

# **ncRNA Network Modeler (NMM)**

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# 1 Introduction

The purpose of this system is to provide users with the construction of non-coding RNA to complete the simulation of non-coding RNA, mainly including two main functions:

- (1) non-coding RNA modeling and visualization;
- (2) dynamic model management and viewing.

Among them, non-coding RNA modeling and visualization is based on those nodes and lines that users use when drawing and modeling, then generate xml type files. Dynamic model management and viewing refers to saving and managing models through input information in the software.

This software provides biomolecular modeling and simulation functions for researchers in the field of systems biology.

## 1.1 Non-Coding RNA

A non-coding RNA (ncRNA) is a functional RNA molecule that is transcribed from DNA but not translated into proteins. Epigenetic related ncRNAs include miRNA, siRNA, piRNA and lncRNA. In general, ncRNAs function to regulate gene expression at the transcriptional and posttranscriptional level. Those ncRNAs that appear to be involved in epigenetic processes can be divided into two main groups; the short ncRNAs (<30 nts) and the long ncRNAs (>200 nts). The three major classes of short non-coding RNAs are microRNAs (miRNAs), short interfering RNAs (siRNAs), and piwi-interacting RNAs (piRNAs). Both major groups are shown to play a role in heterochromatin formation, histone modification, DNA methylation targeting, and gene silencing.

## 1.2 NCRV tool

### 1.2.1 Main functions

This software mainly includes two main functions: (1) non-coding RNA modeling and visualization (2) dynamic model management and viewing. The following lists all the sub-templates of the two templates:

- (1) Non-coding RNA modeling and visualization:
  - 1) Use the drawing module in the software for biological modeling and drawing
  - 2) Modify various attributes in the figure
  - 3) Save and delete the model
  - 4) Import a new non-coding RNA model
  - 5) Node external database link
  - 6) Network analysis function
- (2) Dynamic model management and viewing:
  - 1) Manage model database entries
  - 2) View and search the model database

### 1.2.1 Architecture

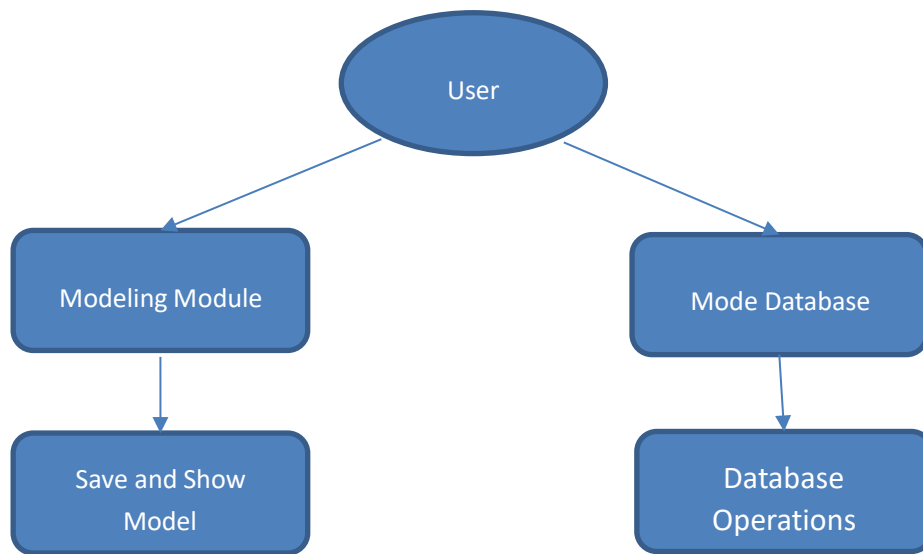


Figure 1: The architecture of NCRV tool.

## 1.3 Features – overview

- 1) User-friendly non-coding RNA icon, Protein icon, cell icon, etc.
- 2) Easy to build a strong non-coding RNA network.
- 3) Formal analysis based on graph theory.
- 4) Link non-coding RNA to Kinetic model based on Snoopy.

## 2 Modeling

This section will present a general step-by-step procedure for how to construct an NCRV model. This part of the model is just to show the function, without specific practical significance

### 2.1 Main interface

Figure 2 shows the main interface of the software. The menu and tool bar is on the top. The tools from left to right include “File”, “Edit”, “Options”, “View”, “Tool”, “Search”, and “Help”. Click “New” to create a new file, click “Save” to save the current page, and click “Open” to import the existing model of the computer.

