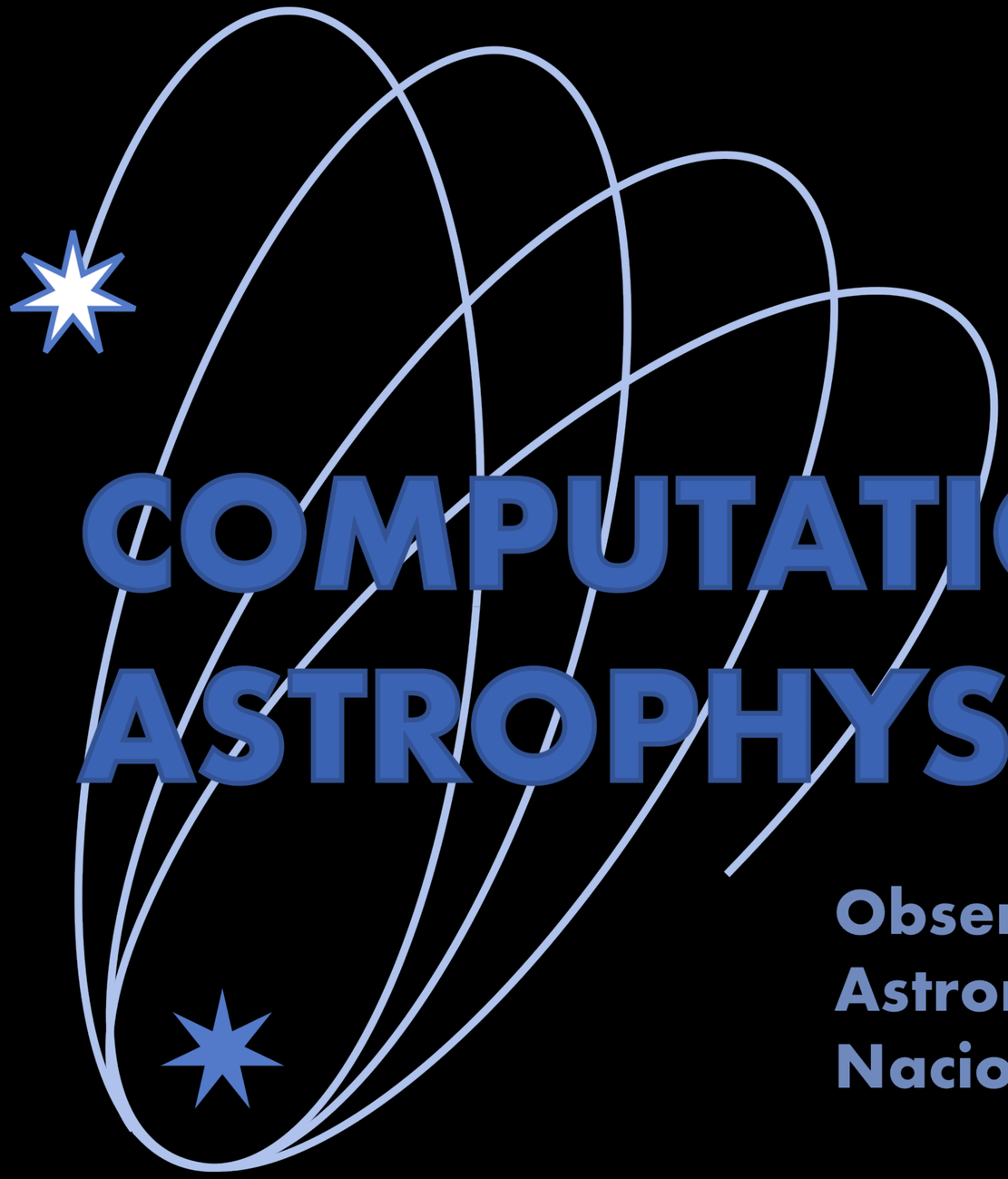
ASTRONÓMICO

NACIONAL DE COLOMBIA



COMPUTATIONAL ASTROPHYSICS

Observatorio
Astronómico
Nacional

Extended Seminar
“A code to generate the image of a black hole”

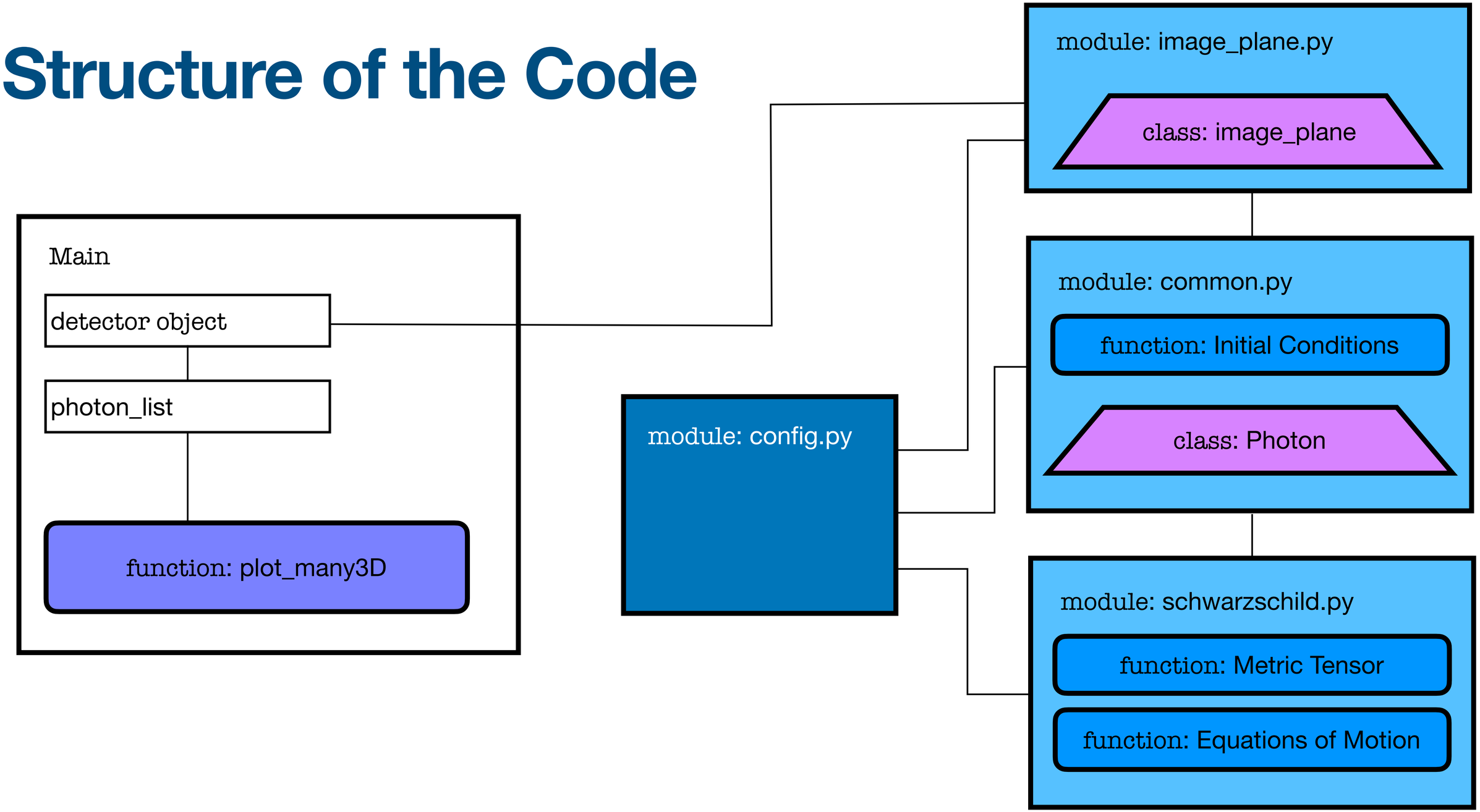
Eduard Larrañaga
Observatorio Astronómico Nacional

