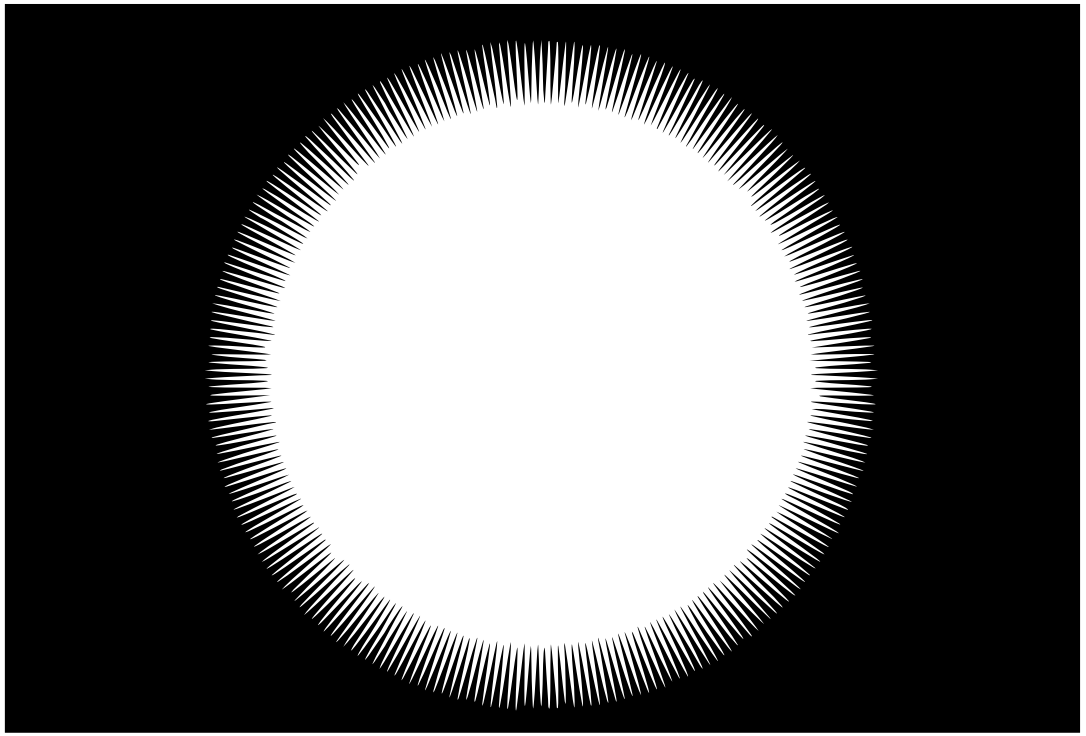
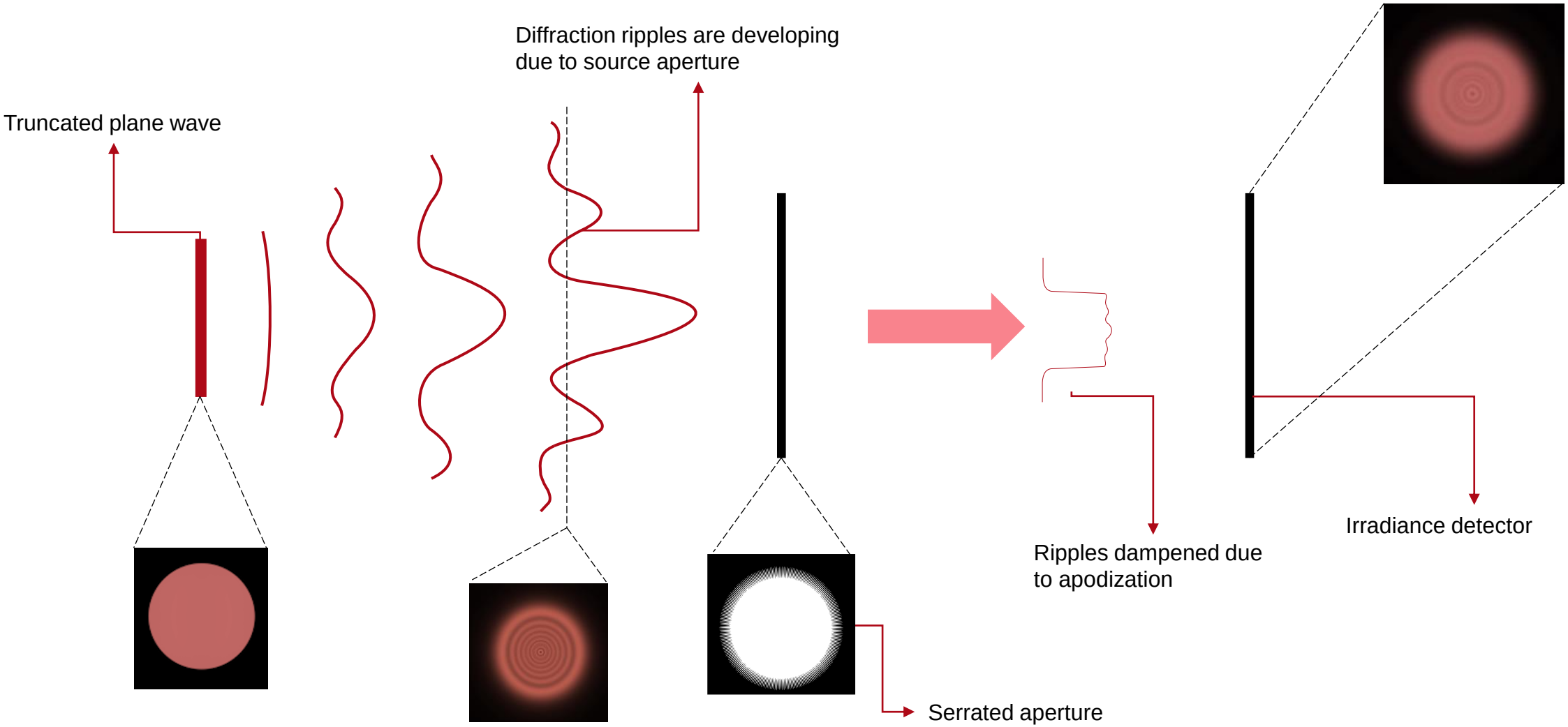
Circularly Serrated Aperture for Beam Apodization

