{d}{dt}\text{species\_14} = v_{11} + v_{12} + v_{15} + v_{16} - v_{31} \quad (134)$$

### 10.14 Species [species\\_15](#)

**Name** R4

**Notes** Complementation receptor (human) CXCR4, with N-terminus of click beetle luciferase

-(Has Part) of human CXCR4 since it is CXCR4, and (Has Part) of click beetle luciferase

**Initial concentration** 133539.963932179 item · dimensionless<sup>-1</sup>

This species takes part in eight reactions (as a reactant in [reaction\\_7](#), [reaction\\_8](#), [reaction\\_1](#) and as a product in [reaction\\_29](#), [reaction\\_30](#) and as a modifier in [reaction\\_7](#), [reaction\\_8](#), [reaction\\_1](#)).

$$\frac{d}{dt}\text{species\_15} = v_{23} + v_{24} - v_1 - v_2 - v_{32} \quad (135)$$

### 10.15 Species [species\\_16](#)

**Name** R4Be

**Notes** Complex of:

-R4 is Complementation receptor (human) CXCR4, with N-terminus of click beetle luciferase

-Be (is) human Beta-arrestin-2. It is not labelled. Be in the model is endogenous.

**Initial concentration** 5434.48582568463 item · dimensionless<sup>-1</sup>

This species takes part in six reactions (as a reactant in [reaction\\_15](#), [reaction\\_3](#) and as a product in [reaction\\_7](#) and as a modifier in [reaction\\_7](#), [reaction\\_15](#), [reaction\\_3](#)).

$$\frac{d}{dt}\text{species\_16} = v_1 - v_9 - v_{34} \quad (136)$$

## 10.16 Species [species\\_17](#)

**Name** C7Bpii

**Notes** Intracellular Complex (after trafficking to late endosomes) of:

- R7 is Complementation receptor (human) CXCR7, with N-terminus of click beetle luciferase.
- L12 is human CXCL12, Stromal cell-derived factor-1. This is not labelled.
- Bp is human Beta-arrestin-2 tagged with C-terminal of click beetle luciferase.

**Initial concentration** 0 item · dimensionless<sup>-1</sup>

This species takes part in three reactions (as a reactant in [reaction\\_34](#) and as a product in [reaction\\_28](#) and as a modifier in [reaction\\_34](#)).

$$\frac{d}{dt}\text{species\_17} = v_{22} - v_{28} \quad (137)$$

## 10.17 Species [species\\_18](#)

**Name** R7Bpii

**Notes** Intracellular receptor (after dissociation of Beta-arrestin-2 tagged with C-terminal of click beetle luciferase)

- R7 is Complementation receptor (human) CXCR7, with N-terminus of click beetle luciferase.

**Initial concentration** 345117.328033337 item · dimensionless<sup>-1</sup>

This species takes part in three reactions (as a reactant in [reaction\\_32](#) and as a product in [reaction\\_26](#) and as a modifier in [reaction\\_32](#)).

$$\frac{d}{dt}\text{species\_18} = v_{20} - v_{26} \quad (138)$$

## 10.18 Species [species\\_19](#)

**Name** R7Bp

**Notes** Complex of:

- R7 is Complementation receptor (human) CXCR7, with N-terminus of click beetle luciferase.
- Bp is human Beta-arrestin-2 tagged with C-terminal of click beetle luciferase.

**Initial concentration** 97340.7848290227 item · dimensionless<sup>-1</sup>

This species takes part in six reactions (as a reactant in [reaction\\_20](#), [reaction\\_6](#) and as a product in [reaction\\_12](#) and as a modifier in [reaction\\_12](#), [reaction\\_20](#), [reaction\\_6](#)).

$$\frac{d}{dt}\text{species\_19} = v_6 - v_{14} - v_{37} \quad (139)$$

### 10.19 Species [species\\_20](#)

**Name** R7

**Notes** Complementation receptor (human) CXCR7, with N-terminus of click beetle luciferase  
-(Has Part) of human CXCR7 since it is CXCR7, and (Has Part) of click beetle luciferase