Session 03

Imaging a Static Black Hole

The Code [ver:0.3]

Structure of the Code



The Photon class

Attributes:

photon.alpha photon.beta

photon.xin photon.kin

photon.iC

Methods:

photon.initial_conditions()

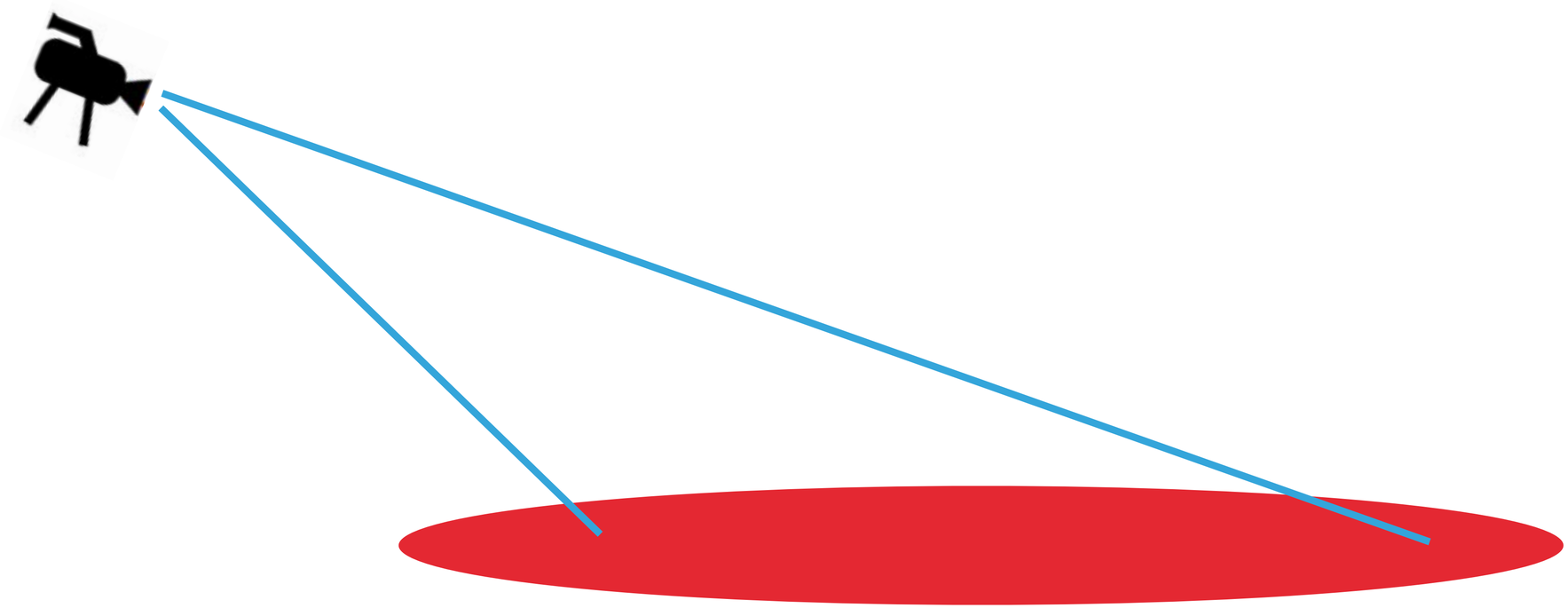
