

Semi-numerical Reionization

Generated by Doxygen 1.8.8

Sat Oct 11 2014 21:23:14

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Chapter 1

MPI version of ionz_codes

This code was adapted from https://github.com/midsuman/ionz_codes.

This is the parallelized version of the old one.

Original [README.md](#)

ionz_codes

A simple set of codes to simulate (semi-numerically) HI maps during reionization.

Use the makefile for compilation in the following manner:

```
make ionz_main
```

It will create the executable 'ionz_main'

You need to install FFTW 2.x.x with following flags: '-enable-float' and '-enable-type-prefix' to compile this set of codes.

Please acknowledge this paper (<http://arxiv.org/abs/1403.0941>), if you are using this code.

Chapter 2

Data Structure Index

2.1 Data Structures

Here are the data structures with brief descriptions:

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Chapter 3

File Index

3.1 File List

Here is a list of all files with brief descriptions:

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Chapter 4

Data Structure Documentation

4.1 GLOBALVARS Struct Reference

```
#include <global.h>
```

Data Fields

- float `vhh`
Hubble parameter.
- float `vomegam`
Omega_matter.
- float `vomegalam`
Omega_lambda.
- float `vomegab`
Omega_baryon.
- float `LL`
grid spacing in Mpc
- float `pi =M_PI`
pi constant
- `fftw_real *** ro`
arrays for storing data
- `rfftwnd_plan p_ro`
for density/potential
- `rfftwnd_plan q_ro`
for FFT
- `fftw_real *** nh`
for FFT
- `fftw_real *** nhs`
- `fftw_real *** ngamma`
- `fftw_real *** ngammas`
- `fftw_real **** nxion`

4.1.1 Field Documentation

4.1.1.1 float LL

grid spacing in Mpc

4.1.1.2 `fftw_real *** ngamma`

4.1.1.3 `fftw_real *** ngammas`

4.1.1.4 `fftw_real*** nh`

for FFT

end of declaration of global variables for output binary file

4.1.1.5 `fftw_real *** nhs`

4.1.1.6 `fftw_real ***** nxion`

4.1.1.7 `rfftwnd_plan p_ro`

for density/potential

4.1.1.8 `float pi =M_PI`

pi constant

4.1.1.9 `rfftwnd_plan q_ro`

for FFT

4.1.1.10 `fftw_real*** ro`

arrays for storing data

4.1.1.11 `float vhh`

Hubble parameter.

4.1.1.12 `float vomegab`

Omega_baryon.

4.1.1.13 `float vomegalam`

Omega_lambda.

4.1.1.14 `float vomegam`

Omega_matter.

The documentation for this struct was generated from the following file:

- [global.h](#)

4.2 params Struct Reference

```
#include <ion.h>
```

Data Fields

- int [Nnion](#)
- float * [nion](#)
- float [a_expansion](#)
- float [z](#)
- float [Hubble_h](#)
- float [omegam](#)
- float [omegalam](#)
- float [omegab](#)
- int [N1](#)
- int [N2](#)
- int [N3](#)
- float [boxsize](#)
- float [gridsize](#)

4.2.1 Field Documentation

4.2.1.1 float [a_expansion](#)

4.2.1.2 float [boxsize](#)

4.2.1.3 float [gridsize](#)

4.2.1.4 float [Hubble_h](#)

4.2.1.5 int [N1](#)

4.2.1.6 int [N2](#)

4.2.1.7 int [N3](#)

4.2.1.8 float* [nion](#)

4.2.1.9 int [Nnion](#)

4.2.1.10 float [omegab](#)

4.2.1.11 float [omegalam](#)

4.2.1.12 float [omegam](#)

4.2.1.13 float [z](#)

The documentation for this struct was generated from the following file:

- [ion.h](#)

Chapter 5

File Documentation

5.1 allotarrays.c File Reference

```
#include <stdlib.h>
#include <sfftw.h>
#include <srfftw.h>
```

