ESRF | The European Synchrotron

OASYS, is it a mirage?

Laura Torino

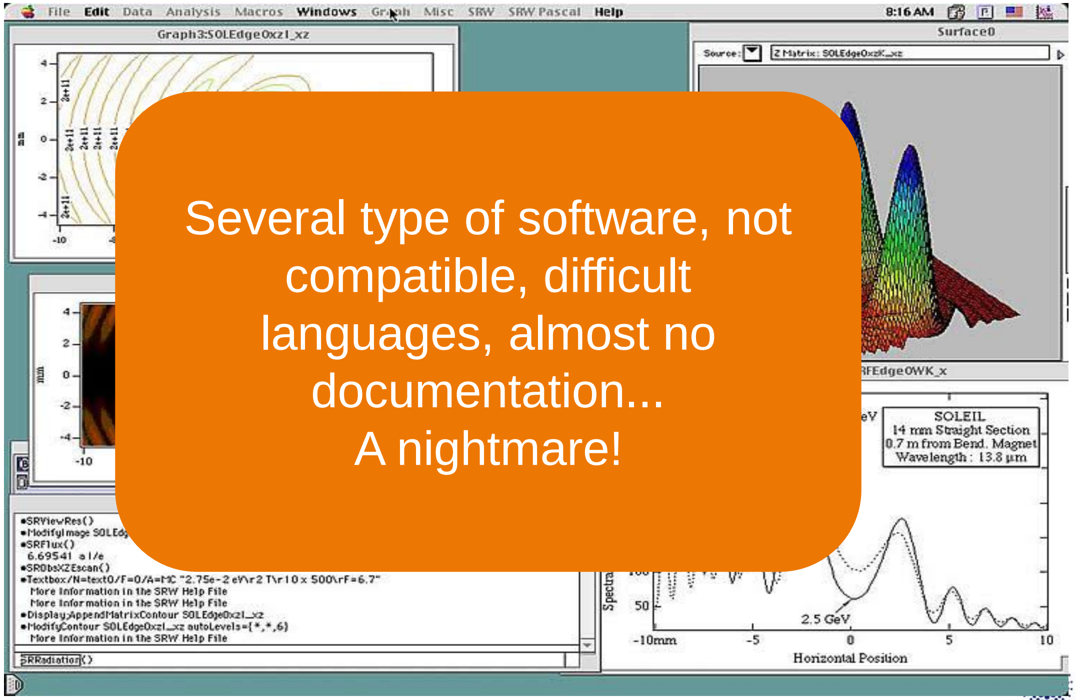
DEELS 2019, 05/06/2019

SR SIMULATION SOFTWARE

The Synchrotron Radiation (SR) is strongly used by the be beam diagnostics community to perform deferent type of measurements (emittance, position, energy, power load...)

It is useful to simulate SR generation, propagation, and absorption.

- X-ray Oriented Program (XOP)
- SHADOW/SHADOWOUI
- Synchrotron Radiation Workshop (SRW)
- ...



Several type of software, not compatible, difficult languages, almost no documentation...
A nightmare!

OASYS

Manuel Sanchez del Rio (ESRF) and Luca Rebuffi (APS)

"The implemented software architecture allows to obtain not only an intuitive and **very-easy-to-use** graphical interface, but also provides high flexibility and **rapidity for interactive simulations**, allowing to make quick configuration changes to compare multiple beamline configurations" *

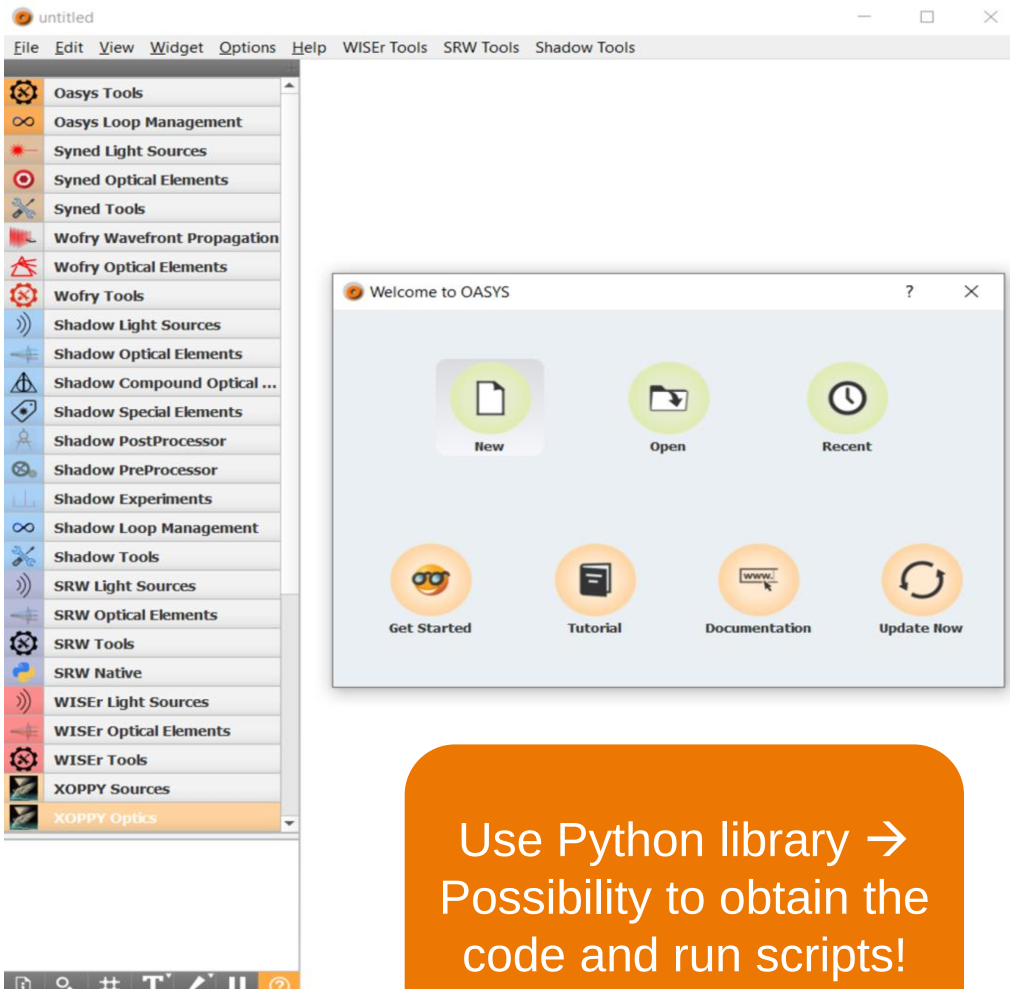
Graphical environment for optical (and more) simulation:

- Python based
- Module adds-on
- Communicating packages

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

OASYS

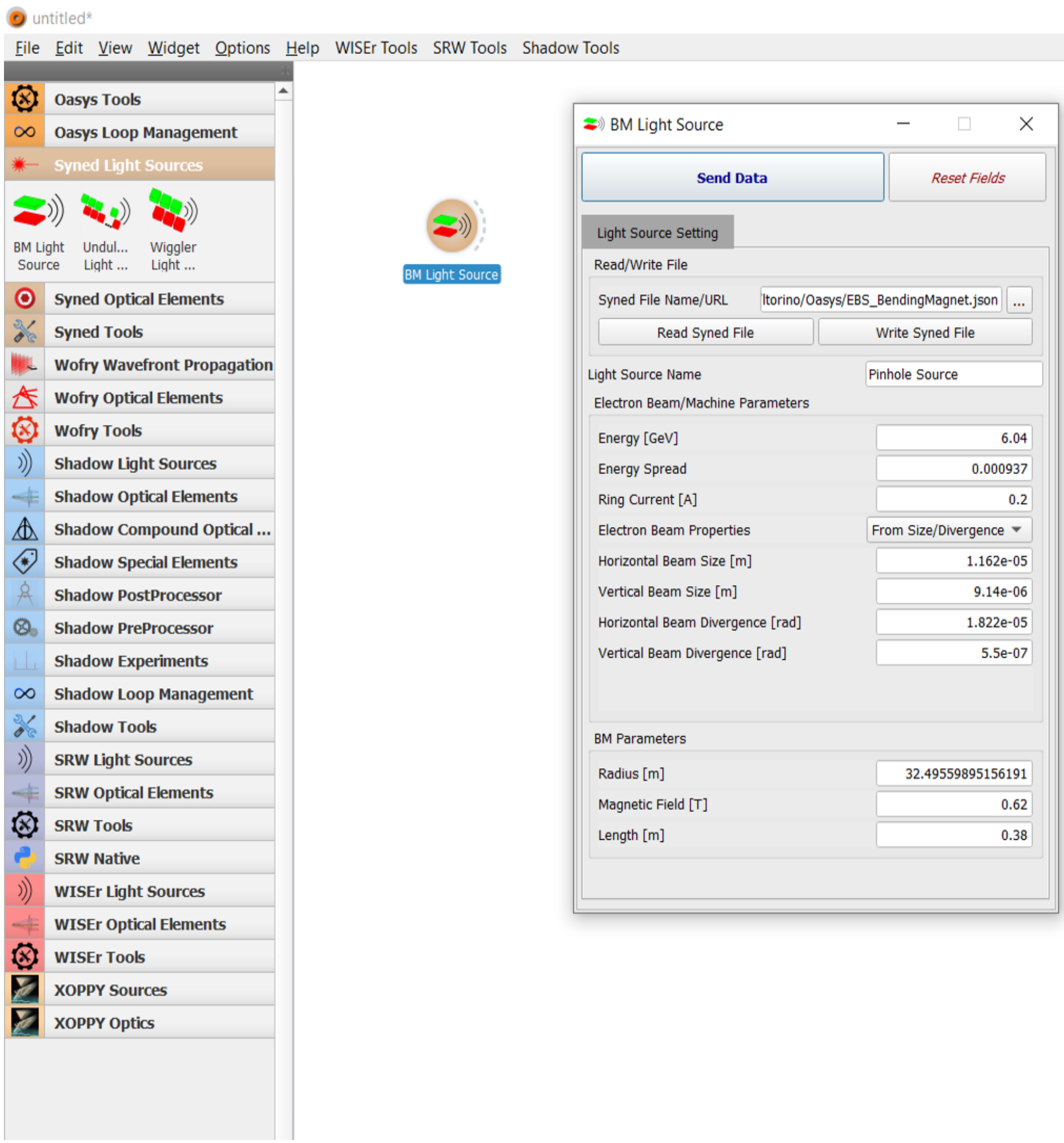
Graphical User Interface available for Windows, Linux, macOs



Use Python library → Possibility to obtain the code and run scripts!

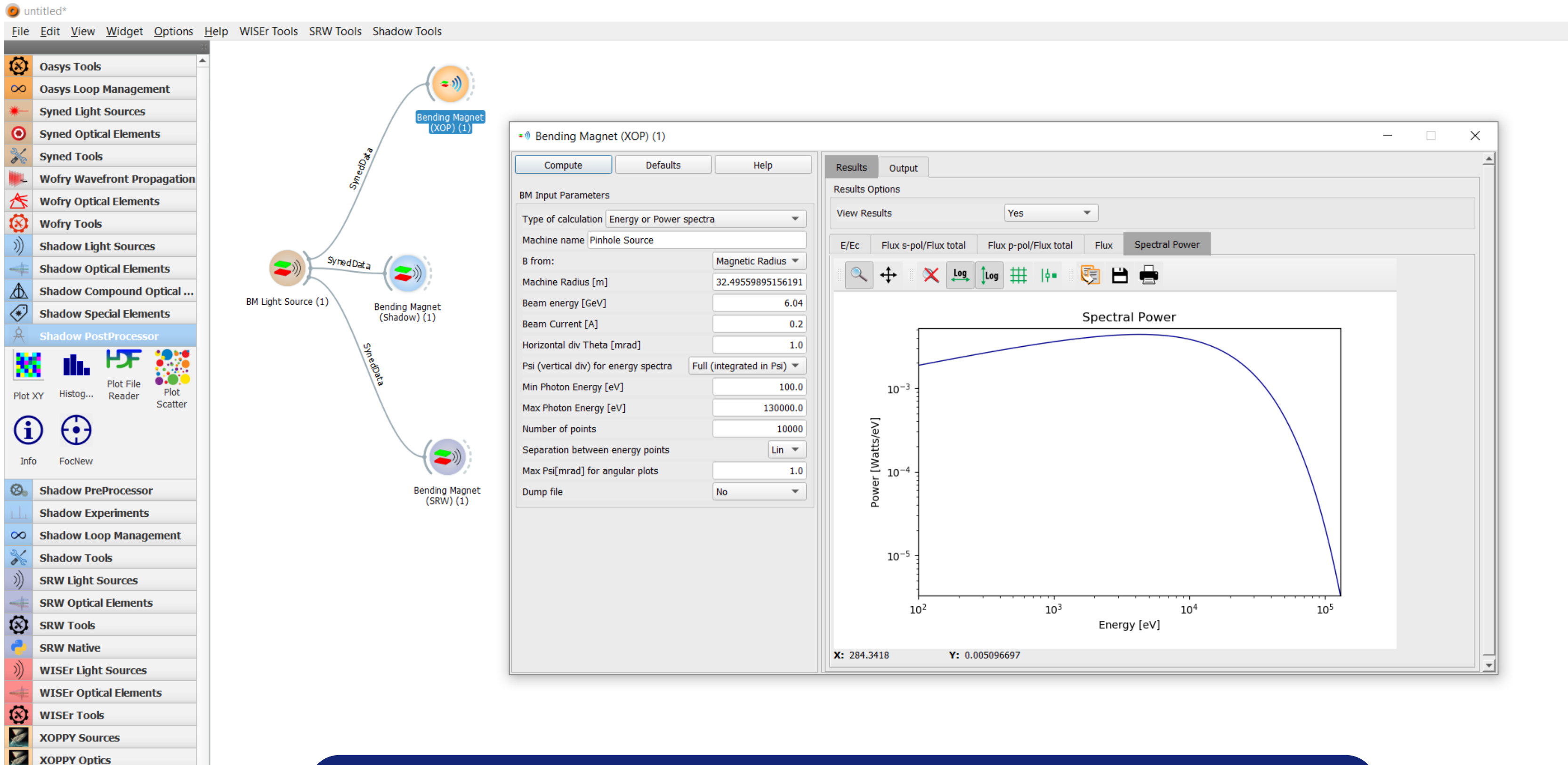
- **Worfry:** Simple optical wavefront (plane, spherical, Gaussian) propagation tool
- **Shadow:** Ray tracing simulations + Hybrid: to introduce diffraction (quick and dirty)
- **SRW:** Generation and optical propagation of SR wavefront
- **XOPY:** Generation and transmission/absorption of SR spectra