The image_plane class

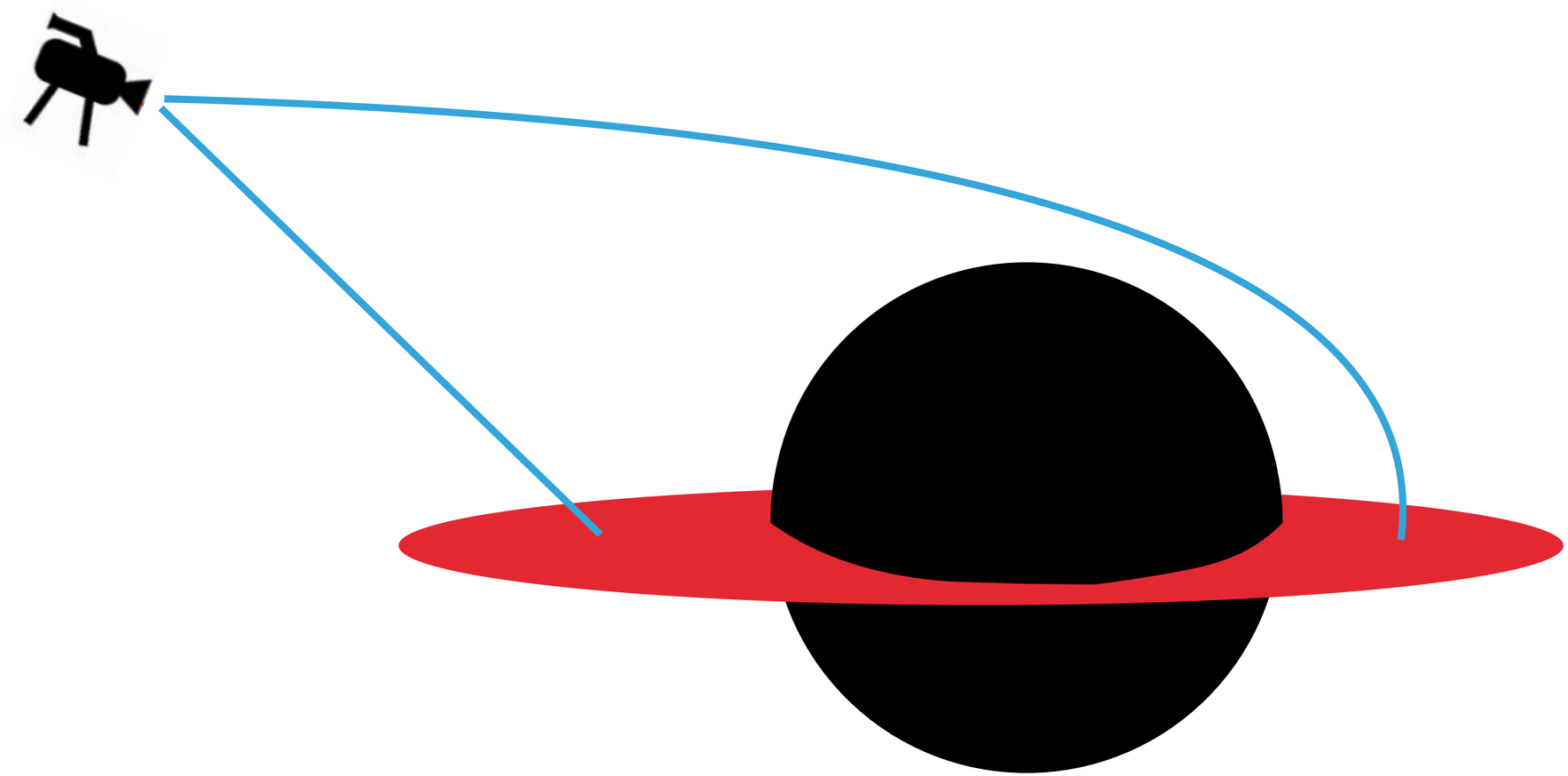
Attributes:

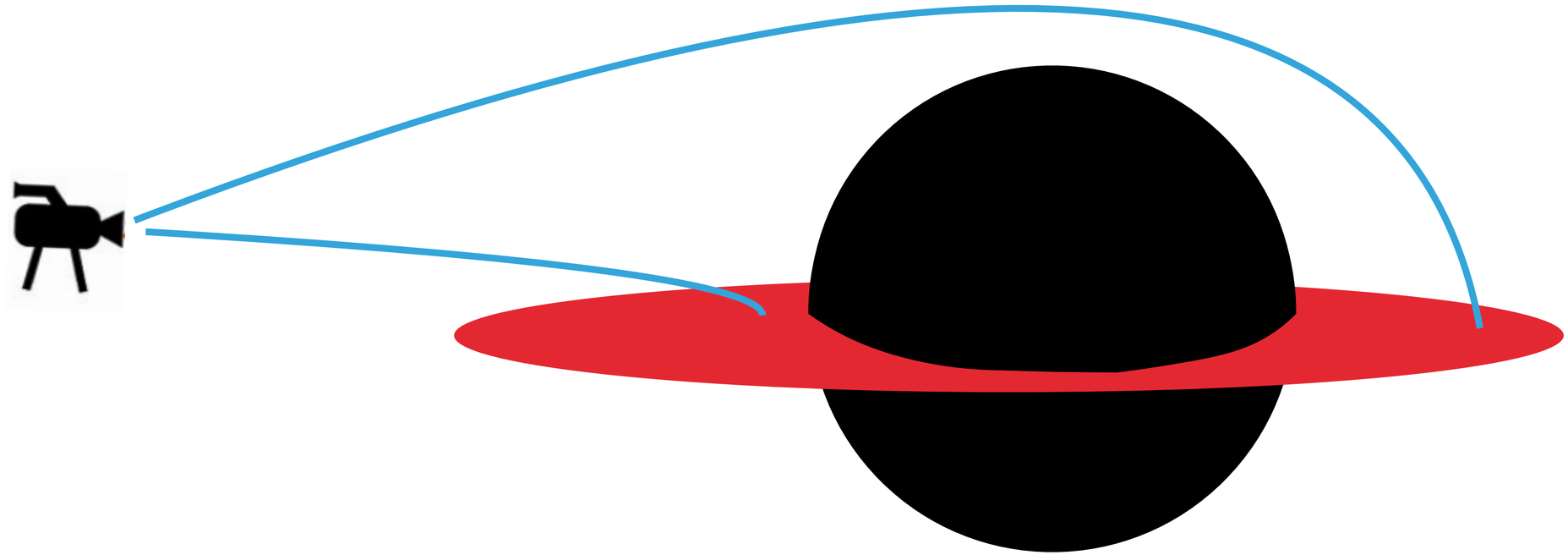
image_plane.D
image_plane.iota
image_plane.numPixels

Methods:

image_plane.photon_coords(alpha,beta,freq)
image_plane.create_photons()