Functions

- `fftw_real*** allocate_fftw_real_3d` (int *N1*, int *N2*, int *N3*)
- `float** allocate_float_2d` (long *N1*, int *N2*)

5.1.1 Function Documentation

5.1.1.1 `fftw_real*** allocate_fftw_real_3d` (int *N1*, int *N2*, int *N3*)

5.1.1.2 `float** allocate_float_2d` (long *N1*, int *N2*)

5.2 global.h File Reference

Global variables.

```
#include "srfftw.h"
#include <math.h>
```

Data Structures

- struct `GLOBALVARS`

Macros

- `#define GLOBAL_H_`

Variables

- struct `GLOBALVARS` `globals`

5.2.1 Detailed Description

Global variables.

Author

Chaichalit Srisawat <boyd.srisawat@gmail.com>

Date

Sat Oct 11 20:39:04 2014

5.2.2 Macro Definition Documentation

5.2.2.1 #define GLOBAL_H_

5.2.3 Variable Documentation

5.2.3.1 struct GLOBALVARS globals

5.3 ion.h File Reference

Define all functions.

```
#include "srfftw.h"
#include <stdio.h>
#include <math.h>
#include <stdlib.h>
#include <string.h>
#include "global.h"
```

Data Structures

- struct [params](#)

Macros

- #define [ION_H_](#)

Functions

- int [make_radii_list](#) (float *radii_p, float r_min, float r_max)
- double [Get_Current_time](#) ()
- float ** [allocate_float_2d](#) (long N1, int N2)
- fftw_real *** [allocate_fftw_real_3d](#) (int N1, int N2, int N3)
- void [Setting_Up_Memory_For_ionz](#) (int Nnion)
- void [smooth](#) (fftw_real ***ro_dum, float Radii)
- void [reionization](#) (float Radii, fftw_real ***nh_p, fftw_real ***ngamma_p, fftw_real *****nxion_p, float *nion←_p, int Nnion, int N1, int N2, int N3)
- void [read_param](#) (char filename[2048])

Variables

- struct `params` `input_param`

5.3.1 Detailed Description

Define all functions.

Author

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Date

Sat Oct 11 20:49:08 2014

5.3.2 Macro Definition Documentation

5.3.2.1 #define ION_H_

5.3.3 Function Documentation

5.3.3.1 `fftw_real*** allocate_fftw_real_3d (int N1, int N2, int N3)`

5.3.3.2 `float** allocate_float_2d (long N1, int N2)`

5.3.3.3 `double Get_Current_time ()`

5.3.3.4 `int make_radii_list (float * radii_p, float r_min, float r_max)`

5.3.3.5 `void read_param (char filename[2048])`

5.3.3.6 `void reionization (float Radii, fftw_real *** nh_p, fftw_real *** ngamma_p, fftw_real **** nxion_p, float * nion_p, int Nnion, int N1, int N2, int N3)`

5.3.3.7 `void Setting_Up_Memory_For_ionz (int Nnion)`

5.3.3.8 `void smooth (fftw_real *** ro_dum, float Radii)`

5.3.4 Variable Documentation

5.3.4.1 struct `params` `input_param`

5.4 ionz_funcs.c File Reference

```
#include <stdio.h>
#include <stdlib.h>
#include <math.h>
#include <srfftw.h>
#include "ion.h"
```

Functions

- void [Setting_Up_Memory_For_ionz](#) (int *Nnion*)
- void [smooth](#) (fftw_real ****ro_dum*, float *Radii*)

5.4.1 Function Documentation

5.4.1.1 void [Setting_Up_Memory_For_ionz](#) (int *Nnion*)

5.4.1.2 void [smooth](#) (fftw_real *** *ro_dum*, float *Radii*)