EXAMPLE - COMMON SOURCE GENERATION



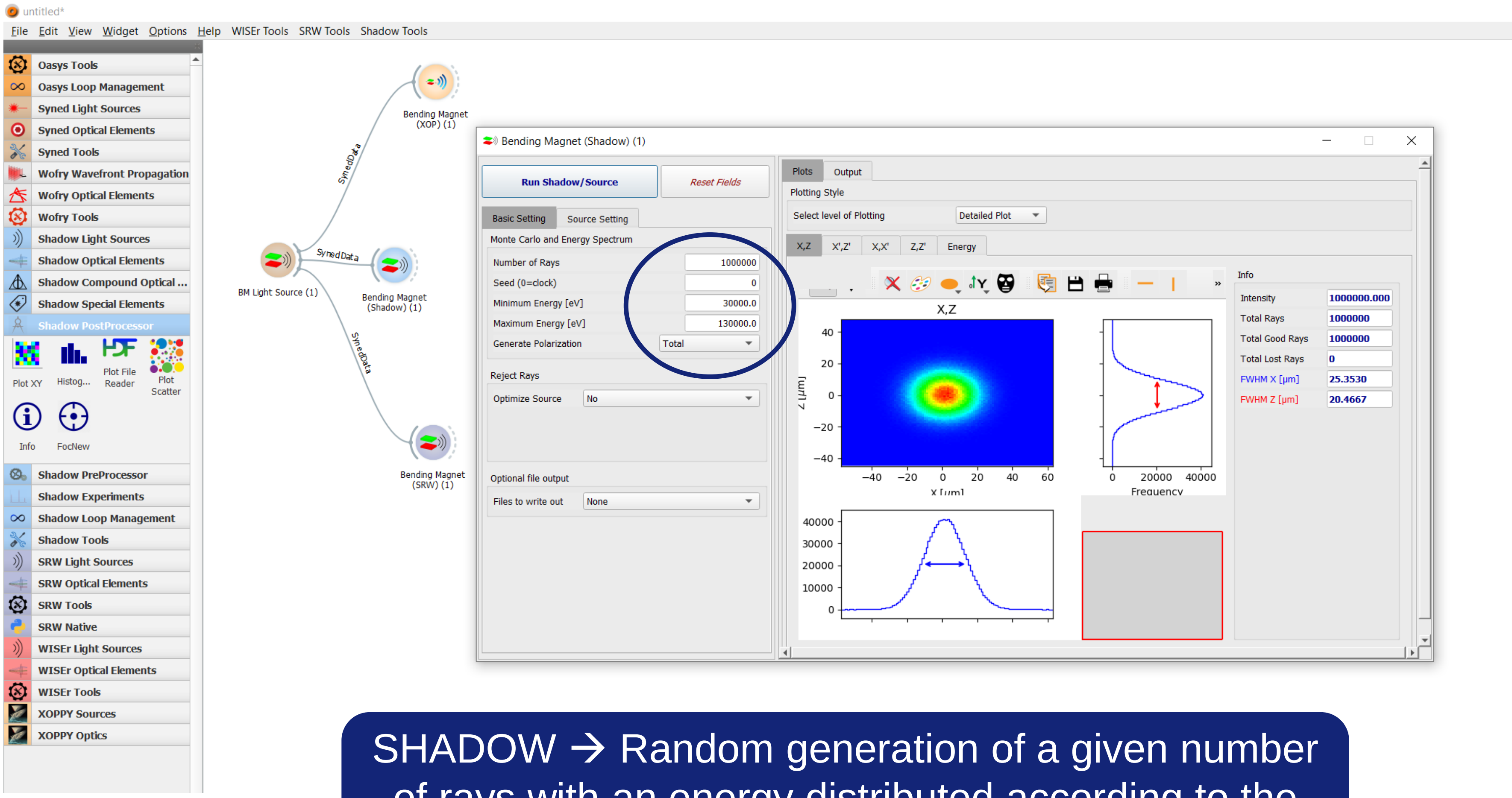
Possibility to create and save different source, common for all the different software, by defining lattice characteristics and beam parameters

