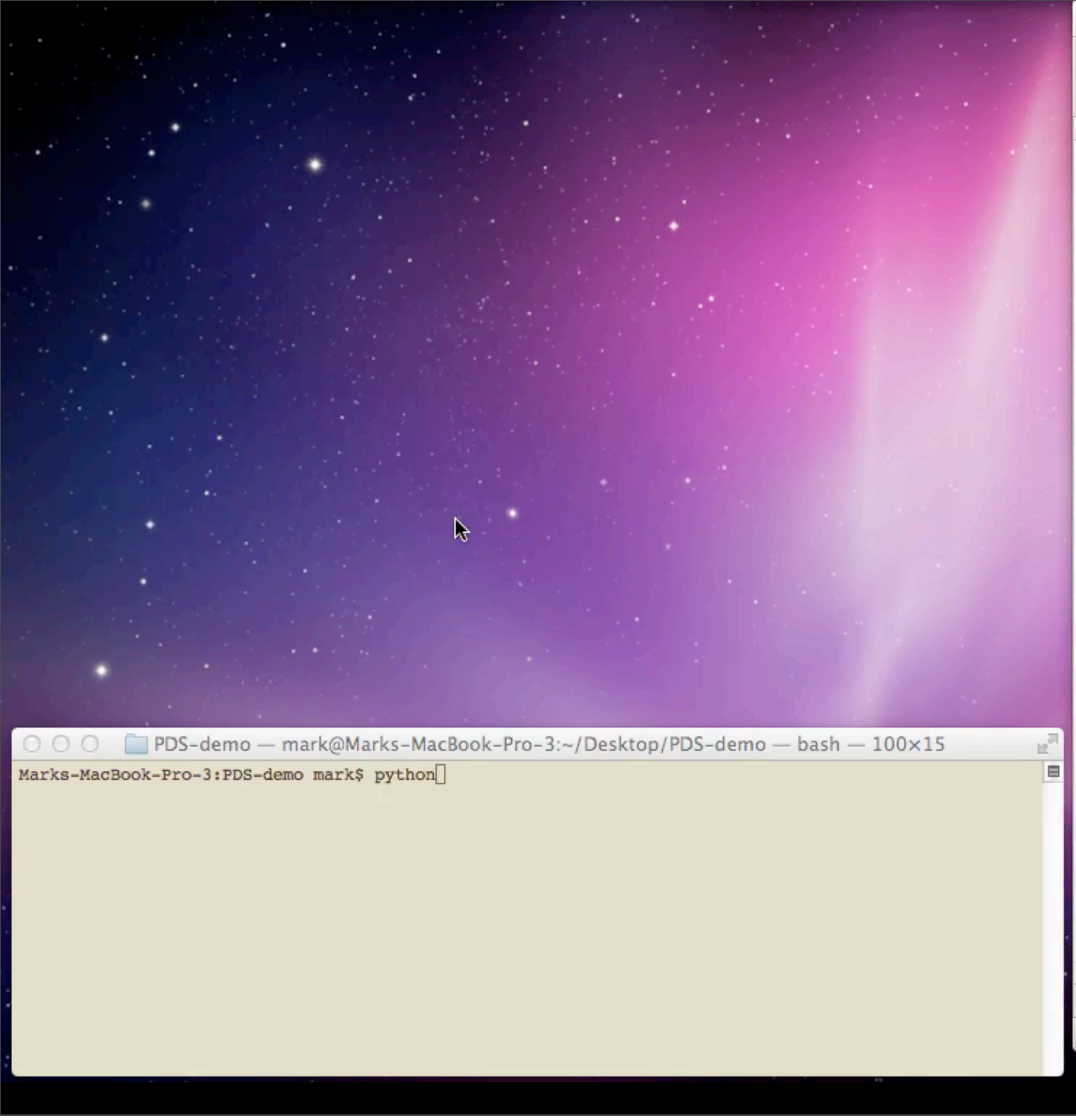
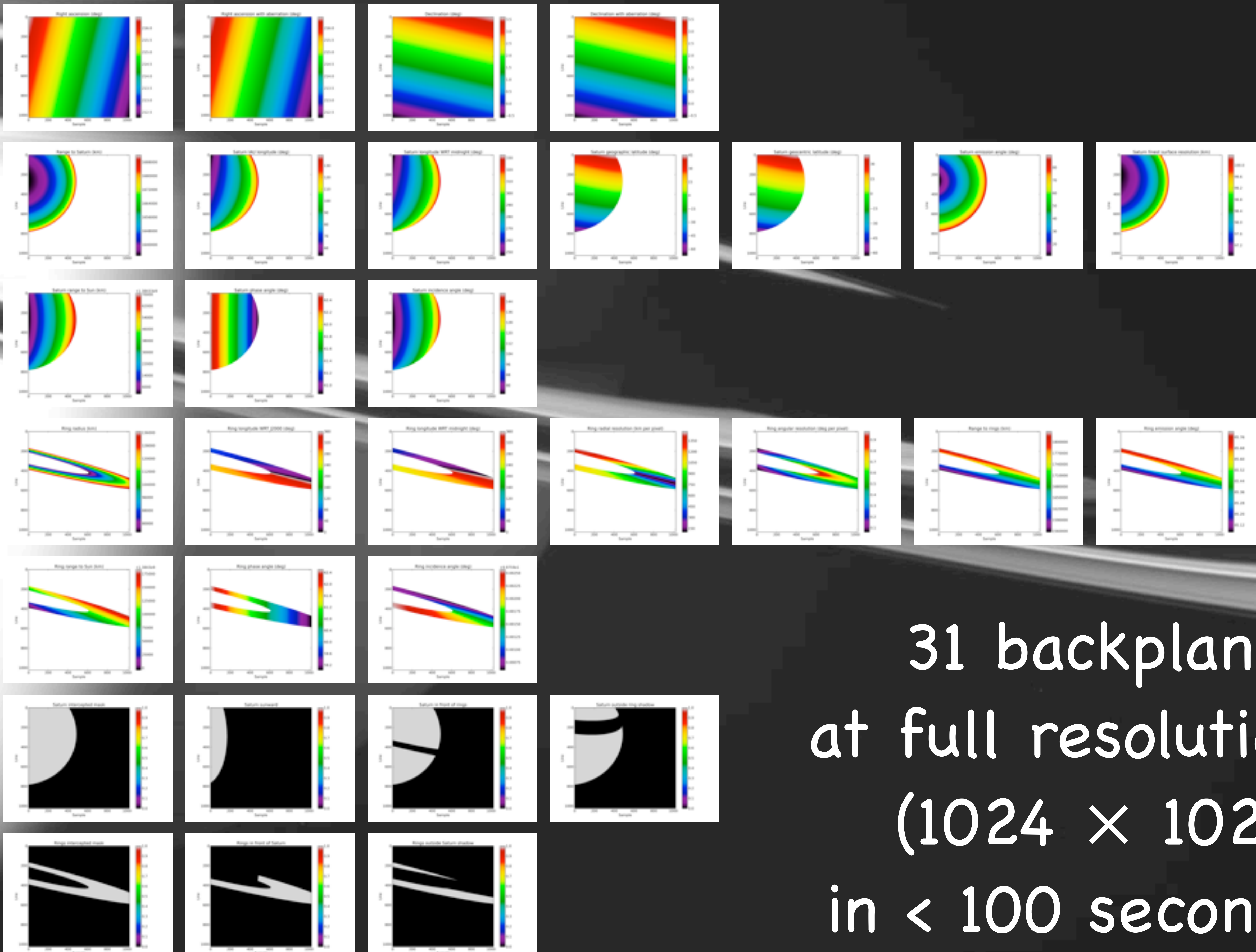

PDS-demo
Back
View
Arrange
Name
script.py
W1573721822_1_full.jpg
W1573721822_1.IMG
PDS-demo — mark@Marks-MacBook-Pro-3:~/Desktop/PDS-demo — bash — 100×15
Marks-MacBook-Pro-3:PDS-demo mark$ python
MBP SSD
Users
mark
Desktop
3 items, 28.77 GB availa


Introducing
"Object-Oriented
Python & SPICE"