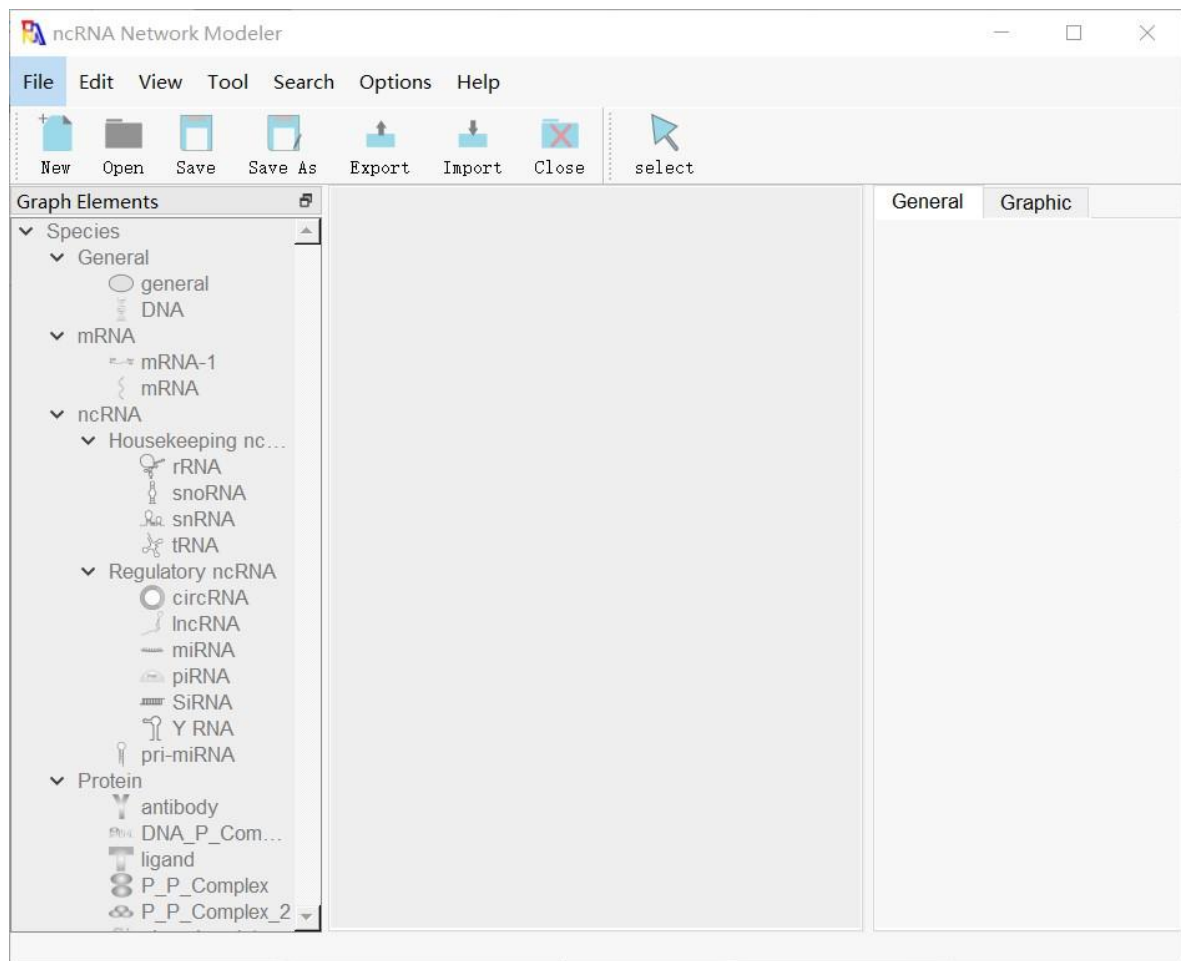


Figure 2: Main interface of NCRV tool.

## 2.2 Add nodes

Click on the element on the left side of the page to draw. There are two ways to add a node, one is to click the node (add one by one), or double-click the node (add continuously).

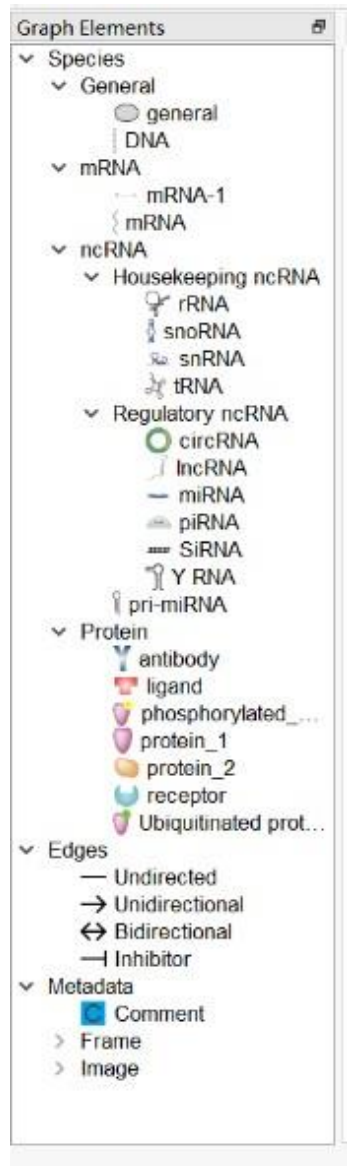


Figure 3: Graph elements

## 2.3 Node attributes

After adding a node, there is general attributes of the node on the right as show in Figure 4. Then user can change some attribute as show in Figure 5. The ID and Type (marked in red) in the attribute cannot be modified. Name, Standard Name, Alias Name (blue label) in the attribute can change the name. Among them, different names of Alias Name need to be separated by semicolon ";". Logic attribute bar binds multiple attributes together, only their positions are different, all other attributes are the same, including the name. Node Graphic attributes are show in Figure 6.

General	Graphic
ID	4
Name	mRNA_4
	<input checked="" type="checkbox"/> Show
Standard Name	mRNA
Alias Name	ncrna;sdf
Type	mRNA
Logic	<input type="checkbox"/>
Comment	

Figure 4: Node General attributes

ID	4
Name	mRNA_4
	<input checked="" type="checkbox"/> Show
Standard Name	mRNA
Alias Name	ncrna;sdf
Type	mRNA

Figure 5: The ID and Type (marked in red) in the attribute cannot be modified. Name, Standard Name, Alias Name (blue label) in the attribute can change the name. Among them, different names of Alias Name need to be separated by semicolon ";".

General	Graphic
Opacity	1.00
Width	52
Height	52

Figure 6: Node Graphic attributes

## 2.4 Frame attributes

Frame has no name by default, users can define the name. The type and ID cannot be changed. The width and height in graphic attributes cannot be changed.

General	Graphic
ID	2
Name	
	<input checked="" type="checkbox"/> Show
Type	Rectangle
Comment	

Figure 7: Frame General attributes

General	Graphic
Border Style	solid
Opacity	1.00
Brush Color	
Border Color	
Border Width	2
Width	200
Height	200

Figure 8: Frame Graphic attributes

## 2.5 Line attributes

General	Graphic
Name	
	<input checked="" type="checkbox"/> Sho
Weight	1.0000
Type	Bidirectional
Source	circRNA_4
Target	piRNA_7
Comm	

Figure 9: Line General attributes



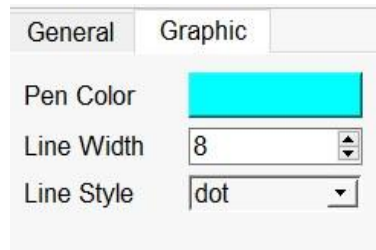


Figure 10: Line Graphic attributes

## 2.6 External database

Right-click the node icon and click “External Links” to display the external link database. You can access the external database of information you are interested in. Shown in Figure 11.

