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# 1 rl\_RayLib User's Guide

## 1.1 Copyright and License

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## 1.2 Purpose

The rl\_RaySupLib library consists of a set of C++ classes for manipulating rays, including the effects of multilayer reflectivity.

### 1.2.1 classes.

The rl\_RaySupLib library includes a number of classes providing i/o support for rl\_RayLib: reading initialization information from rdb database tables. These include:

- [rl\\_DielectricPOD\\_rdb](#) handles initializing rl\_DielectricPOD from rdb tables. The rdb table contains a list of energies and the corresponding complex dielectric decrements.
- [rl\\_Multilayer\\_rdb](#) handles initializing an rl\_Multilayer from an rdb table. The rdb table provides the information on each layer (name, thickness, roughness type) and the name of an rdb file specifying the dielectric decrement information.

## 2 Basic Interface

### 2.1 A Basic Ray Class

The `rl_RayLib` library includes a class encapsulating a basic ray consisting of position and direction information, ray energy, and a ray id number.

The ray is nominally defined in a standard coordinate system (STD) which serves as a default global coordinate system. The ray can be transformed into a local “body-centered” coordinate system (BCS) (e.g., attached to a piece of hardware such as a mirror).

In transforming from the STD system to the BCS system, the ray is first translated by the difference between the BCS origin and the STD origin, then transformed to the orientation of the BCS system relative to the STD system by rotation about the BCS origin.

To transform back to the STD system the operations are performed in reverse: first “derotate” the vector about the BCS origin to account for the different orientation, then “detranslate” the position by the difference between the BCS and STD origins.

Other operations on a basic ray include projection (moving the ray position by a given distance in the direction specified by the ray direction vector) and reflection of the ray direction vector about a surface normal provided by the user. In the reflection operation, it is assumed that the ray position is at the surface about which the reflection takes place.

## 3 Purpose

### 3.1 Purpose

The `rl_RayLib` library consists of a set of C++ classes for manipulating rays, including the effects of multilayer reflectivity.

#### 3.1.1 classes

The ray classes include:

- `rl_BasicRay`: a stripped-down ray consisting of position, direction, energy, and an id number.
- `rl_Ray`: adds ray polarization information to an `rl_BasicRay`. The rays can be translated/rotated from a standard coordinate system (STD) to a “body center system” (BCS), and de-rotated/de-translated from the BCS system back to the STD system. Given a surface normal, the ray direction can be reflected to a

new direction. This replicates much of the transformation functionality of the OSAC library. the intention is to eventually implement the rest of the OSAC functionality. The main missing component at this point is the evaluation of the distorted surface interception; most of the rest of the functionality (including [multilayer] reflectivity is in rl\_RayLib.

### 3.1.2 classes

The reflectivity classes include a number of components:

- `rl_DielectricData` encapsulates an array of energy bins providing the dielectric decrement information and methods to evaluate (interpolate) the decrements at a requested energy. The array is built on a helper “Plain Ol’ Data” (POD) struct `rl_DielectricPOD` which provides the dielectric decrement at a specific energy.
- `rl_DielectricLayer` encapsulates the information about the interaction of a photon with a single dielectric layer, including the layer thickness, dielectric decrements given the photon energy, the component of the photon wave vector perpendicular to the layer, and various reflection and transmission coefficients, and surface “roughness” information. The layer can be a “substrate” (in which case the layer is considered as semi-infinite), vacuum, or a dielectric layer. These are mediated by helper “Plain Ol’ Data” (POD) structs and classes: `rl_ReflectionCoefPOD`, `rl_TransmissionCoefPOD`, `rl_ReflectionCoefPOD`.
- `rl_Multilayer` encapsulates a stack of `rl_DielectricLayer`’s. Given the energy, sine of the graze angle, the multilayer reflectivity can be evaluated.
- `rl_MultilayerSurface` adds surface normal information to an `rl_Multilayer`. Given an `rl_Ray`, `rl_MultilayerSurface` can evaluate the reflectivity for the surface. This is also where hooks for surface interception and scattering could be placed.

### 3.1.3 classes.

The `rl_RaySupLib` library includes a number of classes providing i/o support: interfacing with the BPipe transport, and reading initialization information from rdb database tables. These include:

- `rl_BPipe` sets up and handles the BPipe transport
- [`rl\_DielectricPOD\_rdb`](#) handles initializing `rl_DielectricPOD` from rdb tables. The rdb table contains a list of energies and the corresponding complex dielectric decrements.
- `rl_Multilayer_rdb` handles initializing an `rl_Multilayer` from an rdb table. The rdb table provides the information on each layer (name, thickness, roughness type) and the name of an rdb file specifying the dielectric decrement information.