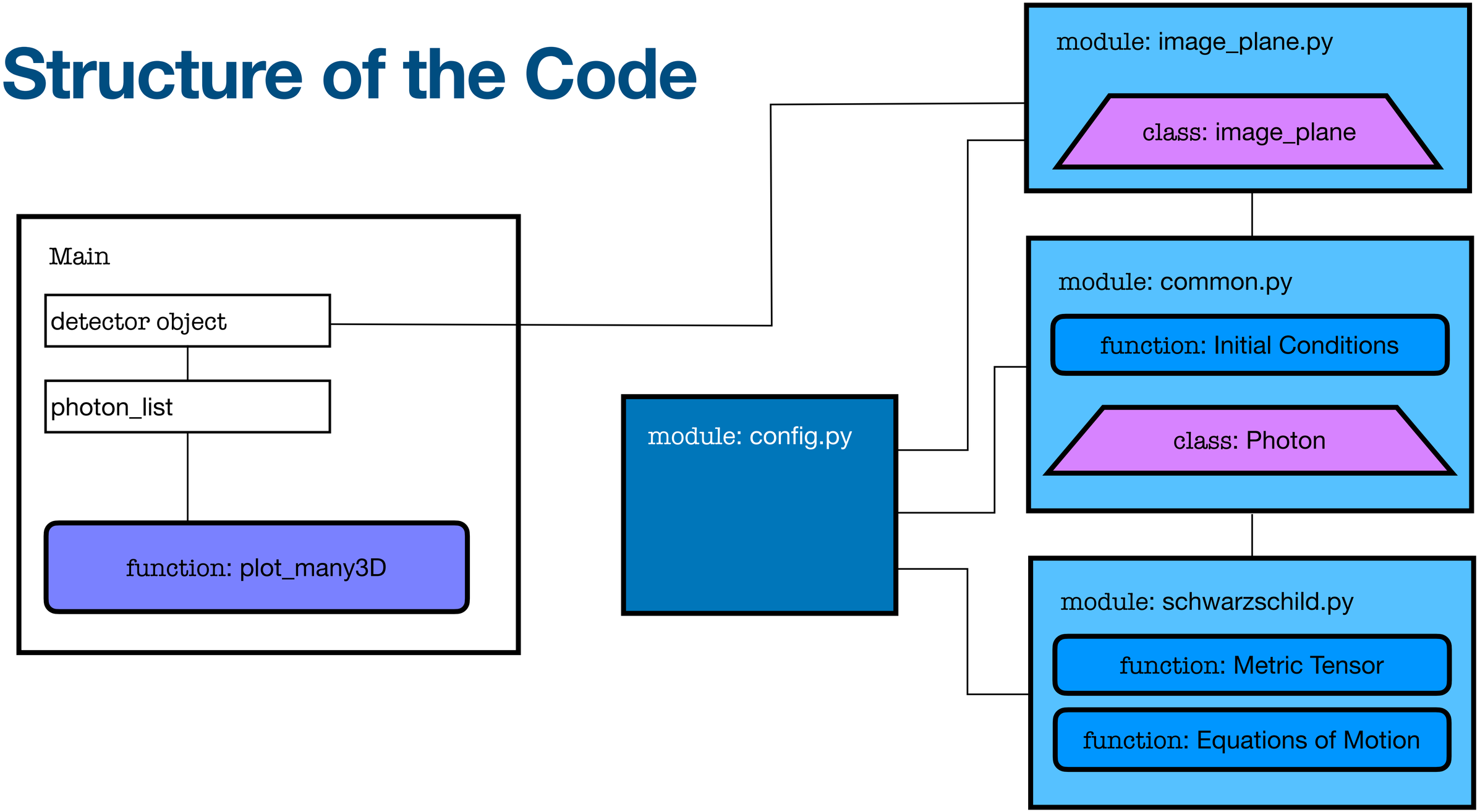






The Code [ver:0.4]

Structure of the Code



The Photon class

Attributes:

photon.alpha photon.beta

photon.xin photon.kin

photon.iC

photon.fP

Methods:

photon.initial_conditions()

The image_plane class

Attributes:

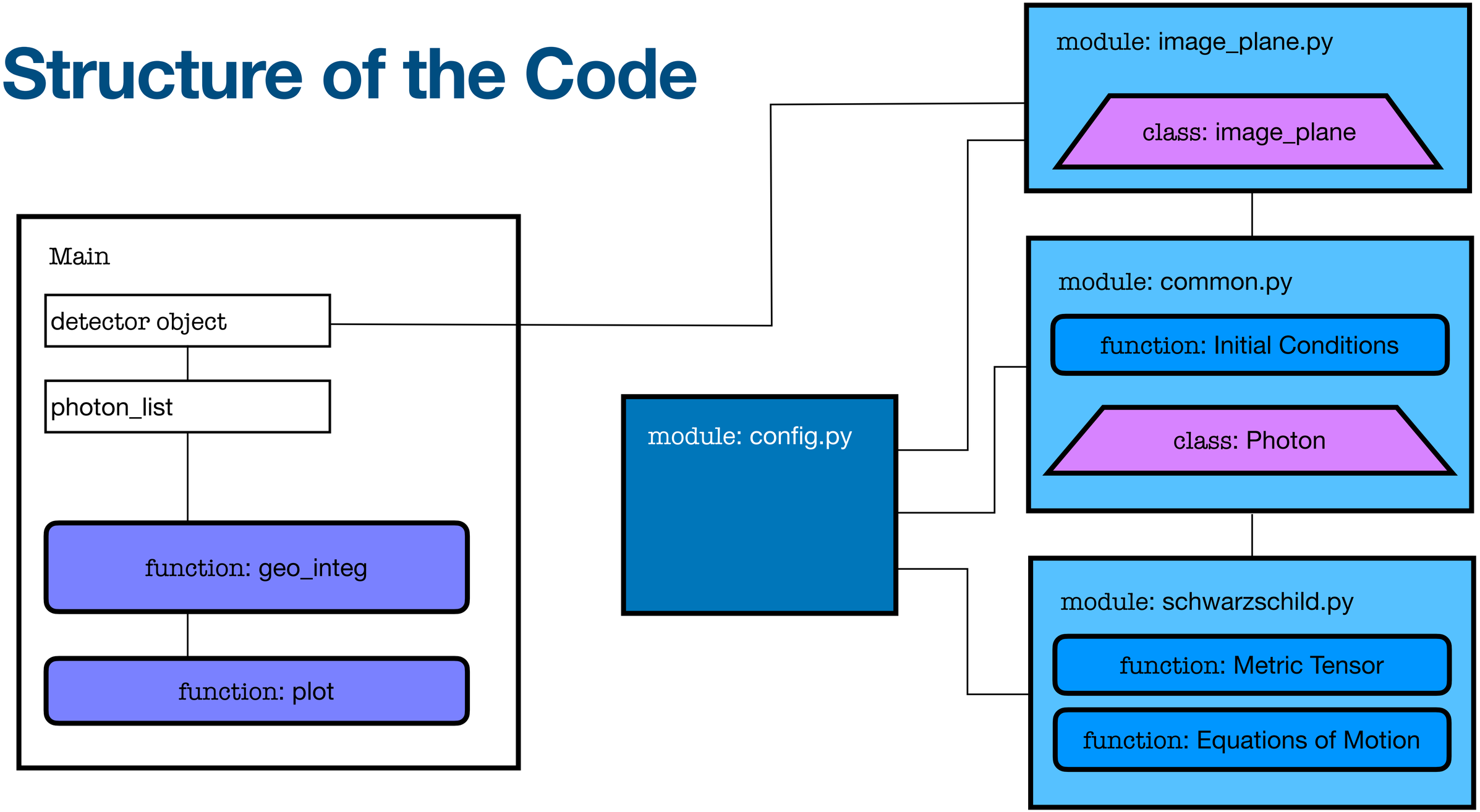
image_plane.D
image_plane.iota
image_plane.numPixels

