

How to use MEMSIC®

MEMSIC®, a CAPE-OPEN compliant simulation module

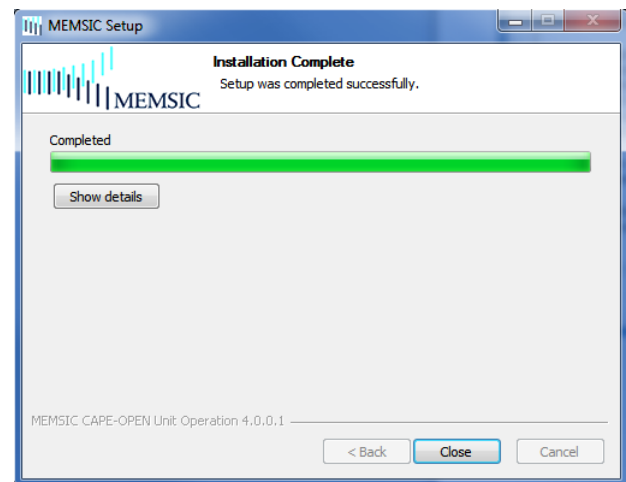
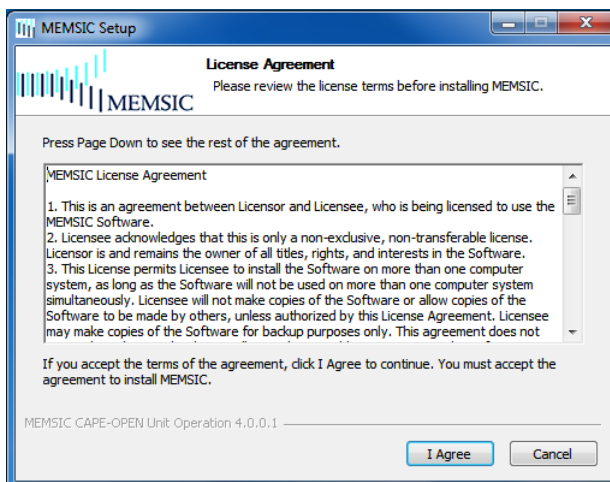
MEMSIC® is a useful CAPE-OPEN compliant simulation software to simulate gas separation processes through a membrane module. This software has been developed at the Separation Processes Group (Laboratoire Réactions et Génie des Procédés, UMR CNRS 7274 – Nancy, France). Most process simulation software tools (PSE: Process Simulation Environment as ASPEN®, HYSYS®, PRO/II®, PROSIM®, etc.) implement CAPE-OPEN interfaces that enables the end-user to plug CAPE-OPEN compliant tools and to export CAPE-OPEN compliant components.

Four different types of hydrodynamic conditions are taken into account in MEMSIC®: (1) cross plug flow, (2) perfect mixing, (3) Co-Current plug flow and (4) Counter-Current plug flow. Additionally, five different concepts and/or theoretical model are proposed to describe the transport mechanism of molecular species through a membrane: (1) Constant Permeability, (2) Dual Mode, (3) Henry, (4) ENSIC and (5) Flory-Huggins.

This notice explains how to install the software on your computer and activate the MEMSIC® unit operation on several Process Simulation Software, and how to use MEMSIC®.

Installation of the CAPE-OPEN module

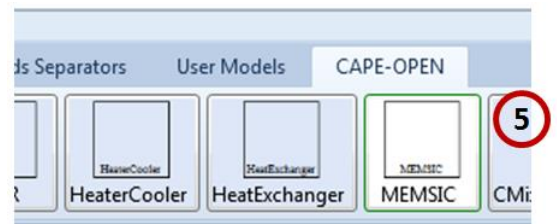
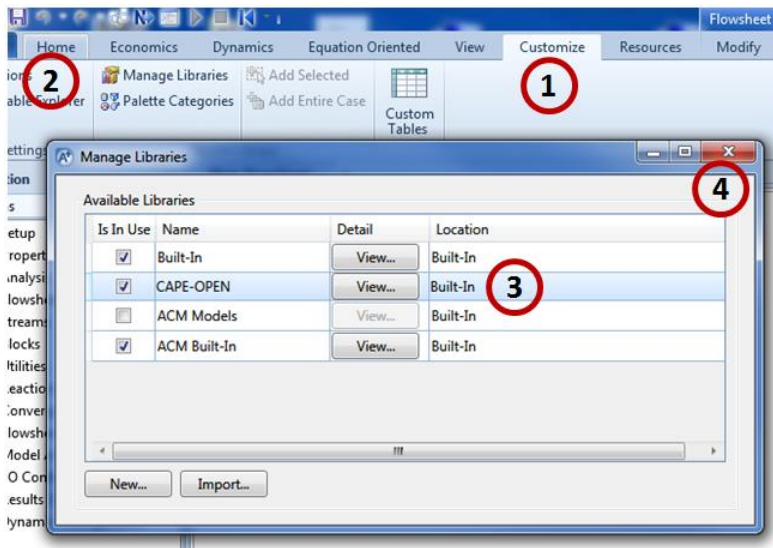
To install the MEMSIC® module, we have developed a setup assistant. By clicking on the setup assistant, and after having accepted the license agreement, the installation goes through a series of dialog boxes. **Do not forget to plug the dongle into your computer before installing the program.**