EXAMPLE - SOURCE GENERATION - XOP



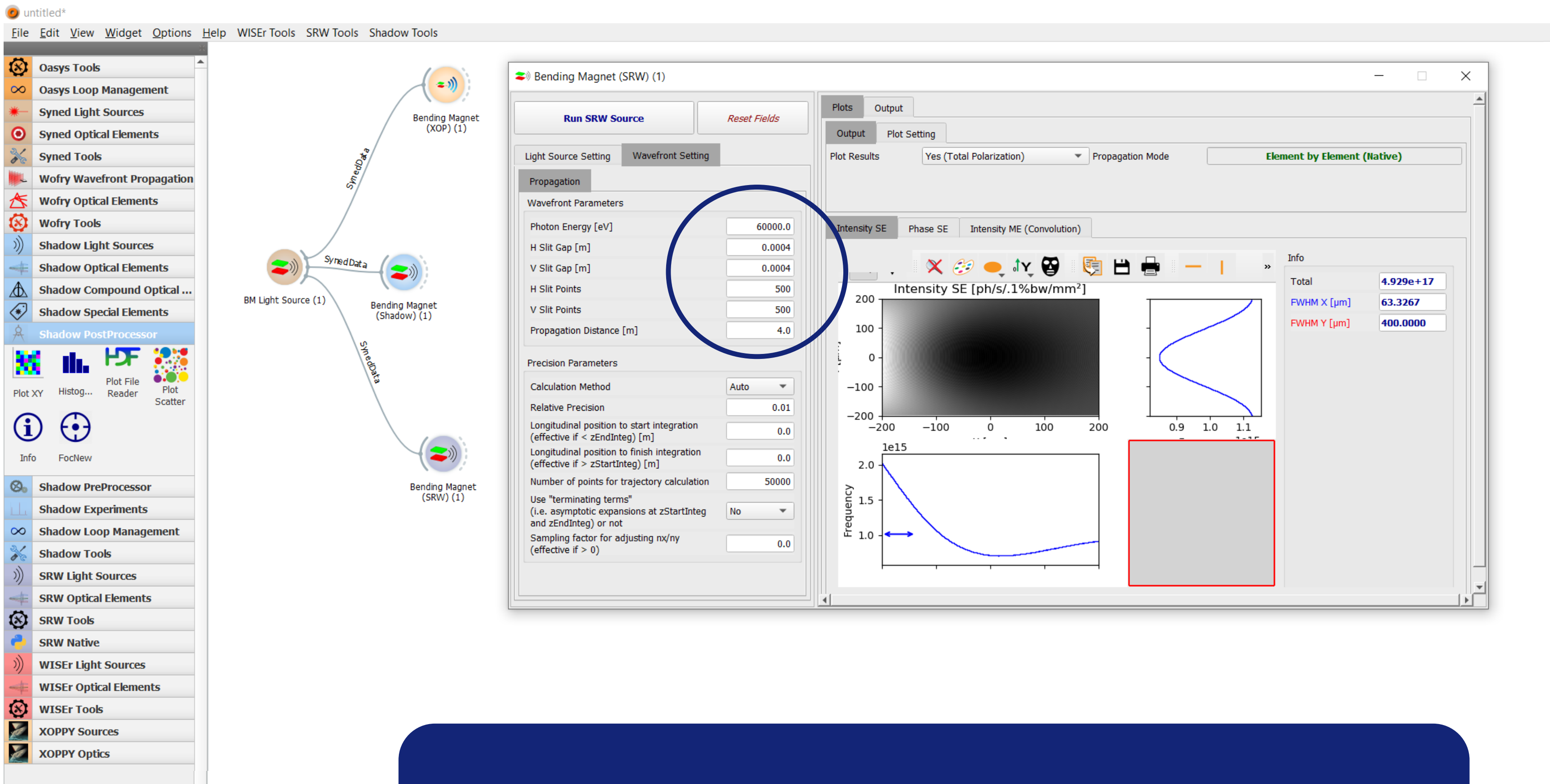
XOP → Generation of the SR spectra

EXAMPLE - SOURCE GENERATION - SHADOW



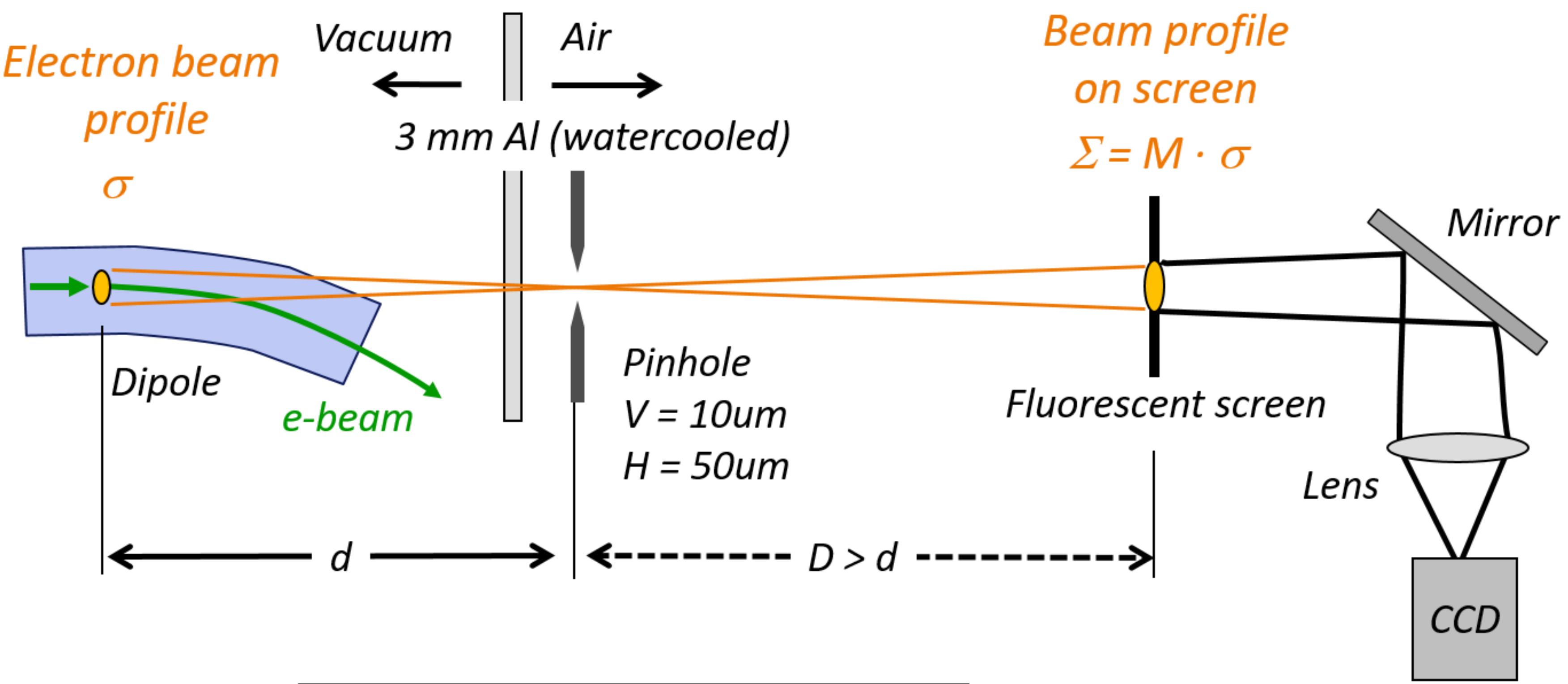
SHADOW → Random generation of a given number of rays with an energy distributed according to the SR spectra

