

APC\_524

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# Contents



# Chapter 1

## Hierarchical Index

### 1.1 Class Hierarchy

This inheritance list is sorted roughly, but not completely, alphabetically:

Domain . . . . .	??
Field_part . . . . .	??
Grid . . . . .	??
Input_Info_t . . . . .	??
Interpolator . . . . .	??
Particle . . . . .	??
Particle_Compare . . . . .	??
Particle_Field_List . . . . .	??
Pusher . . . . .	??
Boris . . . . .	??



## Chapter 2

# Class Index

### 2.1 Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

<a href="#">Boris</a>	.....	??
<a href="#">Domain</a>	.....	??
<a href="#">Field_part</a>	.....	??
<a href="#">Grid</a>	.....	??
	Class representing grid on which E and B fields and currents are defined	??
<a href="#">Input_Info_t</a>	.....	??
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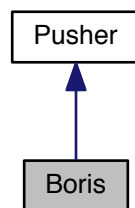


## Chapter 3

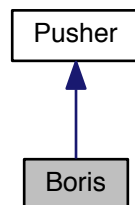
# Class Documentation

### 3.1 Boris Class Reference

Inheritance diagram for Boris:



Collaboration diagram for Boris:



### Public Member Functions

- int **Step** ([Particle](#) \*part, [Field\\_part](#) \*field, double dt)

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

- src/pusher/boris.hpp
- src/pusher/boris.cpp

## 3.2 Domain Class Reference

### Public Member Functions

- **Domain** (int size, int rank, [Input\\_Info\\_t](#) \*input\_info)
- int **getnGhosts** (void)
- int \* **getnxyz** (void)
- double \* **getxyz0** (void)
- double \* **getLxyz** (void)

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

- src/domain/domain.hpp
- src/domain/domain.cpp

## 3.3 Field\_part Struct Reference

### Public Attributes

- double **e1**
- double **e2**
- double **e3**
- double **b1**
- double **b2**
- double **b3**

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

- src/particles/particle.hpp

## 3.4 Grid Class Reference

Class representing grid on which E and B fields and currents are defined.

```
#include <grid.hpp>
```

## Public Member Functions

- **Grid** (int \*nxyz, int nGhosts, double \*xyz0, double \*Lxyz)
- int **evolveFields** (double dt)  
*Evolve Electric and Magnetic fields in time.*
- int **getFieldInterpolatorVec** (int cellID, double \*InterpolatorVec)  
*Return vector for field interpolation.*
- int **getCellID** (double x, double y, double z)  
*Get cell ID based on particle position.*
- int **getNumberOfCells** ()  
*Get total number of cells.*
- double **getStepSize** (int dimension)  
*Get number of cells along dimension in grid.*
- void **updateGhostCells** ()
- int **getGhostVecSize** ()
- void **getGhostVec** (const int side, double \*ghostVec)
- void **getGhostVecAlt** (const int side, double \*ghostVec)
- void **setGhostVec** (const int side, const double \*ghostVec)
- void **setGhostVecAlt** (const int side, const double \*ghostVec)

## Protected Member Functions

- double \*\*\* **newField\_** ()
- void **deleteField\_** (double \*\*\*fieldPt)
- int **sideToIndex\_** (const int side)
- void **checkInput\_** ()
- void **sliceMatToVec\_** (double \*\*\*const mat, const int side)
- void **unsliceMatToVec\_** (double \*\*\*mat, const int side)

## Protected Attributes

- const int **nx\_**
- const int **ny\_**
- const int **nz\_**
- const int **nGhosts\_**
- const double **x0\_**
- const double **y0\_**
- const double **z0\_**
- const double **Lx\_**
- const double **Ly\_**
- const double **Lz\_**
- const int **iBeg\_**
- const int **jBeg\_**
- const int **kBeg\_**
- const int **iEnd\_**
- const int **jEnd\_**
- const int **kEnd\_**
- const double **dx\_**
- const double **dy\_**
- const double **dz\_**
- const double **idx\_**
- const double **idy\_**

- const double **idz\_**
- const int **nRealPtsYZPlane\_**
- const int **nFields\_**
- const int **ghostVecSize\_**
- double \*\*\* **Ex\_**
- double \*\*\* **Ey\_**
- double \*\*\* **Ez\_**
- double \*\*\* **Bx\_**
- double \*\*\* **By\_**
- double \*\*\* **Bz\_**
- double \*\*\* **Bx\_tm1\_**
- double \*\*\* **By\_tm1\_**
- double \*\*\* **Bz\_tm1\_**
- double \*\*\* **Jx\_**
- double \*\*\* **Jy\_**
- double \*\*\* **Jz\_**
- double \* **sliceTmp\_**

### 3.4.1 Detailed Description

Class representing grid on which E and B fields and currents are defined.

