
ESRF
The European Synchrotron

Modelling synchrotron radiation beamlines with OASYS

Introduction

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June 8th 2023

Introduction to OASYS

Outline:

- What is OASYS? What is its structure?
- What kind of simulations can be performed with it
- Expected outcome of this OASYS seminar

What is OASYS?

OASYS (Orange Synchrotron Suite) is graphical environment for modelling synchrotron beamlines.

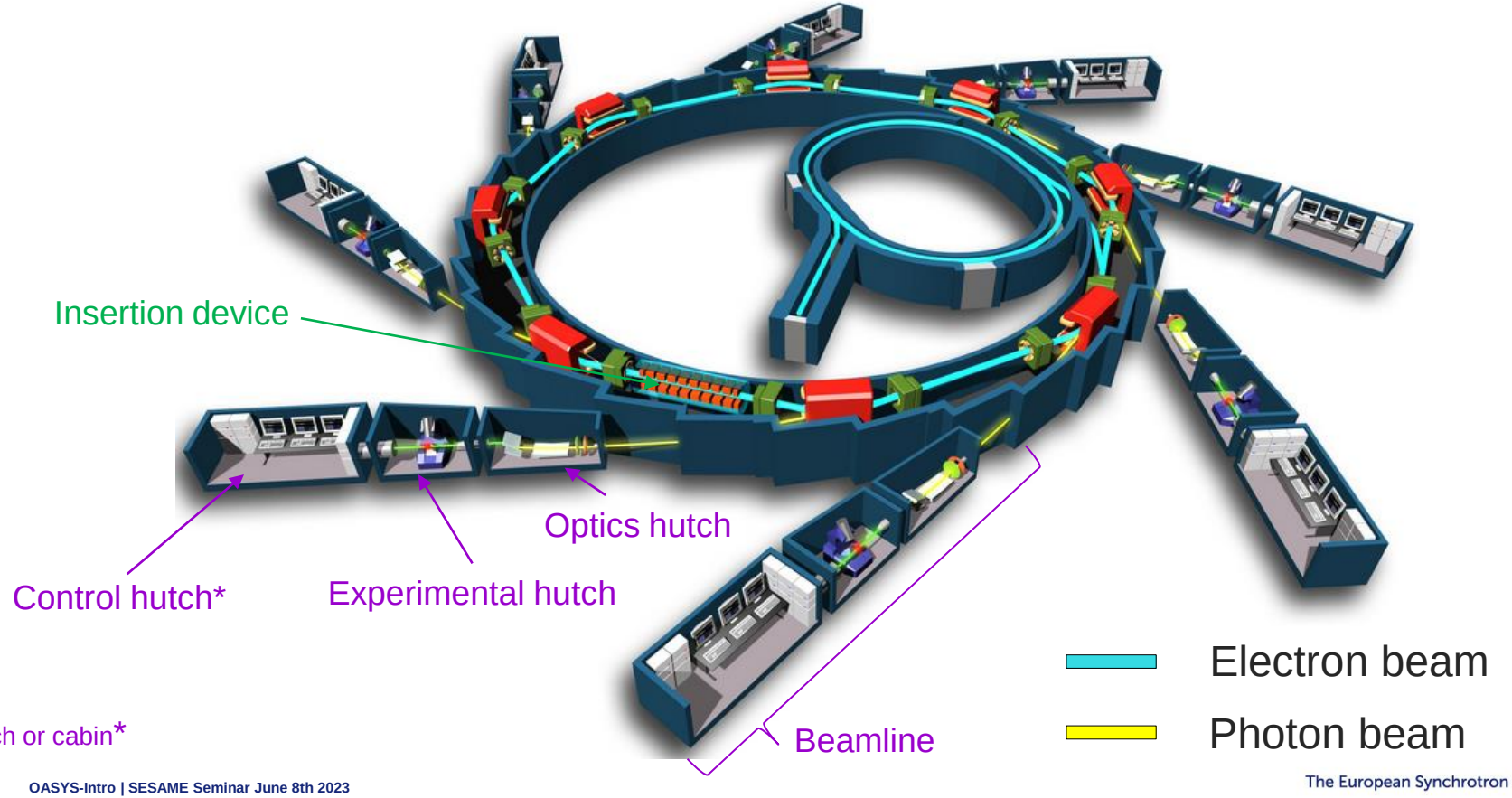
In OASYS, we can perform visual programing: using “boxes and arrows” to recreate a photon beamline