EXAMPLE - SOURCE GENERATION - SRW



SRW → Generation of the SR wavefront at a given energy and a given position

THE PINHOLE

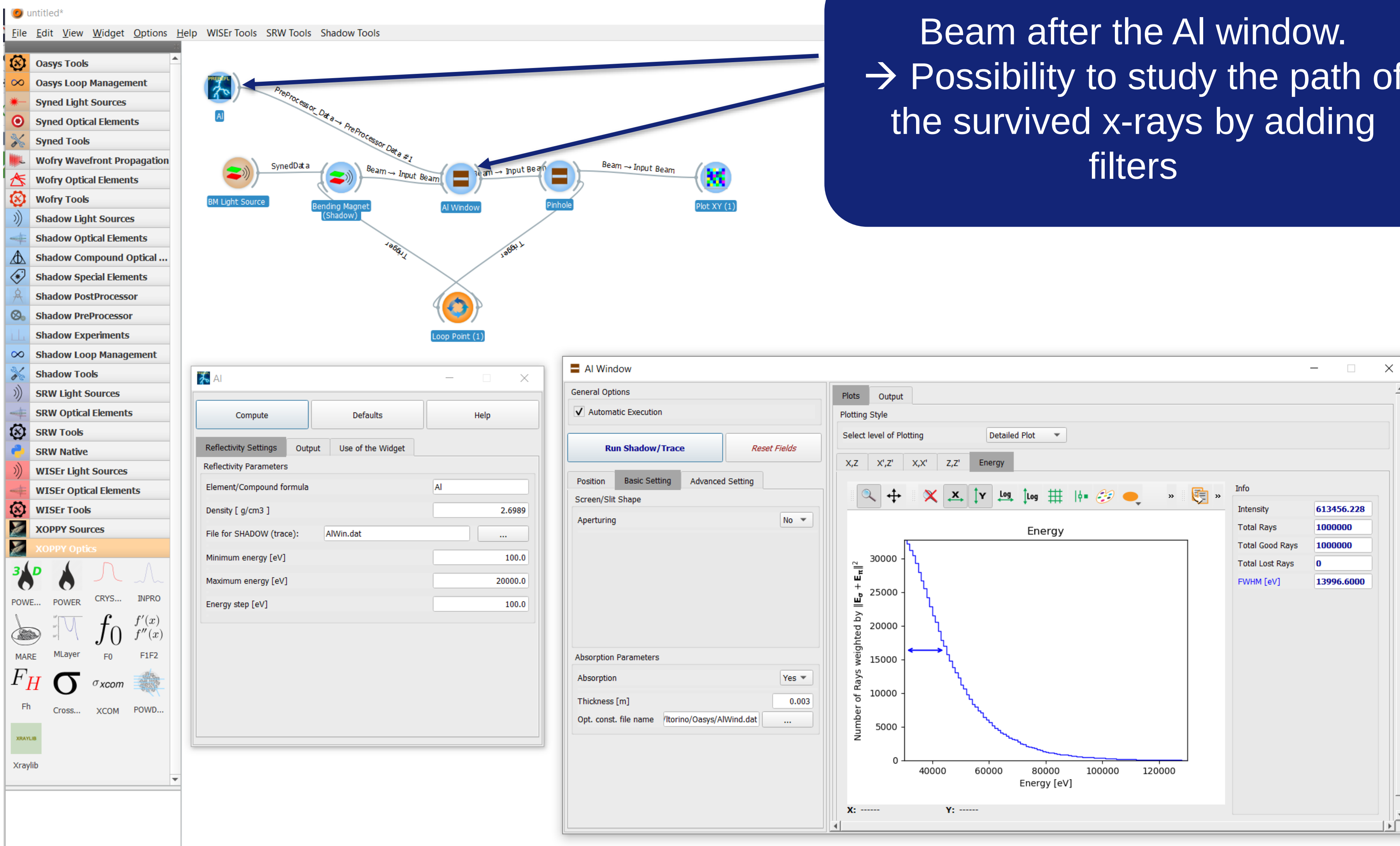


Pinhole magnification $M = D / d$

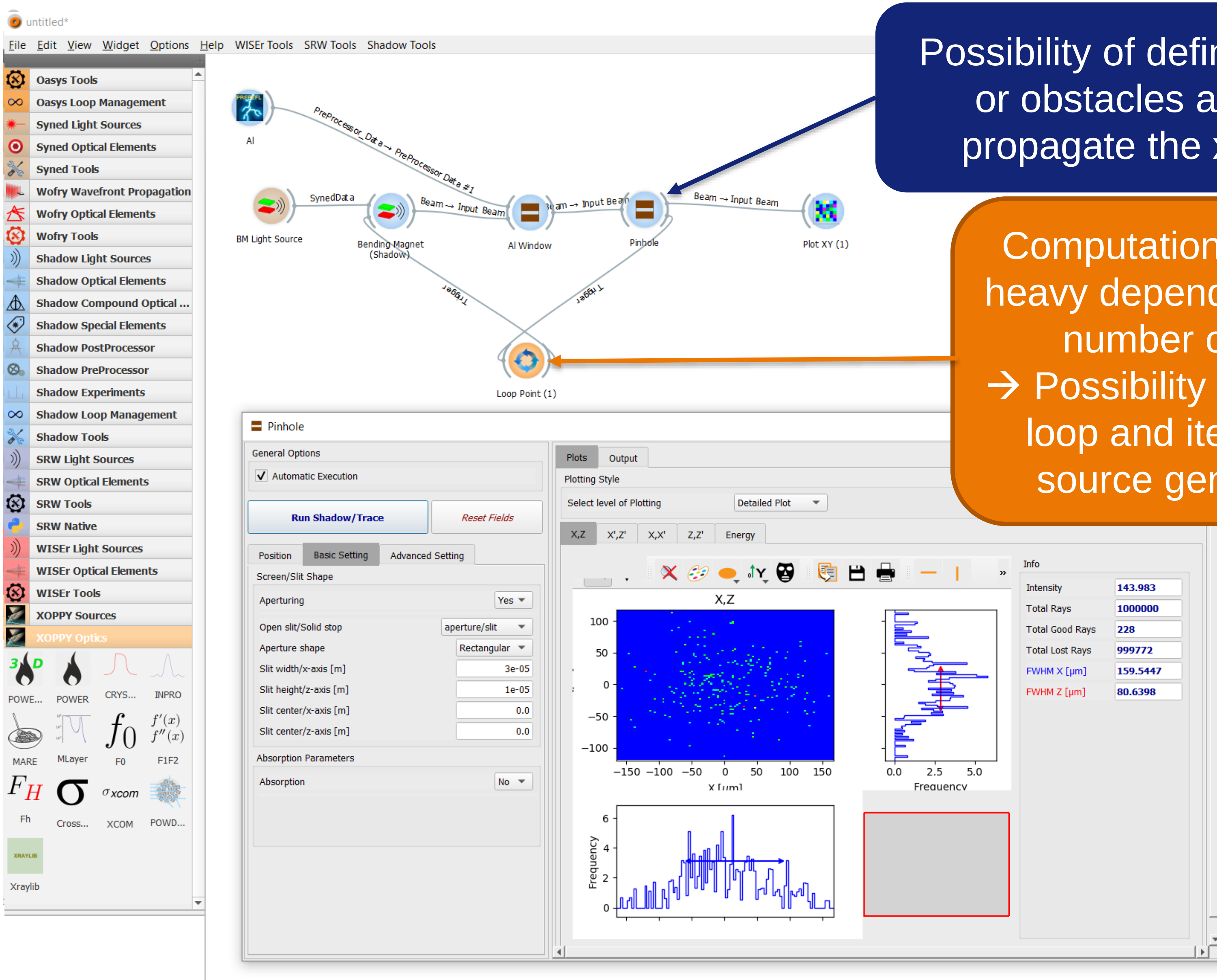
F. Ewald, "*Beam Size Monitoring at the ESRF: Comparison of different X-ray based techniques*"
Topical Workshop on Emittance Measurements for Light Sources and FELs, Barcelona, 29-30 January 2018

EXAMPLE - PINHOLE - SHADOW

Beam after the Al window.
→ Possibility to study the path of the survived x-rays by adding filters