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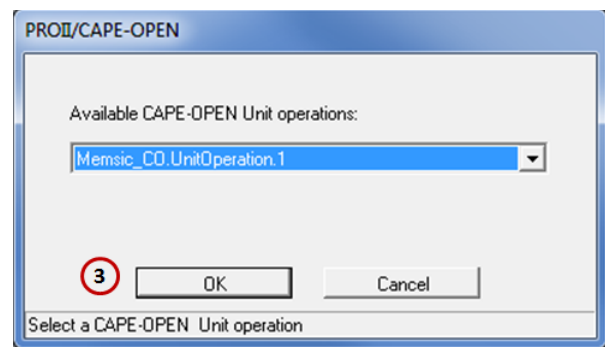
Implementation of the module in AspenPlus®

1. Click on “Customize” on the menu bar.
2. Click on “Manage Libraries” on the toolbar.
3. Activate the “CAPE-OPEN” module.
4. Close the window. A new model library appears at the bottom toolbar, named “CAPE-OPEN”. Click on this new tab, and select “MEMSIC” module. You can then place a new MEMSIC® unit operation on the flowsheet.



Implementation of the module in PRO/II®

1. Click “Miscellaneous” on the menu bar.
2. Click on the “CAPE-OPEN” icon.
3. Select the “MEMSIC” module. Then, drag and drop the icon on the flowsheet to create a MEMSIC® unit operation on your flowsheet.



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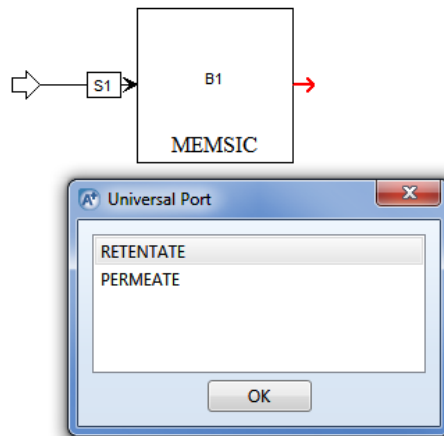
How to use MEMSIC

Whatever the PSE you choose, you have to follow these required steps to use the MEMSIC® module:

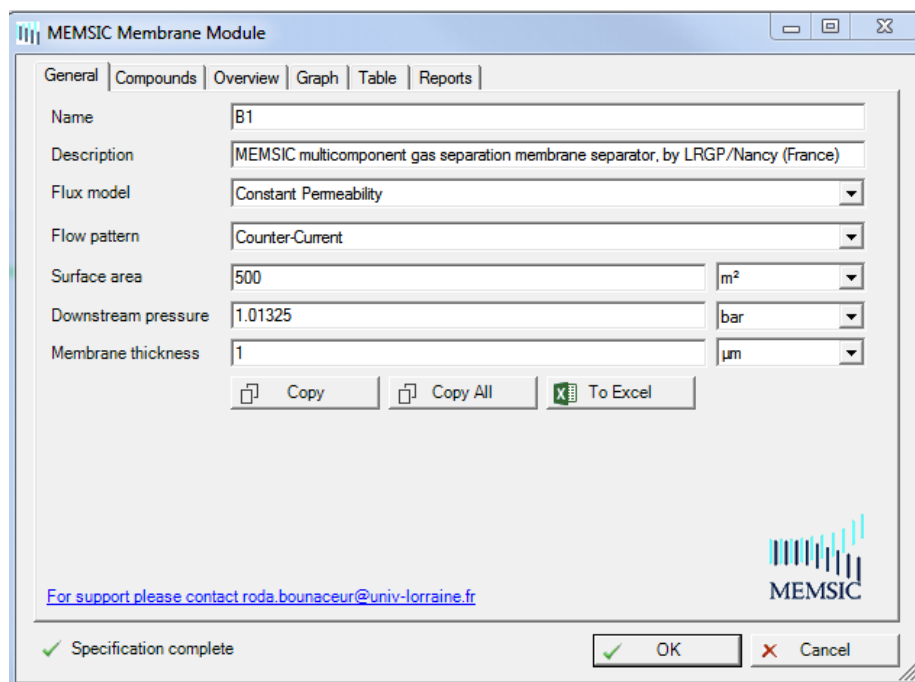
1. Select the components to be used in your model
2. Set the calculation methods for physical and thermodynamics properties
3. Create your flowsheet by adding object: unit operation, streamline, compressor, etc.
4. Define input and outputs streams of the MEMSIC® module.

Define the Material Streams by defining both the stream's composition and its thermodynamic state: pressure, mole fraction, flow rate, etc...

The MEMSIC® module must be connected to one inlet stream and two outlet streams. When you create an output Material Stream from the MEMSIC® unit operation, a message box appears and ask you to specify which outlet this stream is: retentate or permeate.

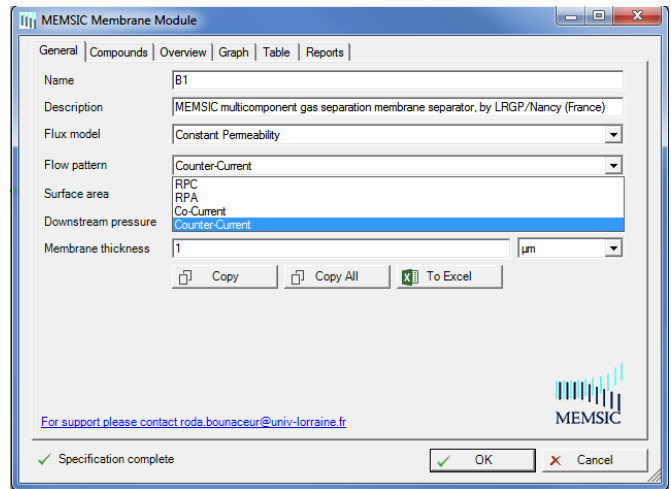
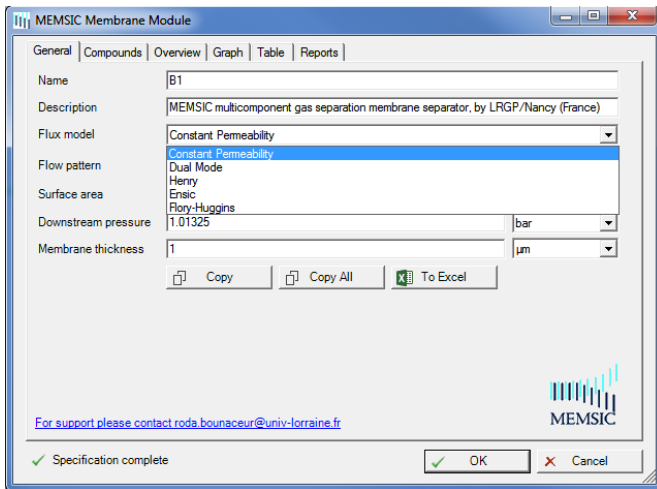


5. When double clicking on the MEMSIC module, a new window opens with 6 different tabs: "General", "Compounds", "Overview", "Graph", "Table", and "Reports".