OASYS integrates different simulation strategies via the implementation of adequate simulation tools for X-ray Optics

https://www.aps.anl.gov/Science/Scientific-Software/OASYS

Modelling a beamline

A synchrotron beamline is the instrumentation that transports the synchrotron radiation to the sample (experimental end station)



Modelling a beamline with OASYS

Main components of the beamline:

Source

Bending magnet, wiggler or undulator

Optics

Slits, mirrors, crystals, filters, refractive lens, Fresnel lens, multilayers, etc.

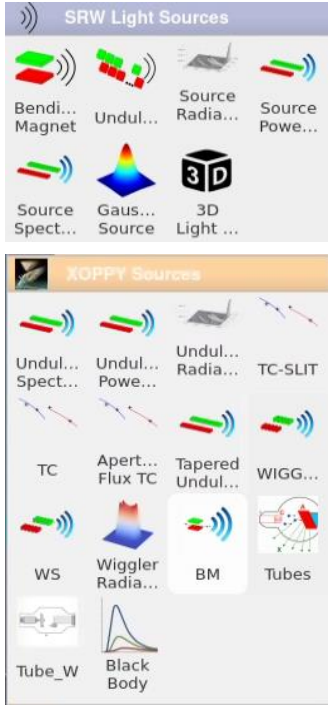
Experimental station

Sample, detectors, etc.

Modelling a beamline with OASYS

The visual programing boxes, in OASYS, are called ***Widgets*** and they represent optical components, including a wide variability of tools, example:

Sources:



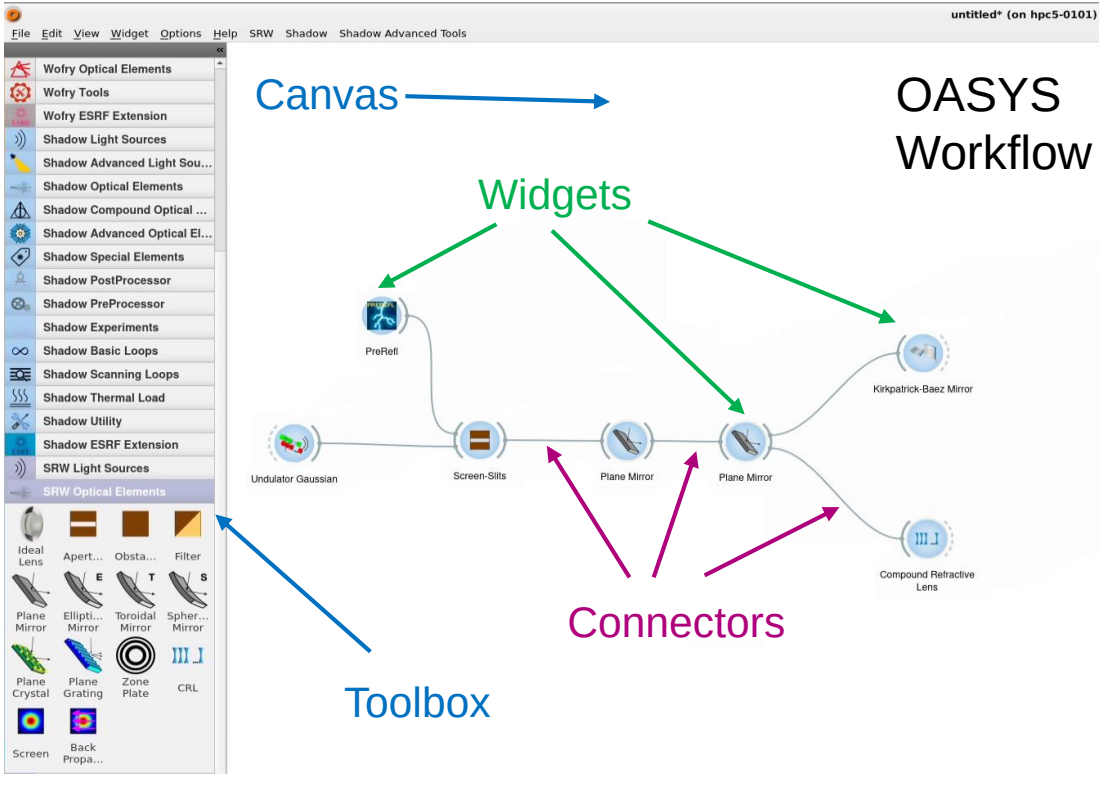
Optics:

Allowing to get at the Sample:

Energy distribution, intensity (photon flux), beam size and divergence, etc.

Modelling a beamline with OASYS

The ***Widgets*** are connected as a workflow (or dataflow) in the OASYS canvas:



Full beamline model

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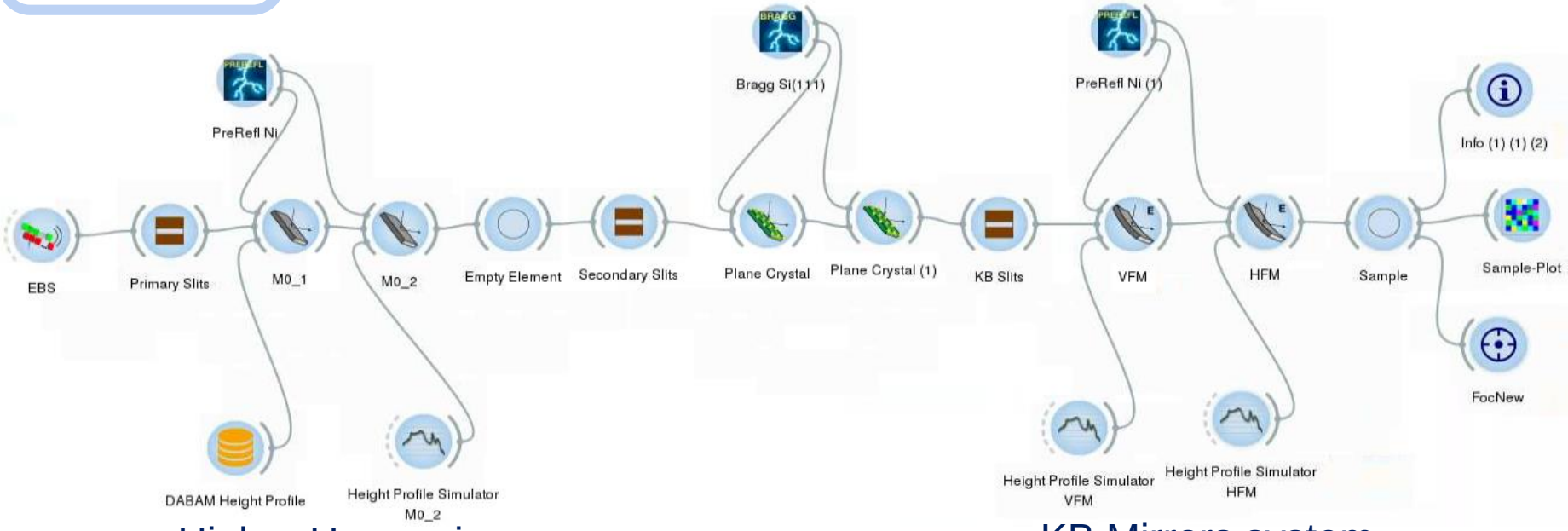
Double Crystal Monochromator