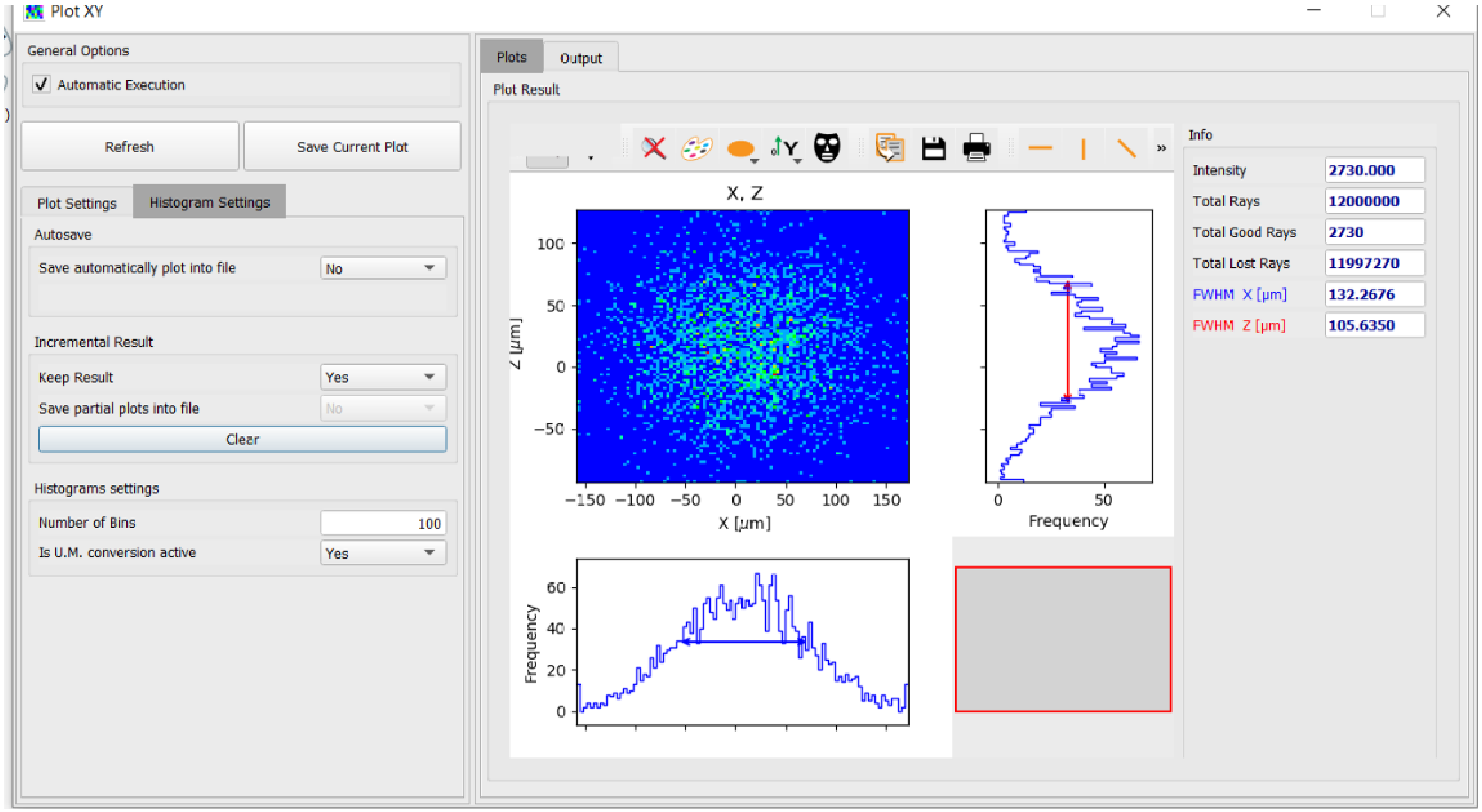
EXAMPLE - PINHOLE - SHADOW



Possibility of defining slits or obstacles and to propagate the x-rays

Computation might be heavy depending on the number of rays
→ Possibility to define a loop and iterate the source generation