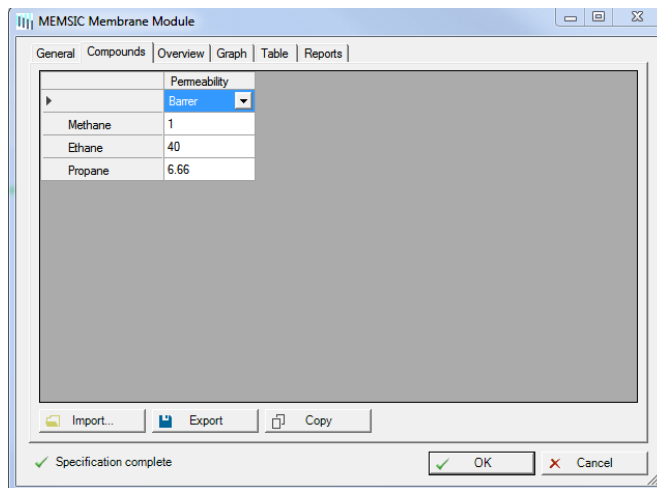


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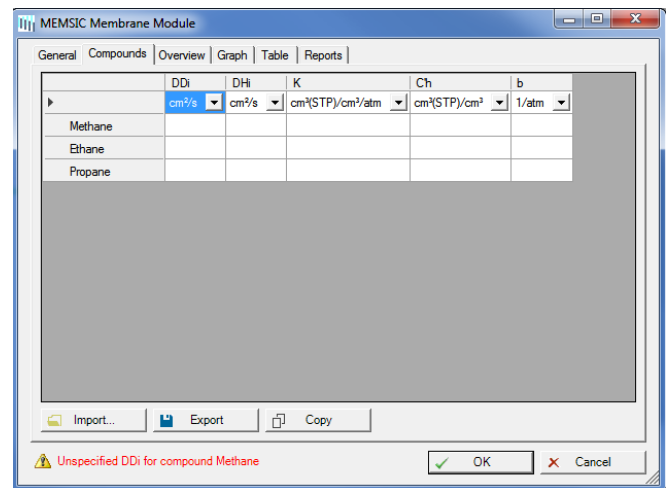
6. Select the “General” tab, select the flux model and the flow pattern, and then define the operating parameters: surface area, membrane thickness, and downstream pressure.



7. Select the “Compound” tab, enter the required parameters depending on the selected flux model.



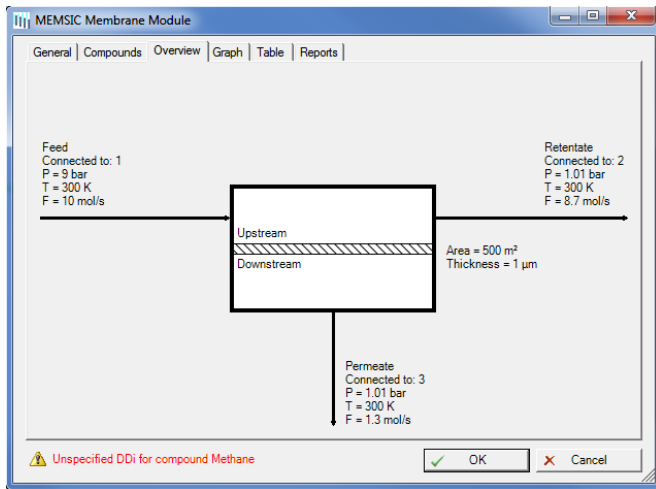
(Constant permeability)



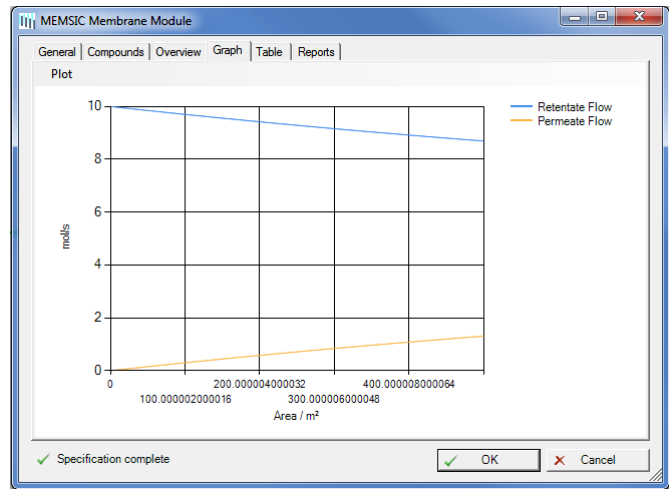
(Dual Mode)