Methods:

image_plane.photon_coords(alpha,beta,freq)
image_plane.create_photons()

The Code [ver:0.5]

Structure of the Code



The Photon class

Attributes:

photon.alpha photon.beta
photon.xin photon.kin
photon.iC
photon.fP

Methods:

photon.initial_conditions()

The image_plane class

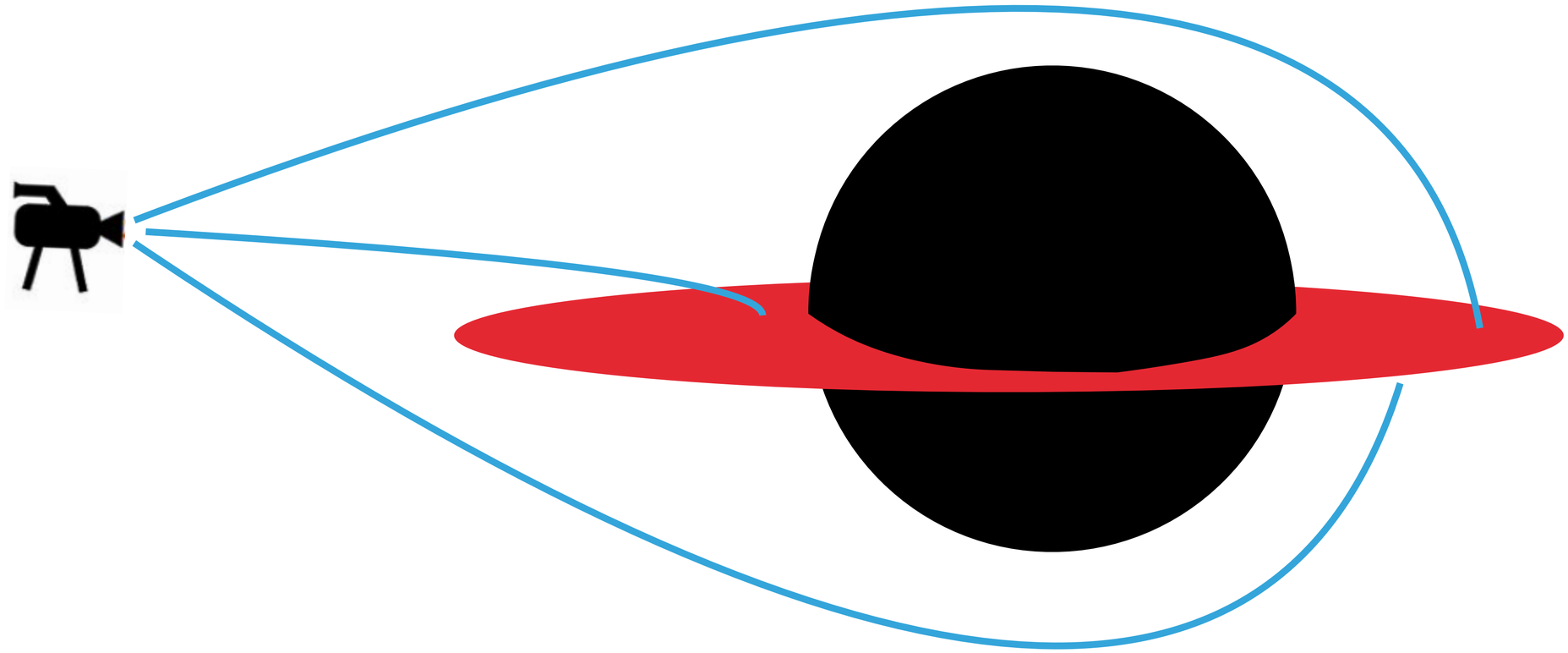
Attributes:

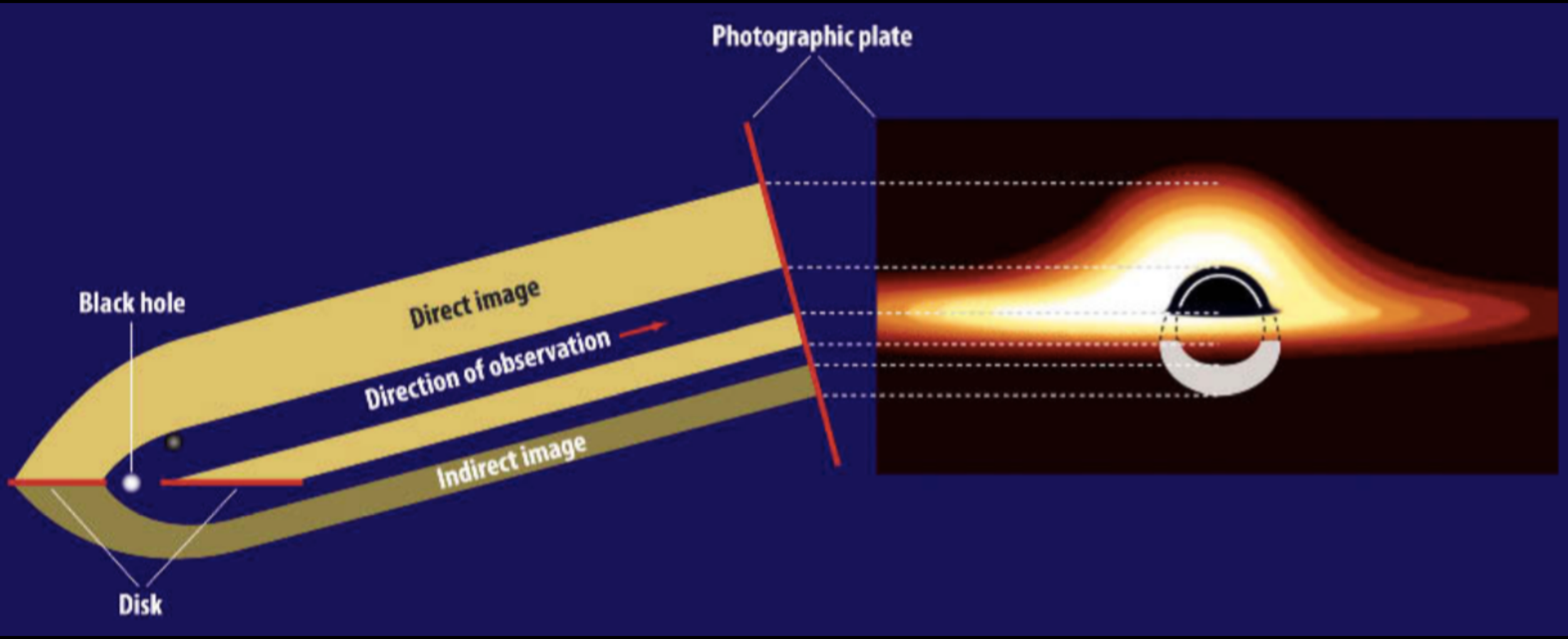
image_plane.D
image_plane.iota
image_plane.numPixels

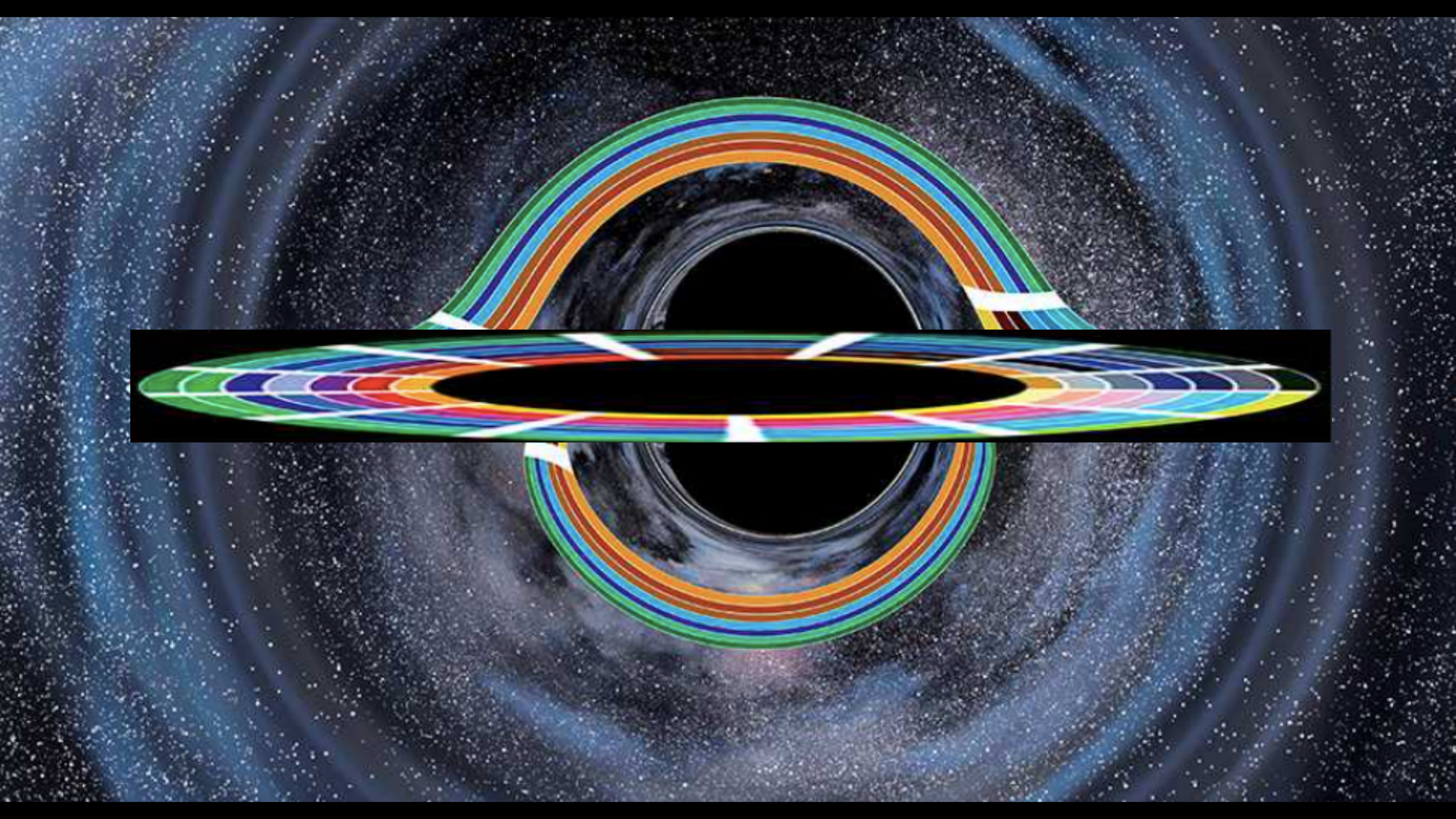
Methods:

image_plane.photon_coords(alpha,beta,freq)
image_plane.create_photons()

