Introduction to WOFRY

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ALS ADVANCED LIGHT SOURCE

WOFRY https://github.com/oasys-kit/wofry

Wave Optics FRamwork in pYthon

WOFRY is the OASYS framework for waveoptics calculations. It contains a threefold functionality:

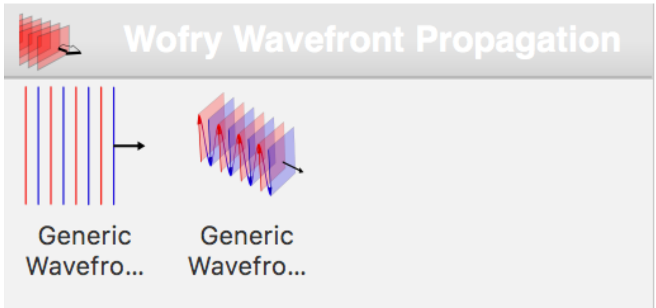
- it provides a generalization (or abstraction) of a software tool for wave optics, combining the component definitions from SYNED with the abstract declaration of wavefronts and propagators https://doi.org/10.1117/12.2274232

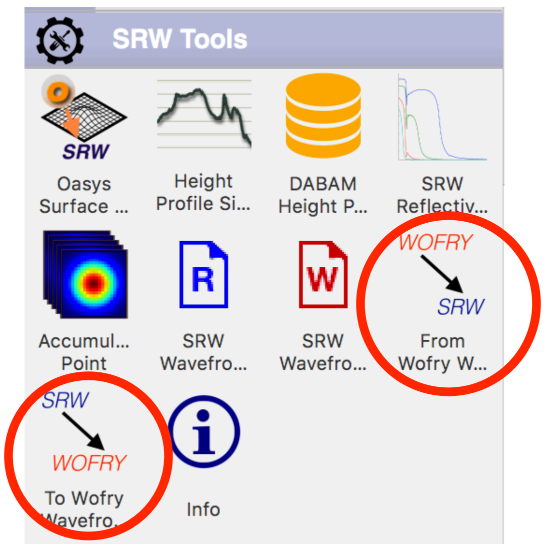
- it defines a mechanism for interfacing a wave optics code (e.g., SRW, WISE etc.) in it, a first step for becoming interfaced in OASYS

- it provides native implementations of simple wavefronts (e.g., plane waves, spherical waves, Gaussian sources) and propagators for prototyping optical systems.