5.5 ionz_main.c File Reference

Main program.

```
#include "ion.h"
```

Functions

- void [pack_3d_array_mpi_transfer](#) (fftw_real ****input*, float **output*, int *N1*, int *N2*, int *N3*)
- void [unpack_3d_array_mpi_transfer](#) (float **input*, fftw_real ****output*, int *n1*, int *n2*, int *n3*)
- void [pack_4d_array_mpi_transfer](#) (fftw_real *****input*, float **output*, int *n_nion*, int *n1*, int *n2*, int *n3*)
- void [unpack_4d_array_mpi_transfer](#) (float **input*, fftw_real *****output*, int *n_nion*, int *n1*, int *n2*, int *n3*)
- void [read_density](#) (char **filename*, float **buffer_3d*, double **robar_p*, int *N1*, int *N2*, int *N3*, float *vomegam*, float *vomegab*)
- void [read_sources](#) (char **filename*, float **buffer_3d*, double **robarhalo_p*, int *N1*, int *N2*, int *N3*)
- [main](#) (int *argc*, char ***argv*)

5.5.1 Detailed Description

Main program.

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Date

Sat Oct 11 21:01:59 2014

5.5.2 Function Documentation

5.5.2.1 [main](#) (int *argc*, char ** *argv*)

5.5.2.2 void [pack_3d_array_mpi_transfer](#) (fftw_real *** *input*, float * *output*, int *N1*, int *N2*, int *N3*)

Convert 3D array of fftw_real to 1D float array. This is used to simplify MPI transfer process.

Parameters

<i>input</i>	3D fftw_real array input.
<i>output</i>	1D float array output.
<i>N1</i>	1st dimension grid number.
<i>N2</i>	2nd dimension grid number.
<i>N3</i>	3rd dimension grid number.

5.5.2.3 void pack_4d_array_mpi_transfer (fftw_real **** *input*, float * *output*, int *n_nion*, int *n1*, int *n2*, int *n3*)

5.5.2.4 void read_density (char * *filename*, float * *buffer_3d*, double * *robar_p*, int *N1*, int *N2*, int *N3*, float *vomegam*, float *vomegab*)

5.5.2.5 void read_sources (char * *filename*, float * *buffer_3d*, double * *robarhalo_p*, int *N1*, int *N2*, int *N3*)

5.5.2.6 void unpack_3d_array_mpi_transfer (float * *input*, fftw_real *** *output*, int *n1*, int *n2*, int *n3*)

5.5.2.7 void unpack_4d_array_mpi_transfer (float * *input*, fftw_real **** *output*, int *n_nion*, int *n1*, int *n2*, int *n3*)

5.6 ionz_misc.c File Reference

```
#include "ion.h"
```

Functions

- double [Get_Current_time](#) ()
- int [make_radii_list](#) (float **radii_p*, float *r_min*, float *r_max*, float *dt*)

5.6.1 Function Documentation

5.6.1.1 double [Get_Current_time](#) ()

5.6.1.2 int [make_radii_list](#) (float * *radii_p*, float *r_min*, float *r_max*, float *dt*)

5.7 ionz_mpi.c File Reference

```
#include "ionz_mpi.h"
```

Variables

- int [ThisTask](#)
- int [NTask](#)

5.7.1 Variable Documentation

5.7.1.1 int [NTask](#)

5.7.1.2 int [ThisTask](#)

5.8 ionz_mpi.h File Reference

```
#include <mpi.h>
```

Variables

- int [NTask](#)
- int [ThisTask](#)

5.8.1 Variable Documentation

5.8.1.1 int [NTask](#)

5.8.1.2 int [ThisTask](#)

5.9 read_param.c File Reference

```
#include "ion.h"
```

Functions

- void [read_params](#) (char filename[2048])

Variables

- struct [params](#) [input_param](#)

5.9.1 Function Documentation

5.9.1.1 void [read_params](#) (char *filename*[2048])

5.9.2 Variable Documentation

5.9.2.1 struct [params](#) [input_param](#)

5.10 README.md File Reference

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