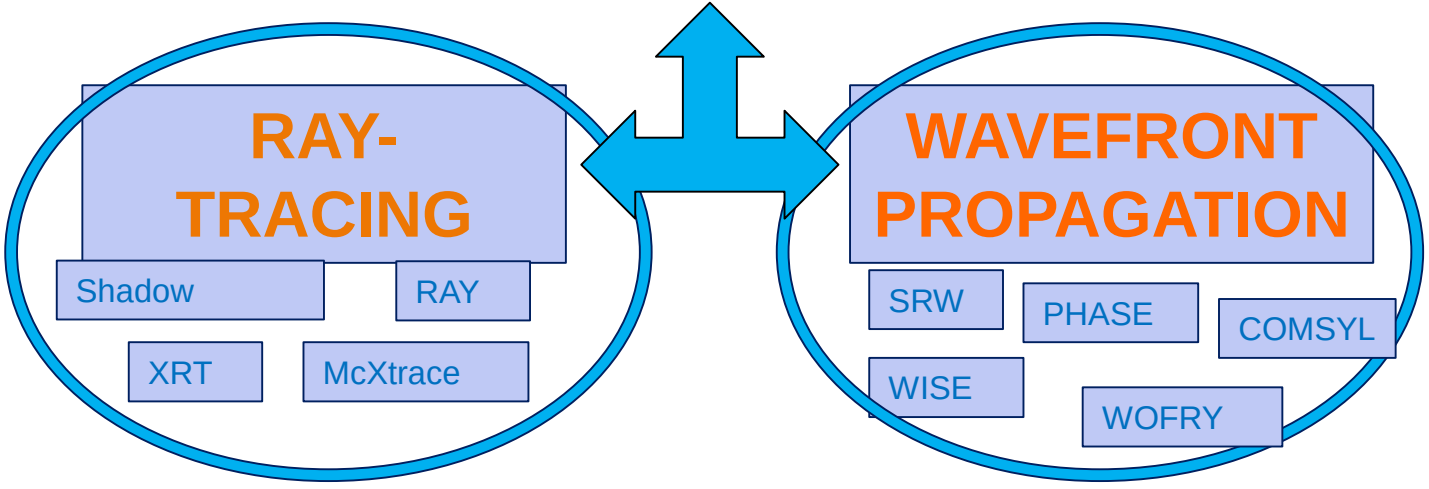
Higher Harmonic Rejection Mirrors

KB Mirrors system

Introduction to OASYS

Computer simulation of light sources and optical components is a mandatory step in the design and optimization of synchrotron and FEL radiation beamlines

different codes for numerical simulations are available, implementing different physical approaches