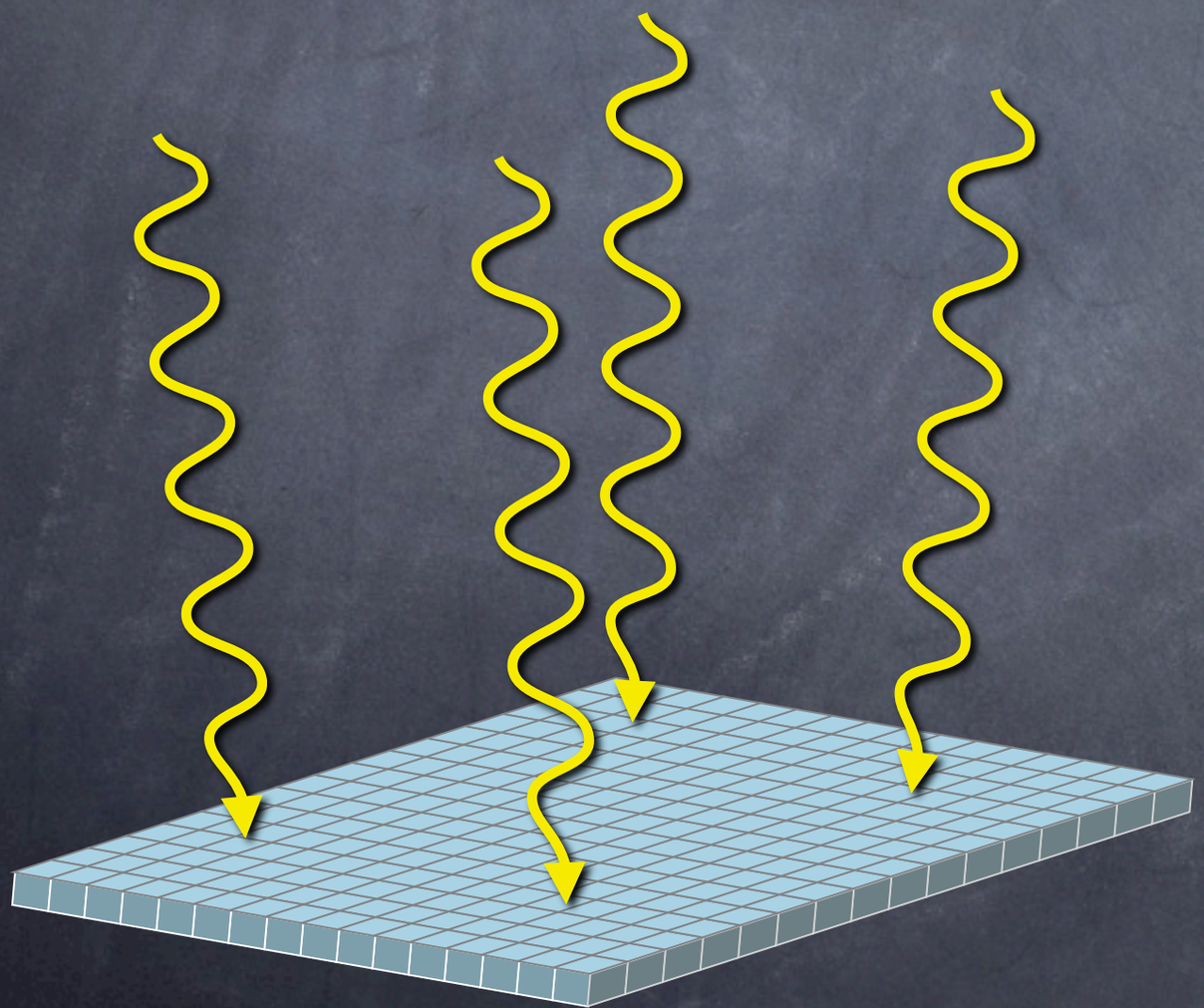

Introducing
"Object-Oriented
Python & SPICE"
aka "OOPS"

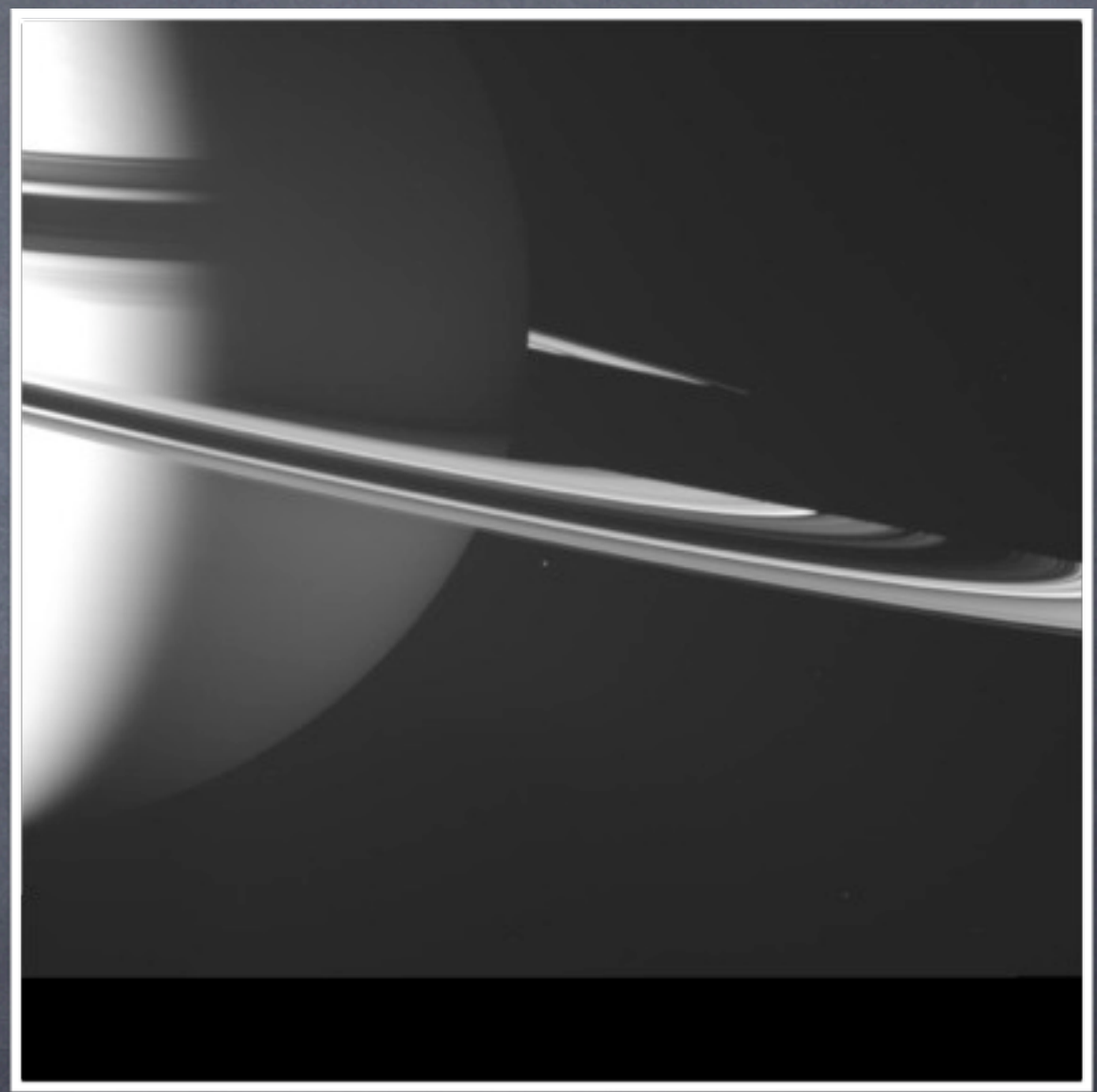


31 backplanes
at full resolution
(1024 × 1024)
in < 100 seconds

So What Just Happened?

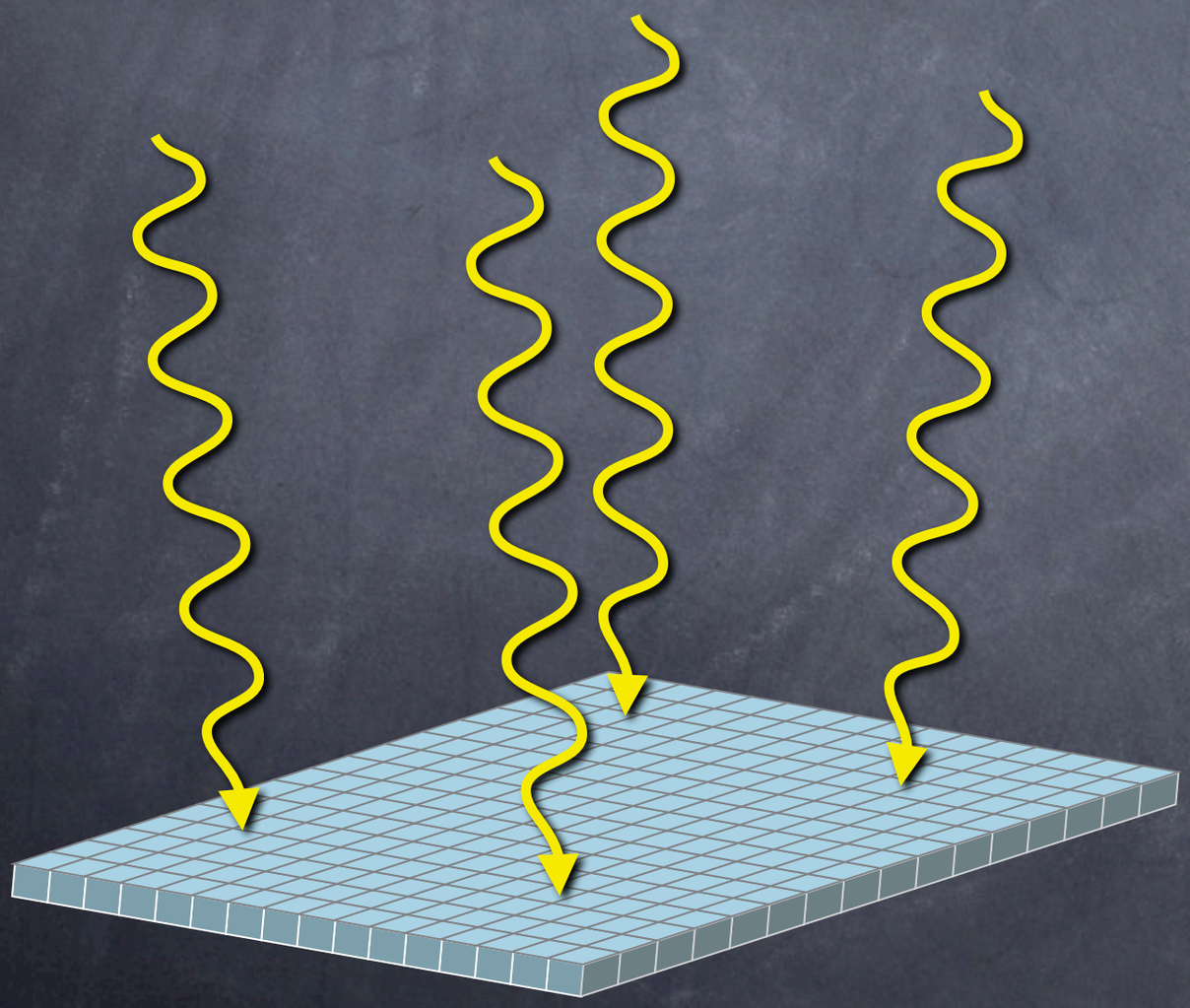
- We define an "Event" associated with photon arrivals at the Cassini camera.