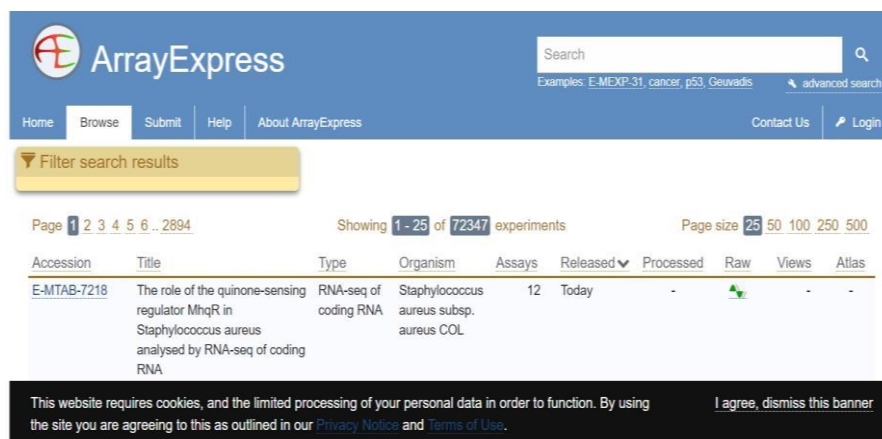
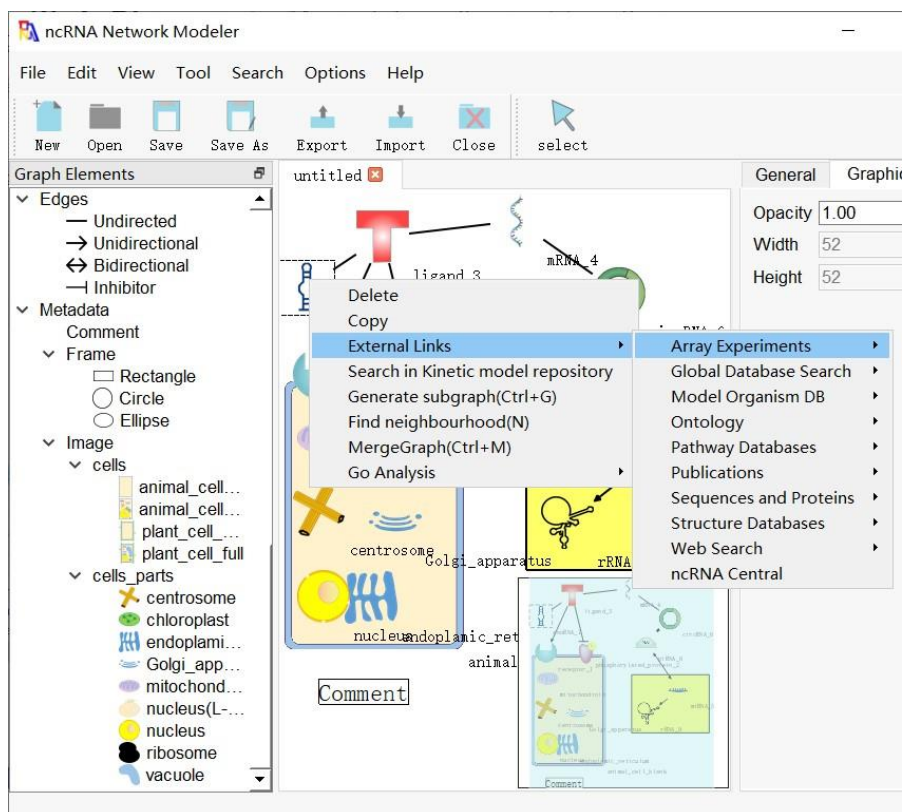


Figure 11: Access the external database.

## 2.7 Molecular information sheet

Double-click the node, click on the node's preference and you can view the analysis information table.

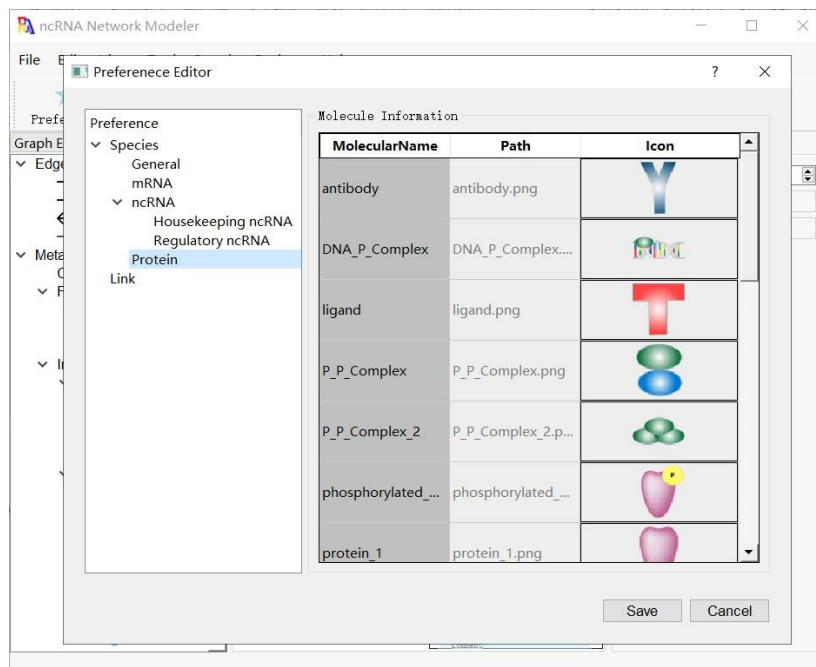
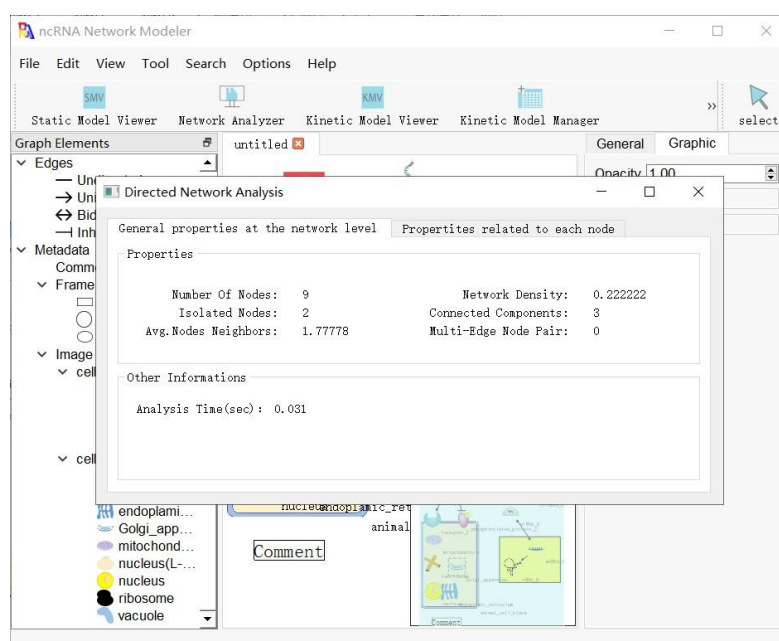


Figure 12: Molecular information sheet

## 2.8 Network analysis

Click the image analysis button to view the image analysis results. There are the number of nodes, the number of discrete nodes, and the number of connected devices.



