Optical simulations of SmartPhantom

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Further Zemax work (from LhARA Collaboration meeting)

Develop image correction procedure based on synthetic sources;

Include realistic sensor pixel size and noise;

Investigate the optical effect of including an acoustic sensor within the scintillator volume;

Determine the sensitivity of the simulation to intensity cut-off (0.1 % relative at present);

Determine the sensitivity of the simulation to scintillation wavelength (chromatic aberration);

See if any further optimisation of the imaging optics is helpful;

Develop a system to help us focus the imaging optics

Ultima XR –radioluminescence spectrum

Scintillation spectrum of Ultima XR (from reference graph)

Wavelength weighting for optical simulation
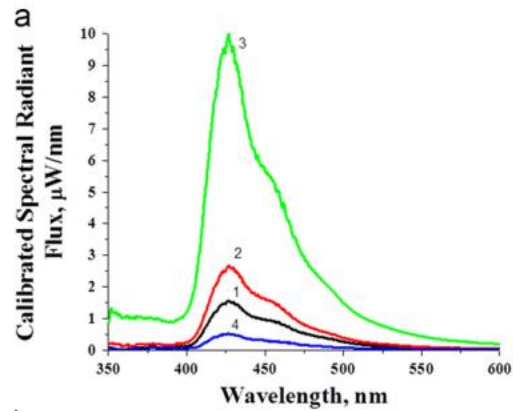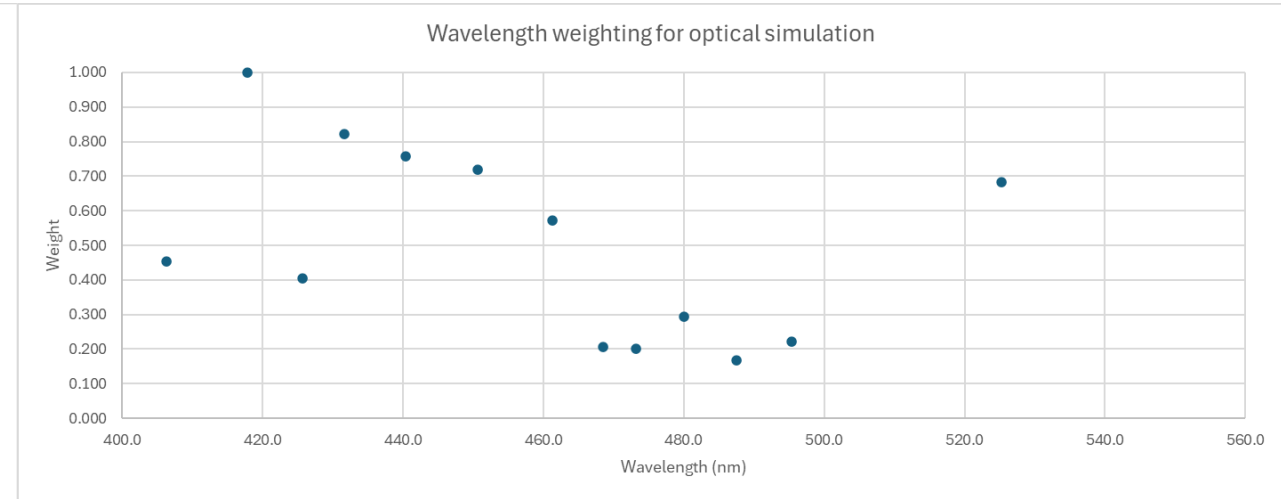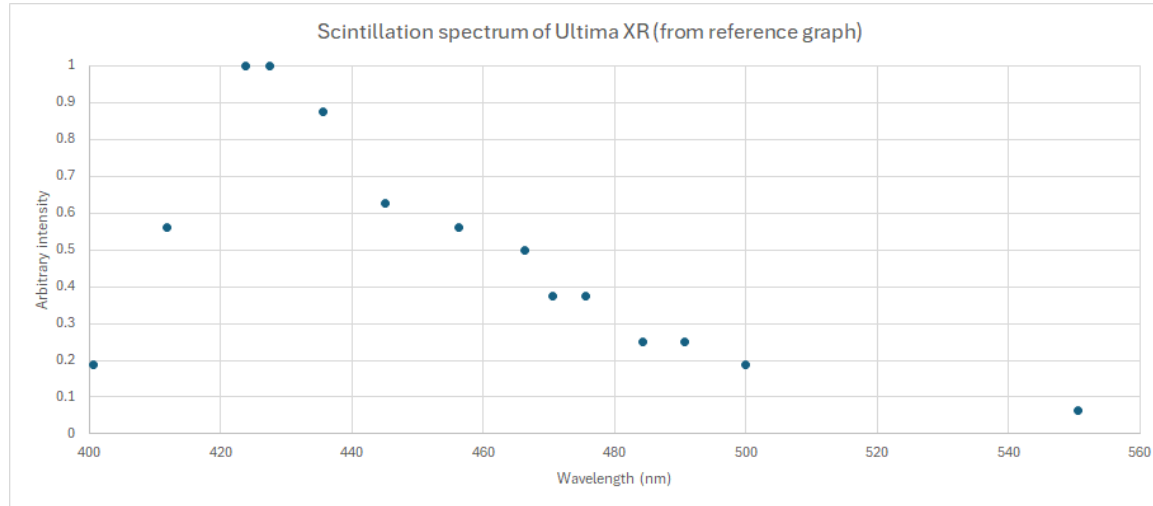
Data taken from this graph (curve 4 in blue) in
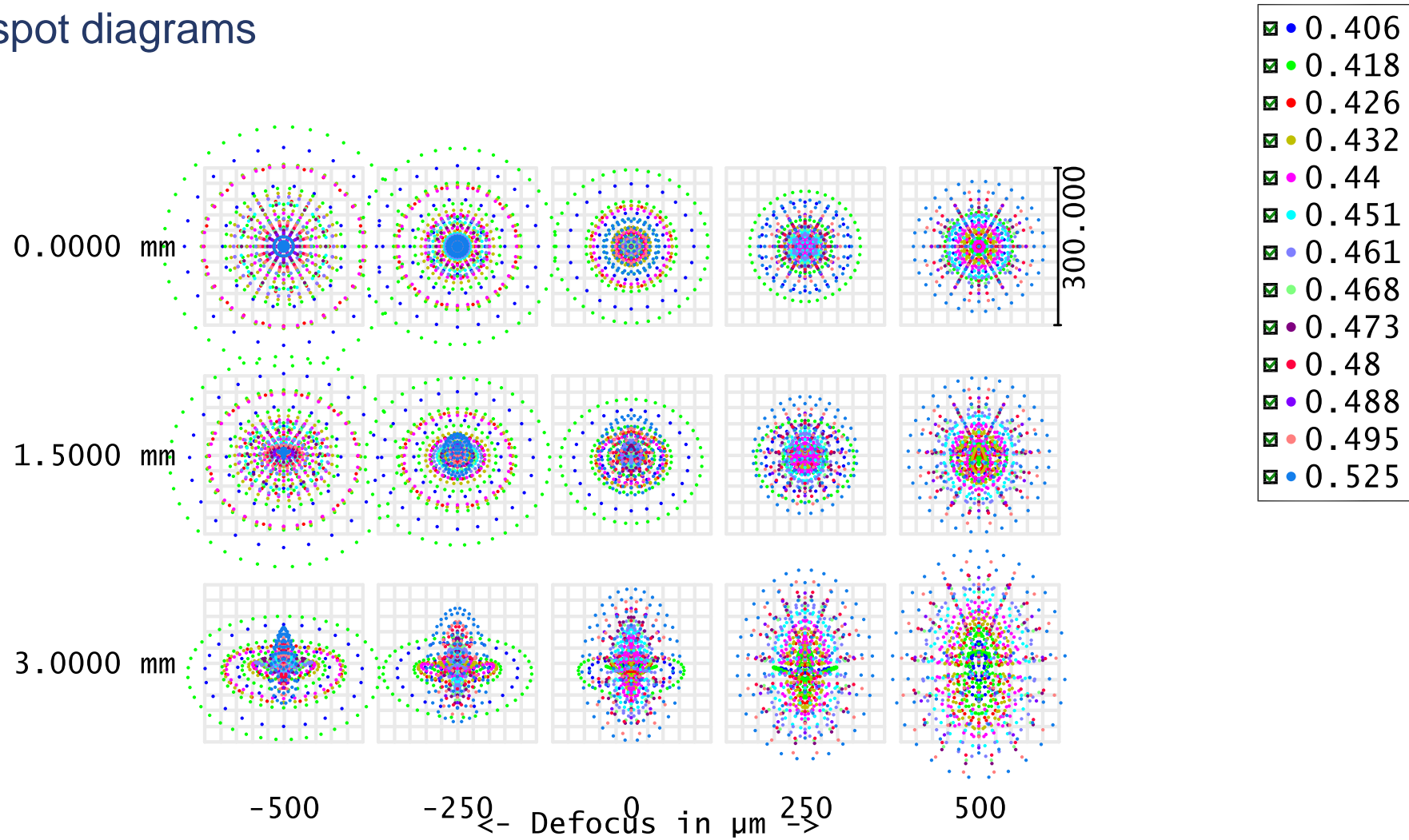*Radiation Physics and Chemistry* **84** (2013) 59–65