So What Just Happened?

- We define an "Event" associated with photon arrivals at the Cassini camera.



Geek Note

An "Event" object has these properties:

- Time
- Position
- Velocity
- Reference "Path" object defines the origin vs. time
- Reference "Frame" object defines coordinates system vs. time

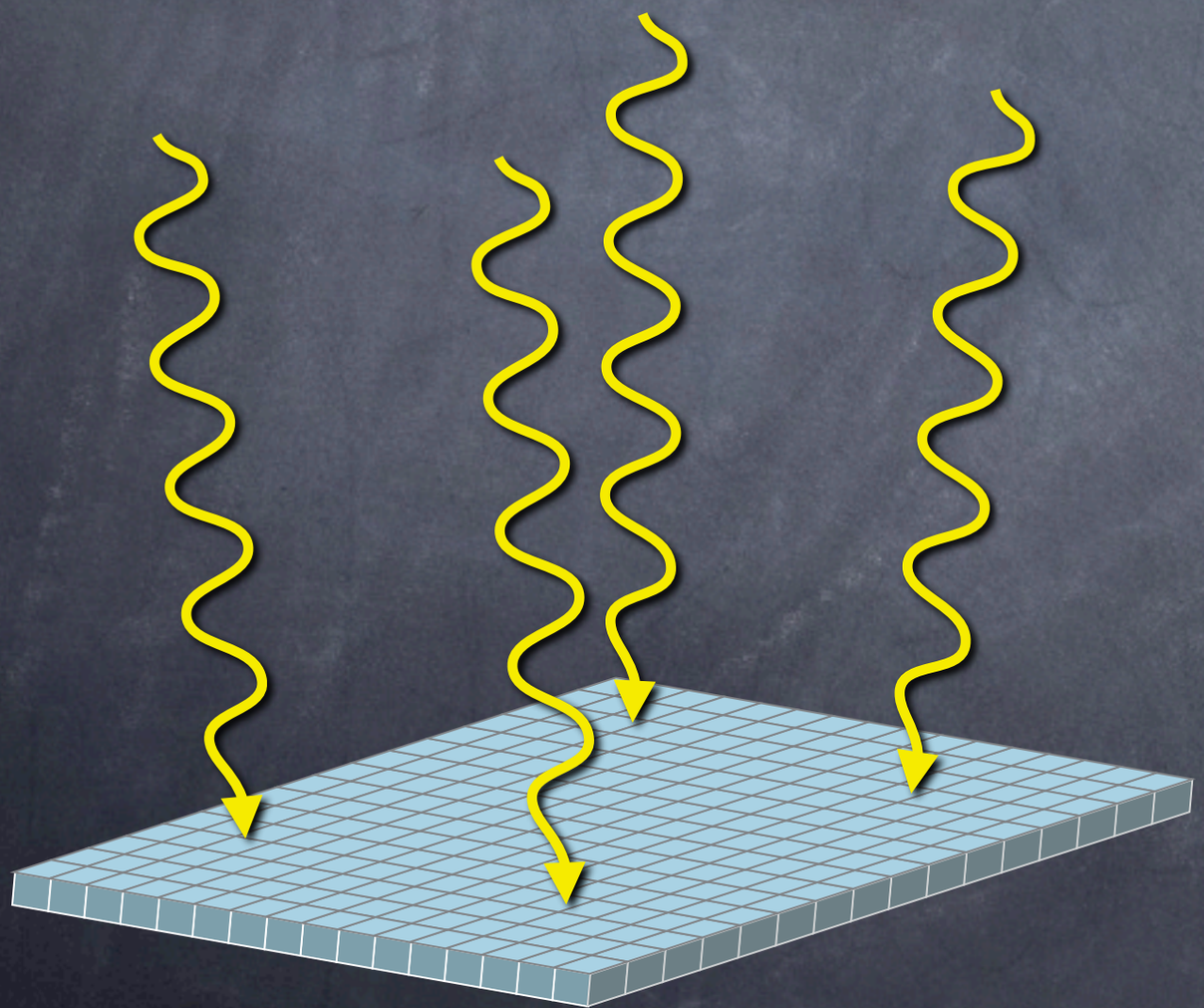
Optionally...

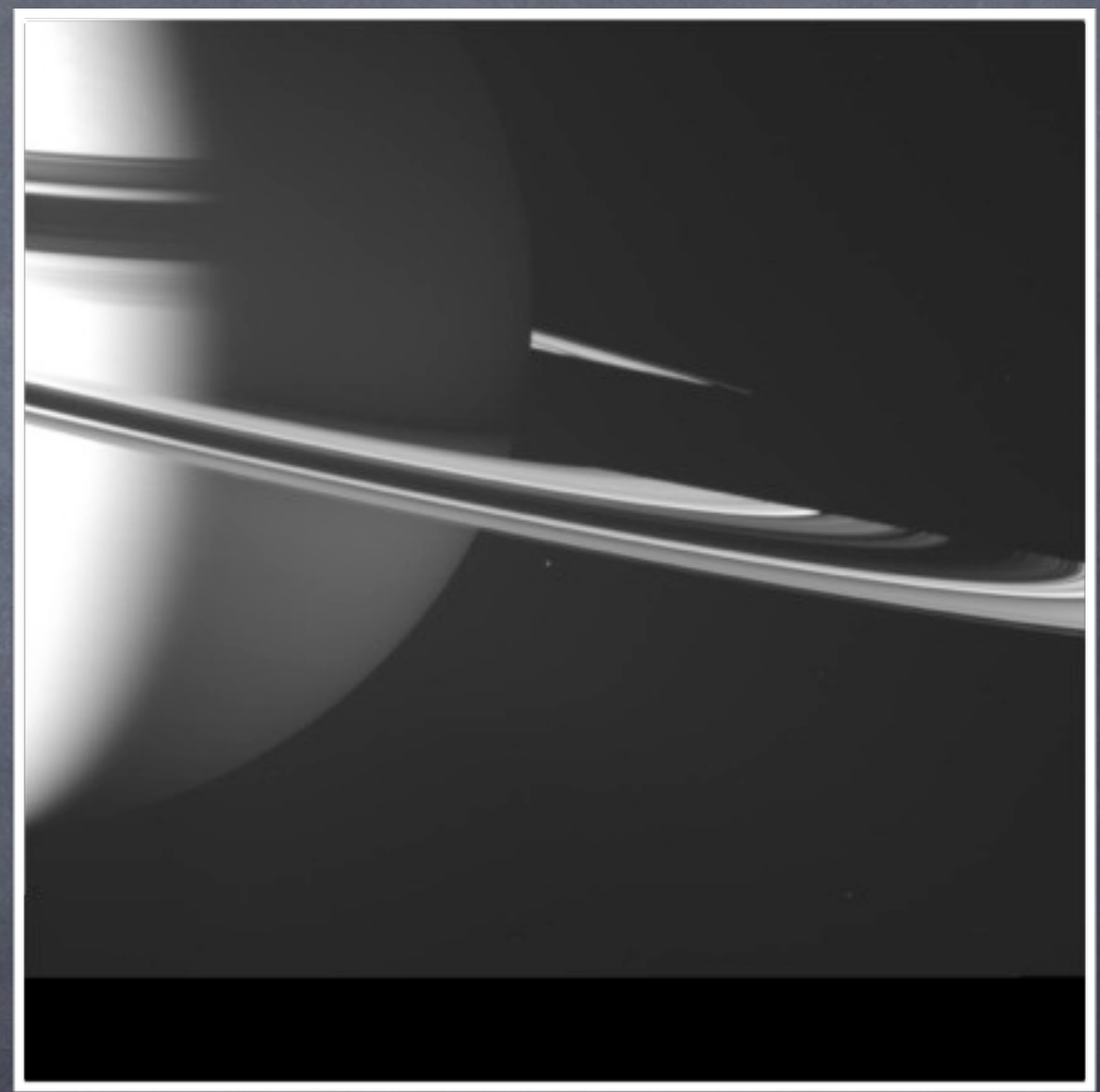
- Direction of incoming photon
- Direction of outgoing photon
- Surface normal vector
- Link to another associated event
- More...