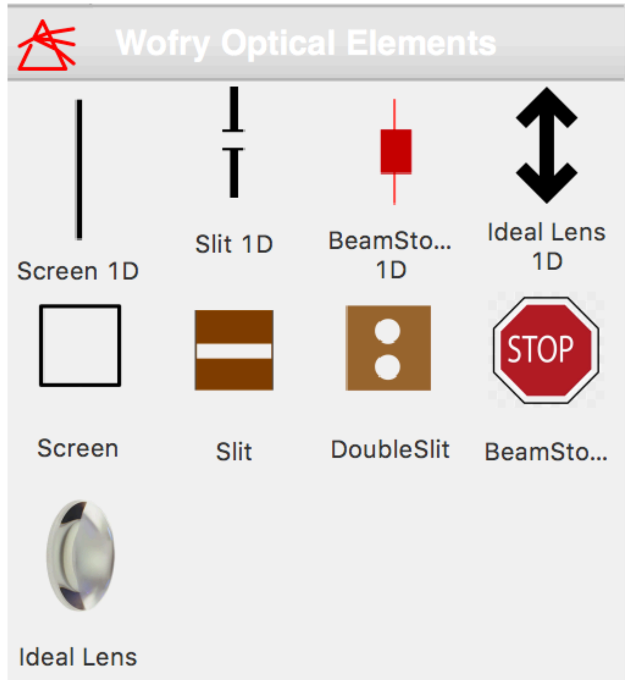
WOFRY

Sources

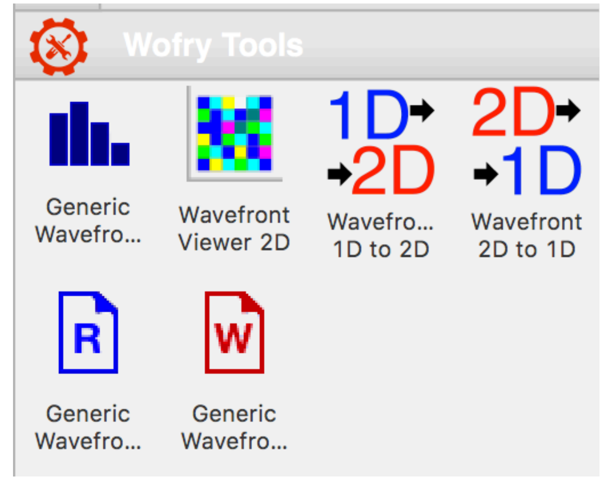




Optical elements

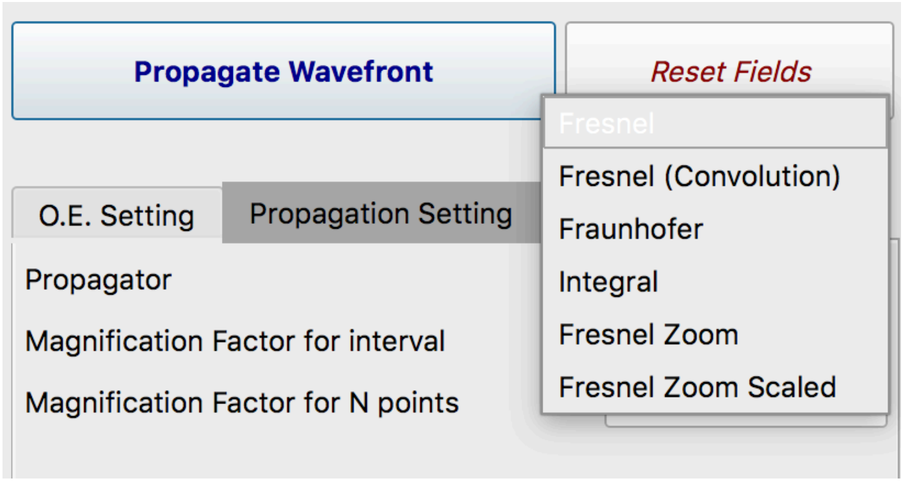


Tools

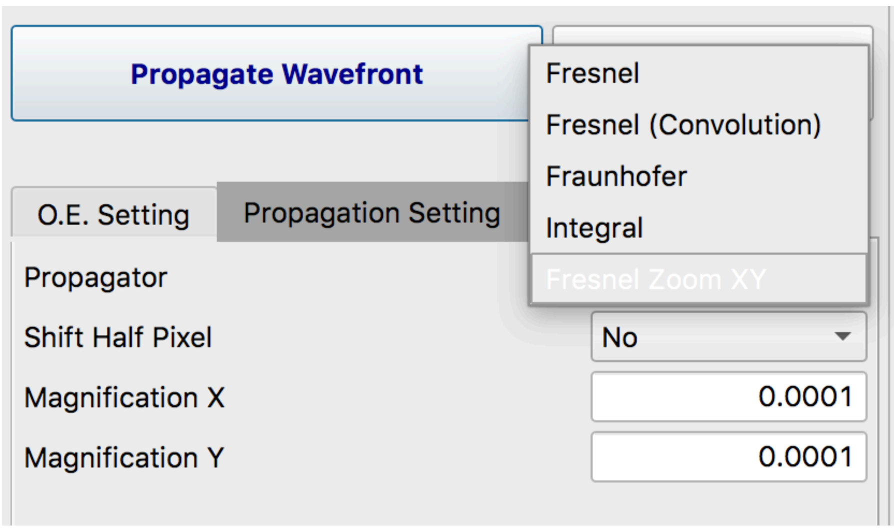


Propagators

1D



2D



Fresnel

Fresnel (convolution)