Zemax simulation – imaging optics only!
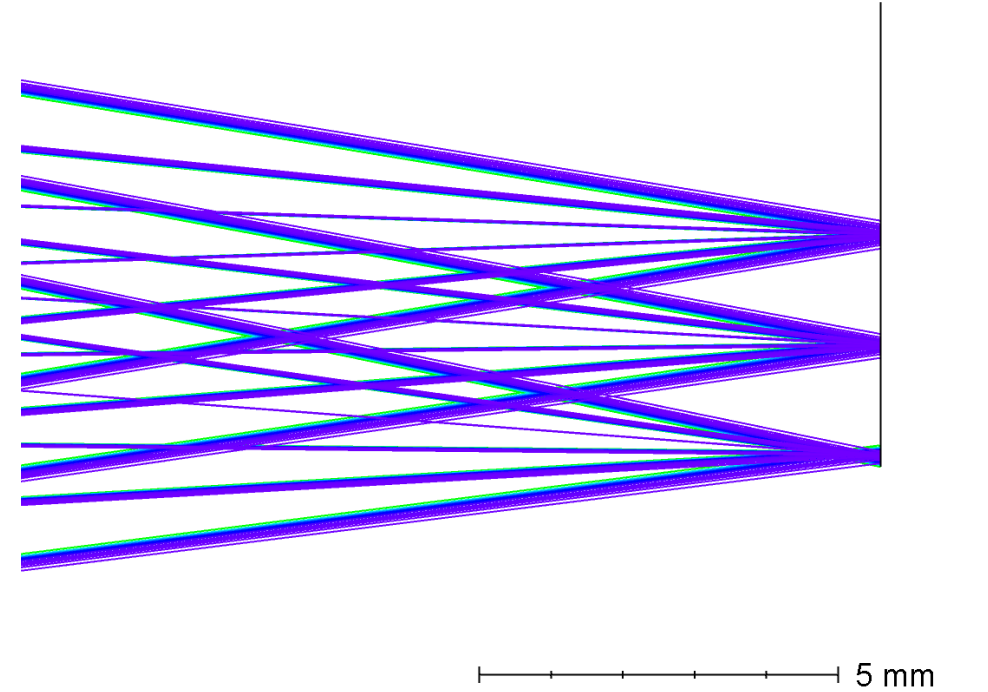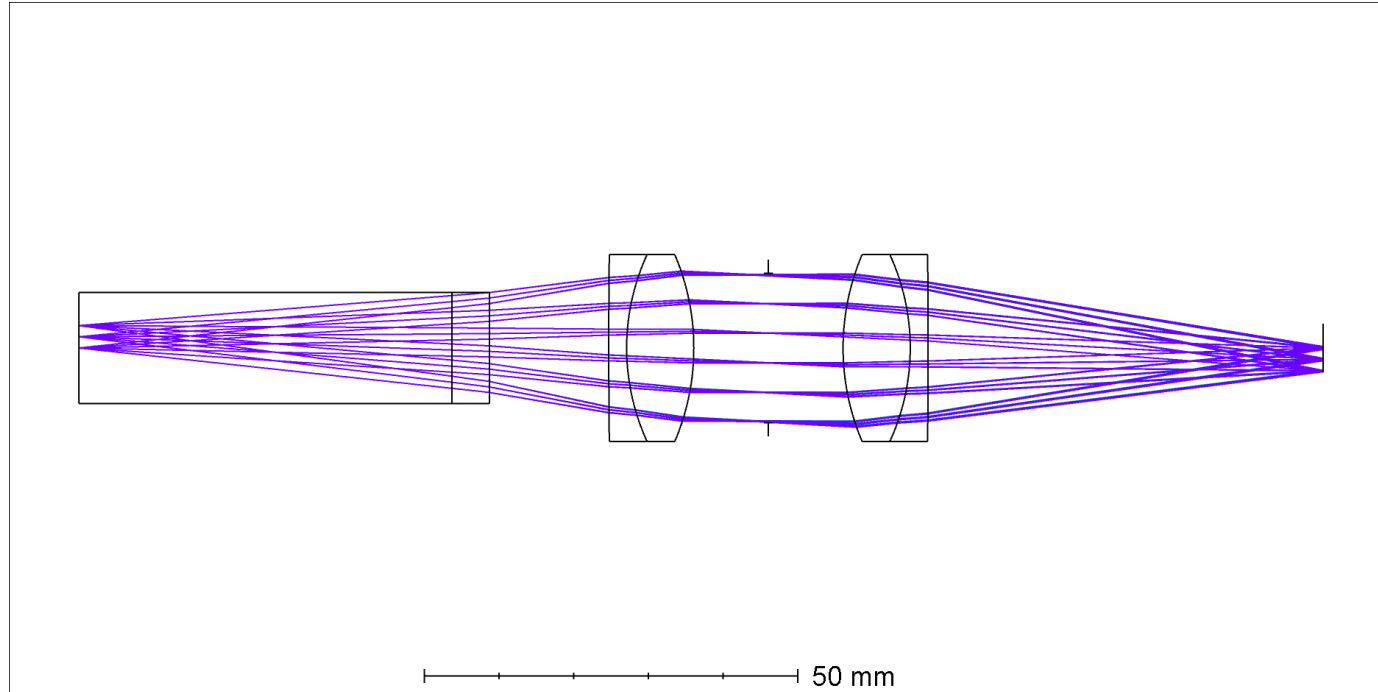
Volumes are Ultima XR, BK7 window and two achromatic doublets in air, finally the sensor plane.
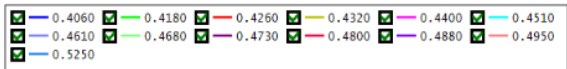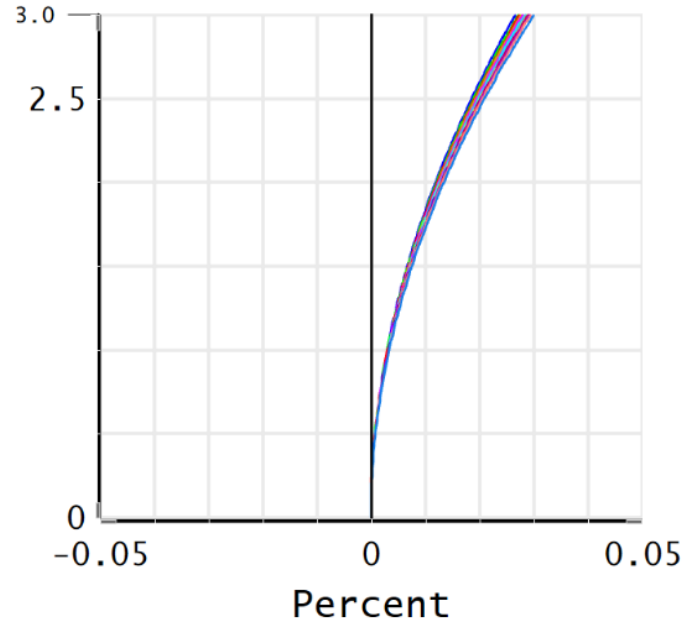Fields at 0, 1.5 and 3 mm on the object are traced.