Note: All OOPs objects are implemented as arrays of arbitrary size and shape.

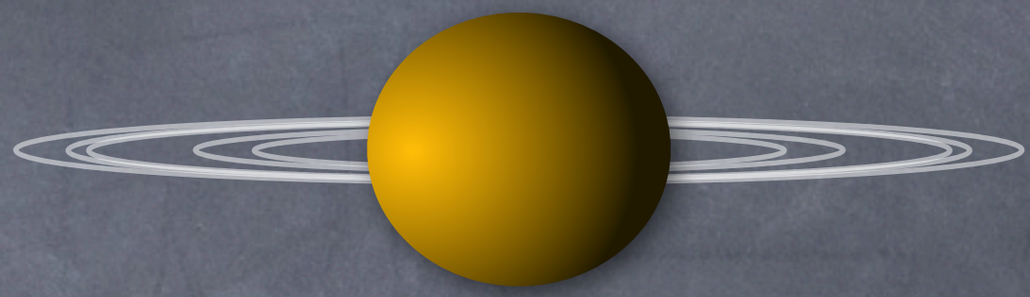
So What Just Happened?

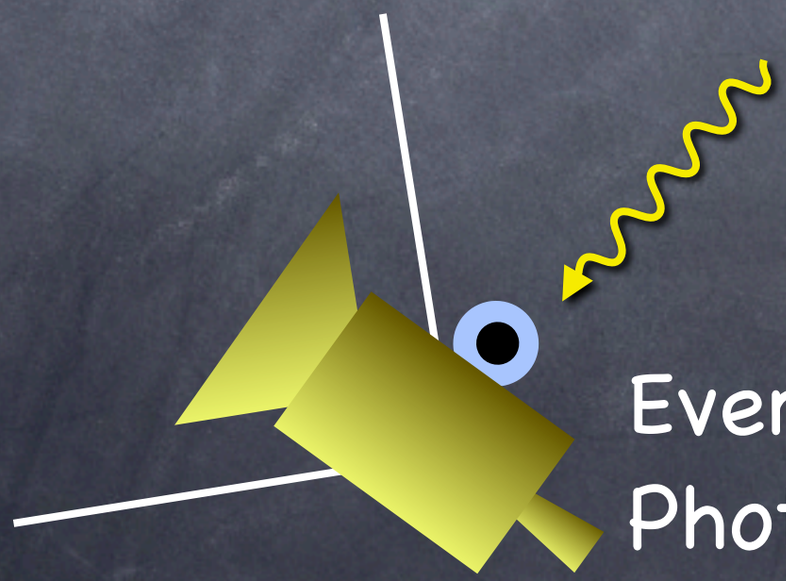
- We define an "Event" associated with photon arrivals at the Cassini camera.





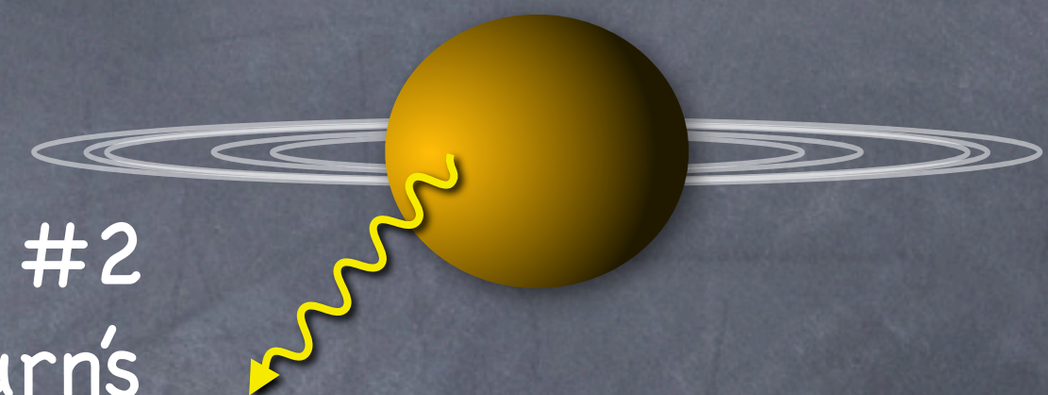
So What Just Happened?



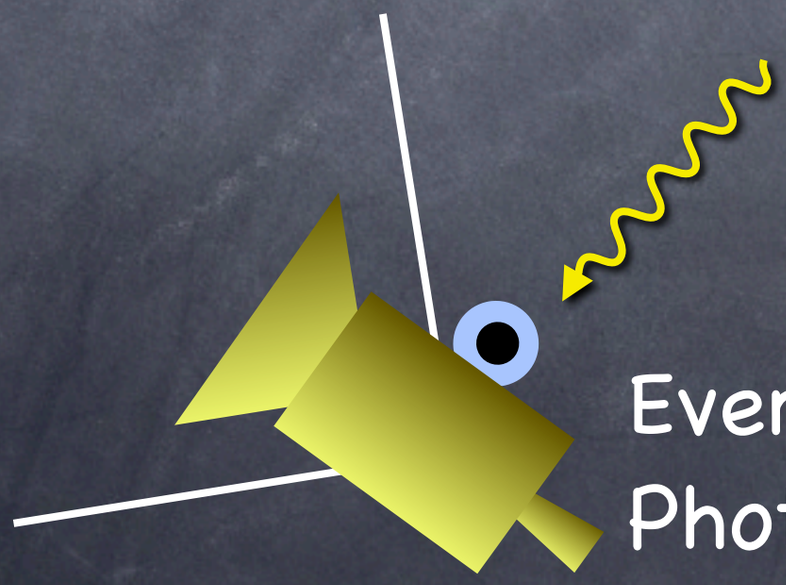


Event #1
Photons arrive at camera

So What Just Happened?



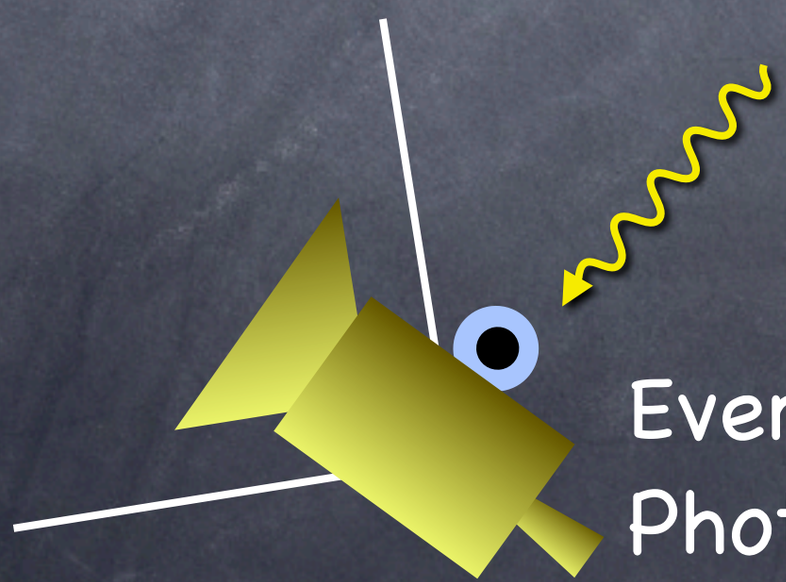
Event #2
Photons depart Saturn's
"Surface"



Event #1
Photons arrive at camera

So What Just Happened?

Event #2
Photons depart Saturn's
"Surface"



Event #1
Photons arr

Geek Note

A "Surface" object defines a 2-D surface in 3-D space.

Subclasses:

- Spheroid
- Ellipsoid
- RingPlane
- OrbitPlane
- Ansa (edge-on ring)

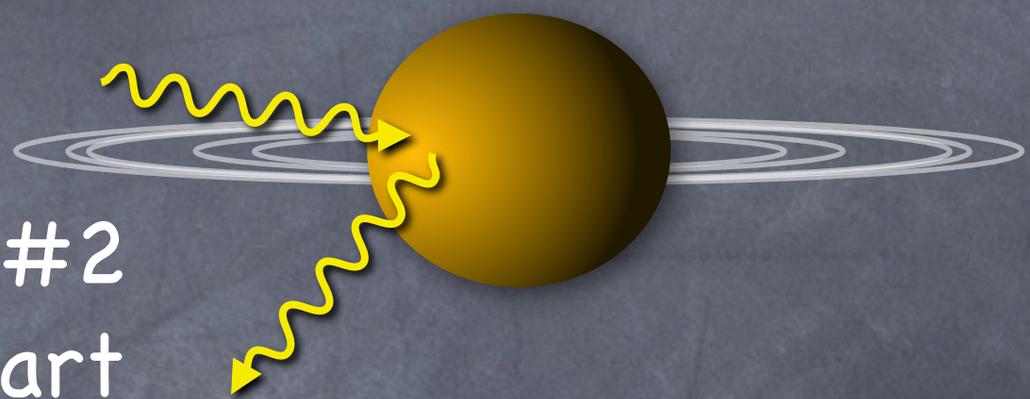
Attributes:

- photon_to_event()
- photon_from_event()
- normal vector
- coordinate conversions
- More...

So What Just Happened?