Integral

Fresnel Zoom

Fresnel Zoom Scaled

Zoom Propagator

$$U(x_2, y_2) = \frac{e^{ik\Delta z}}{\sqrt{m_x m_y}} e^{i\frac{k}{2\Delta z}[\frac{m_x - 1}{m_x} x_2^2 + \frac{m_y - 1}{m_y} y_2^2]}$$

$$\mathcal{F}^{-1}\left[\mathcal{F}\left[U(x_1, y_1) e^{i\frac{k}{2\Delta z}[(1-m_x)x_1^2 + (1-m_y)y_1^2]}\right] \times e^{-i\pi\lambda\Delta z(\frac{f_x^2}{m_x} + \frac{f_y^2}{m_y})}\right]$$

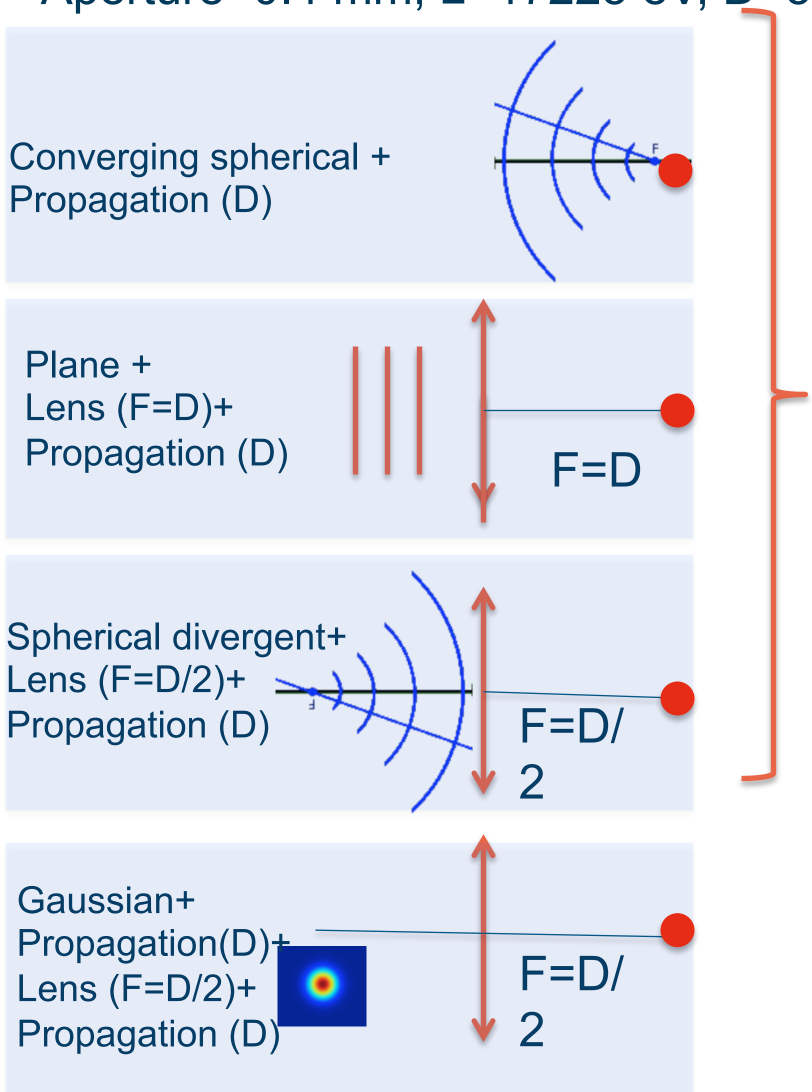
Jason D. Schmidt. *Numerical Simulation of Optical Wave Propagation*. SPIE Press, Bellingham, WA, USA, 2010.