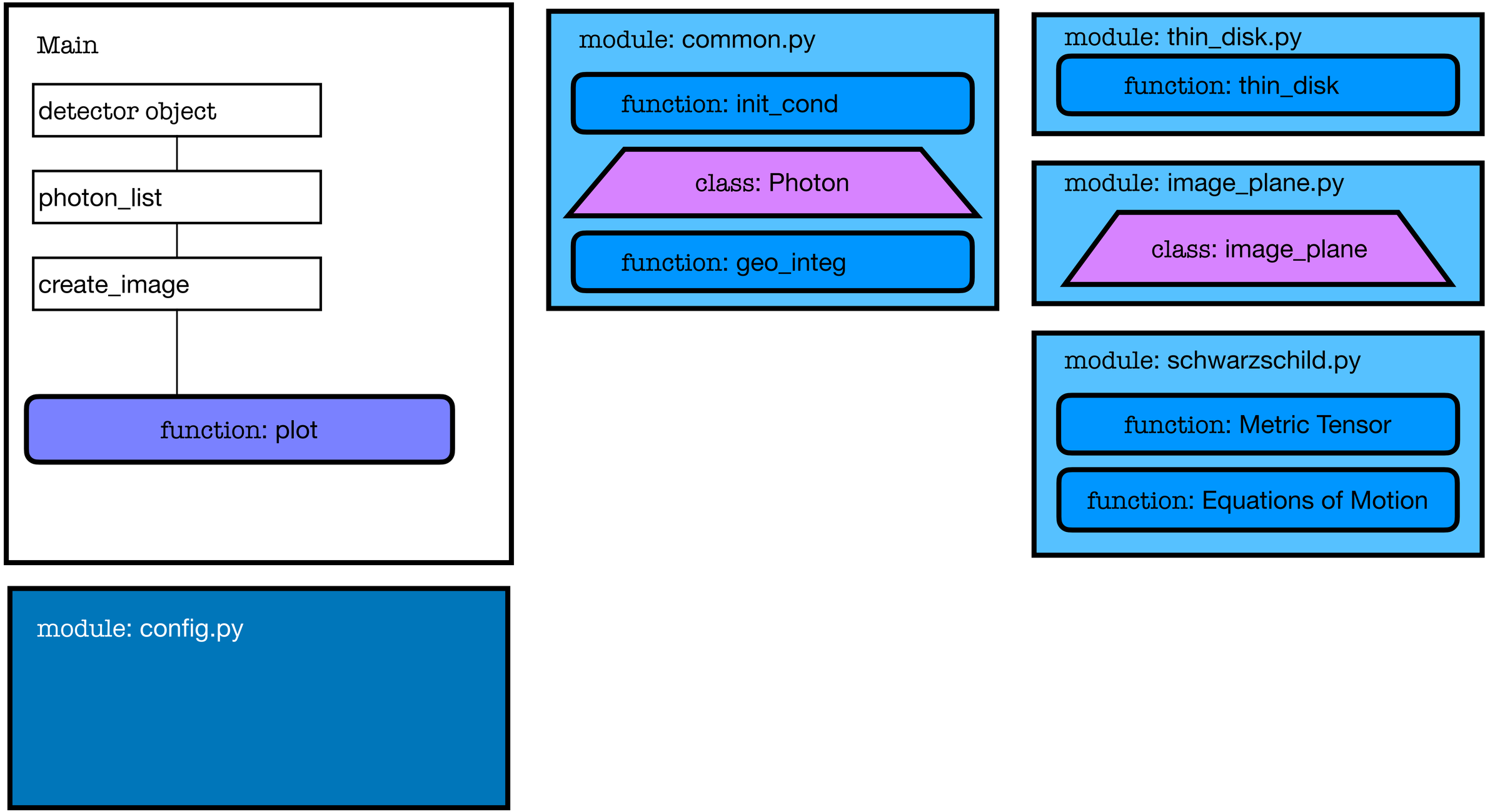
image_plane.create_image()