Zemax simulation – imaging optics only!
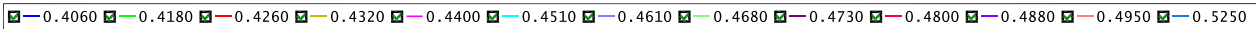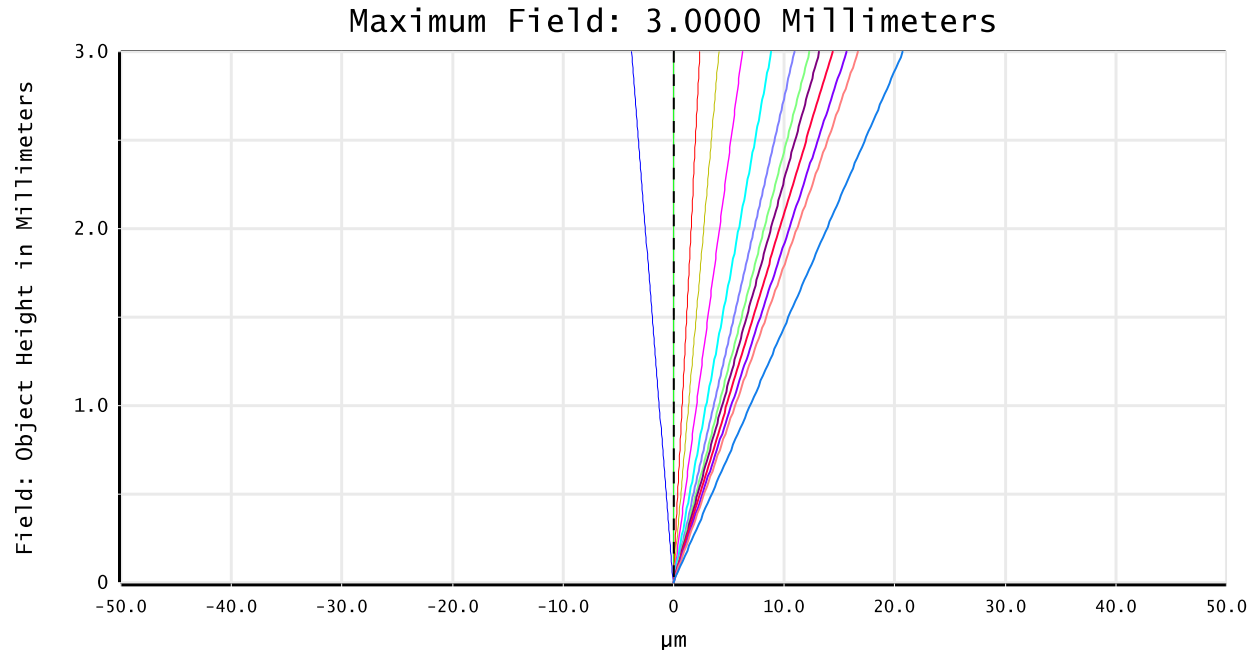
Through-focus spot diagrams

Zemax simulation – imaging optics only!
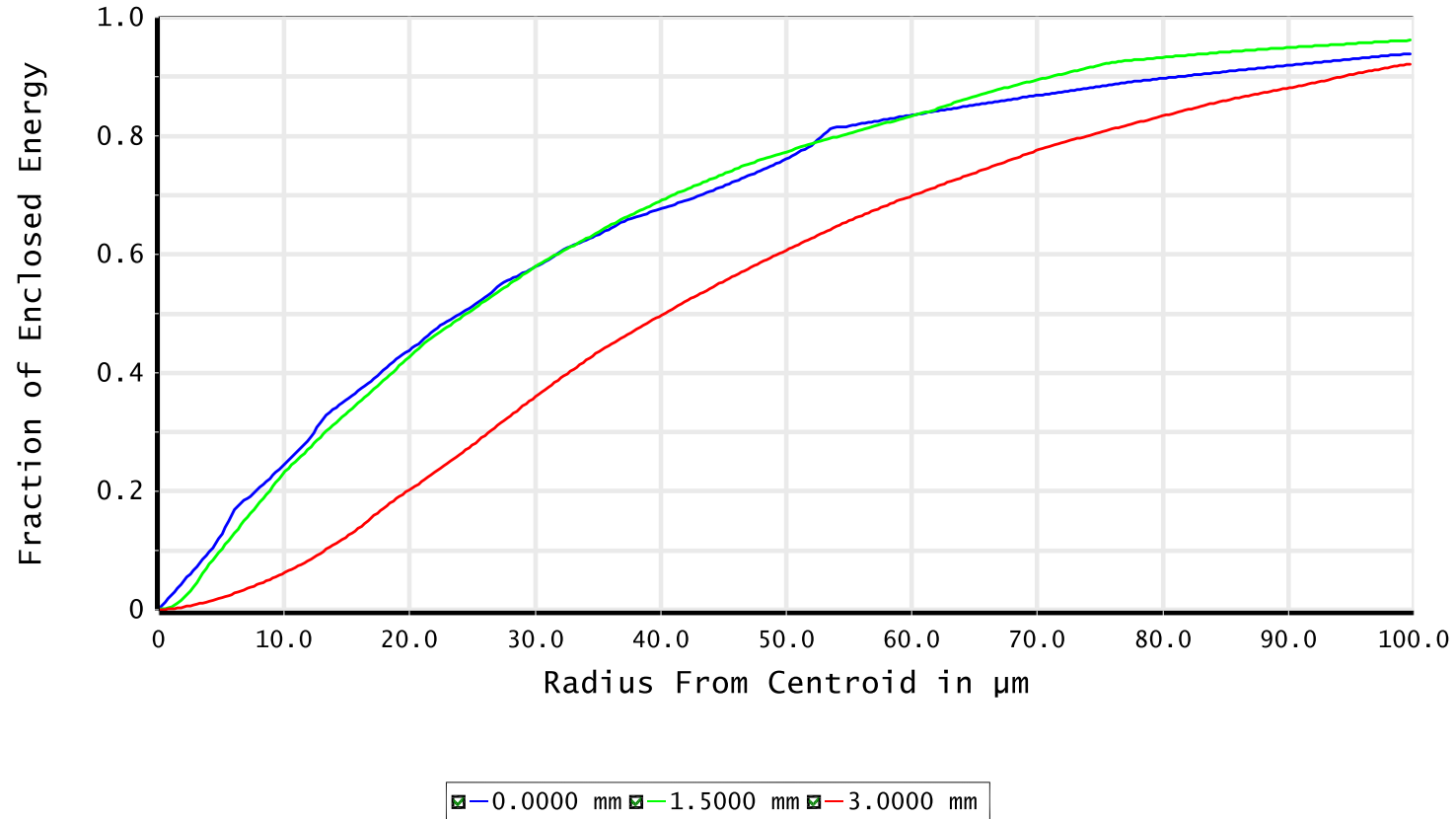
Distortion

F-Tan(Theta) Distortion

Lateral Colour

Maximum Field: 3.0000 Millimeters

Lateral Color

Zemax simulation – imaging optics only!

Polychromatic encircled energy using
weighted wavelengths

Geometric Encircled Energy
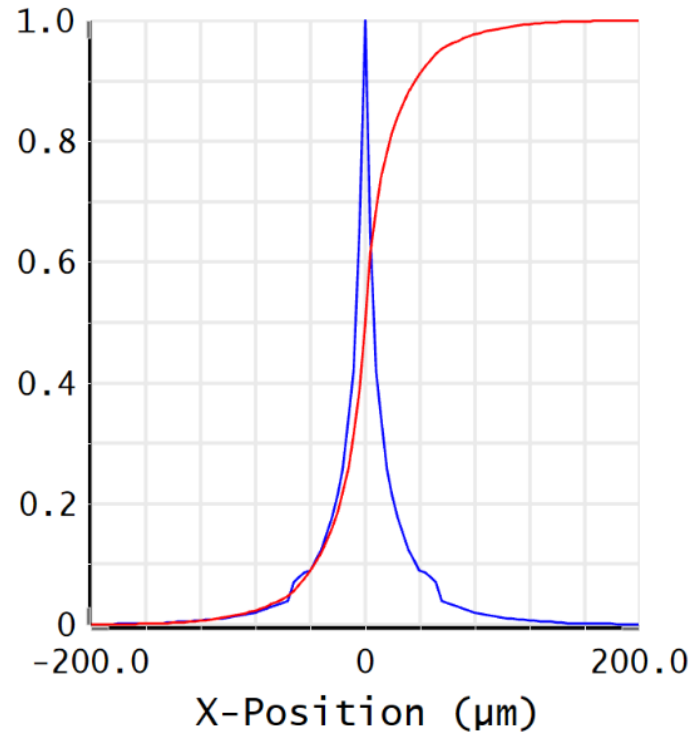
Queen Mary
University of London
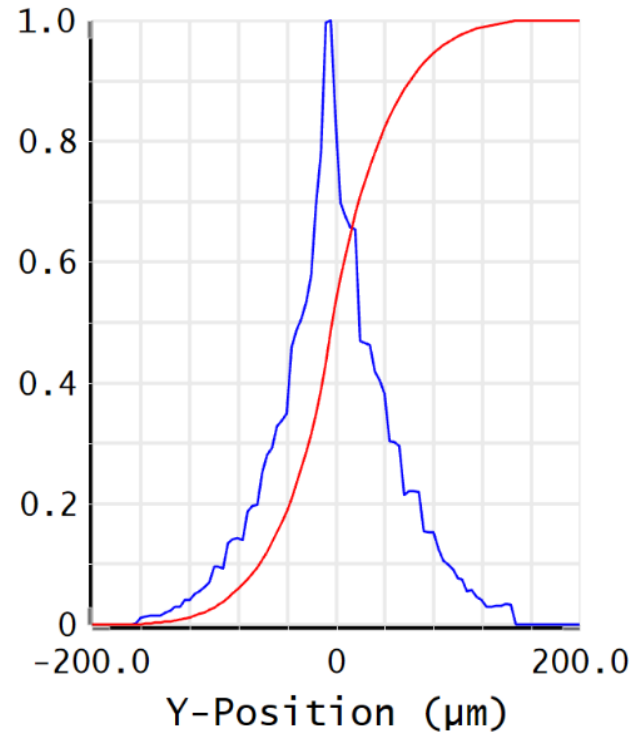Science and Engineering