Event #3

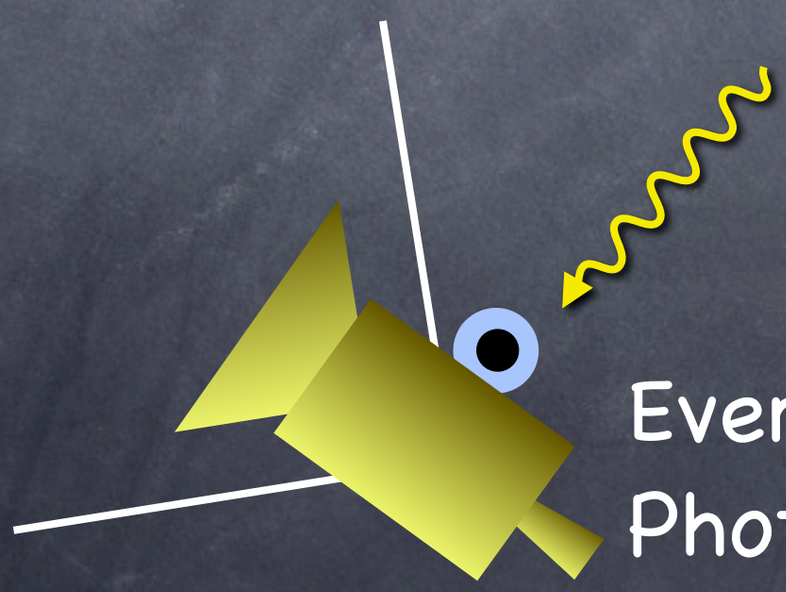
Photons depart Sun's "Path"



Event #2

Photons arrive & depart

Saturn's surface



Event #1

Photons arrive at camera

So What Just Happened?

Geek Note

A "Path" defines a position & velocity as a function of time.

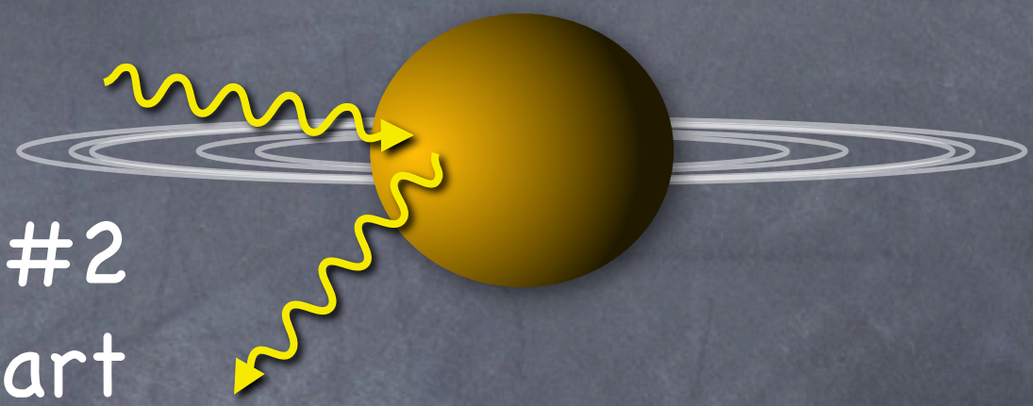
Subclasses:

- SpicePath
- Orbit
- QuickPath (interpolates a SpicePath)

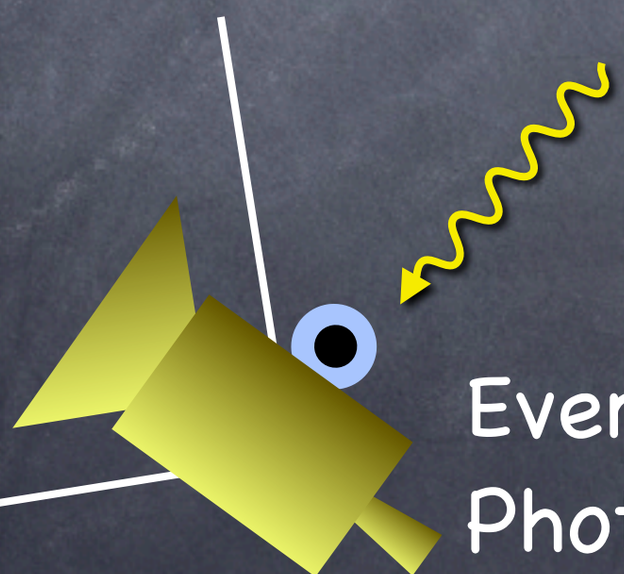
Attributes:

- photon_to_event()
- photon_from_event()
- More...

ns "Path"



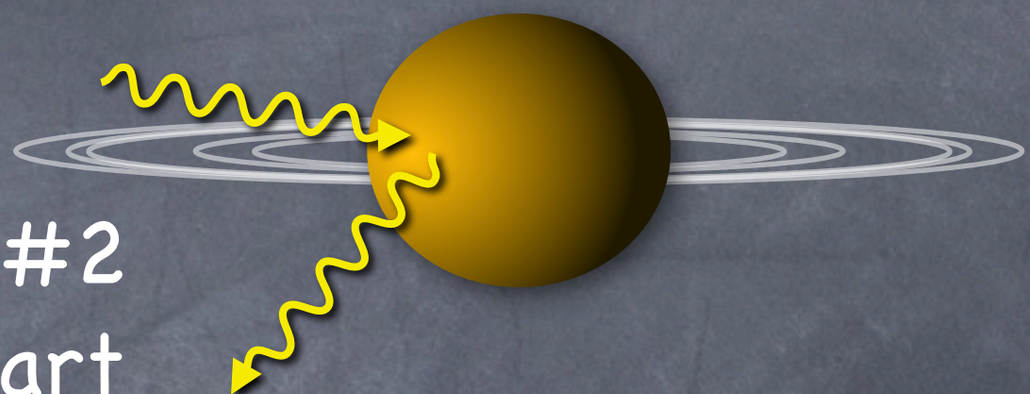
Event #2
ons arrive & depart
Saturn's surface



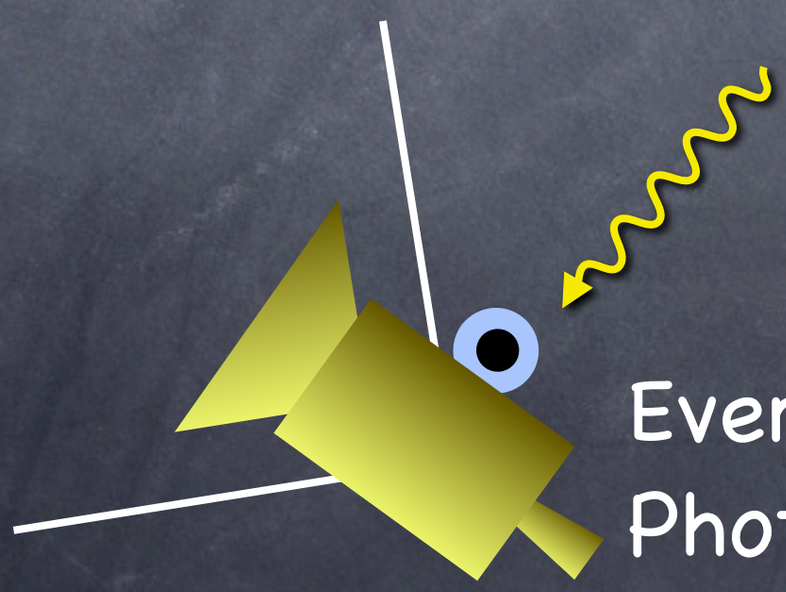
Event #1
Photons arrive at camera

So What Just Happened?

Event #3
Photons depart Sun's path



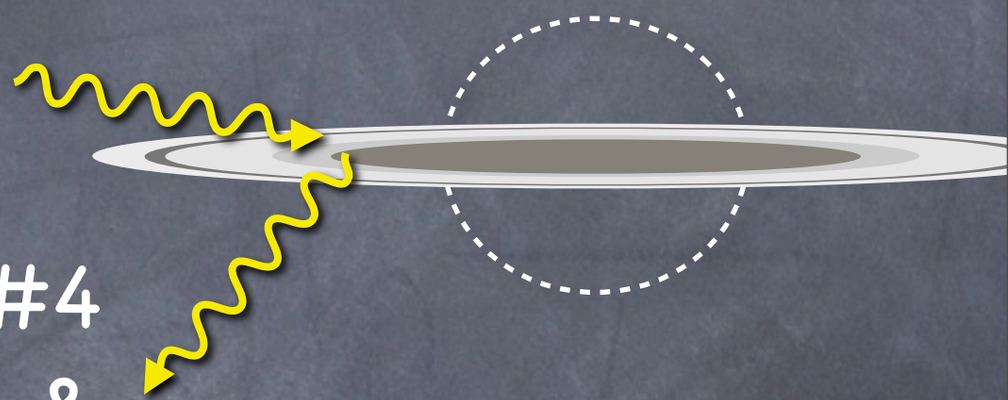
Event #2
Photons arrive & depart
Saturn's surface



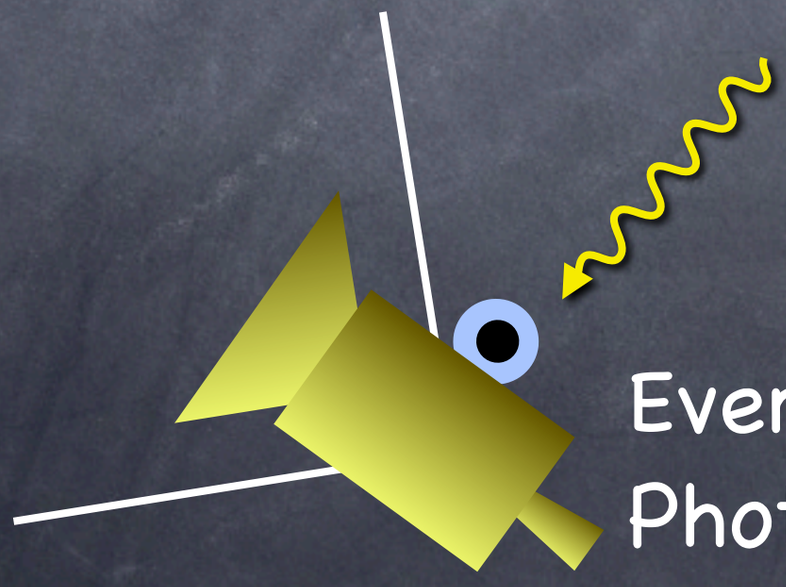
Event #1
Photons arrive at camera

So What Just Happened?