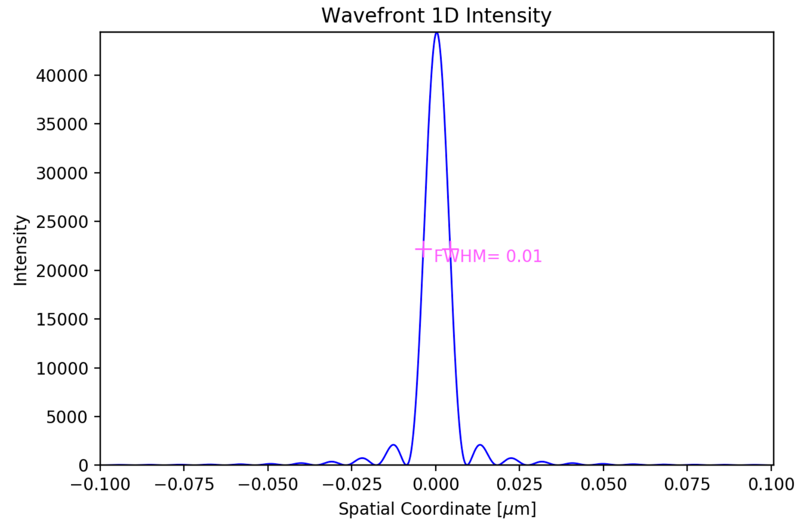
G. Pirro, Master Thesis (2017)

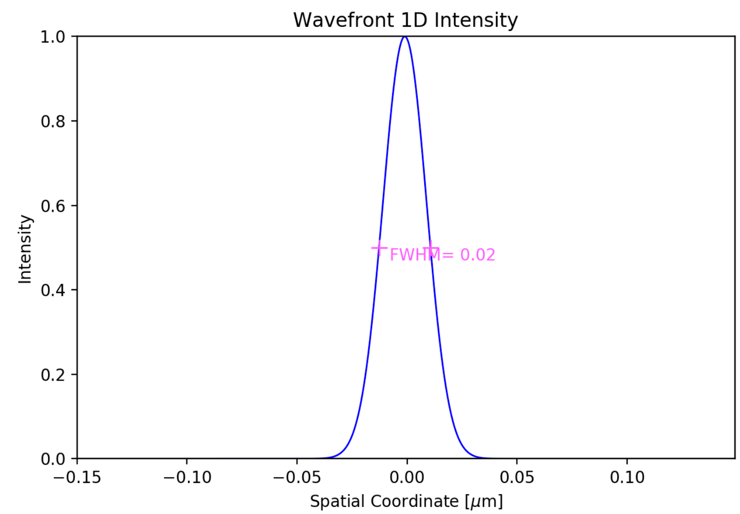
https://github.com/oasys-kit/documents/blob/master/zoom_propagator_pirro_thesis.pdf