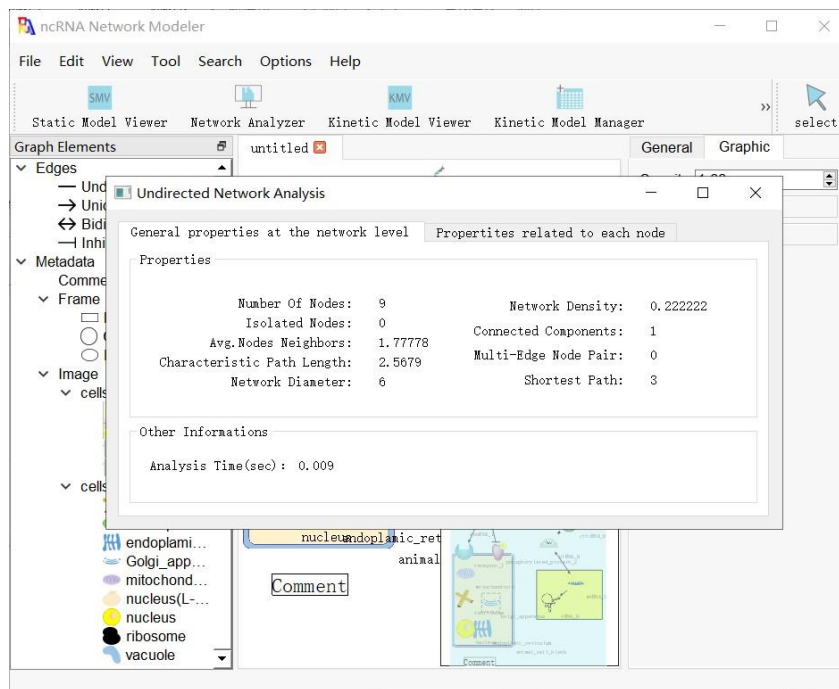


Figure 13: Network analysis function

## 2.9 Node analysis

Click the DegreeAnalyzer button to view the node analysis results. You can choose to show the degree of nodes by size and color.

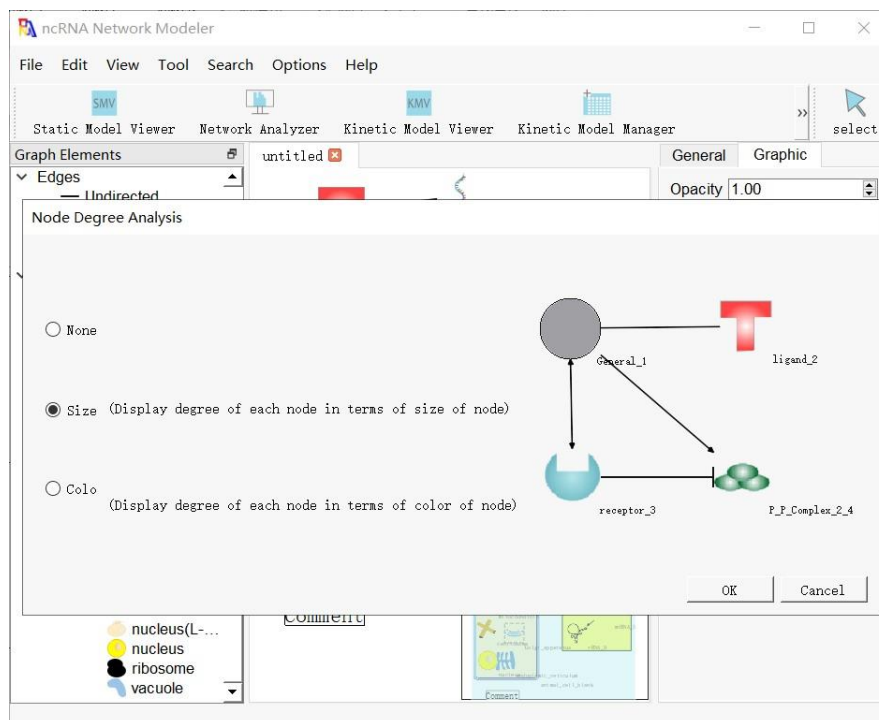


Figure 14: Node analysis function

## 2.10 Search Kenitic Repository

Select node and click the search kenitic repository button. All lists containing this mRNA can be listed.