Event #5
Photons depart Sun



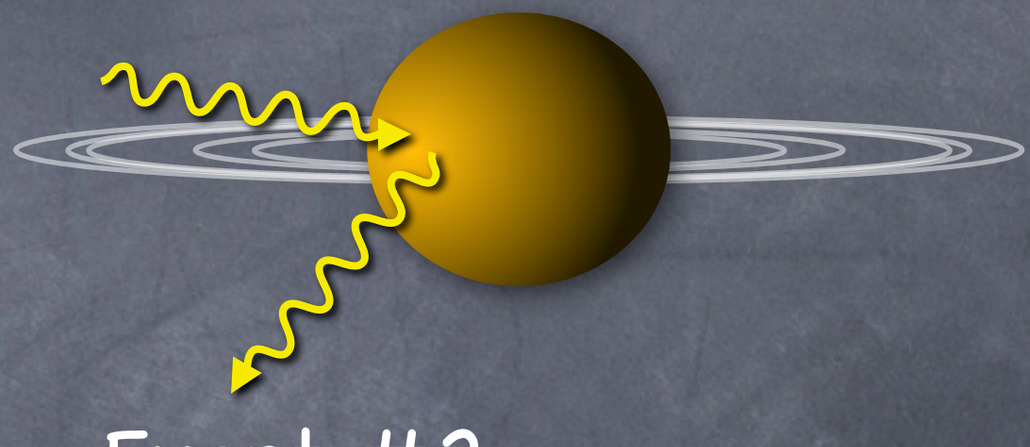
Event #4
Photons arrive & depart the ring plane