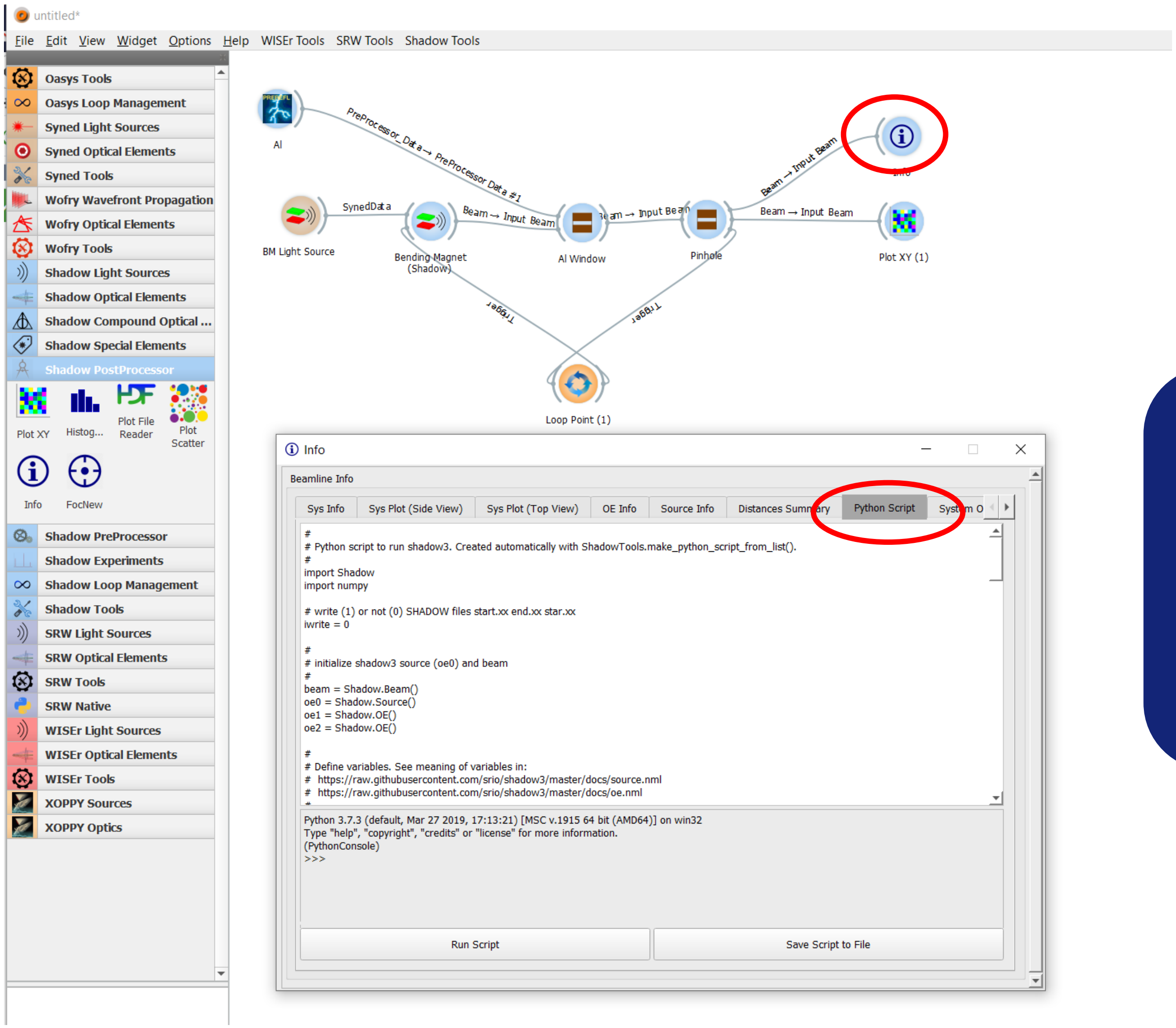
EXAMPLE - PINHOLE - SHADOW



NOTE: Very heavy for the computer!

Possibility to retrieve the python script and run it into a cluster!

EXAMPLE - PINHOLE - SHADOW



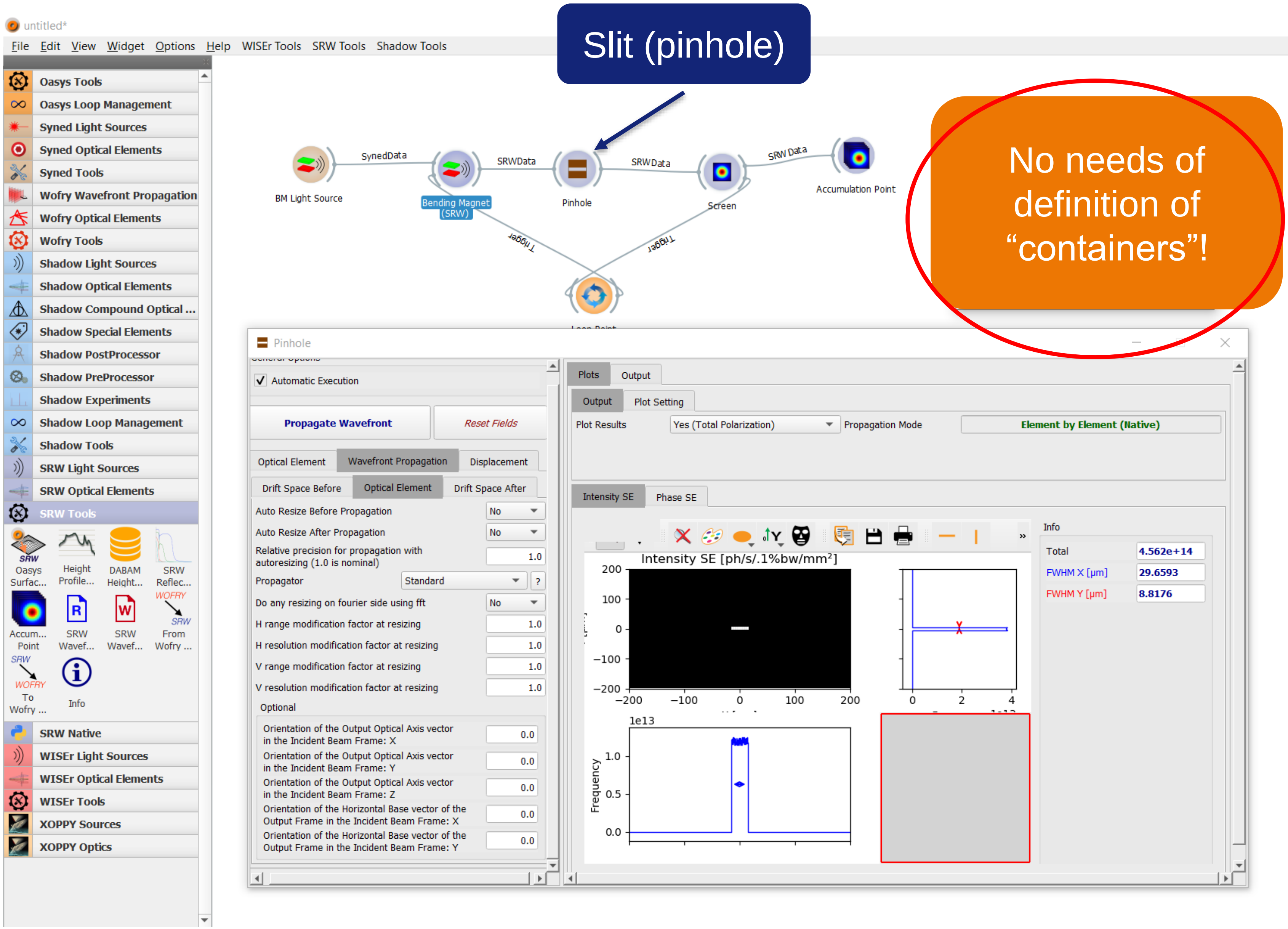
On the “Info” buttons it is possible to find several info on the simulation and the Python script!