**Initial concentration** 509483.771339917 item · dimensionless<sup>-1</sup>

This species takes part in ten reactions (as a reactant in [reaction\\_11](#), [reaction\\_12](#), [reaction\\_2](#) and as a product in [reaction\\_31](#), [reaction\\_32](#), [reaction\\_33](#), [reaction\\_34](#) and as a modifier in [reaction\\_11](#), [reaction\\_12](#), [reaction\\_2](#)).

$$\frac{d}{dt}\text{species\_20} = v_{25} + v_{26} + v_{27} + v_{28} - v_5 - v_6 - v_{33} \quad (140)$$

### 10.20 Species [species\\_21](#)

**Name** C4Bpii

**Notes** Intracellular Complex (after dissociation of Beta-arrestin-2 tagged with C-terminal luciferase)  
-R4 is Complementation receptor (human) CXCR4, with N-terminus of click beetle luciferase  
-L12 is human CXCL12, Stromal cell-derived factor-1. This is not labelled.

**Initial concentration** 0 item · dimensionless<sup>-1</sup>

This species takes part in three reactions (as a reactant in [reaction\\_36](#) and as a product in [reaction\\_24](#) and as a modifier in [reaction\\_36](#)).

$$\frac{d}{dt}\text{species\_21} = v_{18} - v_{30} \quad (141)$$

### 10.21 Species [species\\_22](#)

**Name** C4Bei

**Notes** Intracellular Complex of:  
-R4 is Complementation receptor (human) CXCR4, with N-terminus of click beetle luciferase  
-L12 is human CXCL12, Stromal cell-derived factor-1. This is not labelled.  
-Be is human Beta-arrestin-2. It is not labelled. Be in the model is endogenous.

**Initial concentration** 0 item · dimensionless<sup>-1</sup>

This species takes part in three reactions (as a reactant in [reaction\\_23](#) and as a product in [reaction\\_17](#) and as a modifier in [reaction\\_23](#)).

$$\frac{d}{dt}\text{species\_22} = v_{11} - v_{17} \quad (142)$$

## 10.22 Species [species\\_23](#)

**Name** R4Bpi

**Notes** Intracellular Complex of:

- R4 is Complementation receptor (human) CXCR4, with N-terminus of click beetle luciferase.
- Bp is human Beta-arrestin-2 tagged with C-terminal of click beetle luciferase.

**Initial concentration** 271724.292902136 item · dimensionless<sup>-1</sup>

This species takes part in three reactions (as a reactant in [reaction\\_30](#) and as a product in [reaction\\_16](#) and as a modifier in [reaction\\_30](#)).

$$\frac{d}{dt}\text{species\_23} = v_{10} - v_{24} \quad (143)$$

## 10.23 Species [species\\_24](#)

**Name** R4Bp

**Notes** Complex of:

- R4 is Complementation receptor (human) CXCR4, with N-terminus of click beetle luciferase.
- Bp is human Beta-arrestin-2 tagged with C-terminal of click beetle luciferase.

**Initial concentration** 8151.72873852455 item · dimensionless<sup>-1</sup>

This species takes part in six reactions (as a reactant in [reaction\\_16](#), [reaction\\_4](#) and as a product in [reaction\\_8](#) and as a modifier in [reaction\\_8](#), [reaction\\_16](#), [reaction\\_4](#)).

$$\frac{d}{dt}\text{species\_24} = v_2 - v_{10} - v_{35} \quad (144)$$

## 10.24 Species [species\\_25](#)

**Name** R7Be

**Notes** Complex of:

- R7 is Complementation receptor (human) CXCR7, with N-terminus of click beetle luciferase.
- Be is human Beta-arrestin-2. It is not labelled. Be in the model is endogenous.

**Initial concentration** 64893.856552701 item · dimensionless<sup>-1</sup>

This species takes part in six reactions (as a reactant in [reaction\\_19](#), [reaction\\_5](#) and as a product in [reaction\\_11](#) and as a modifier in [reaction\\_11](#), [reaction\\_19](#), [reaction\\_5](#)).

$$\frac{d}{dt}\text{species\_25} = v_5 - v_{13} - v_{36} \quad (145)$$

## 10.25 Species [species\\_26](#)

**Name** R7Bei

**Notes** Intracellular Complex of:

- R7 is Complementation receptor (human) CXCR7, with N-terminus of click beetle luciferase
- Be is human Beta-arrestin-2. It is not labelled. Be in the model is endogenous.

