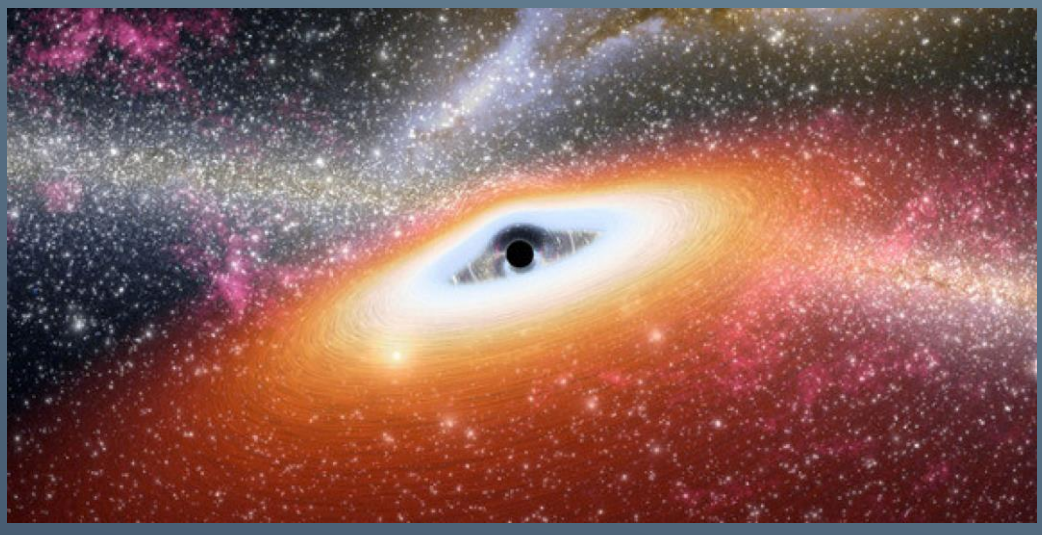

micrOMEGAs++

USER MANUAL

Contents

Introduction

This package includes “micrOMEGAs++”, which is derived from open source project “micrOMEGAs”, meant for calculations of dark matter properties. In addition, this software is capable of running in parallel and facilitates user with simple and intuitive graphical user interface. It is assumed that the user is familiar with concepts of high energy particle physics.

System Requirements

- Operating System : Linux
- Java runtime environment 1.6 or above
- Any spreadsheet software to read *.csv file.
- Processor : Preferably multi-core

Installation

1. Extract the “micrOMEGAs++.zip” file to desired directory.
2. Open “terminal” inside the extracted folder or else open terminal and run the command “cd path”, where path represents the path to the extracted folder.
3. Now run the command “./micromegas++”.
4. A message saying “Installation successful” confirms successful installation.
5. To check the JRE version on your system, run the command “java –version”.

Get Started

Using the software

To start using the software follow these steps:

1. Go to "micrOMEGAs++" directory and double click on file proj1.jar. This will open GUI for software. If this is not working open command prompt and change directory to "micrOMEGAs++" directory. Type the command "java –jar proj1.jar" in terminal to open GUI.

2. After GUI opens select model you want to use. This will open page which enlists all parameters for selected model and three text fields in front each parameter.

3. This page enables you to calculate properties for different combinations of input parameters. For this you have to give starting value, ending value and step size for each parameter. e.g. –

Parameter	Starting Value	Ending Value	Step Size
laL	10	12	1
mH	14	15	1

Then this input will calculate properties for following input combinations to micrOMEGAs
(10,14), (11,14), (12,14),
(10,15), (11,15), (12,15)

4. In first text box you have to fill the starting value for that parameter. In next the ending value and finally the step size.

5. After filling out all information, click on ‘SUBMIT’ button.

6. Next window will open which will have option for selecting properties which you want to calculate. Select the radio buttons next to property which you want to calculate. Others will not be calculated.

7. Next finish ‘SUBMIT’ button and micrOMEGAs will start executing.

8. After finishing execution, output_final.csv file will be created which is final output file.

9. This file can be opened with any spreadsheet software/ programs like “MS Excel” or “Gnumeric”.

Handling *.csv file

1. First select everything using Ctrl+A.

2. Then go to ‘Format’ option then select option for ‘Auto Fit Row Height’ option. Then select ‘Auto Fit Column Width’ option.

3. Then select top-most row and go to ‘View’ and click on option ‘Freeze Pane’.

4. Then you can save this file as .gnumeric so that changes will be permanent.

(Note that this instruction set is written for GNumeric. For other software it will change slightly.)

Advanced Modifications

In this section we assume that the user has adequate knowledge of C programming and micrOMEGAs.

Re-using code for new models

- First create new model as usual using command ./newProject .
- Then go to directory General model code and copy main.c and divideData.c from there. Paste this two file in newly created model's directory. This will replace the main file.
- Now you need to change divideData.c as main.c is already modified.
- Steps to change divideData.c are given below.
- Now model is ready for use like another model.
- This model will not have GUI. So you need to create input files yourself.
- For this you need two files – one for parameter combination and other for properties.
- Parameter file format will be like :

Parameter Name1	Initial Value1	Final Value1	Step Size1
Parameter Name2	Initial Value2	Final Value2	Step Size2
Parameter Name3	Initial Value3	Final Value3	Step Size3
Parameter Name4	Initial Value4	Final Value4	Step Size4
.	.	.	.
.	.	.	.
.	.	.	.
.	.	.	.

For example:

laL	121	132	2
mH	20	20.5	0.01
kappa	58	60	0.5

- Property file format is very easy. You need to check main and see the order in which they are calculated. Then you have to put '1' for properties which you want to calculate and '0' for those which you don't want to calculate one below one. For example – If properties are in order Relic Density, CDM nucleons, Neutrino telescope and you want to calculate only Relic Density and Neutrino telescope, your property file will look like:

```
1
0
1
```

- Now you have to compile main.c as usual by executing command "make main=main.c".

- You will compile divideData.c by executing the command "gcc –fopenmp divideData.c".

- This will create a.out file in your working directory.

- Now, to run this a.out file run the following command
  ./a.out <parameters_file.txt> <prop_file.txt>
  for example if your parameters file is "Input.txt" and properties file is "prop.txt" the command would be as follows
  ./a.out Input.txt prop.txt

- This will start execution of the program and output will be generated in .csv file as in other cases.

Making changes in **divideData.c**

- You can set number of threads at line 4.
- Then you have to set number of parameters in line 5.
- Now you will come directly to section named parallel section.
- In this section you will find twenty nested 'for loops'. Now you need to keep only number of parameters less one 'for loops'. So delete or insert required number of for loops. Be sure to insert for loops inside innermost one and similarly delete for loops from innermost loop. Don't touch outer loops while doing so.
- Now you are done.