Abstract



There is a high demand for beams with uniform irradiance profile (flat-top beams) in various industry sectors. It is also known that light sources with a flat-top profile are more prone to develop diffraction ripples after propagation. In this demo, we seek to tackle this challenge by introducing a serrated beam apodizer. Beam apodization plays a key role in the design of high-energy laser systems and beam delivery.

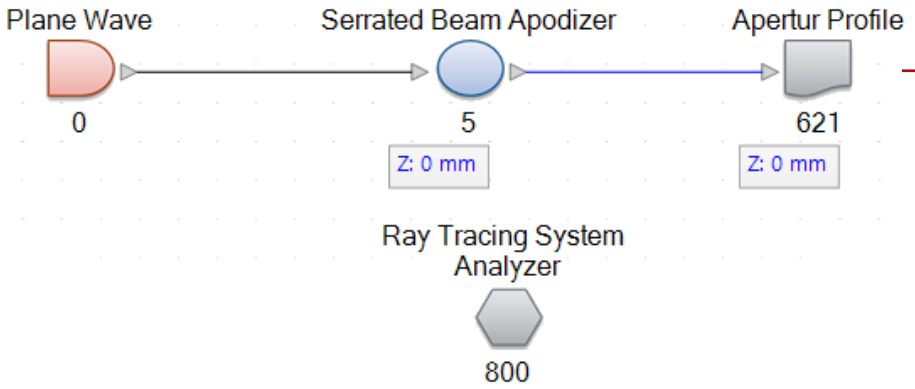
Setup without Spatial Filtering



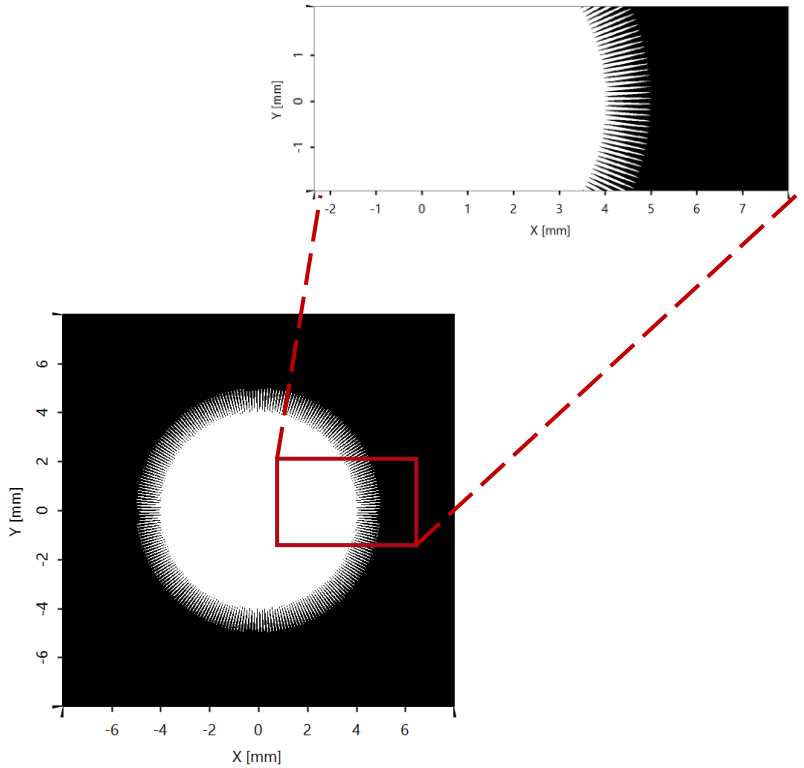
Serrated Beam Apodizer

```
if(serratedRadius >= Math.Sqrt((Math.Pow(x,2) + Math.Pow(y,2))))
{
    realPart = 1.0;
}
```