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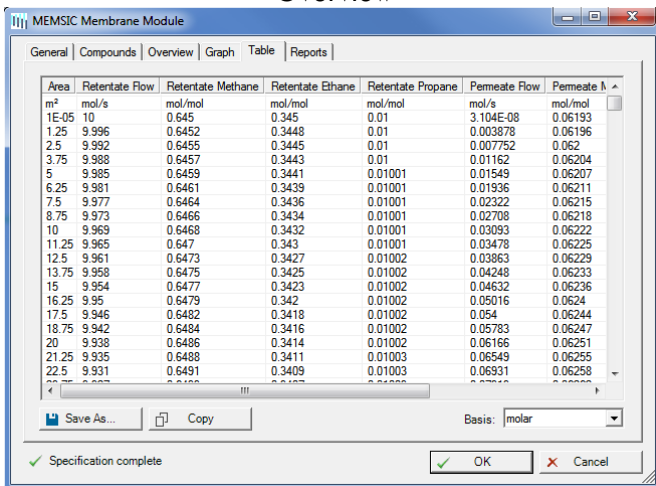
8. "Overview" / "Graph" / "Table" / "Reports": when the simulation have been run and the calculation is finished, those tabs give an overview of the results.



"Overview"



"Graph"

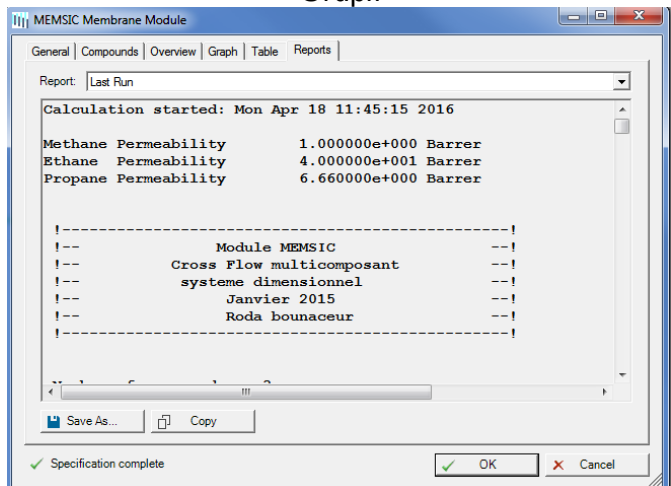


Area	Retentate Flow	Retentate Methane	Retentate Ethane	Retentate Propane	Permeate Flow	Permeate Methane
m ²	mol/s	mol/mol	mol/mol	mol/mol	mol/s	mol/mol
1E-05	10	0.645	0.345	0.01	3.104E-08	0.06193
1.25	9.996	0.6452	0.3448	0.01	0.003878	0.06196
2.5	9.992	0.6455	0.3445	0.01	0.007752	0.062
3.75	9.988	0.6457	0.3443	0.01	0.01162	0.06204
5	9.985	0.6459	0.3441	0.01001	0.01549	0.06207
6.25	9.981	0.6461	0.3439	0.01001	0.01936	0.06211
7.5	9.977	0.6464	0.3436	0.01001	0.02322	0.06215
8.75	9.973	0.6466	0.3434	0.01001	0.02708	0.06218
10	9.969	0.6468	0.3432	0.01001	0.03093	0.06222
11.25	9.965	0.647	0.343	0.01001	0.03478	0.06225
12.5	9.961	0.6473	0.3427	0.01002	0.03863	0.06229
13.75	9.958	0.6475	0.3425	0.01002	0.04248	0.06233
15	9.954	0.6477	0.3423	0.01002	0.04632	0.06236
16.25	9.95	0.6479	0.342	0.01002	0.05016	0.0624
17.5	9.946	0.6482	0.3418	0.01002	0.054	0.06244
18.75	9.942	0.6484	0.3416	0.01002	0.05783	0.06247
20	9.938	0.6486	0.3414	0.01002	0.06166	0.06251
21.25	9.935	0.6488	0.3411	0.01003	0.06549	0.06255
22.5	9.931	0.6491	0.3409	0.01003	0.06931	0.06258

Save As... Copy Basis: molar

Specification complete

"Table"



Report: Last Run

Calculation started: Mon Apr 18 11:45:15 2016

Methane Permeability 1.000000e+000 Barrer
Ethane Permeability 4.000000e+001 Barrer
Propane Permeability 6.660000e+000 Barrer