Zemax simulation – imaging optics only!

On-axis

3 mm off-axis
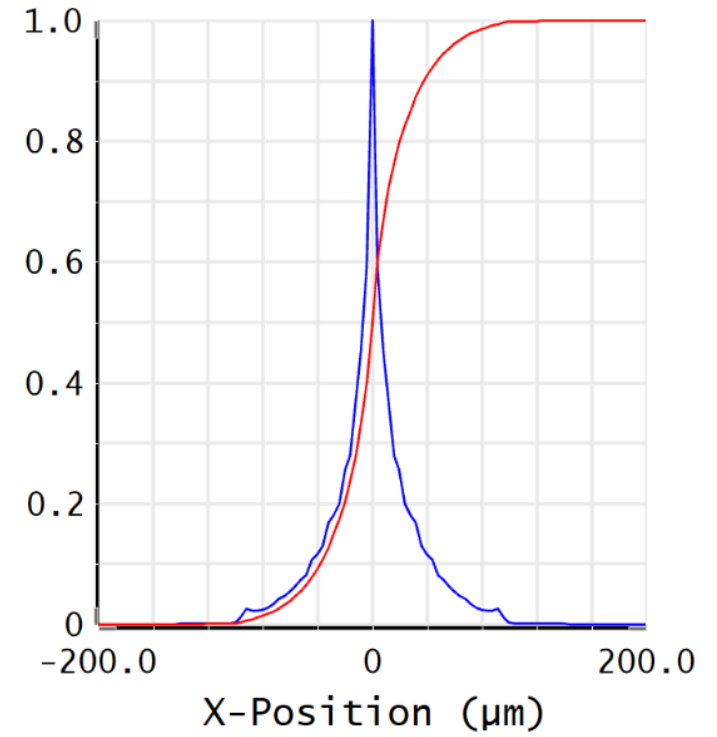
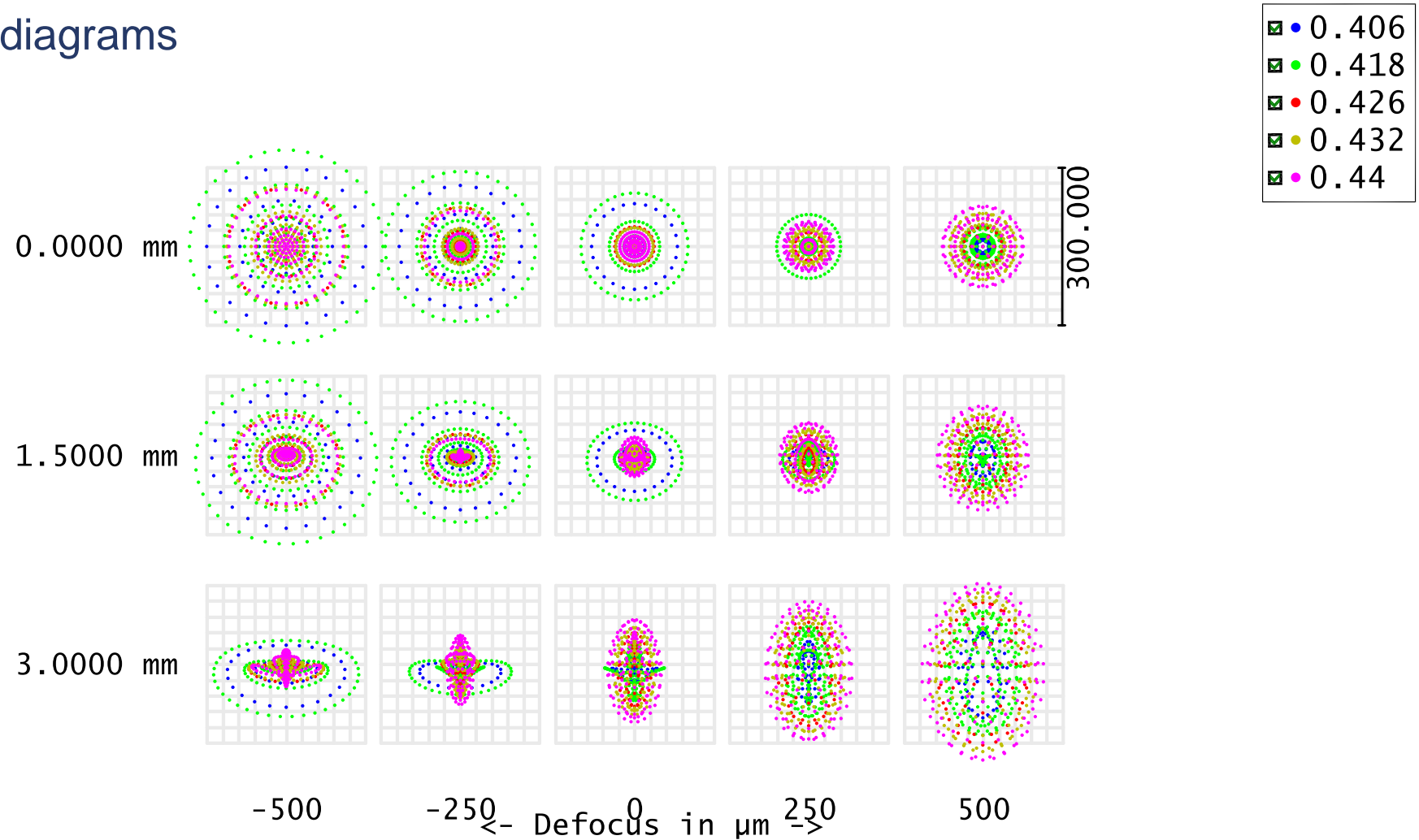Geometric Line and Edge Spread - Y-Orientation | Geometric Line and Edge Spread - X-Orientation | Geometric Line and Edge Spread - Y-Orientation
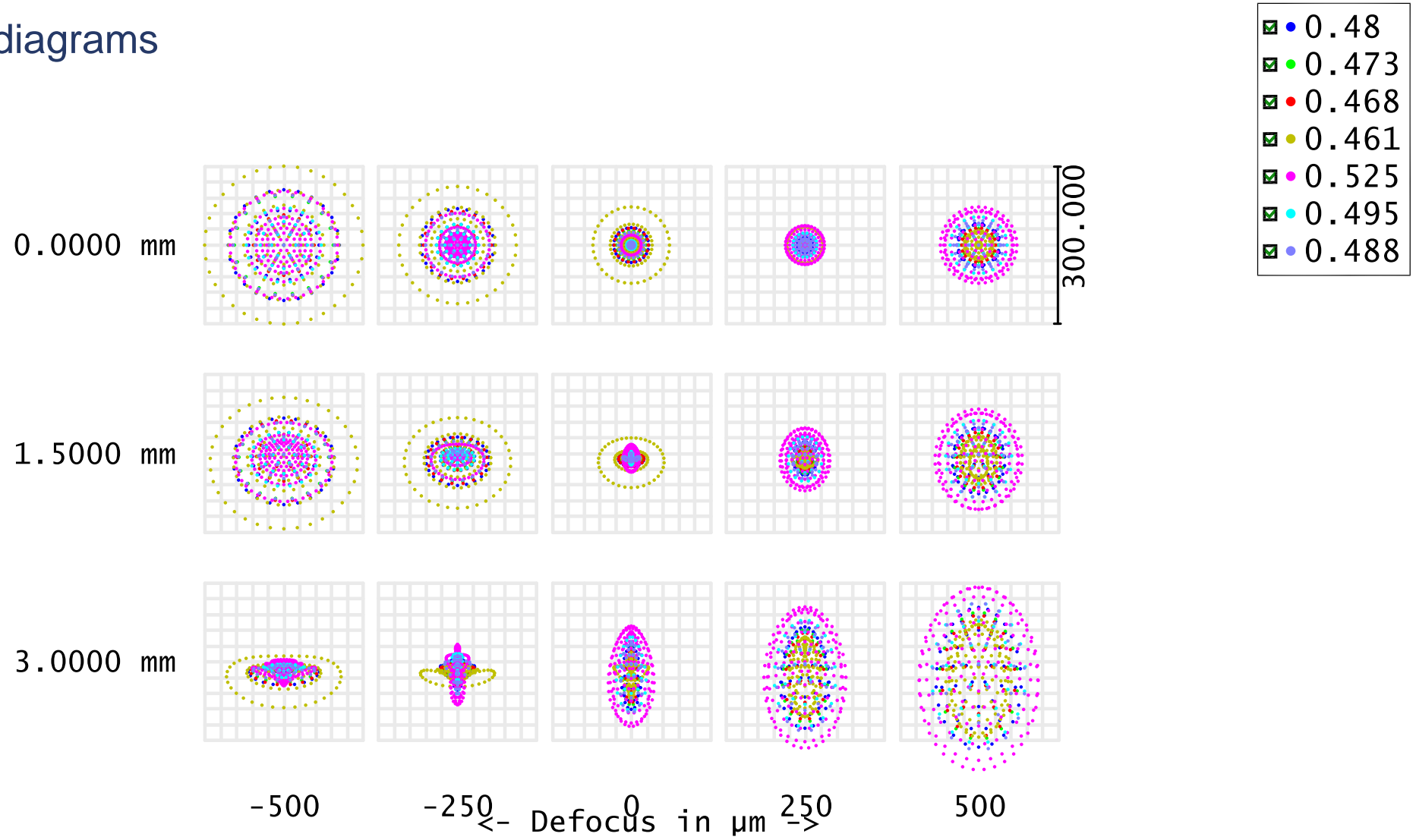
Use only wavelengths shorter than 450 nm

