Cybow Modeller

- Yet Another Cell Modelling Environment

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Introduction

- Cybow Modeller is a software suite for cell modelling
  - Cybow [saibou] 細胞: “cell” in Japanese
- Features
  - Graphical & user-friendly interface with assists
  - Semantic annotations of variables with CPO
  - C++ code generator (under development)
  - OS independent: implemented in Java & XSLT
  - Open source: available at SourceForge.net

Modelling Workflow

Define components

IKATP.cmc – Cybow Component Editor

Component Name: KATP_current

Description: ATP-sensitive potassium channel current

Variable

R	Name	Symbol	Unit	Default	Concept
☑	t	t	ms		time
☐	IKATP	I_{KATP}	mA		ATP-sensitive_potassium_curr
☐	N	N		2.333E3	
☐	gamma	γ			conductance of ATP-sensitive
☑	Vm	V_m	mV		cell_membrane_potential
☑	EK	E_K	mV		potassium_equilibrium_potent
☐	p_open	p(open)			open probability of ATP-sens
☑	K_o	$[K^+]_o$	mM		external_potassium_concentra
☑	ATP_i	$[ATP]_i$	mM		intracellular_ATP_concentratio

Equations

$$I_{KATP} = N \cdot \gamma \cdot (V_m - E_K) \cdot p(open)$$

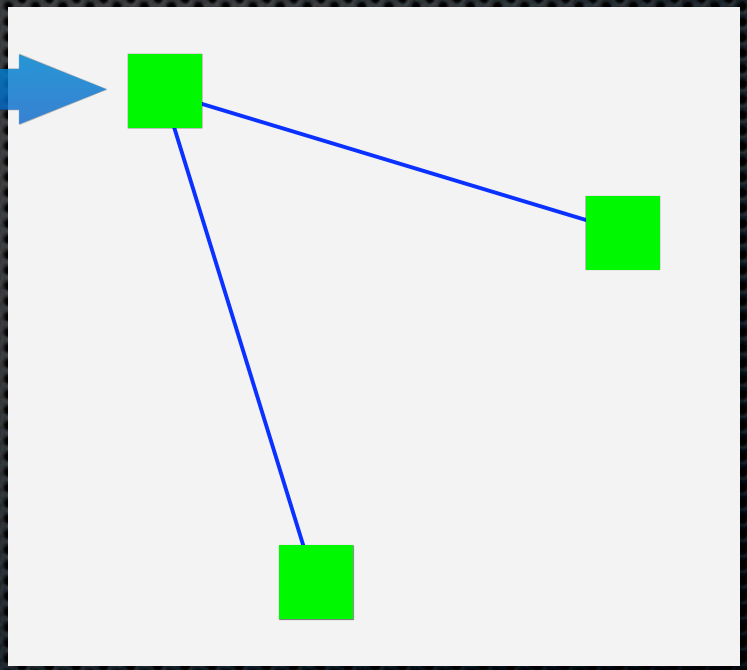
$$\gamma = 0.0236 \cdot [K^+]_o^{0.24}$$

