

## Semi-numerical Reionization

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# Chapter 1

## 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](#)

## 4.3 read\_param Class Reference

### Data Fields

- int [Nnion](#)
- int \* [nion](#)
- float [a\\_expansion](#)
- float [omegam](#)
- float [omegalam](#)
- float [omegab](#)

### 4.3.1 Field Documentation

4.3.1.1 float [a\\_expansion](#)

4.3.1.2 int\* [nion](#)

4.3.1.3 int [Nnion](#)

4.3.1.4 float [omegab](#)

4.3.1.5 float [omegalam](#)

4.3.1.6 float [omegam](#)

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

- [read\\_param.cpp](#)



## 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.

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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

```
#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 Macro Definition Documentation

#### 5.3.1.1 #define ION\_H\_

### 5.3.2 Function Documentation

#### 5.3.2.1 fftw\_real\*\*\* allocate\_fftw\_real\_3d ( int *N1*, int *N2*, int *N3* )

#### 5.3.2.2 float\*\* allocate\_float\_2d ( long *N1*, int *N2* )

#### 5.3.2.3 double Get\_Current\_time ( )

#### 5.3.2.4 int make\_radii\_list ( float \* *radii\_p*, float *r\_min*, float *r\_max* )

#### 5.3.2.5 void read\_param ( char *filename*[2048] )

#### 5.3.2.6 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* )

#### 5.3.2.7 void Setting\_Up\_Memory\_For\_ionz ( int *Nnion* )

#### 5.3.2.8 void smooth ( fftw\_real \*\*\* *ro\_dum*, float *Radii* )

### 5.3.3 Variable Documentation

#### 5.3.3.1 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

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

## Macros

- `#define min(x, y) ((x)<(y) ?(x):(y))`
- `#define max(x, y) ((x)>(y) ?(x):(y))`

## Functions

- 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 [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 Macro Definition Documentation

5.5.1.1 `#define max( x, y ) ((x)>(y) ?(x):(y))`

5.5.1.2 `#define min( x, y ) ((x)<(y) ?(x):(y))`

### 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 )`

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 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 )`

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

5.5.2.8 `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 read\_param.cpp File Reference

```
#include "read_param.h"
```

### Data Structures

- class [read\\_param](#)

### Functions

- class [read\\_param](#) [read\\_params](#) (char filename[2048])

### Variables

- int [Nnion](#)
- int \* [nion](#)
- float [a\\_expansion](#)
- float [omegam](#)
- float [omegalam](#)
- float [omegab](#)

### 5.10.1 Function Documentation

5.10.1.1 class read\_param read\_params ( char filename[2048] )

### 5.10.2 Variable Documentation

5.10.2.1 float a\_expansion

5.10.2.2 int\* nion

5.10.2.3 int Nnion

5.10.2.4 float omegab

5.10.2.5 float omegalam

5.10.2.6 float omegam

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