The European Synchrotron | ESRF

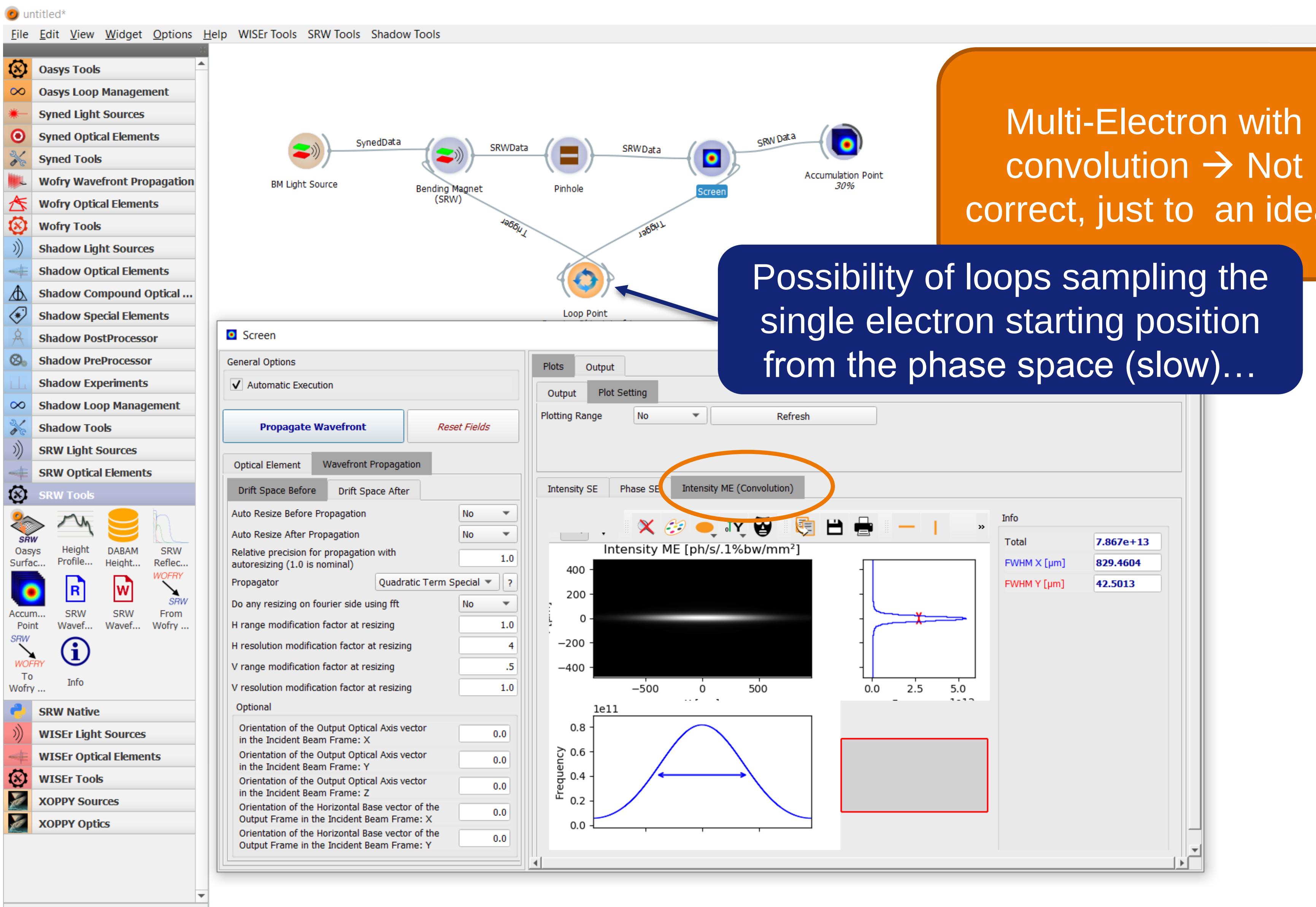
EXAMPLE - PINHOLE - SRW

Generation of the source until the first slit (just before the pinhole)

EXAMPLE - PINHOLE - SRW



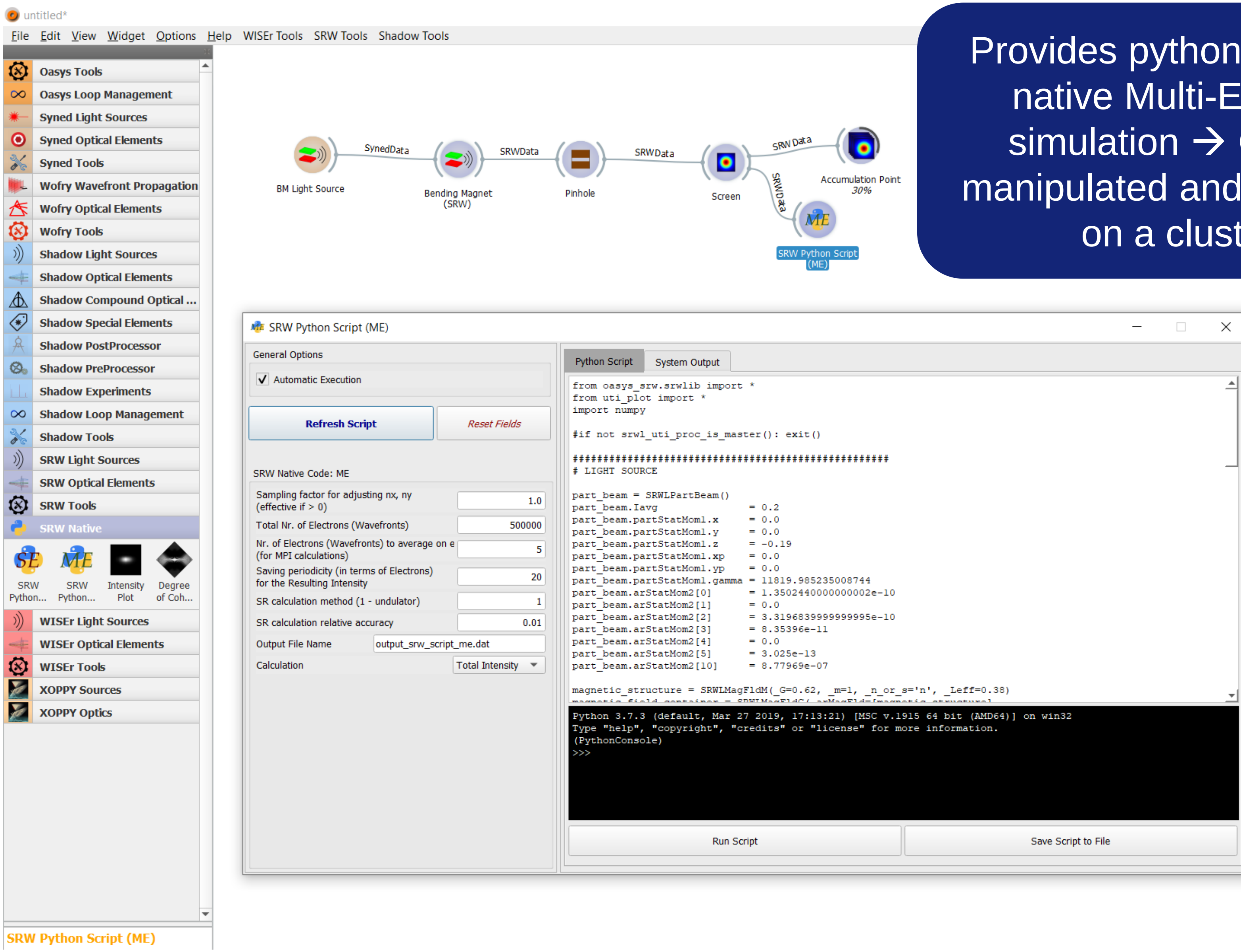
EXAMPLE - PINHOLE - SRW



Multi-Electron with convolution → Not correct, just to an idea!

Possibility of loops sampling the single electron starting position from the phase space (slow)…

EXAMPLE - PINHOLE - SRW



Provides python script for native Multi-Electron simulation → Can be manipulated and launched on a cluster!

OVERVIEW AND REFERENCES

OASYS is an intuitive SR generation and propagation software:

- Allows to perform quick simulations step by step
- Useful to "align" and optimize the main parameter
- Computationally heavy but provides Python scripts which might be modified and run in a cluster (after all the optimization has been done!)

You can find the software and the installation how-to in:
https://github.com/oasys-kit

The material for the First OASYS School, with some extremely useful slides and several examples can be found in:
https://github.com/oasys-kit/oasys_school

A second OASYS school is foreseen soon (in the US…)

Many thanks to M. Sanchez del Rio, R. Celestre, J. Reyes (ESRF), L. Rebuffi (APS)