wofry_examples.ows simple propagation cases

Aperture=0.4 mm, E=17225 eV, D=5cm

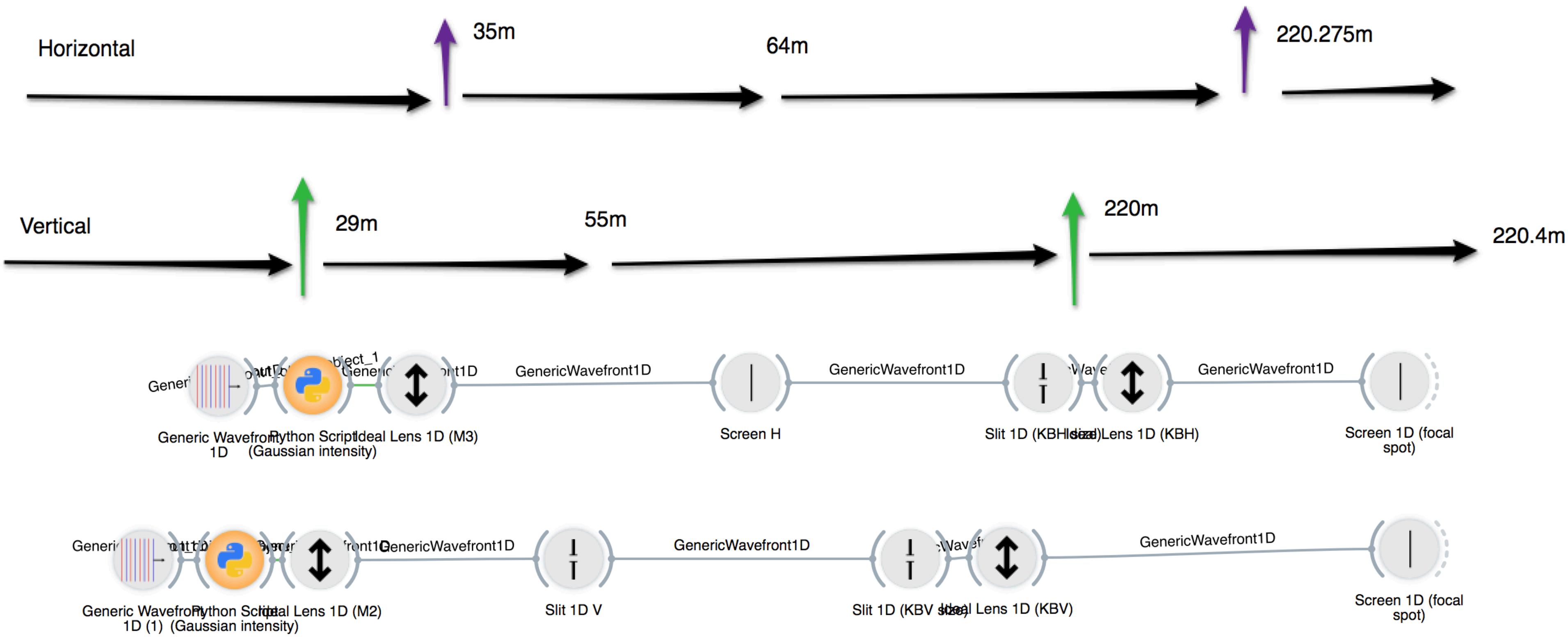




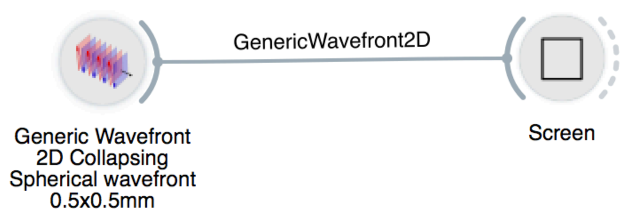


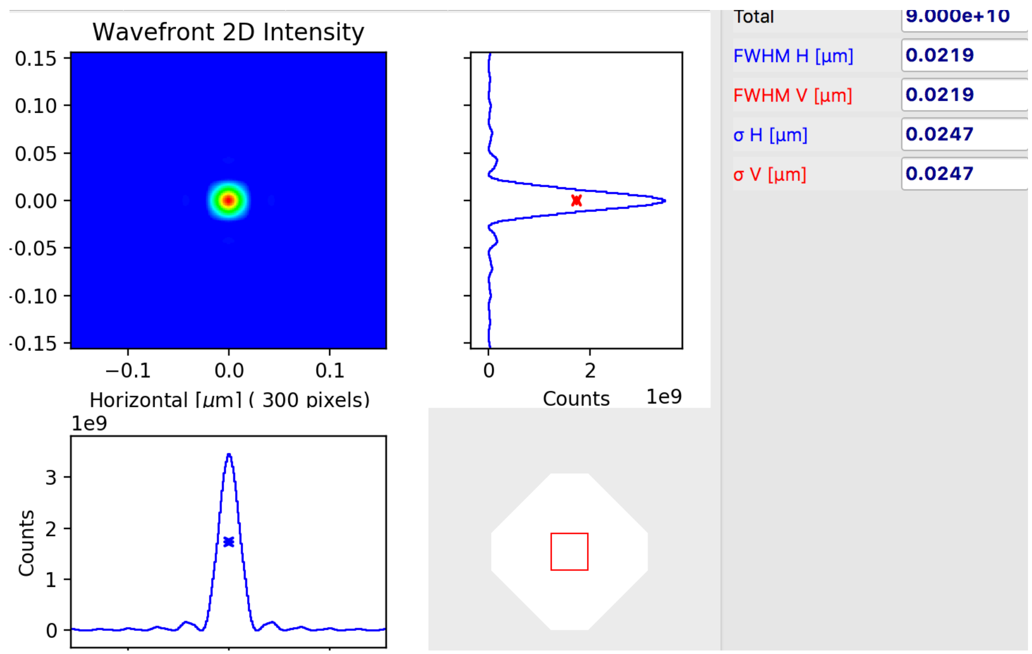
6

1D simplified model of ISN Beamline



2D Oversimplified Beamline

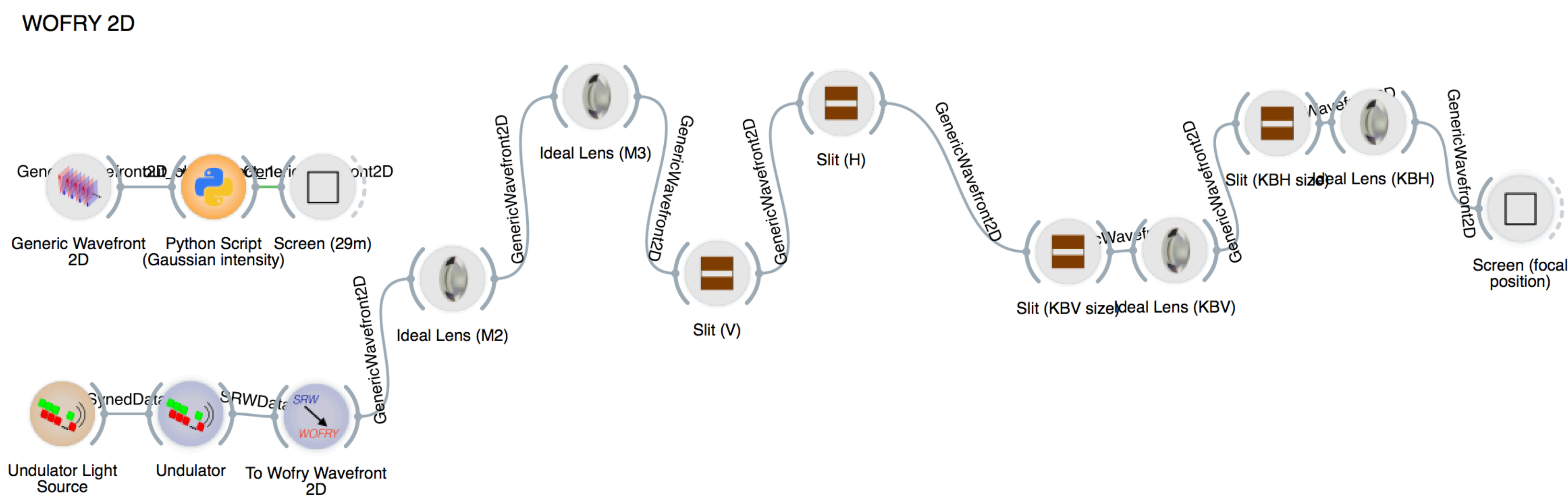




Theoretical consideration

The diffraction by a DxD square aperture of a collapsing spherical wavefront has an intensity distribution proportional to $\mathrm{sinc}^2(kDx/2f)\ \mathrm{sinc}^2(kDy/2f)$, where $k=2\pi/\lambda$, x(y) is the horizontal (vertical) coordinate, and f is the distance aperture-focus (D/f is the divergence). Considering that the FWHM of $\mathrm{sinc}^2(x)$ is approximately 2.78, one obtains a FWHM=0.885 * wavelength / divergence=18nm

2D simplified model of ISN Beamline



Shortcuts to second OASYS school web:

http://tinyurl.com/r5fq6pe

http://tinyurl.com/v98cllg/ISN_undulator_25KeV.json