Through-focus spot diagrams
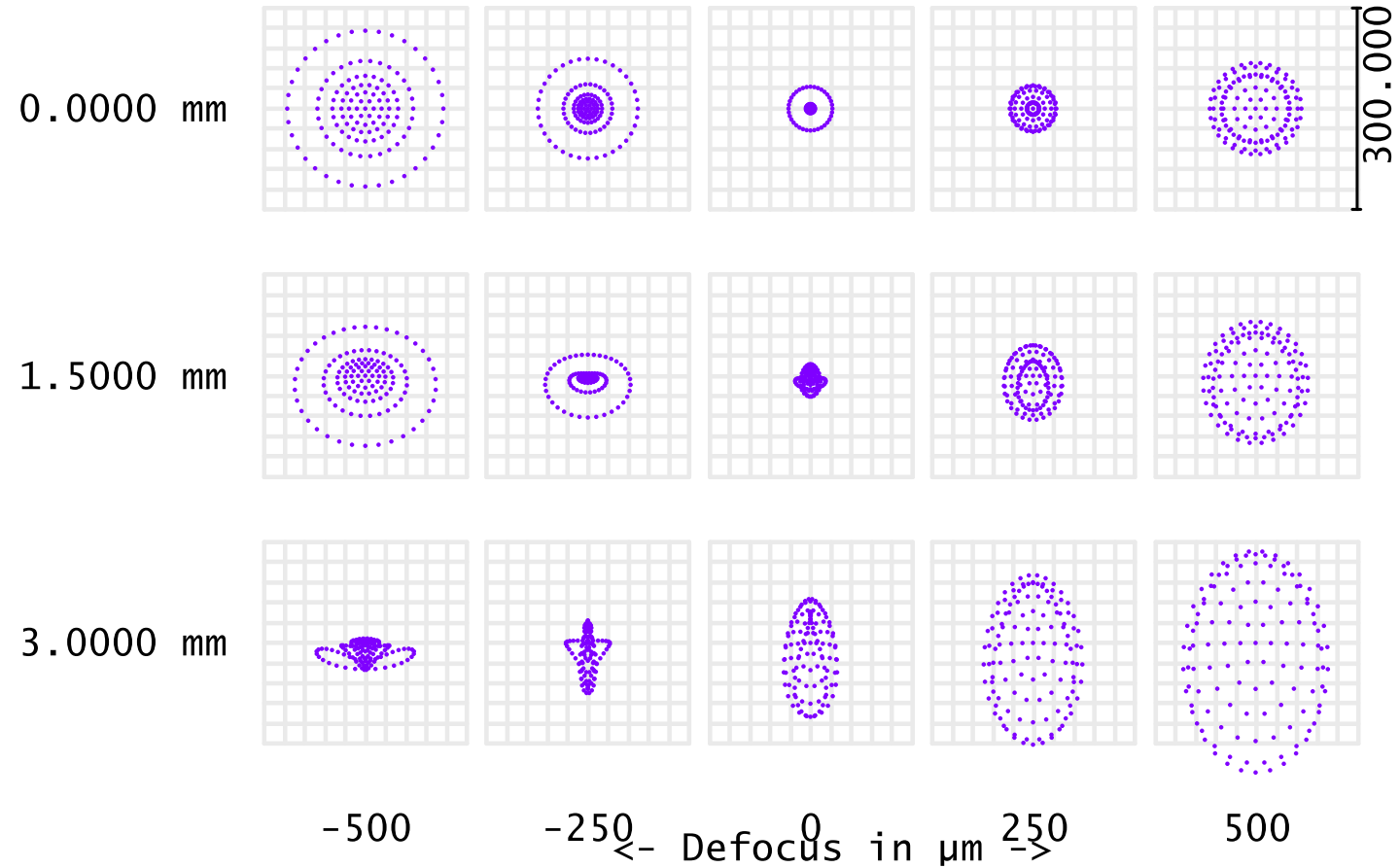
Use only wavelengths longer than 450 nm