## 4 Directory Hierarchy

### 4.1 Directories

This directory hierarchy is sorted roughly, but not completely, alphabetically:

[rl\\_raysuplib](#) 4

## 5 Class Index

### 5.1 Class List

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

[rl\\_DielectricPOD\\_rdb](#) 5

[rl\\_Multilayer\\_rdb](#) 6

## 6 Directory Documentation

### 6.1 rl\_raysuplib/ Directory Reference

Directory dependency graph for rl\_raysuplib/:

```
graph TD; A[rl_raysuplib];
```

#### Files

- file [rl\\_DielectricPOD\\_rdb.cc](#)
- file [rl\\_DielectricPOD\\_rdb.h](#)
- file [rl\\_Multilayer\\_rdb.cc](#)

- file `rl_Multilayer_rdb.h`
- file `rl_RaySupLib.h`

## 7 Class Documentation

### 7.1 `rl_DielectricPOD_rdb` Class Reference

```
#include <rl_DielectricPOD_rdb.h>
```

#### Public Member Functions

- `~rl_DielectricPOD_rdb()`
- `rl_DielectricPOD_rdb(char const rdb_file[ ] = "")`
- void `init(char const rdb_file[ ])`

#### 7.1.1 Detailed Description

A class encapsulating reading of `rl_DielectricPOD` initialization data from an rdb table. The rdb table is assumed to have at least two data rows and 3 columns:

- energy (keV)
- alpha (real part of dielectric decrement)
- gamma (imaginary part of the dielectric decrement)

The complex dielectric constant has real part (1-alpha) and imaginary part (-gamma). Definition at line 58 of file `rl_DielectricPOD_rdb.h`.

#### 7.1.2 Constructor & Destructor Documentation

##### 7.1.2.1 `rl_DielectricPOD_rdb::~~rl_DielectricPOD_rdb()`

Destructor

Definition at line 68 of file `rl_DielectricPOD_rdb.cc`.

##### 7.1.2.2 `rl_DielectricPOD_rdb::rl_DielectricPOD_rdb(char const rdb_file[ ] = "")`

Constructor.

### Parameters

*rdb\_file* name of the /rdb file to be read (optional). If *rdb\_file* is a nonempty string, read in energy, alpha, and gamma from the specified /rdb table. The array is sorted on the energy field. If *rdb\_file* is an empty string, an empty uninitialized `rl_DielectricPOD` is created and the `init` method must be called to initialize the object.

Definition at line 72 of file `rl_DielectricPOD_rdb.cc`.

References `init()`.

### 7.1.3 Member Function Documentation

#### 7.1.3.1 void rl\_DielectricPOD\_rdb::init ( char const rdb\_file[] )

Initializer.

### Parameters

*rdb\_file* name of the /rdb file to be read. *rdb\_file* specifies the name of an /rdb table; energy, alpha, and gamma are read in from the specified /rdb table. The array is sorted on the energy field.

Definition at line 77 of file `rl_DielectricPOD_rdb.cc`.

Referenced by `rl_DielectricPOD_rdb()`.

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

- `rl_DielectricPOD_rdb.h`
- `rl_DielectricPOD_rdb.cc`

## 7.2 rl\_Multilayer\_rdb Class Reference

### Public Member Functions

- [~rl\\_Multilayer\\_rdb\(\)](#)
- [rl\\_Multilayer\\_rdb\(char const rdb\\_file\[\], rl\\_Traits::EInterpMode interp\\_mode\)](#)
- void [init\\_from\\_rdb\(char const rdb\\_file\[\], rl\\_Traits::EInterpMode interp\\_mode\)](#)

### 7.2.1 Detailed Description

Definition at line 74 of file `rl_Multilayer_rdb.h`.



### 7.2.2 Constructor & Destructor Documentation

#### 7.2.2.1 rl\_Multilayer\_rdb::~~rl\_Multilayer\_rdb ( )

Destructor.

Definition at line 60 of file rl\_Multilayer\_rdb.cc.

#### 7.2.2.2 rl\_Multilayer\_rdb::rl\_Multilayer\_rdb ( char const rdb\_file[], rl\_Traits::EInterpMode interp\_mode )

Constructor.

##### Parameters

*rdb\_file* name of the /rdb file to be read.

*interp\_mode* interpolation type for the optical constants.

If rdb\_file is a nonempty string, read in energy, alpha, and gamma from the specified /rdb table. The array is sorted on the energy field. If rdb\_file is an empty string, init\_from\_rdb must be called to initialize the object.

The interp\_mode argument specifies the form of energy/optical constant interpolation (see rl\_Traits in rl\_raylib).

Definition at line 67 of file rl\_Multilayer\_rdb.cc.

References init\_from\_rdb().

### 7.2.3 Member Function Documentation

#### 7.2.3.1 void rl\_Multilayer\_rdb::init\_from\_rdb ( char const rdb\_file[], rl\_Traits::EInterpMode interp\_mode )

Initializer.

##### Parameters

*rdb\_file* name of the /rdb file to be read.

*interp\_mode* interpolation type for the optical constants.

rdb\_file specifies the name of an /rdb table; energy, alpha, and gamma are read in from the specified /rdb table. The array is sorted on the energy field.

The interp\_mode argument specifies the form of energy/optical constant interpolation (see rl\_Traits in rl\_raylib).

Referenced by rl\_Multilayer\_rdb().

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

- rl\_Multilayer\_rdb.h
- rl\_Multilayer\_rdb.cc

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