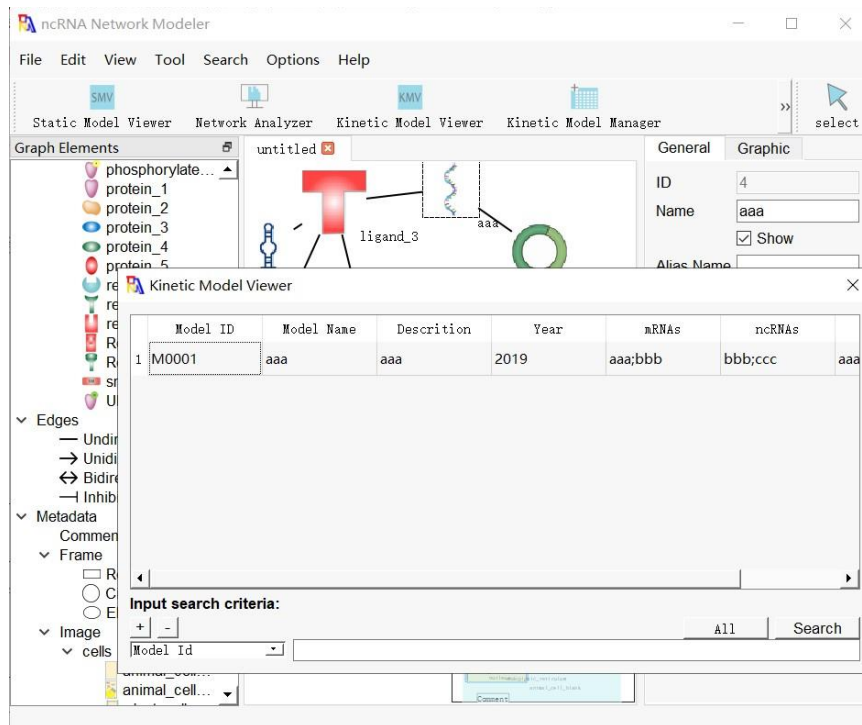


Figure 15: Search Kenitic Repository function

## 2.11 Layout

Users can freely choose three layout modes

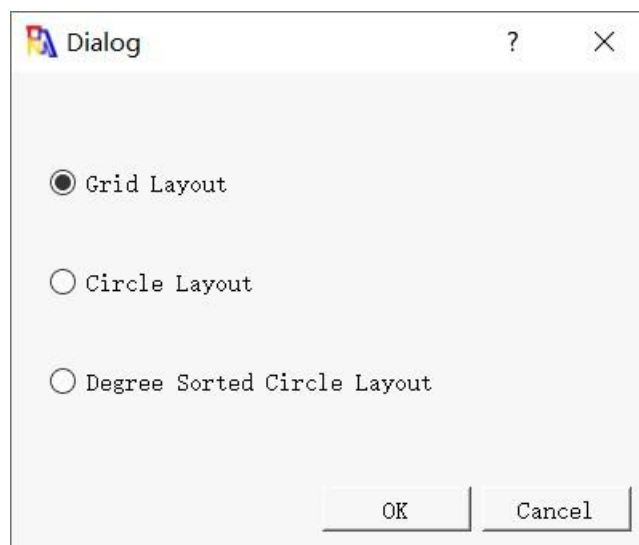


Figure 16: Layout function

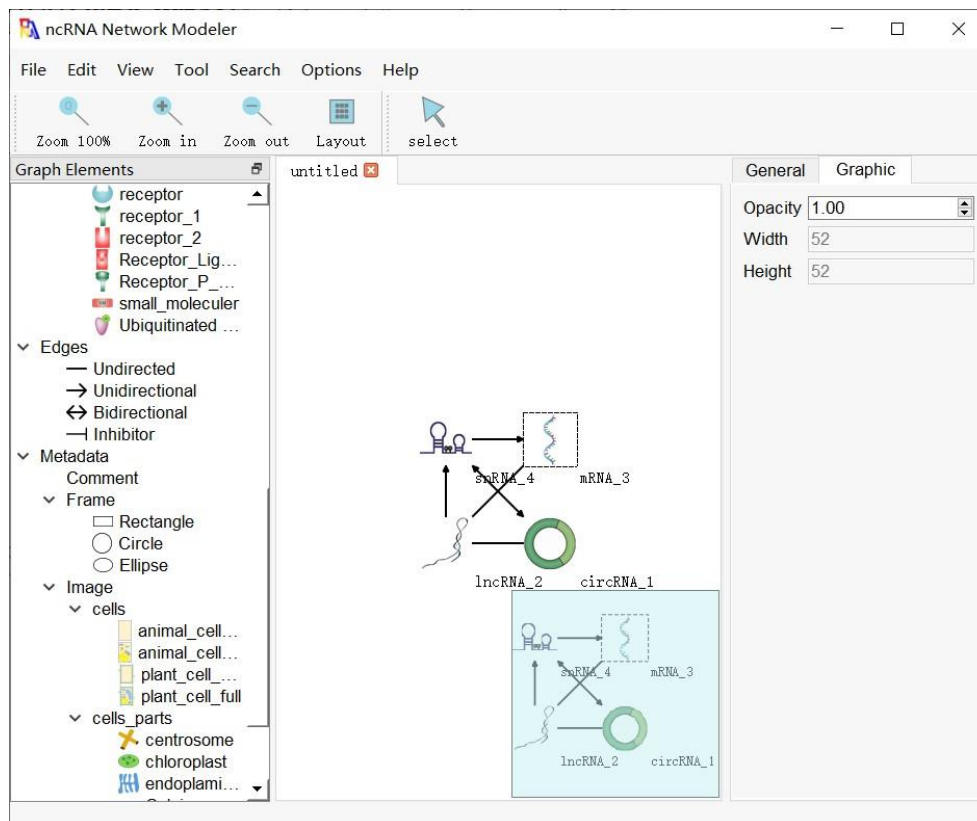


Figure 17: Grid Layout

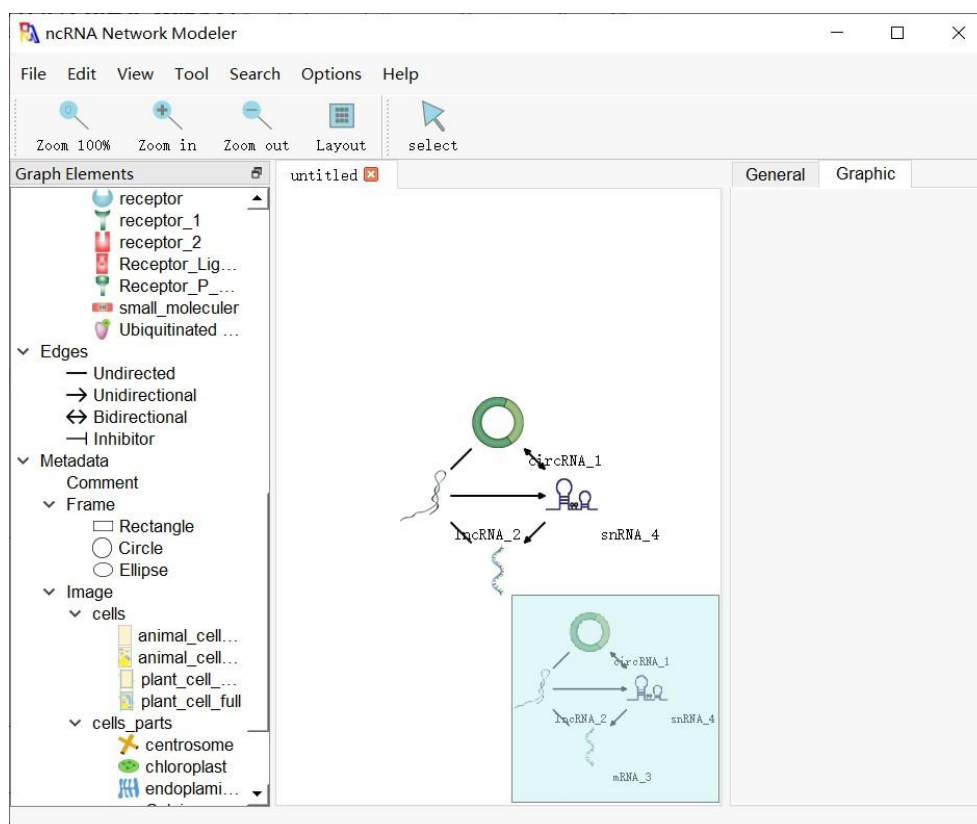


Figure 18: Circle Layout

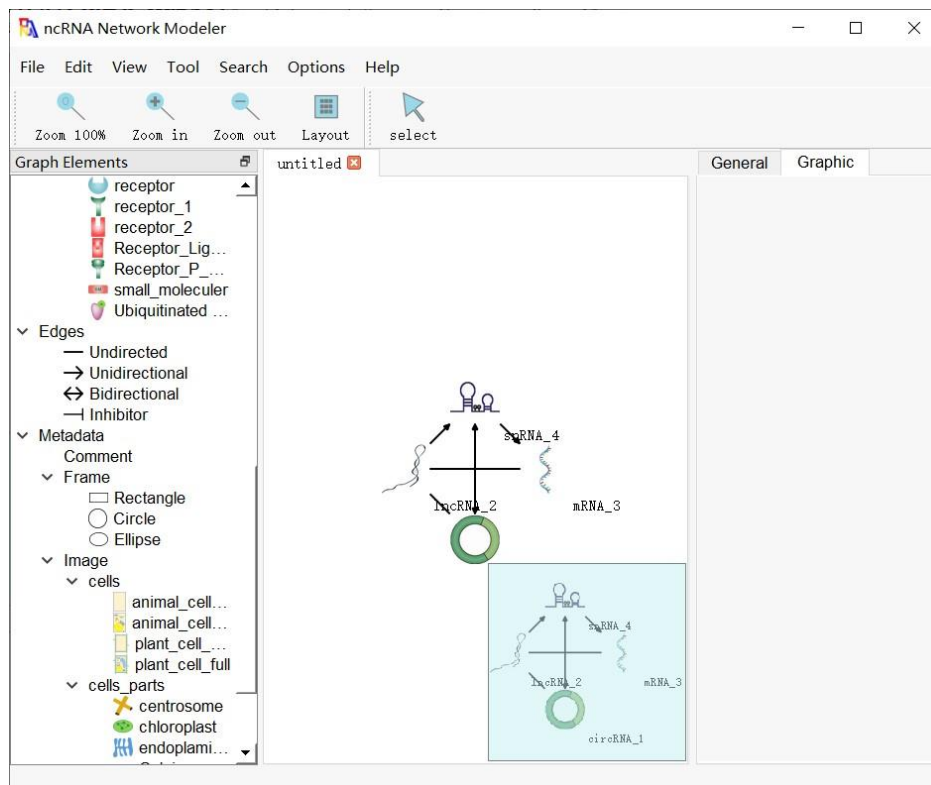


Figure 17: Degree Sorted Circle Layout

### 3 Kinetic model viewing and management

Model database buttons are on the top of the page as shown in Figure 14. Click “Kinetic Model Viewer” to enter the database viewing page. Click “Kinetic Model Manager” to enter the database management page, then click add, fill in the information, add the database model, and finally click add to complete the addition of the dynamic model. To edit a model, users can click “Kinetic Model Manager” to enter the database management page, then click specific items, click edit, modify the dynamic model information in the database here. Click on a specific entry and then click delete to delete the target model in the database.