Through-focus spot diagrams

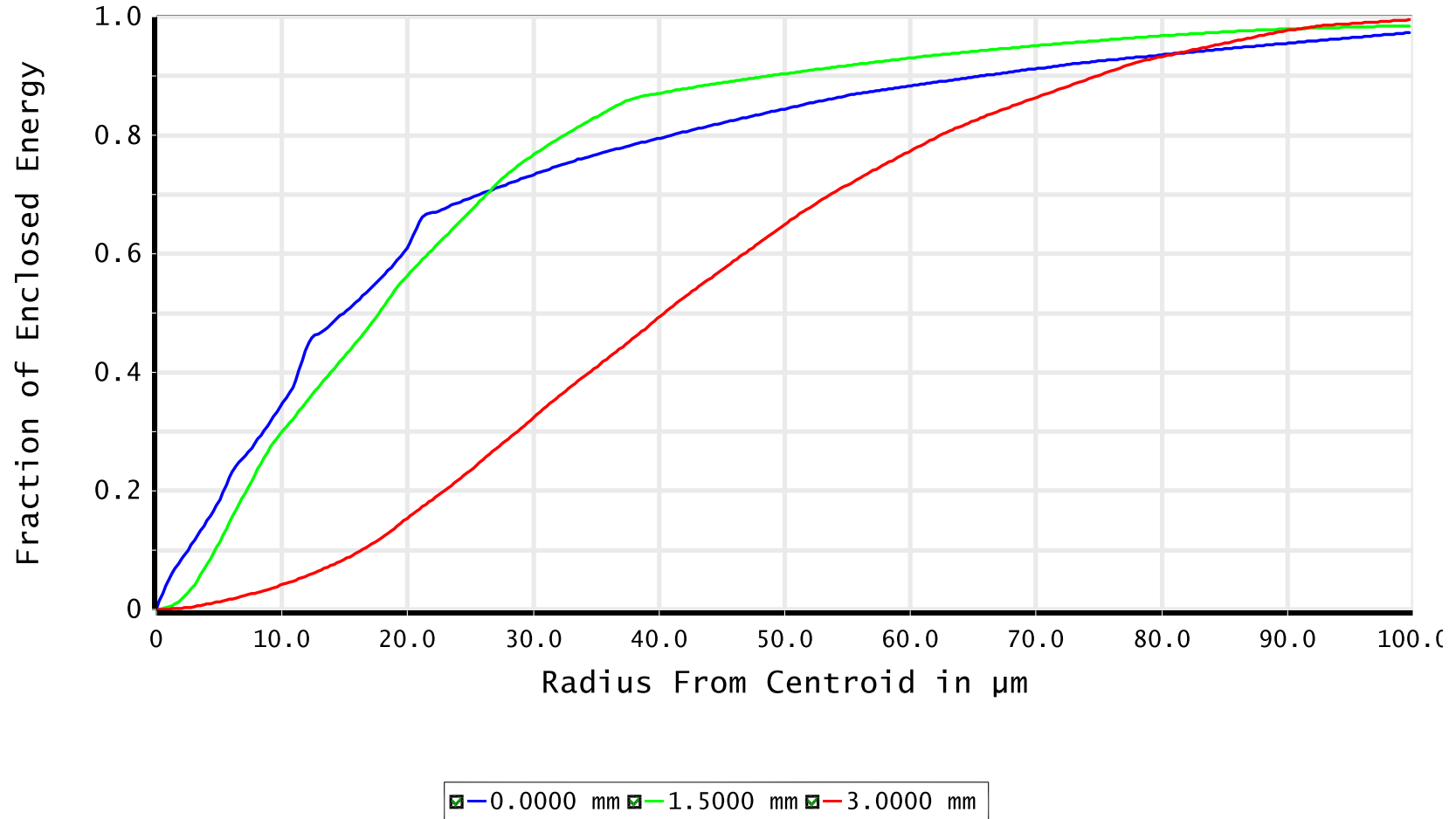# Use only 488 nm (a doublet design wavelength)

Through-focus spot diagrams

0.0000 mm

1.5000 mm

3.0000 mm

300.000

-500   -250   0   250   500

<- Defocus in μm ->

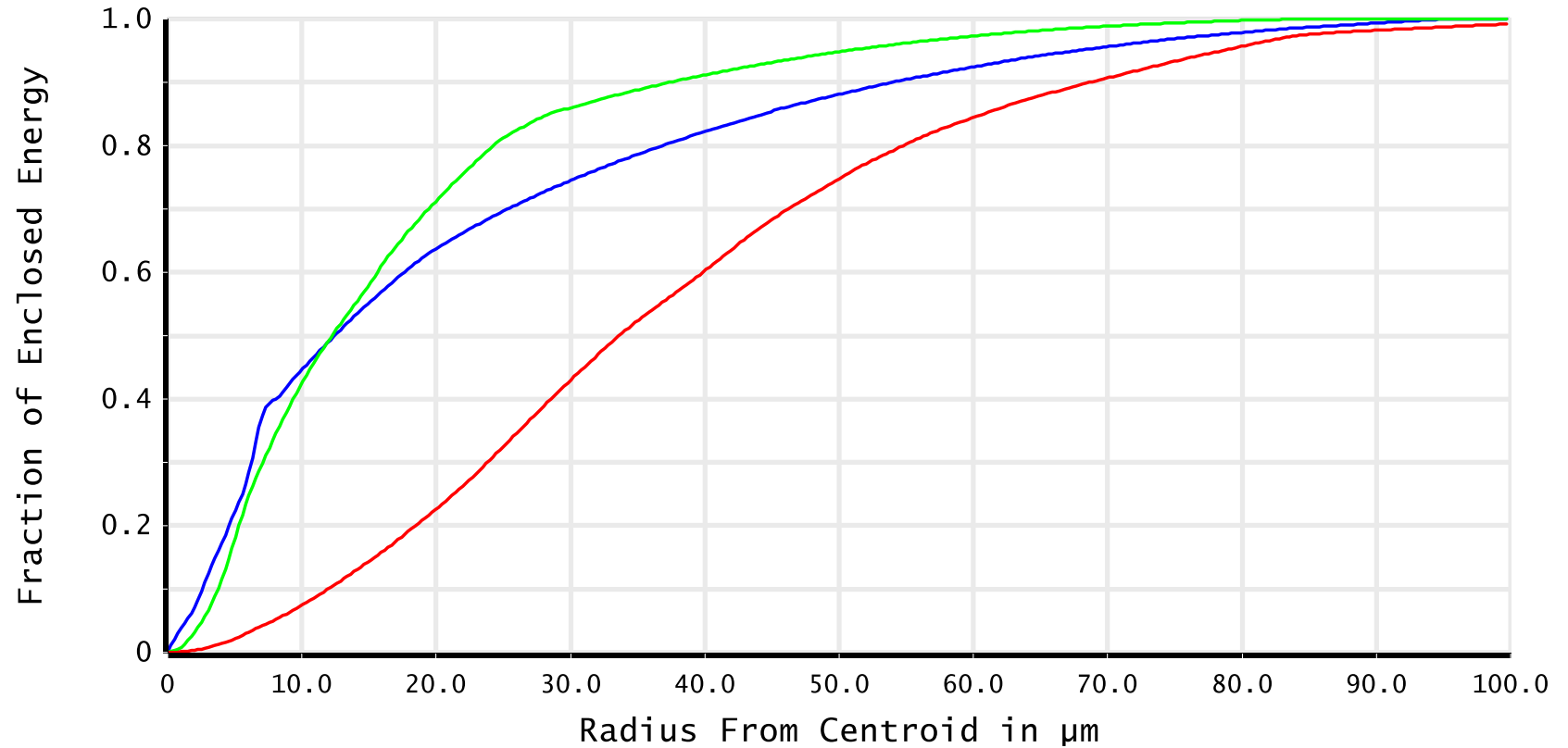# Use only wavelengths shorter than 450 nm

Polychromatic encircled energy using weighted wavelengths

Geometric Encircled Energy

Use only wavelengths longer than 450 nm

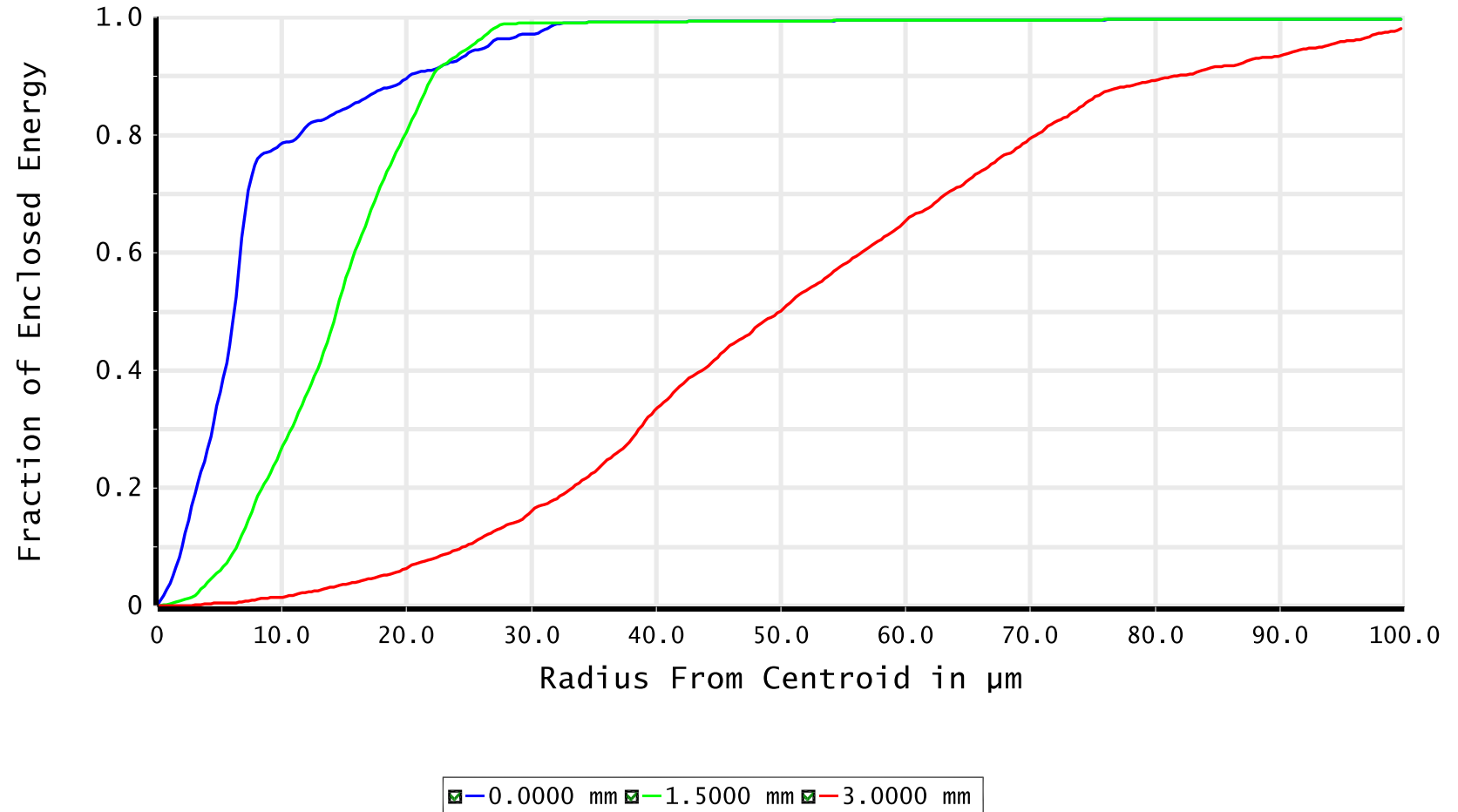**Polychromatic** encircled energy using
weighted wavelengths