**Initial concentration** 101234.416222443 item · dimensionless<sup>-1</sup>

This species takes part in three reactions (as a reactant in [reaction\\_25](#) and as a product in [reaction\\_19](#) and as a modifier in [reaction\\_25](#)).

$$\frac{d}{dt}\text{species\_26} = v_{13} - v_{19} \quad (146)$$

## 10.26 Species [species\\_27](#)

**Name** R7Beii

**Notes** Intracellular receptor (after dissociation of endogenous Beta-arrestin-2) of:

- R7 is Complementation receptor (human) CXCR7, with N-terminus of click beetle luciferase

**Initial concentration** 230078.21868896 item · dimensionless<sup>-1</sup>

This species takes part in three reactions (as a reactant in [reaction\\_31](#) and as a product in [reaction\\_25](#) and as a modifier in [reaction\\_31](#)).

$$\frac{d}{dt}\text{species\_27} = v_{19} - v_{25} \quad (147)$$

## 10.27 Species [species\\_28](#)

**Name** C7Be

**Notes** Complex of:

- R7 is Complementation receptor (human) CXCR7, with N-terminus of click beetle luciferase
- L12 is human CXCL12, Stromal cell-derived factor-1. This is not labelled.
- Be is human Beta-arrestin-2. It is not labelled. Be in the model is endogenous.

**Initial concentration** 0 item · dimensionless<sup>-1</sup>

This species takes part in six reactions (as a reactant in [reaction\\_21](#) and as a product in [reaction\\_13](#), [reaction\\_5](#) and as a modifier in [reaction\\_13](#), [reaction\\_21](#), [reaction\\_5](#)).

$$\frac{d}{dt}\text{species\_28} = v_7 + v_{36} - v_{15} \quad (148)$$



## 10.28 Species `species_29`

**Name** R4Bei

**Notes** Intracellular Complex of:

- R4 is Complementation receptor (human) CXCR4, with N-terminus of click beetle luciferase.
- Be (is) human Beta-arrestin-2. It is not labelled. Be in the model is endogenous.

**Initial concentration** 181149.528601477 item · dimensionless<sup>-1</sup>

This species takes part in three reactions (as a reactant in [reaction\\_29](#) and as a product in [reaction\\_15](#) and as a modifier in [reaction\\_29](#)).

$$\frac{d}{dt}\text{species\_29} = v_9 - v_{23} \quad (149)$$

## 10.29 Species `species_30`

**Name** R7Bpi

**Notes** Intracellular Complex of:

- R7 is Complementation receptor (human) CXCR7, with N-terminus of click beetle luciferase.
- Bp is human Beta-arrestin-2 tagged with C-terminal of click beetle luciferase.

**Initial concentration** 151851.62433362 item · dimensionless<sup>-1</sup>

This species takes part in three reactions (as a reactant in [reaction\\_26](#) and as a product in [reaction\\_20](#) and as a modifier in [reaction\\_26](#)).

$$\frac{d}{dt}\text{species\_30} = v_{14} - v_{20} \quad (150)$$

## 10.30 Species `species_1`

**Name** L12

**Notes** L12 is human CXCL12, Stromal cell-derived factor-1. It is not labelled.

**Initial concentration** 1.16 · 10<sup>8</sup> item · dimensionless<sup>-1</sup>

This species takes part in twelve reactions (as a reactant in [reaction\\_1](#), [reaction\\_2](#), [reaction\\_3](#), [reaction\\_4](#), [reaction\\_5](#), [reaction\\_6](#) and as a modifier in [reaction\\_1](#), [reaction\\_2](#), [reaction\\_3](#), [reaction\\_4](#), [reaction\\_5](#), [reaction\\_6](#)).

$$\frac{d}{dt}\text{species\_1} = -v_{32} - v_{33} - v_{34} - v_{35} - v_{36} - v_{37} \quad (151)$$

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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