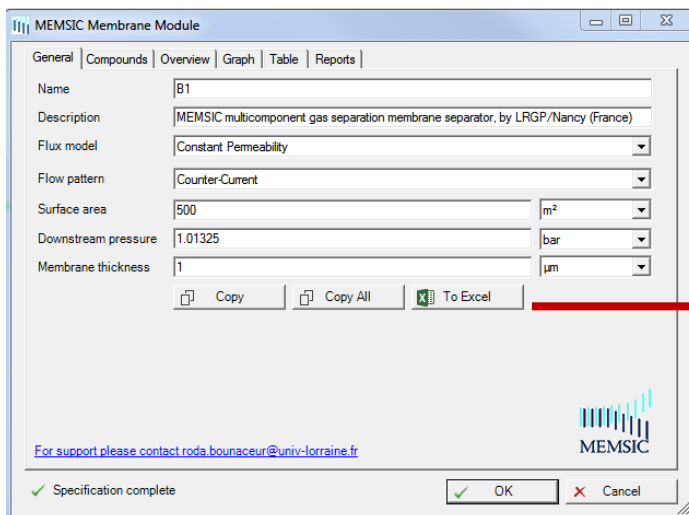
Module MEMSIC
Cross Flow multicomponent
systeme dimensionnel
Janvier 2015
Roda bounaceur

Save As... Copy

Specification complete

"Reports"

9. By clicking on the "To Excel" button, all the results are stored in an Excel file.



MEMSIC Membrane Module

General | Compounds | Overview | Graph | Table | Reports

Name: B1

Description: MEMSIC multicomponent gas separation membrane separator, by LRGP/Nancy (France)

Flux model: Constant Permeability

Flow pattern: Counter-Current

Surface area: 500 m²

Downstream pressure: 1.01325 bar

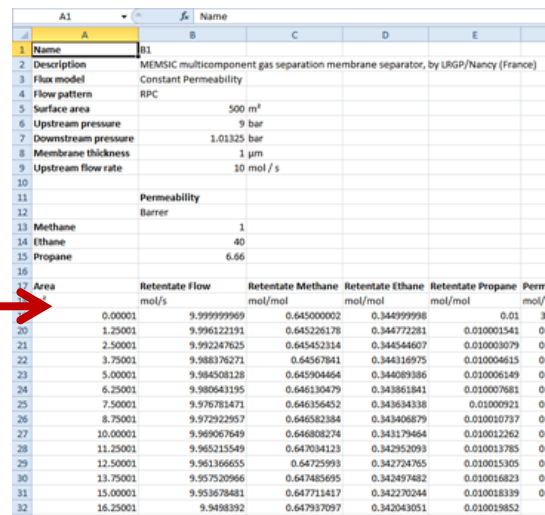
Membrane thickness: 1 μm

Copy Copy All To Excel

For support please contact roda.bounaceur@univ-lorraine.fr

MEMSIC

Specification complete



Area	Retentate Flow	Retentate Methane	Retentate Ethane	Retentate Propane	Permeate Flow
m ²	mol/s	mol/mol	mol/mol	mol/mol	mol/s
0.00001	0.000000000	0.645000002	0.344999998	0.01	3.104E-08
1.25001	9.99622191	0.64523114	0.34476886	0.010003079	0.003878
2.50001	9.99247825	0.64545314	0.34454687	0.010006158	0.007752
3.75001	9.9887271	0.64567941	0.344316975	0.010009237	0.01162
5.00001	9.98498128	0.64590464	0.344089386	0.010012316	0.01549
6.25001	9.98123195	0.646130479	0.343861841	0.010015395	0.01936
7.50001	9.977481471	0.646356452	0.343634338	0.010018474	0.02322
8.75001	9.973732957	0.646582384	0.343406879	0.010021553	0.02708
10.00001	9.969984649	0.646808324	0.343179464	0.010024632	0.03093
11.25001	9.966235549	0.647034123	0.342952093	0.010027711	0.03478
12.50001	9.962486455	0.64725993	0.342724765	0.01003079	0.03863
13.75001	9.95873736	0.647485695	0.342497482	0.010033869	0.04248
15.00001	9.954988266	0.647711417	0.342270244	0.010036948	0.04632
16.25001	9.951239171	0.647937097	0.342043051	0.010040027	0.05016