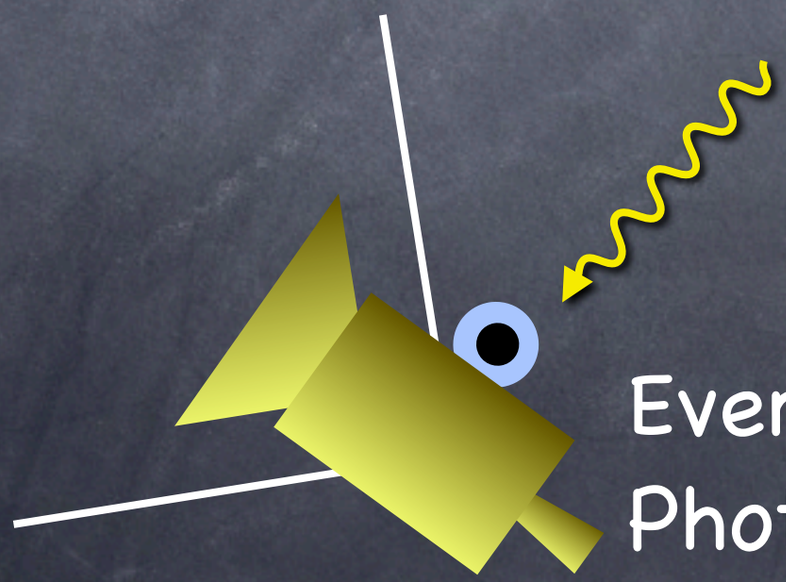
Event #1
Photons arrive at camera

Shadow Calculations

Event #3
Photons depart Sun's path

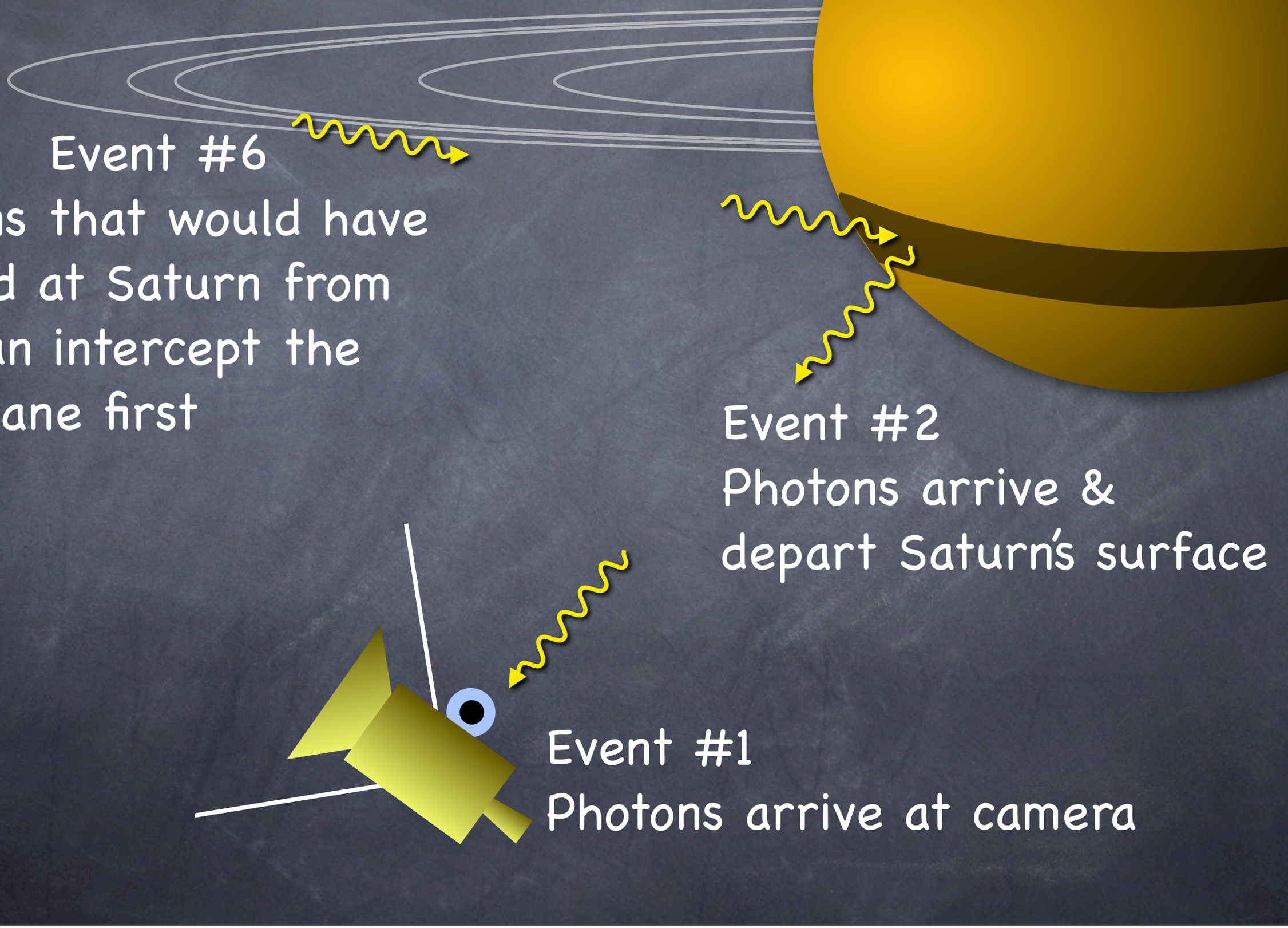


Event #2
Photons arrive &
depart Saturn's surface



Event #1
Photons arrive at camera

Shadow Calculations

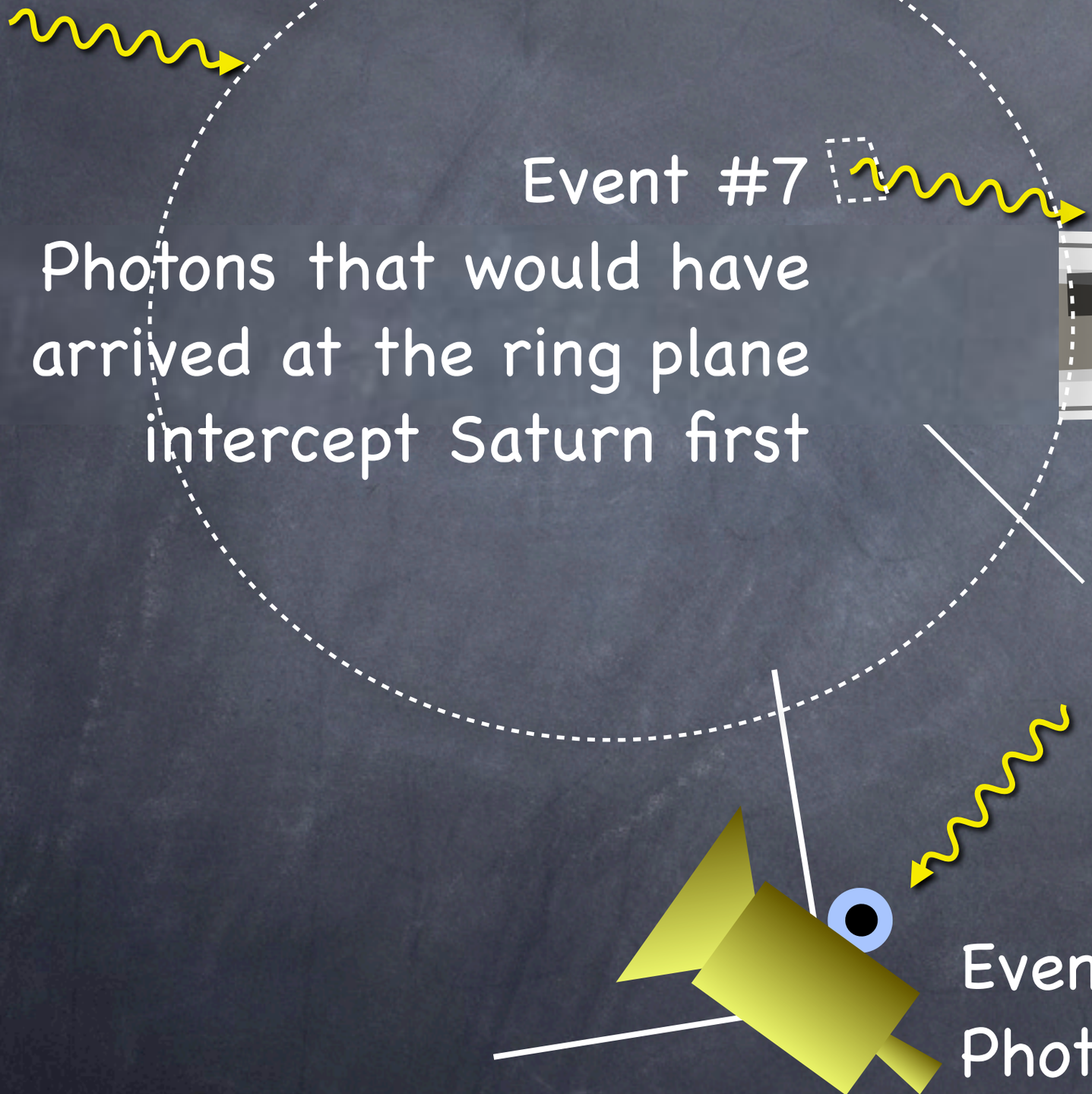


Event #6
Photons that would have arrived at Saturn from the Sun intercept the ring plane first

Event #2
Photons arrive & depart Saturn's surface

Event #1
Photons arrive at camera

Shadow Calculations



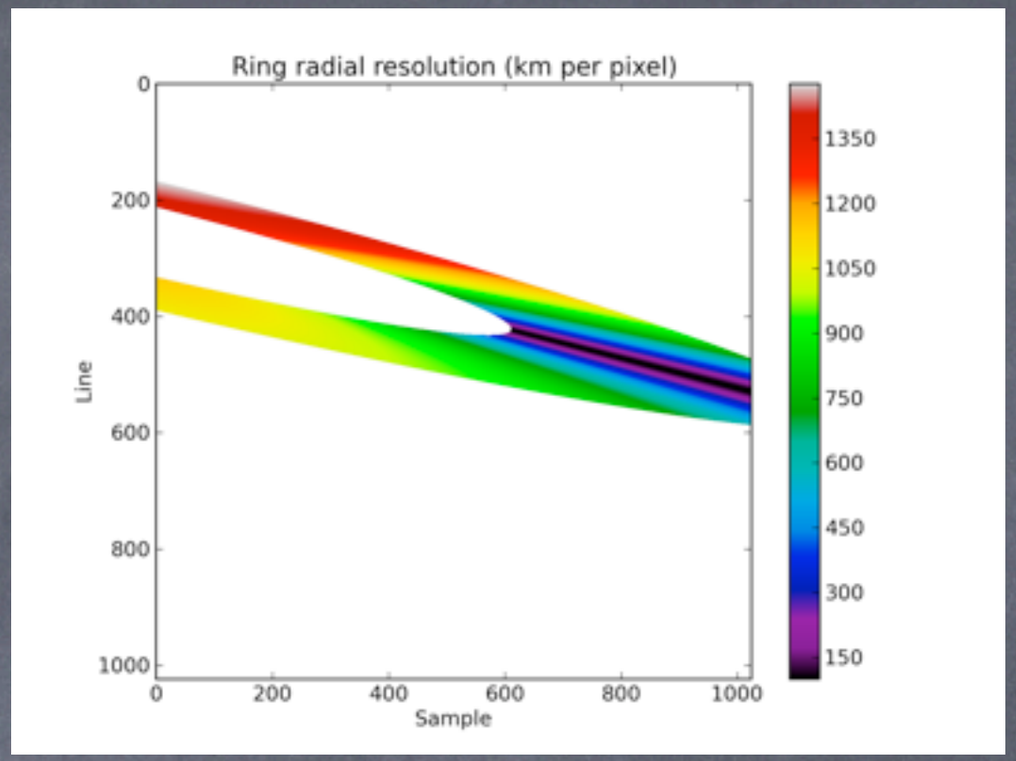
Event #4
Photons arrive & depart ring plane

Event #1
Photons arrive at camera

What OOPS can do

- OOPS performs extremely complicated planetary geometry calculations in a few lines of code.
- Operates on arrays of arbitrary size and shape in parallel.
- "Hides" the SPICE toolkit.
- Manages SPICE kernels via an internal SQL/SQLite database.
- Example: megapixel backplane generation in a few seconds.
  - Full-resolution image backplane generation is now feasible as an on-line service.

What else OOPS can do



- Ring plane resolution via analytic derivatives:

  d(ring radius)/d(line,sample)

  = ∂(ring radius) / ∂(position on ring surface)

  × ∂(position on ring surface) / ∂(line of sight)

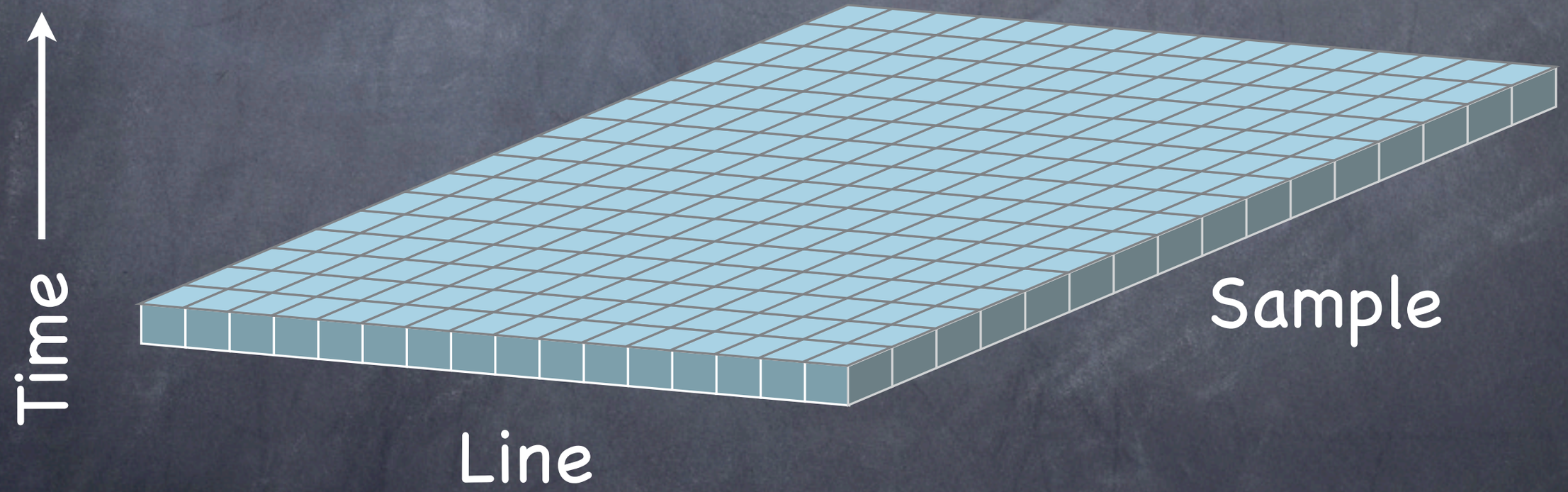
  × ∂(line of sight) / ∂(line,sample)