Geometric Encircled Energy

Use only 488nm

Monochromatic encircled energy
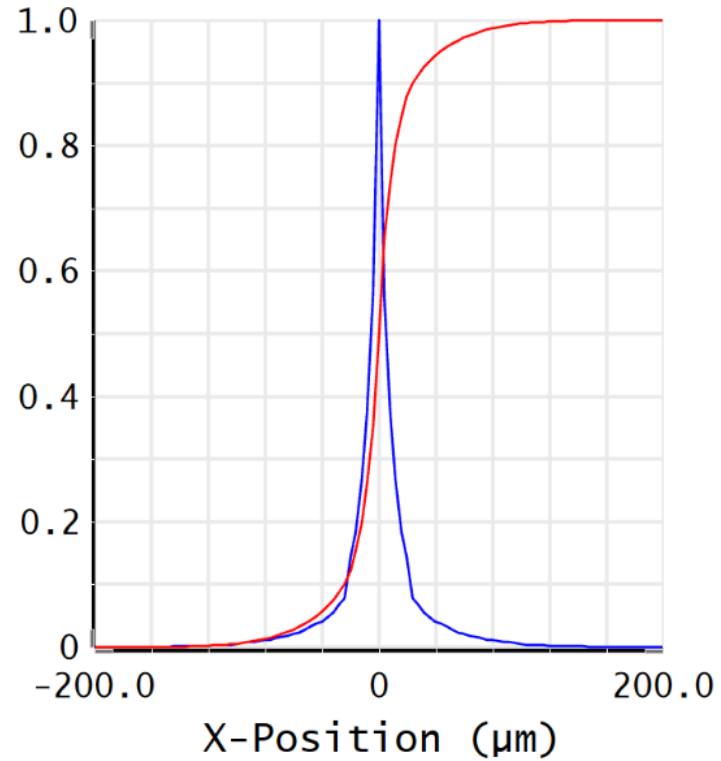

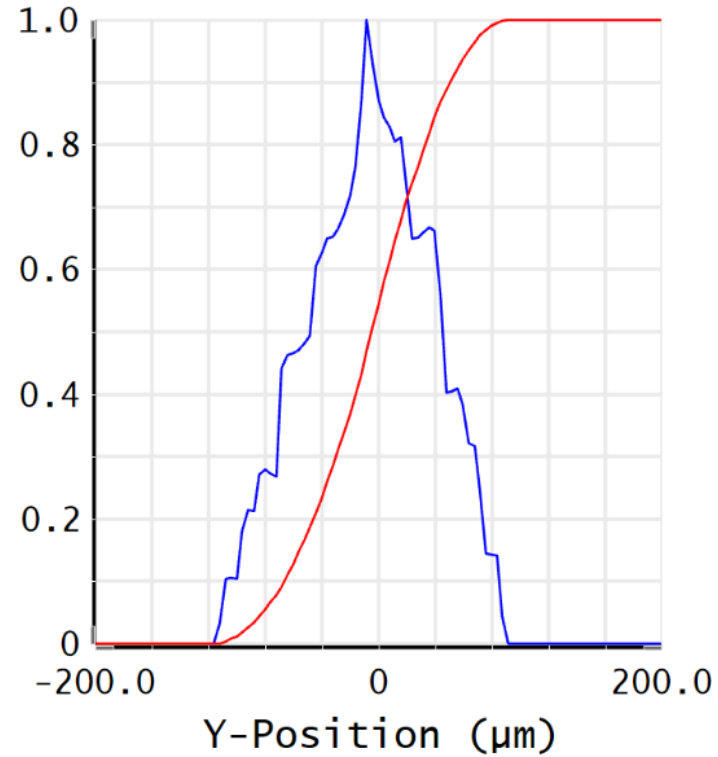Geometric Encircled Energy
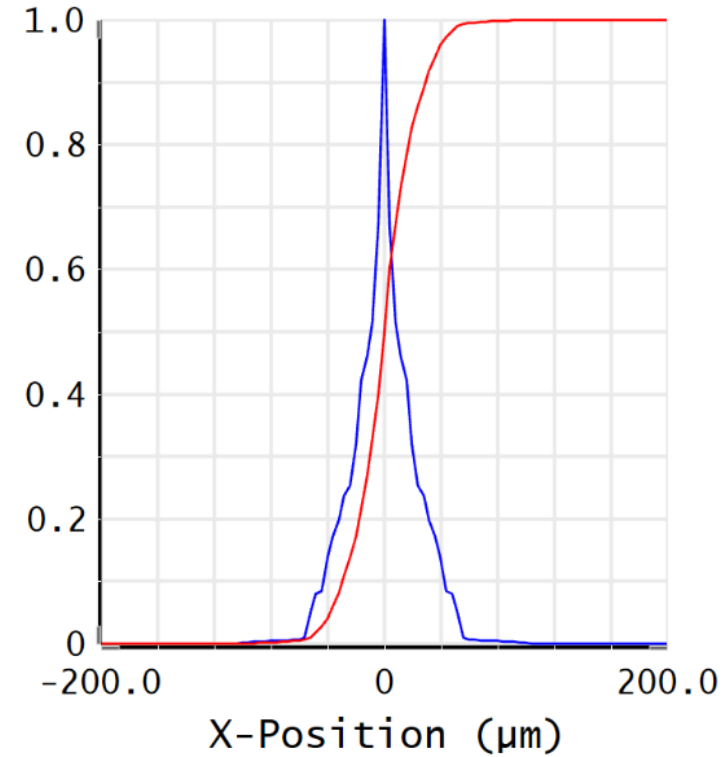
Use only wavelengths shorter than 450 nm