$$p(open) = \frac{0.8}{1 + \left(\frac{[ATP]_i}{0.1}\right)^2}$$

Equation

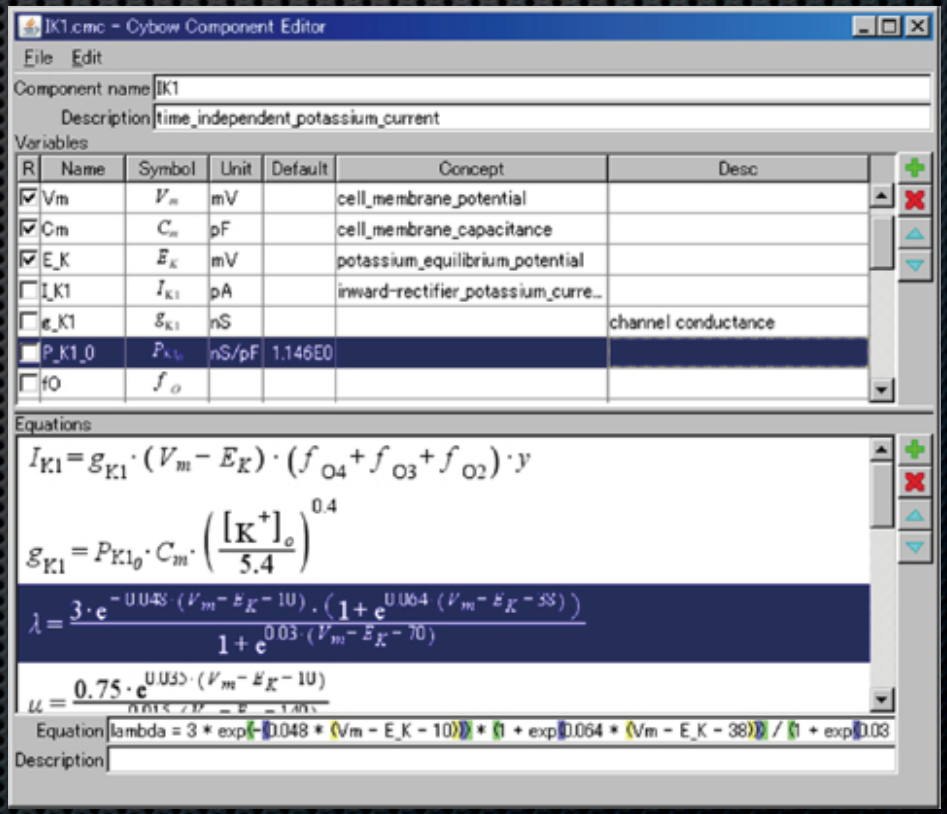
Description

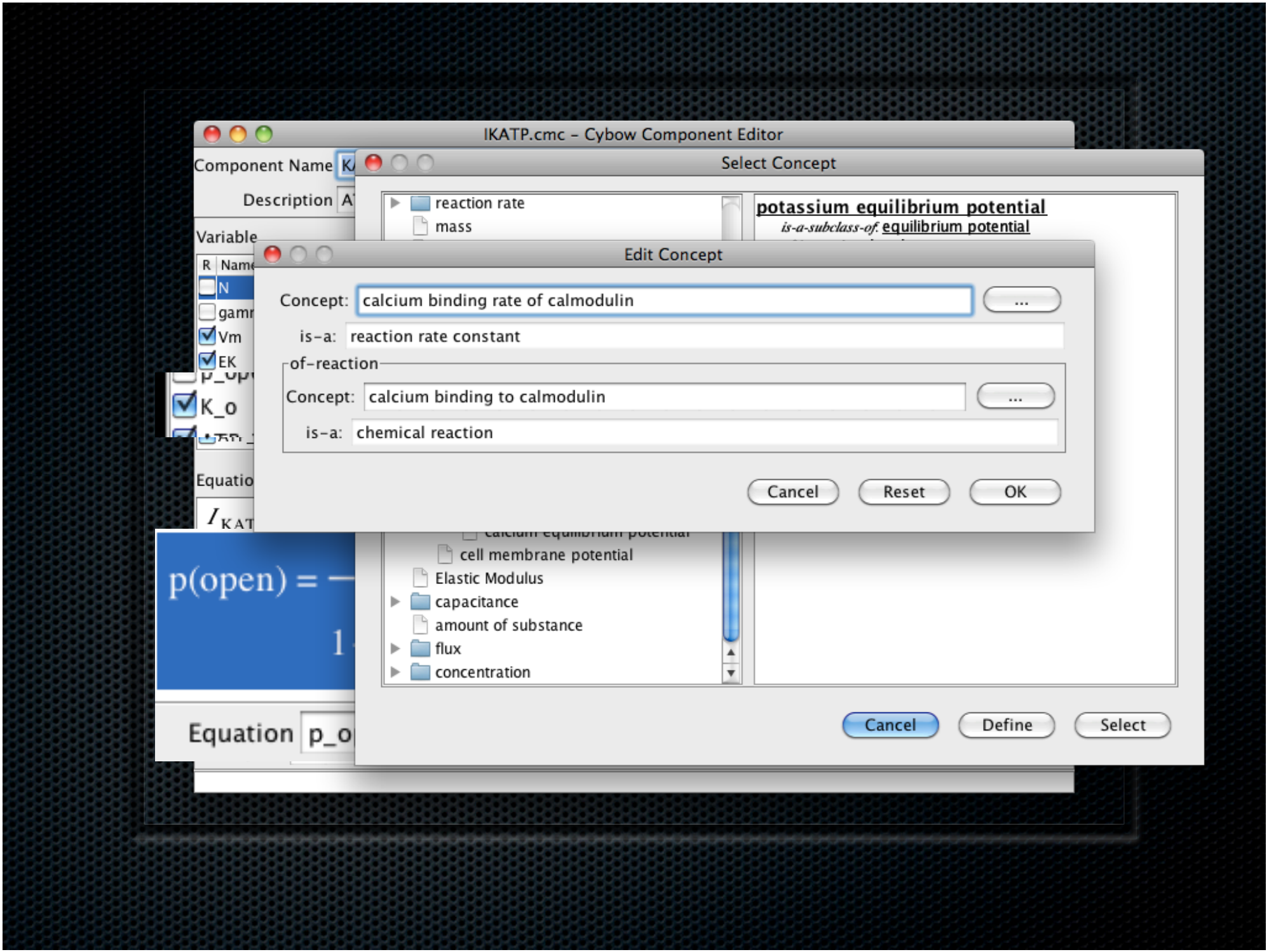
Compose model



Component Editor

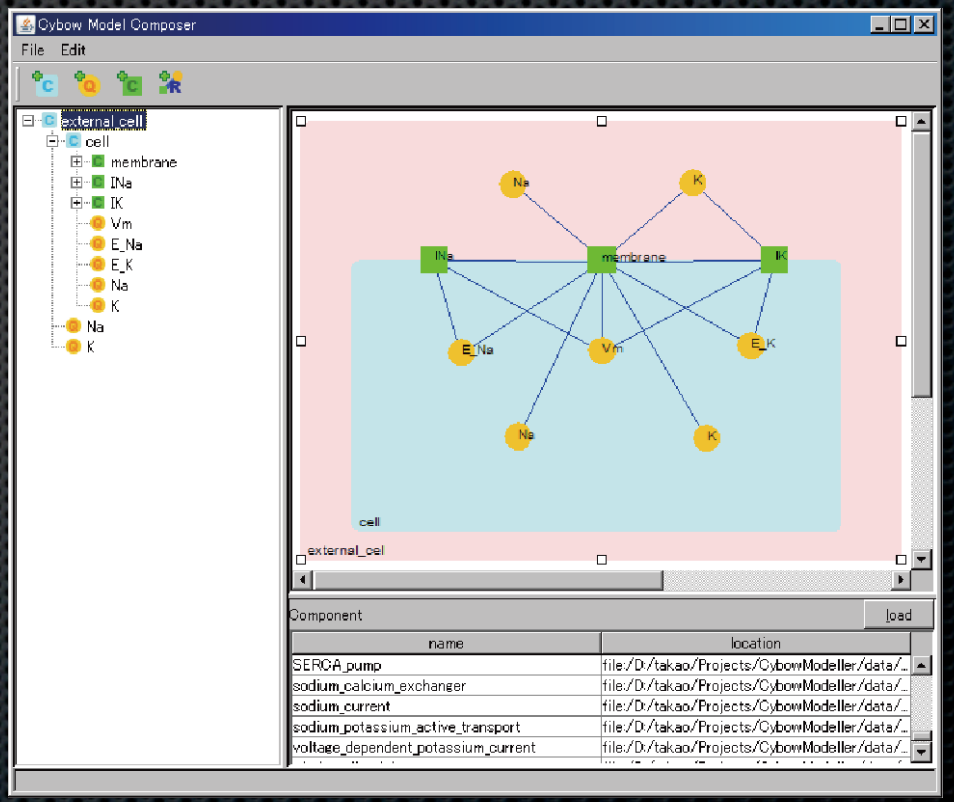
- Graphical rendering of math equations
- Simple one-line text input of a equation
- Graphical symbols for variables
- Annotation to model variables
- HTML document output
- Exportable equations to MS Office 2007