The Full Class Hierarchy

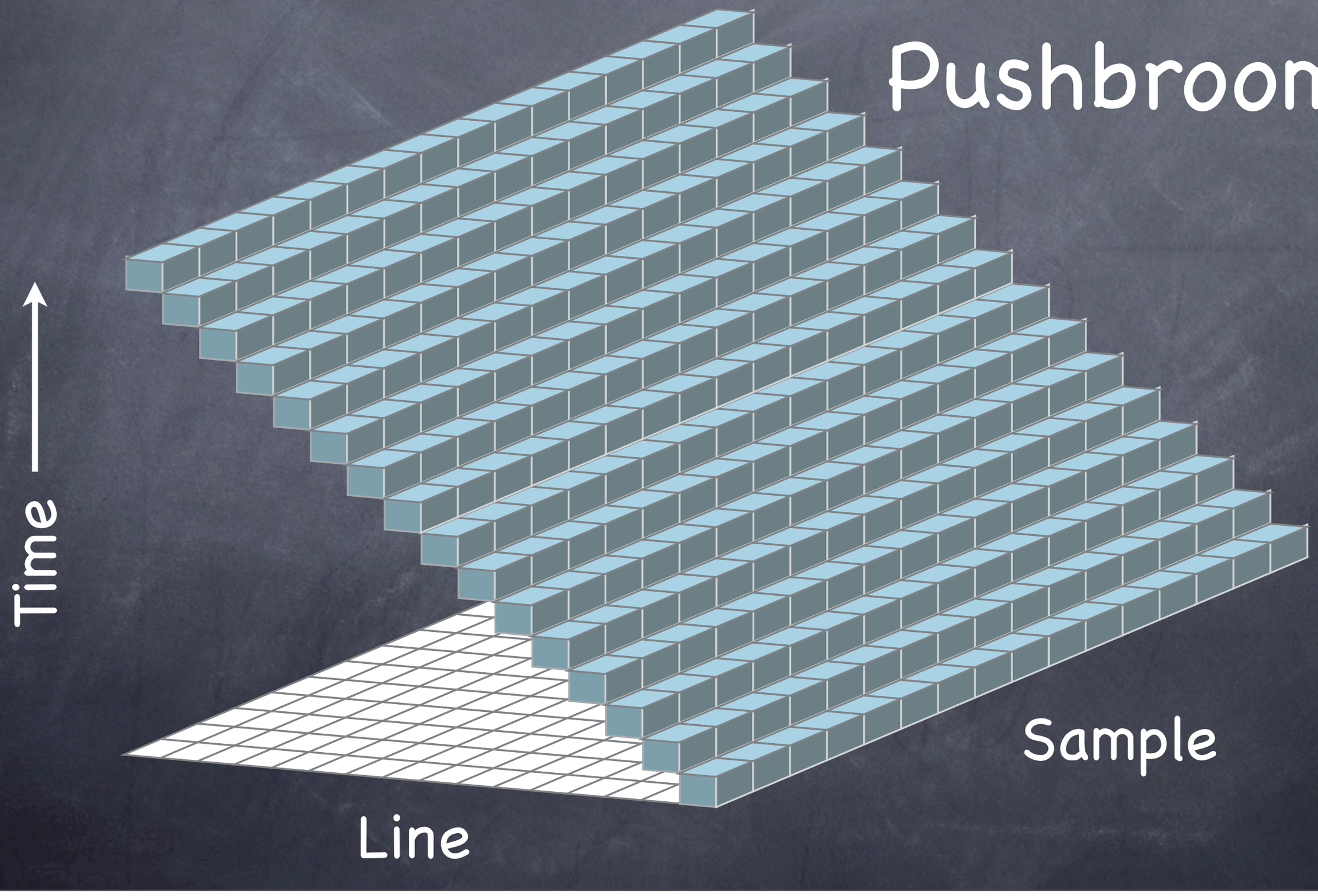
- Backplane
- Body
- Event
- FOV
  - Flat
  - Offset
  - Polynomial
  - Subarray
  - Subsampled
- Frame
  - Cmatrix
  - InclinedFrame
  - QuickFrame
  - RingFrame
  - Rotation
  - SpiceFrame
  - SpinFrame
- Observation
  - Occultation
  - Pushbroom
  - RasterScan
  - Snapshot
- Path
  - CirclePath
  - Multipath
  - Orbit
  - QuickPath
  - SpicePath
- Surface
  - Ansa
  - Ellipsoid
  - OrbitPlane
  - RingPlane
  - Spheroid
- Transform

Observation Subclasses

Snapshot

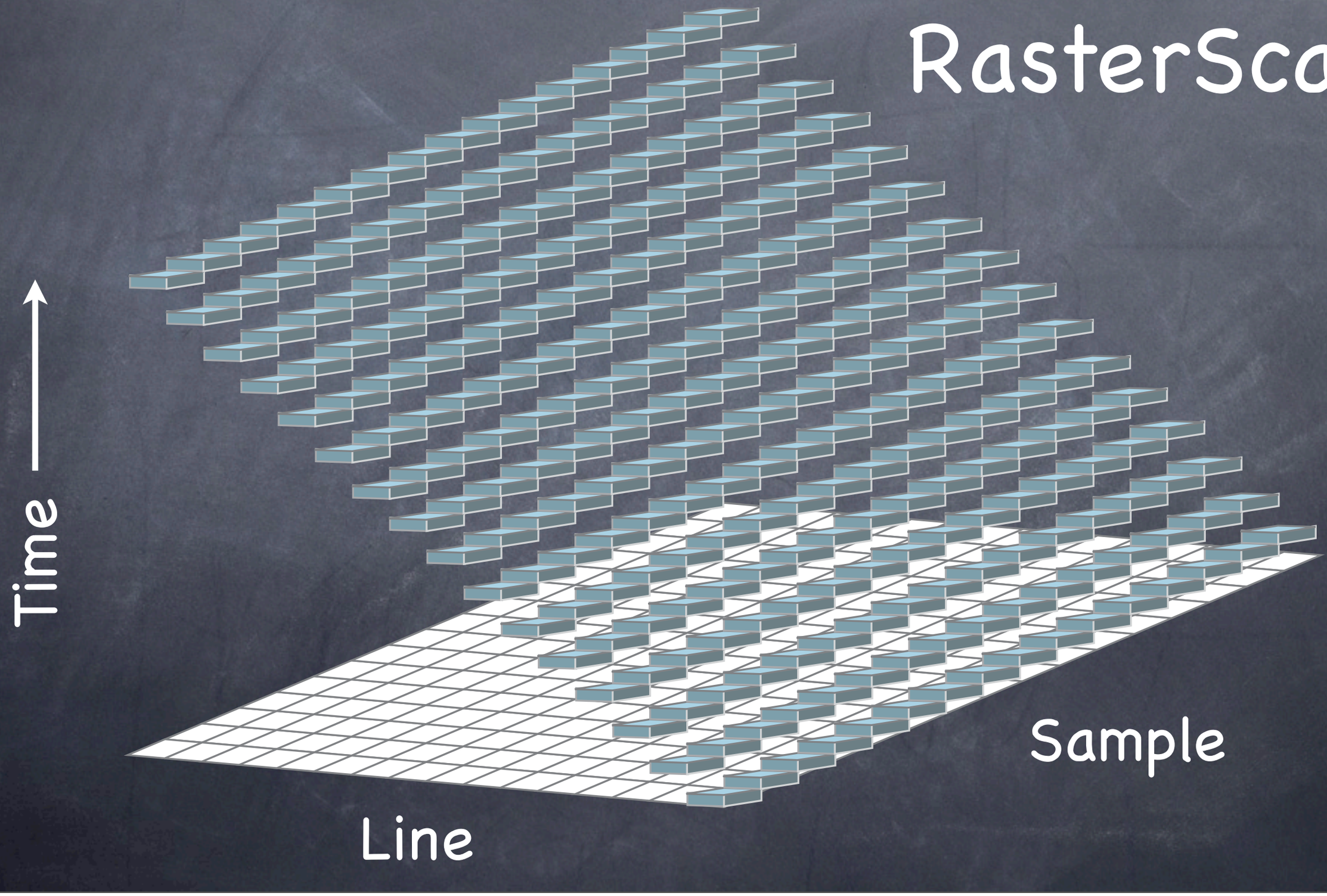


Observation Subclasses



Observation Subclasses

RasterScan



Observation Subclasses

Occultation

Time

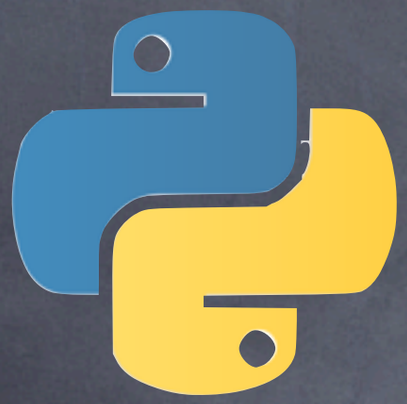
Instruments Supported

- Cassini
  - CIRS
  - ISS
  - UVIS
  - VIMS
    - IR
    - VIS
- Voyager
  - ISS
- HST
  - ACS
    - HRC
    - SBC
    - WFC3
  - NICMOS
    - NIC1
    - NIC2
    - NIC3
  - WFC3
    - IR
    - UVIS
  - WFPC2

Geek Note

Instruments support the following methods

- from_file(filespec)
  - ... returns an Observation subclass object based on a data file specification.
- from_index(filespec)
  - ... returns a list of Observation subclass objects (but no data) for every row of an index file



Mark's $0.02

- OOPS + Python can enable the data services that PDS users want and expect.
- NAIF needs to develop fast, "parallel" alternatives to two SPICE functions.
  - SPKEZ, SXFORM
- SQLite is a free, universally available, lightweight DBMS that is ideal to support the SPICE kernel management needs of most users.