Programmable Function



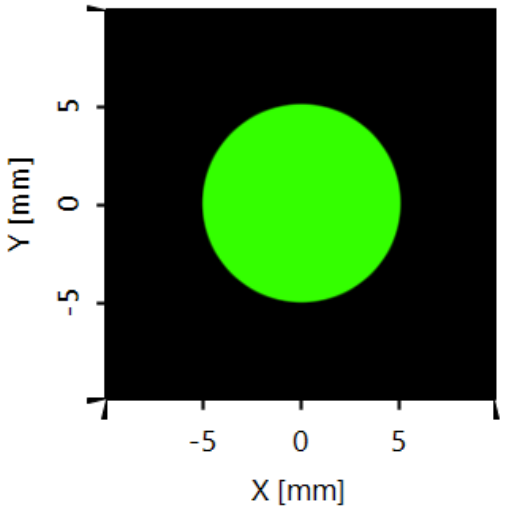
Aperture profile



Aperture Parameters

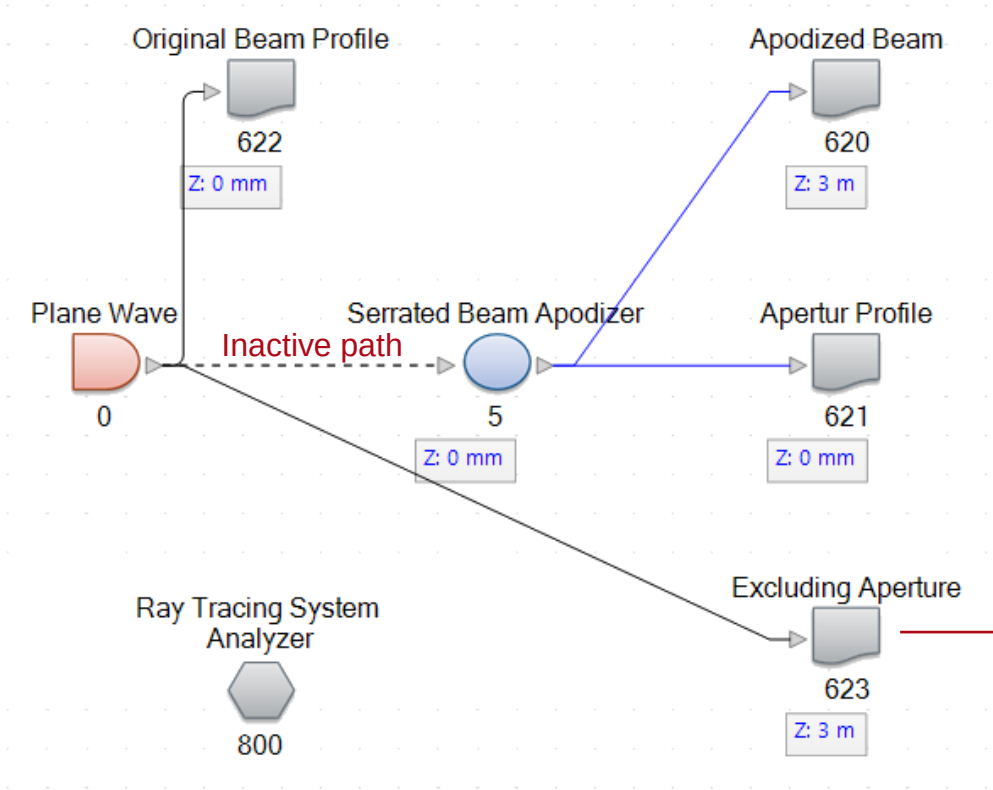
Shape: Circular
Serrating amplitude: 1 mm
Average radius: 3.5 mm
Number of periods: 250

Results: Beam Propagation Excluding Apodizer

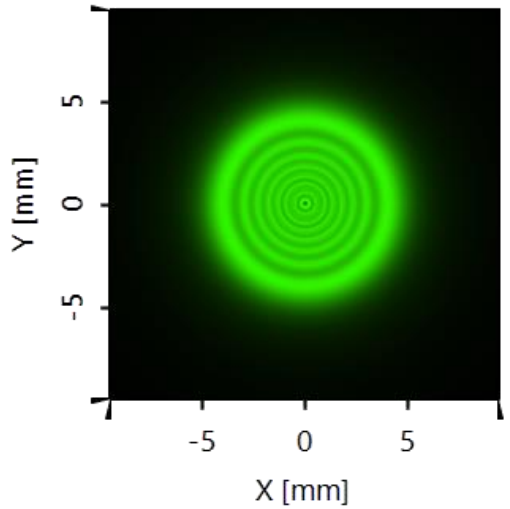


Source Parameters

Shape: Elliptic
Diameter: 10x10 mm
Wavelength: 532 nm
Polarization: Linearly polarized