Incoherent X-ray beams

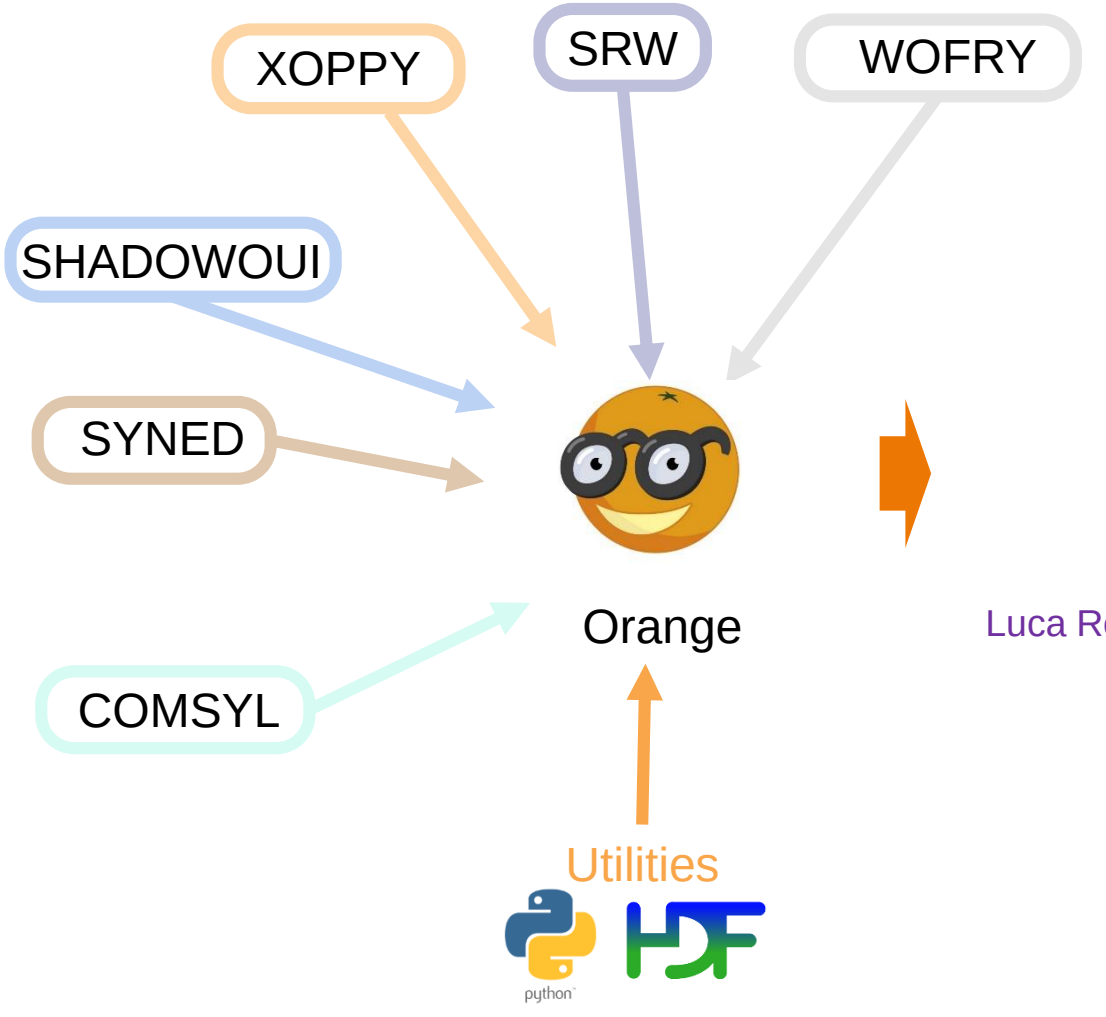
Fully coherent X-ray beams

ORANGE

Orange is a component-based visual programming software package for data visualization, machine learning, data mining, and data analysis. [1].

[1] Demšar, J., Curk, T., and Erjavec, A. "Orange: Data Mining Toolbox in Python," Journal of Machine Learning Research 14, 2349−2353 (2013). https://orange.biolab.si