You can enter the target dynamic model data you want to query in the search bar below, then click Search to query the target dynamic model, or click the target dynamic model you want to view detailed information on this page to enter the target The detailed data page of the model.

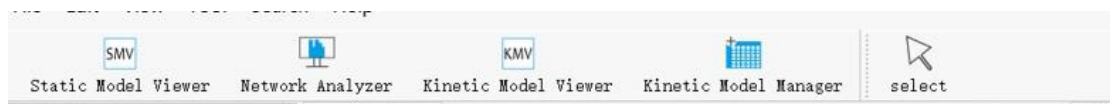


Figure 18: Model database button. Click “Kinetic Model Viewer” to enter the database viewing page. Click “Kinetic Model Manager” to enter the database management page.

### 3.1 Kinetic Model Manager

Click “Kinetic Model Manager” to enter the database management page, then click “add”, fill in the information, add the database model, and finally click “add” to complete the addition of the dynamic model.

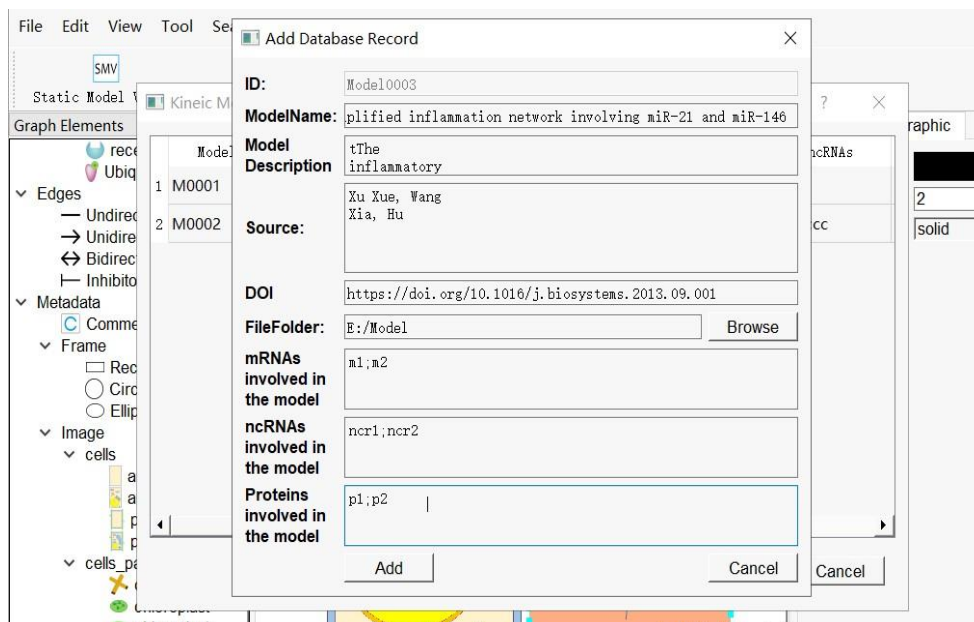


Figure 19: add database model

Click “Kinetic Model Manager” to enter the database management page, then click specific items, click edit, you can modify the dynamic model information in the database here.

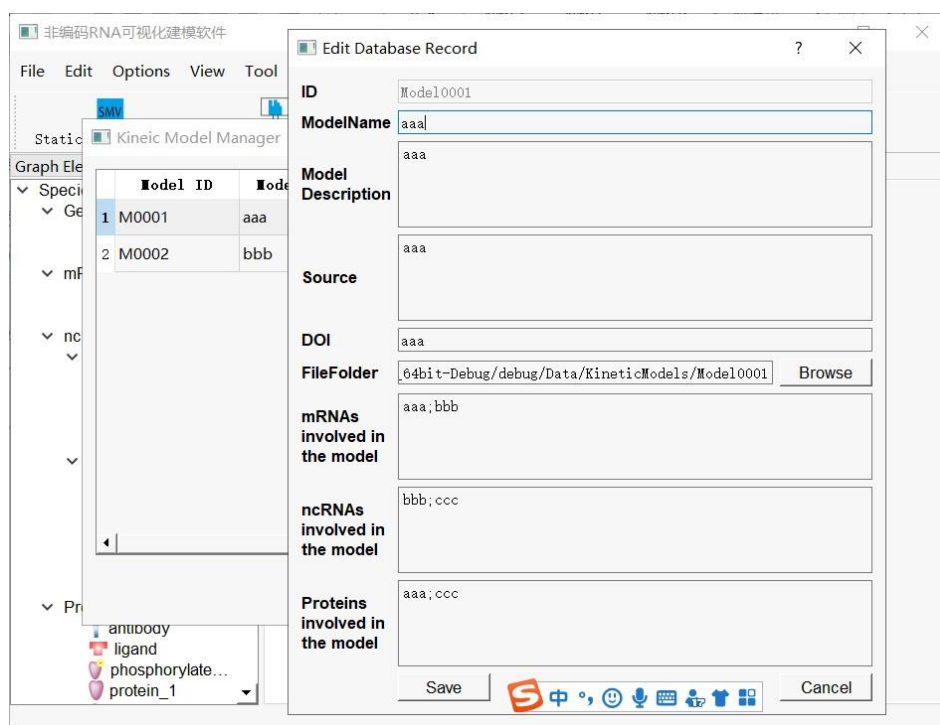


Figure 20: edit database model.