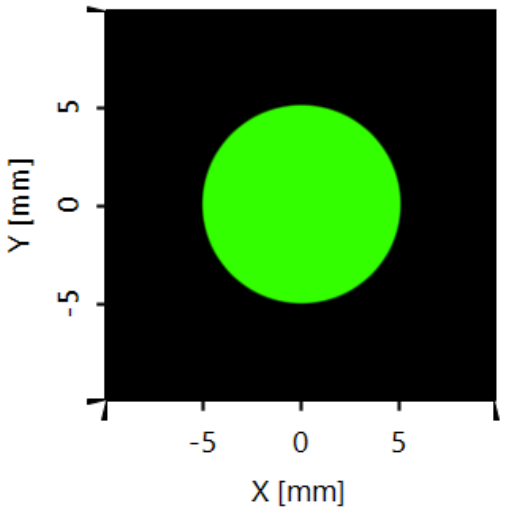


Optical setup in VirtualLab



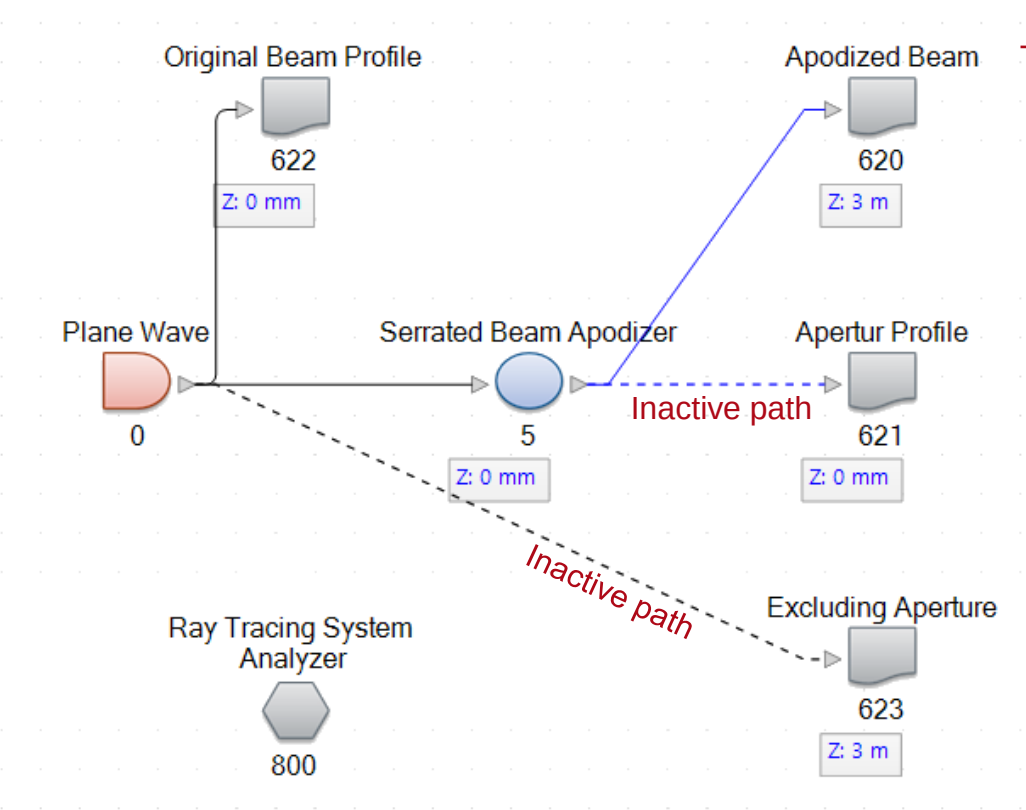
Beam profile in 3 m

Results: Beam Propagation Including Apodizer



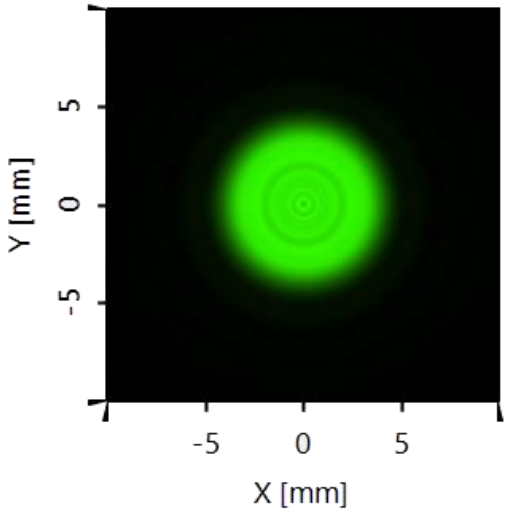
Source Parameters

Shape: Elliptic
Diameter: 10x10 mm
Wavelength: 532 nm
Polarization: Linearly polarized