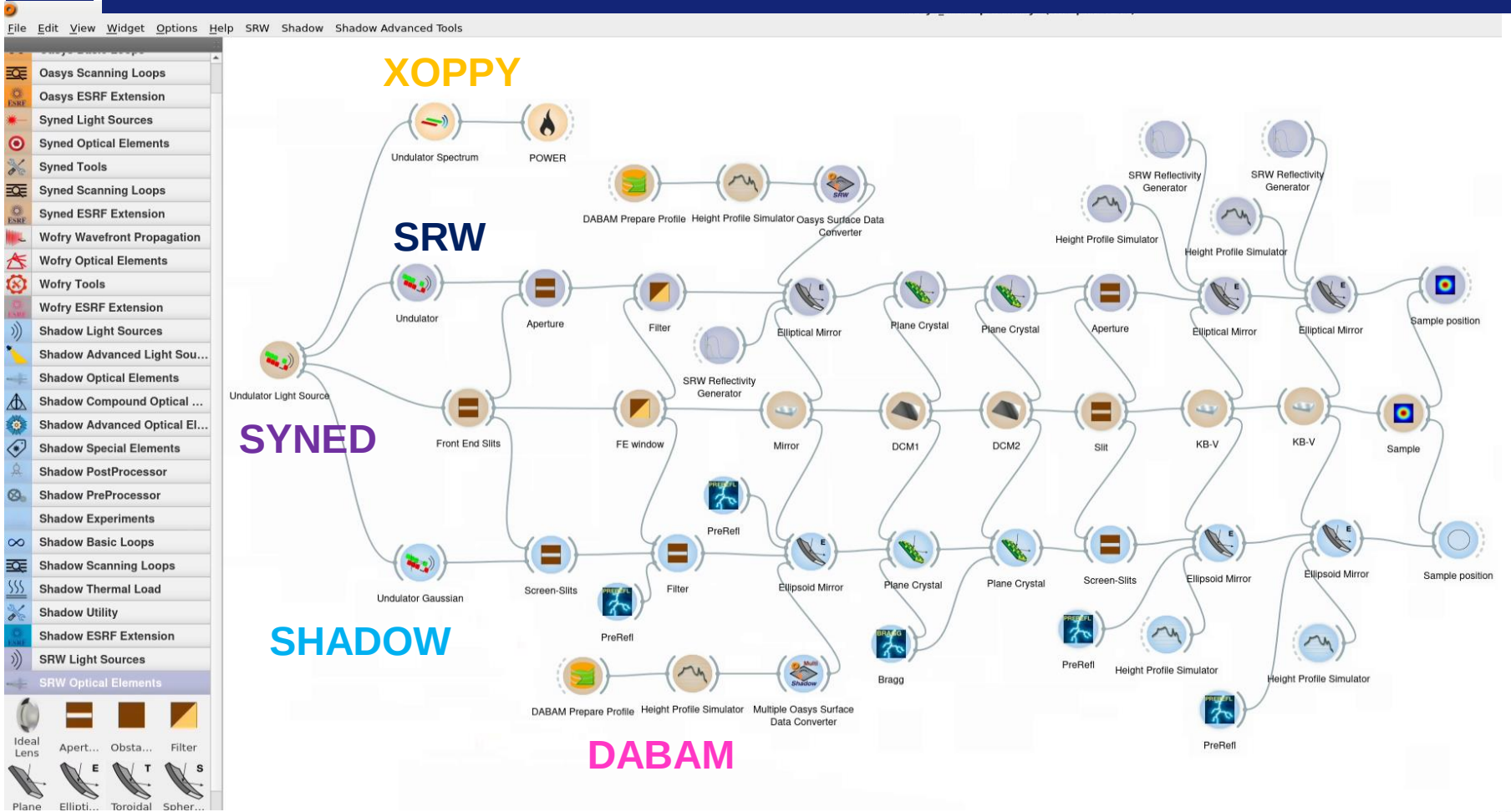
OrAnge SYnchrotron Suite



Luca Rebuffi (ANL) & Manuel Sánchez del Río (ESRF)

L. Rebuffi, M. Sanchez del Rio, "**OASYS (OrAnge SYnchrotron Suite): an open-source graphical environment for x-ray virtual experiments**", Proc. SPIE 10388, 103880S (2017). DOI: 10.1117/12.2274263.

OASYS interoperability



Other OASYS features

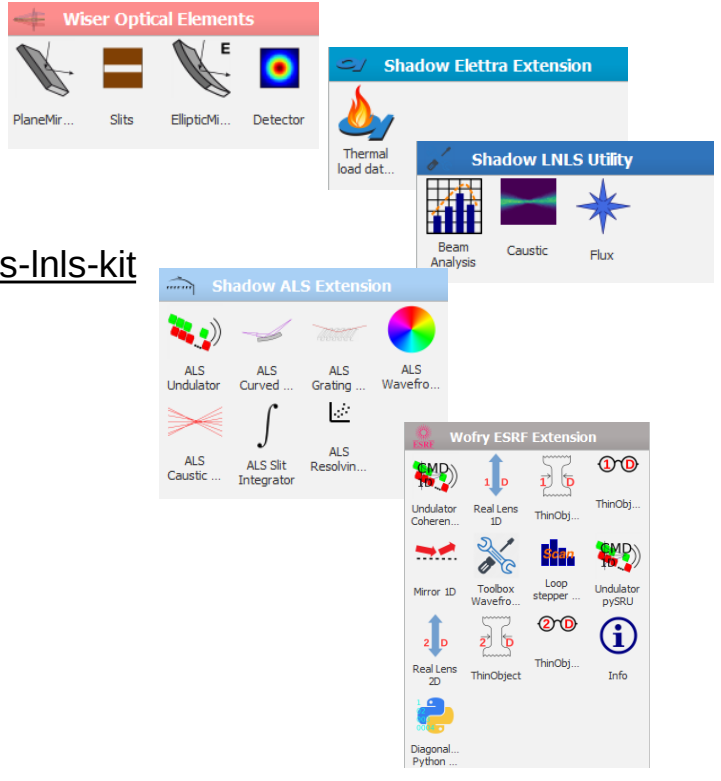
- Open Source, many synchrotron facilities are developing their own customized widgets, Add-ons, for example:

oasys-elettra-kit https://github.com/oasys-elettra-kit

LNLS - Brazilian Synchrotron Light Laboratory https://github.com/oasys-lnls-kit

oasys-als-kit https://github.com/oasys-als-kit

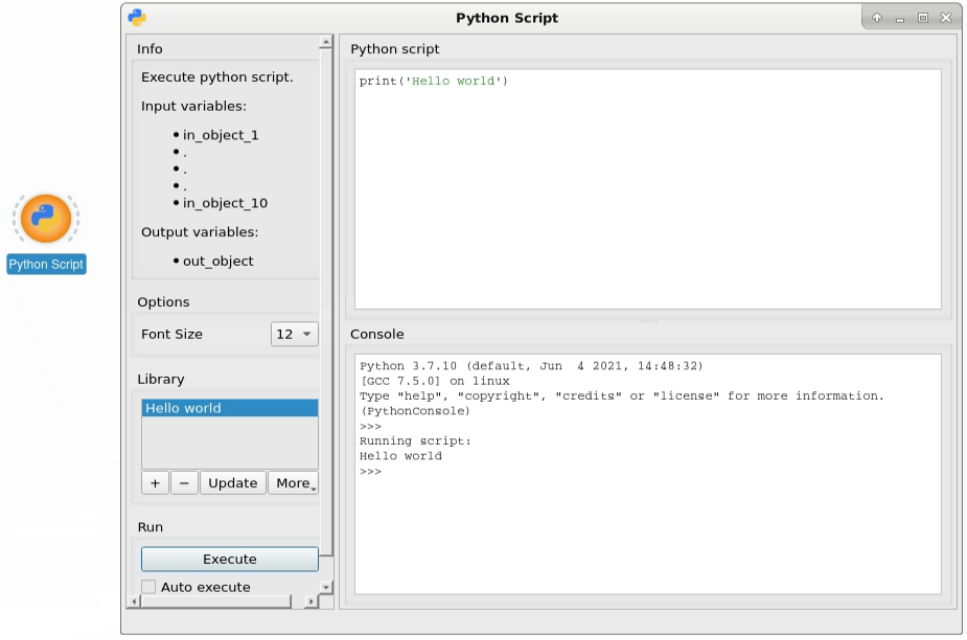
oasys-esrf-kit https://github.com/oasys-esrf-kit *

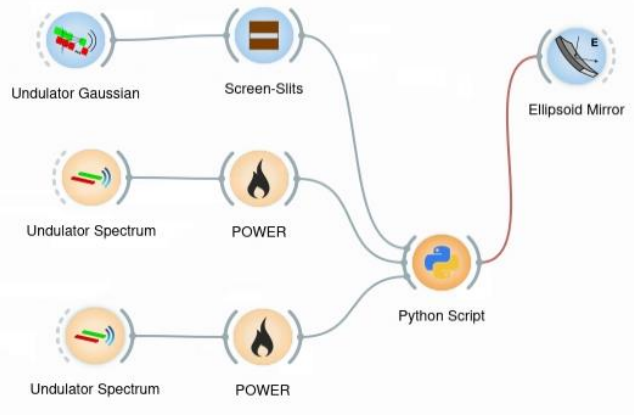


* Add-ons installation example

Other OASYS features

- Python has been chosen as the main programming language, and code can be included in the workflow





Outcome from this seminar

- Calculate main characteristics of synchrotron source (Bending magnets and Insertion devices), in particular for SESAME sources.
- Calculate the heat-load on different beamline components.
- Simulating beamline optics by ray-tracing to obtain main parameters of the beam, e. g., size and divergence, energy resolution, intensity/flux.
- Understand basic principles of X-ray optics: Mirrors and Crystals.

Material of this seminar

All material can be found in the GitHub Repository:

https://github.com/jureyherrera/SESAME_OASYS_seminar