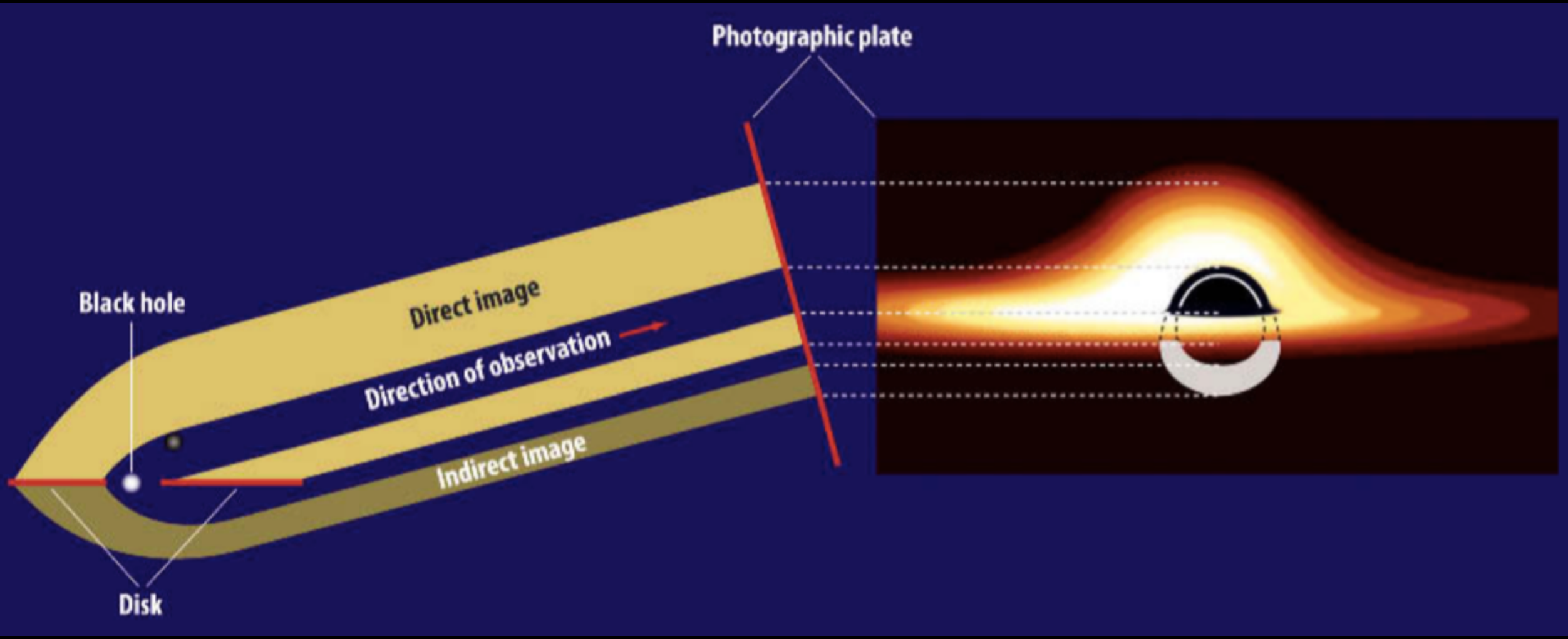



Photographic plate
Black hole
Direct image
Direction of observation
Indirect image
Disk

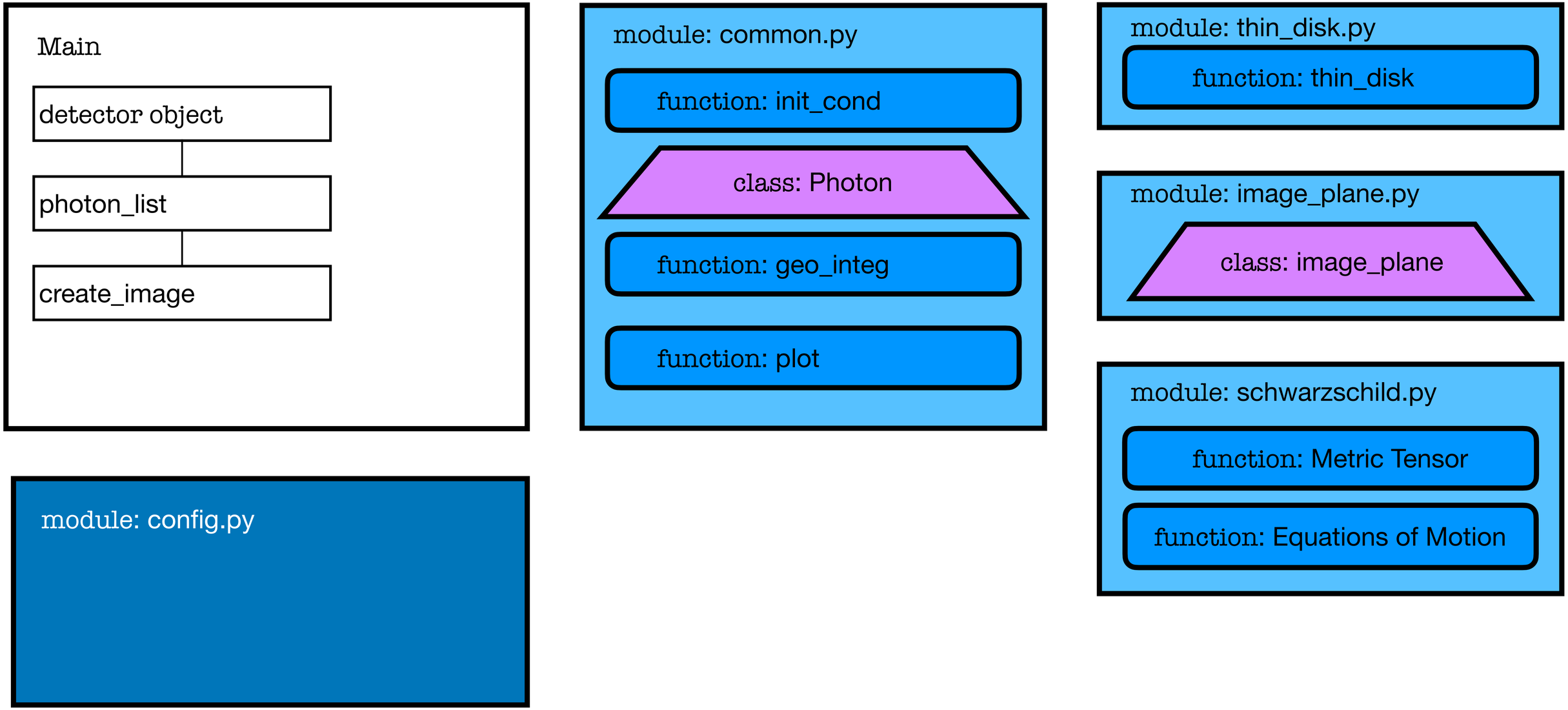


The Code [ver:0.6]


Main
detector object
photon_list
create_image
function: plot
module: common.py
function: init_cond
class: Photon
function: geo_integ
module: thin_disk.py
function: thin_disk
module: image_plane.py
class: image_plane
module: schwarzschild.py
function: Metric Tensor
function: Equations of Motion
module: config.py


Photographic plate
Black hole
Direct image
Direction of observation
Indirect image
Disk

The Code [ver:1.0]


Main
detector object
photon_list
create_image
module: common.py
function: init_cond
class: Photon
function: geo_integ
function: plot
module: thin_disk.py
function: thin_disk
module: image_plane.py
class: image_plane
module: schwarzschild.py
function: Metric Tensor
function: Equations of Motion
module: config.py

Perspectives

- To obtain the lower part of the image of the black hole
- To introduce a more realistic accretion structure model (including a realistic energy spectrum, the Doppler effect due to rotation, the gravitation redshift, etc.)
- To incorporate other static background spacetimes
- To introduce rotating black holes (needs modifications of some of the common functions)
- To optimize the integration process (e.g. using parallelization)

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