[Grid](#) has ghost cells on each face. The ghost cell updating in y and z arises from periodic boundary conditions. x-direction ghost cells allow communication between MPI domains.

Following Yee (1966), electric fields and currents reside on edges, and magnetic fields on faces. Fields are updated using a set of finite-difference equations approximating Ampere's and Faraday's Laws.

A set of getters are available to allow particles to interpolate electric fields based on their position.

### 3.4.2 Member Function Documentation

#### 3.4.2.1 evolveFields()

```
int Grid::evolveFields (
    double dt )
```

Evolve Electric and Magnetic fields in time.

Uses Yee algorithm to advance E and B fields.

#### 3.4.2.2 getCellID()

```
int Grid::getCellID (
    double x,
    double y,
    double z )
```

Get cell ID based on particle position.

Cell ID is uniquely given by  $(ny\_nz\_)*ix + nz\_iy + iz$ . Returns -1 if particle is not on grid.

## 3.4.2.3 getFieldInterpolatorVec()

```
int Grid::getFieldInterpolatorVec (
    int cellID,
    double * InterpolatorVec )
```

Return vector for field interpolation.

Based on cellID, return relevant edge E and face B fields and cell origin, in format [x, y, z, ... Ex( ix, iy, iz ), Ex( ix, iy+1, iz ), Ex( ix, iy+1, iz+1 ), Ex( ix, iy, iz+1 ), ... Ey( ix, iy, iz ), Ey( ix, iy, iz+1 ), Ey( ix+1, iy, iz+1 ), Ey( ix+1, iy, iz ), ... Ez( ix, iy, iz ), Ez( ix+1, iy, iz ), Ez( ix+1, iy+1, iz ), Ez( ix, iy+1, iz ), ... Bx( ix, iy, iz ), Bx( ix+1, iy, iz ), ... By( ix, iy, iz ), By( ix, iy+1, iz ), ... Bz( ix, iy, iz ), Bz( ix, iy, iz+1 ), ...] where ix, iy, and iz are the row indices for each of the three dimensions (calculated from the cellID)

## 3.4.2.4 getStepSize()

```
double Grid::getStepSize (
    int dimension )
```

Get number of cells along dimension in grid.

Returns number of cells along dimension according to; dimension = 0: x dimension = 1: y dimension = 2: z Returns -1 if invalid dimension.

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

- src/grid/grid.hpp
- src/grid/grid.cpp
- src/grid/oGrid.cpp
- src/grid/spookyGrid.cpp

## 3.5 Input\_Info\_t Struct Reference

## Public Attributes

- int **nx**
- long **np**
- int **nt**
- int **restart**
- double **dens**
- double **temp**

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

- src/IO/IO.hpp

## 3.6 Interpolator Class Reference

### Public Member Functions

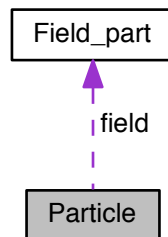
- void **interpolate\_fields** (double \*pos, double \*lcell, double \*cellvars, [Field\\_part](#) \*field)

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

- src/particles/interpolate.hpp
- src/particles/interpolate.cpp

## 3.7 Particle Struct Reference

Collaboration diagram for Particle:



### Public Attributes

- double **x1**
- double **x2**
- double **x3**
- double **v1**
- double **v2**
- double **v3**
- double **q**
- double **m**
- int **my\_id**
- short **isGhost**
- [Field\\_part](#) \* **field**

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

- src/particles/particle.hpp

## 3.8 Particle\_Compare Class Reference

### Public Member Functions

- **Particle\_Compare** ([Grid](#) \*grid)
- bool **operator()** ([Particle](#) const \*a, [Particle](#) const \*b) const

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

- src/particles/particle\_utils.hpp

## 3.9 Particle\_Field\_List Class Reference

### Public Member Functions

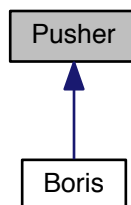
- **Particle\_Field\_List** (long np)
- void **Load** ()
- void **Push** (double dt)
- void **Pass** ()
- long **nParticles** ()
- void **SortParticles** ([Particle\\_Compare](#) comp)
- void **setPusher** ([Pusher](#) \*pusher)
- void **InterpolateEB** ([Grid](#) \*grid)

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

- src/particles/particle\_list.hpp
- src/particles/particle\_list.cpp

## 3.10 Pusher Class Reference

Inheritance diagram for Pusher:



### Public Member Functions

- virtual int **Step** ([Particle](#) \*part, [Field\\_part](#) \*field, double dt)=0

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

- src/pusher/pusher.hpp