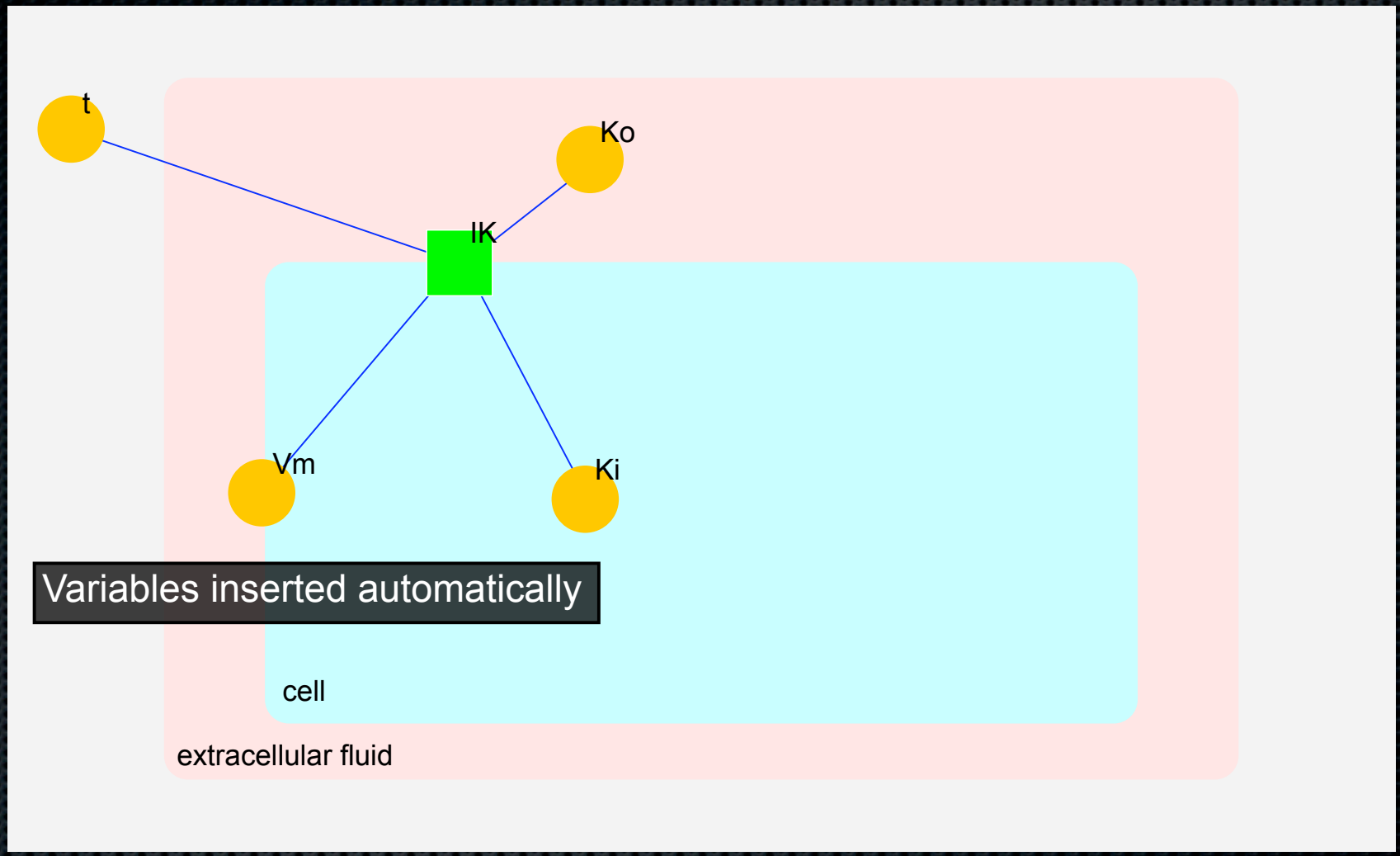


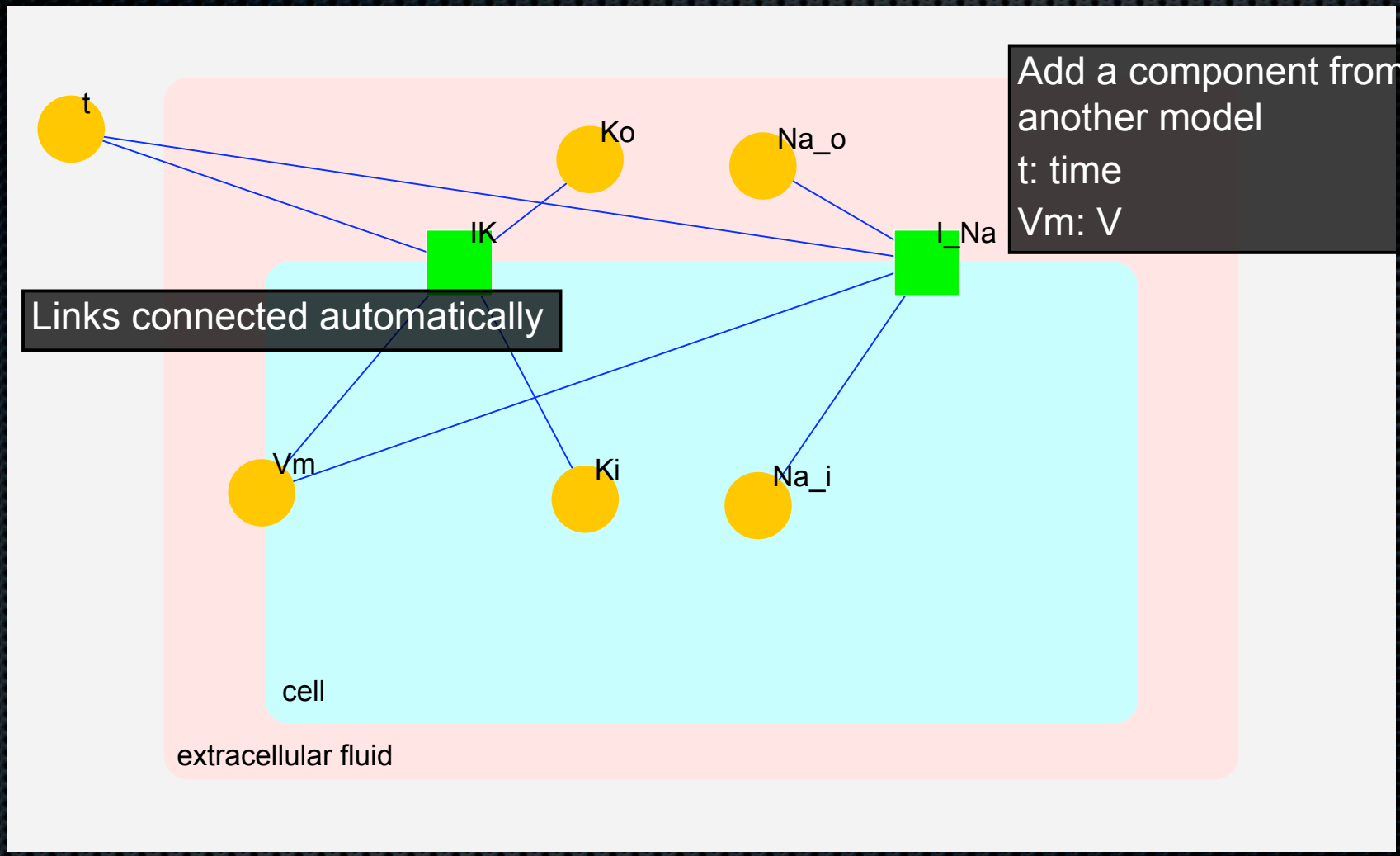

IKATP.cmc – Cybow Component Editor
Component Name
Description
Variable
R
Name
N
gamr
Vm
EK
K_o
Equatio
Equation
p_o
Select Concept
reaction rate
mass
cell membrane potential
Elastic Modulus
capacitance
amount of substance
flux
concentration
potassium equilibrium potential
is-a-subclass-of equilibrium potential
Cancel
Define
Select
Edit Concept
Concept:
calcium binding rate of calmodulin
...
is-a:
reaction rate constant
of-reaction
Concept:
calcium binding to calmodulin
...
is-a:
chemical reaction
Cancel
Reset
OK

Model Composer

- Graphical editing of model composition
- components & quantities on hierarchical compartments
- Automatic assistance by using annotations




t
Ko
IK
Vm
Ki
Variables inserted automatically
cell
extracellular fluid


Add a component from another model
t: time
Vm: V
t
Ko
Na_o
IK
I_Na
Links connected automatically
Vm
Ki
Na_i
cell
extracellular fluid

Compatibility with CellML

- Original XML formats for components & compositions
  - Bindings are automatically generated from XSDs
- Translator from/to CellML in XSLT available
  - from CellML 1.0/1.1
    - import not supported
  - to CellML 1.1
    - variable symbols & annotations lost
    - not fully compatible yet

Code Generator

- C++ source codes, which uses LAPACK & CVODE
- Supports for semi-explicit DAE
  - doi: 10.1109/IEMBS.2009.5335041
- Not opened yet: prototype implementation

Summary

- Cybow Modeller: a software suite for cell modelling
  - Component Editor
  - Model Composer
  - CellML Translator
  - C++ Code Generator (under development)

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