Click a specific entry and then click Delete to delete the target model in the database



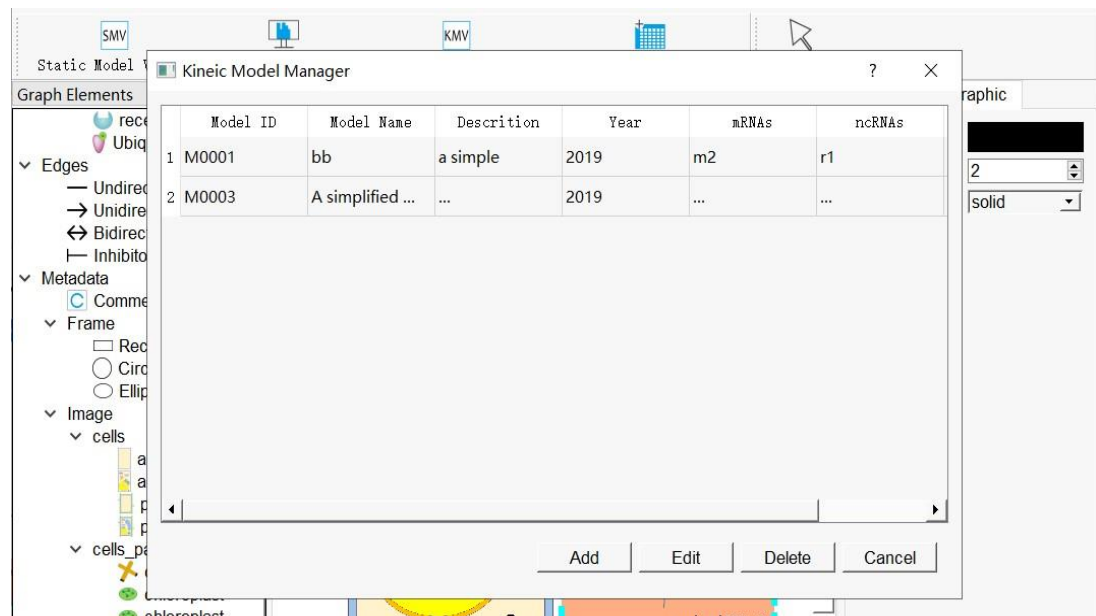
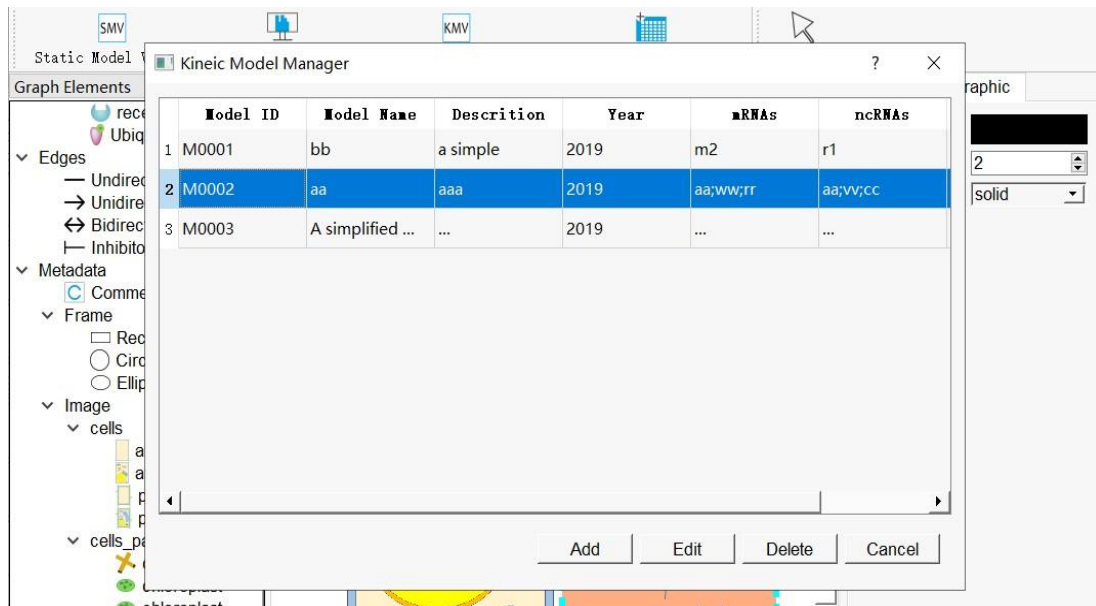


Figure 21: edit database model.

### 3.1 Kinetic Model Viewer

Click the kinetic model viewer button to enter the dynamic model database viewing page, where the brief information of the model in the database will be printed.

You can enter the target dynamic model data you want to query in the search bar below, and then click search to find the target dynamic model, or click the target dynamic model you want to view the detailed information in this page to enter the detailed data page of the target model.



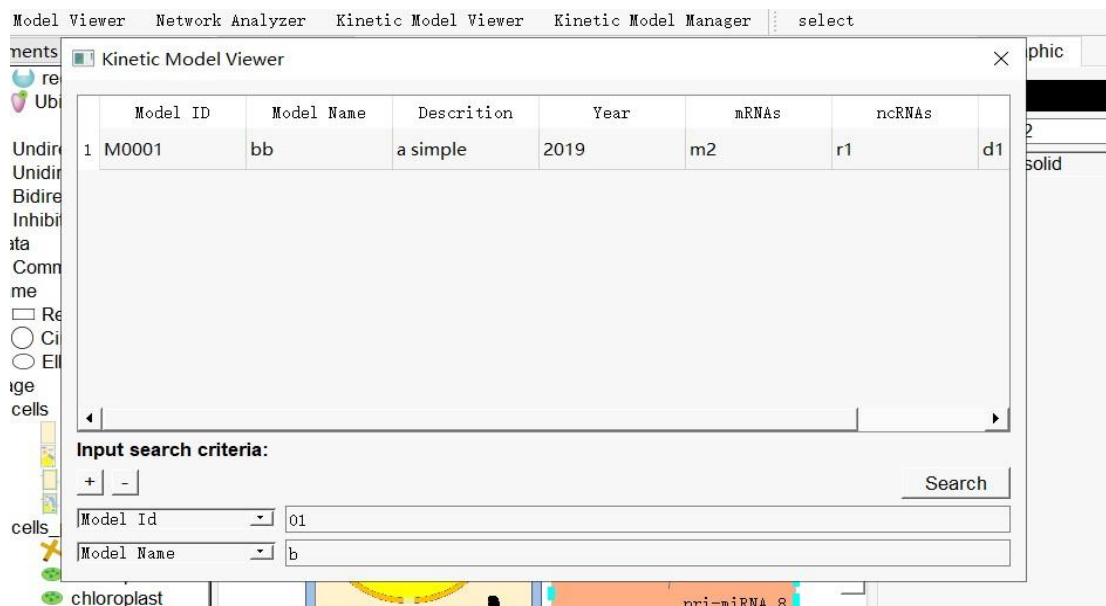


Figure 22: search database model.