On-axis

3 mm off-axis

Use only wavelengths longer than 450 nm

On-axis

3 mm off-axis

Geometric Line and Edge Spread – Y-Orientation | Geometric Line and Edge Spread – X-Orientation | Geometric Line and Edge Spread – Y-Orientation
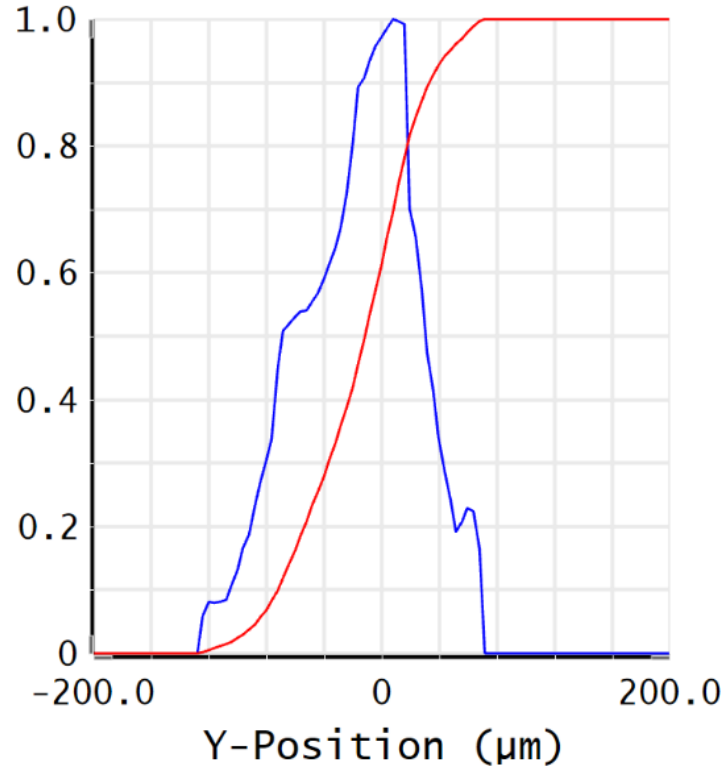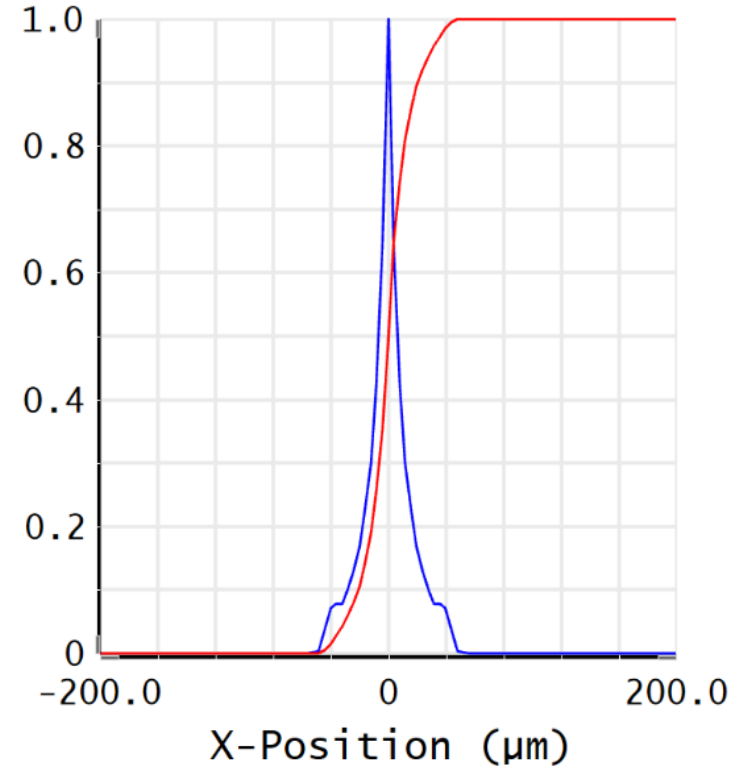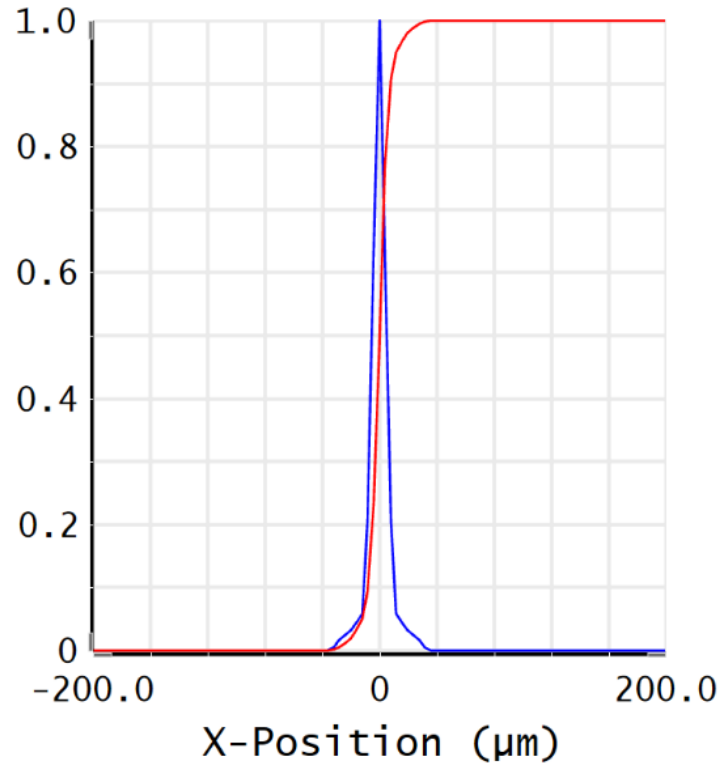
Use only 488 nm

On-axis

3 mm off-axis

Geometric Line and Edge Spread - Y-Orientation

Geometric Line and Edge Spread - X-Orientation

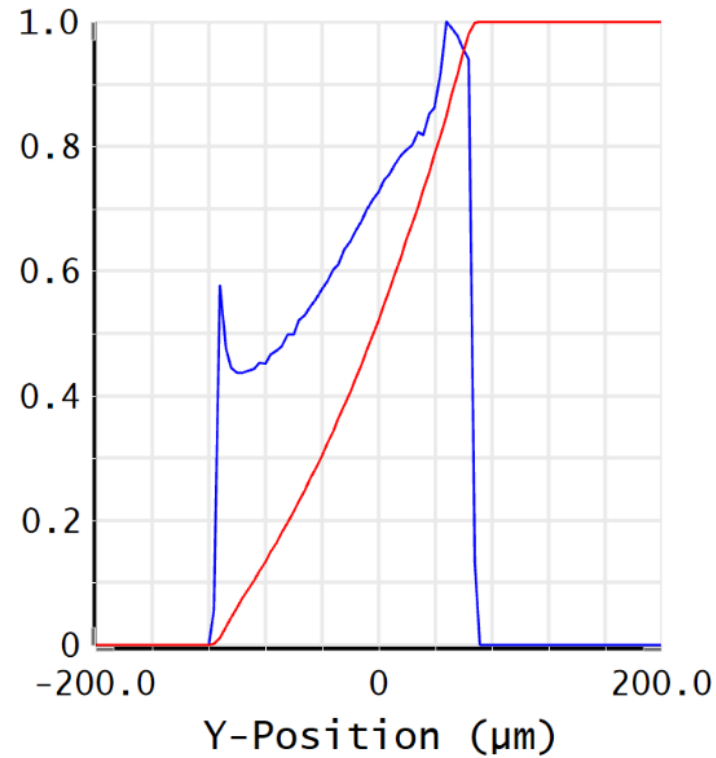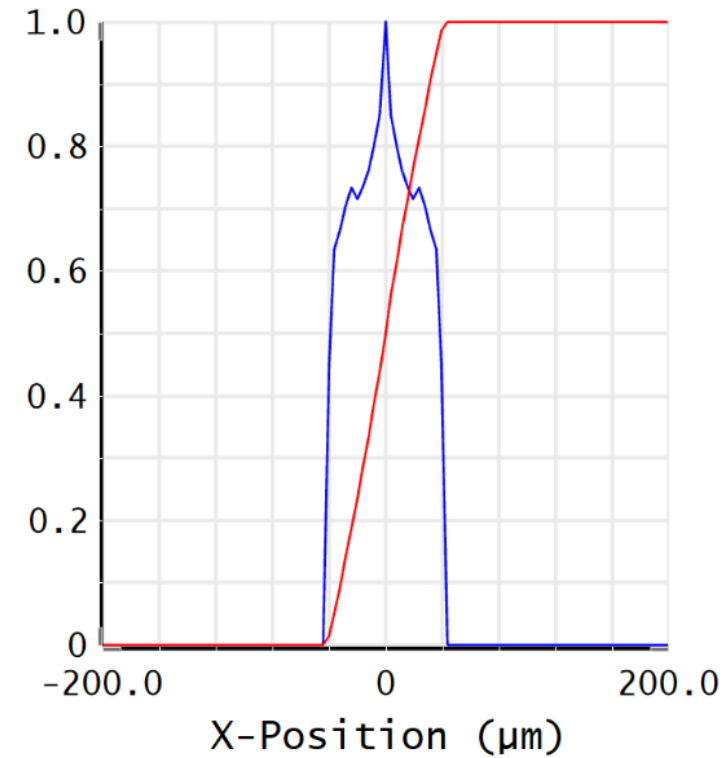Geometric Line and Edge Spread - Y-Orientation