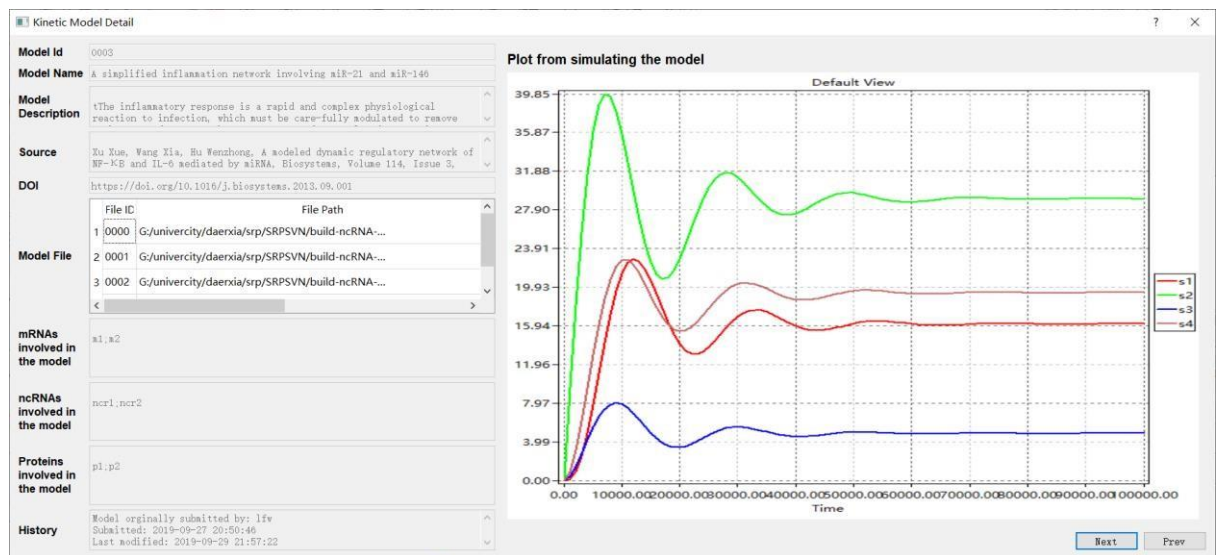


Figure 23: view model information

## 4 Examples

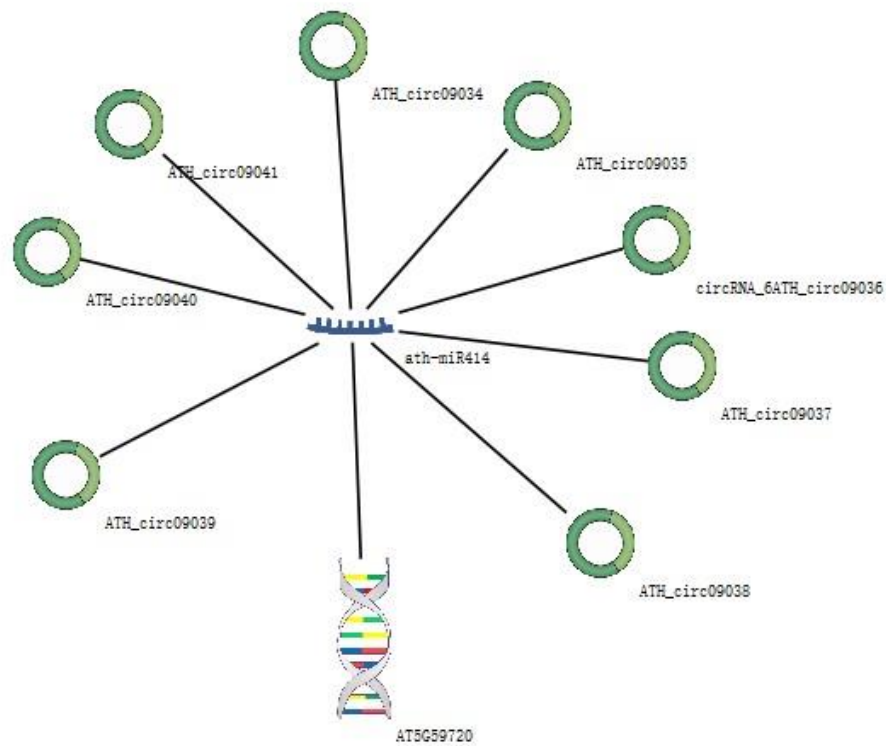


Figure 24: *Arabidopsis thaliana*

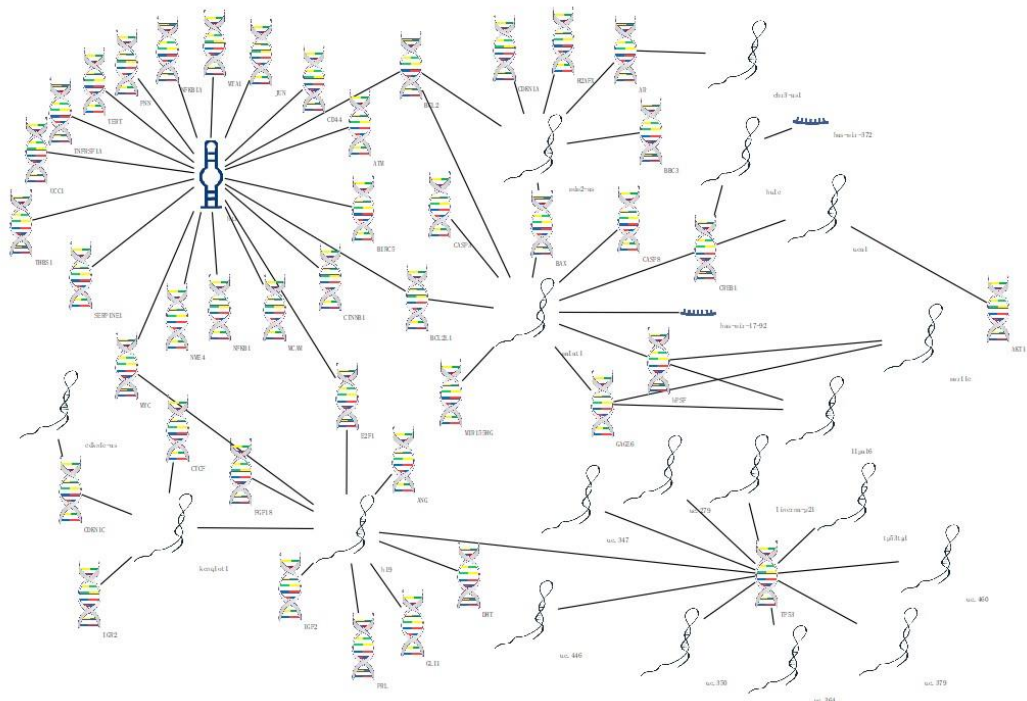


Figure 25: *Human*