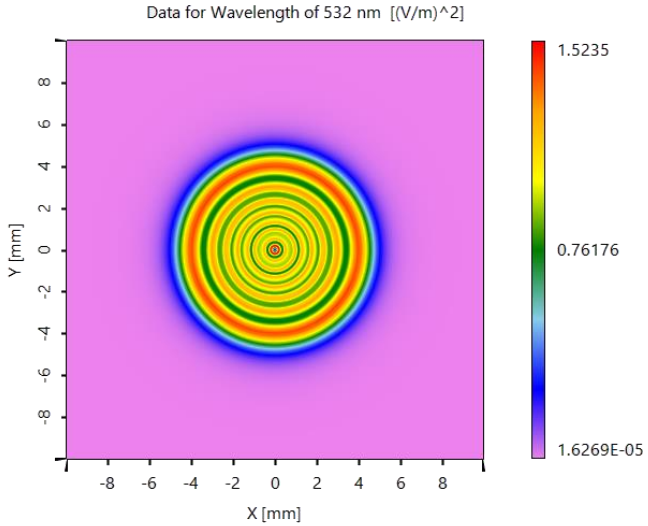
Optical setup in VirtualLab

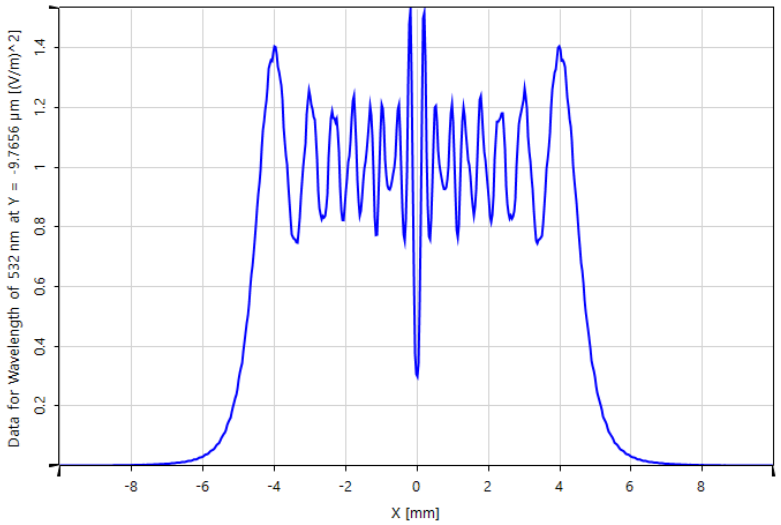
Beam profile in 3 m



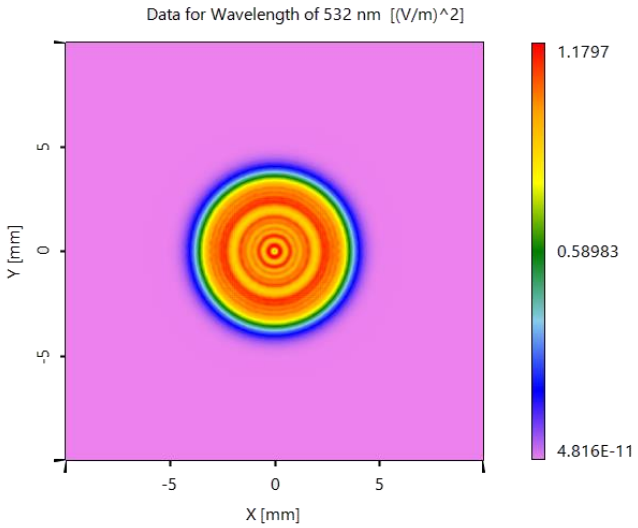
Results Comparison

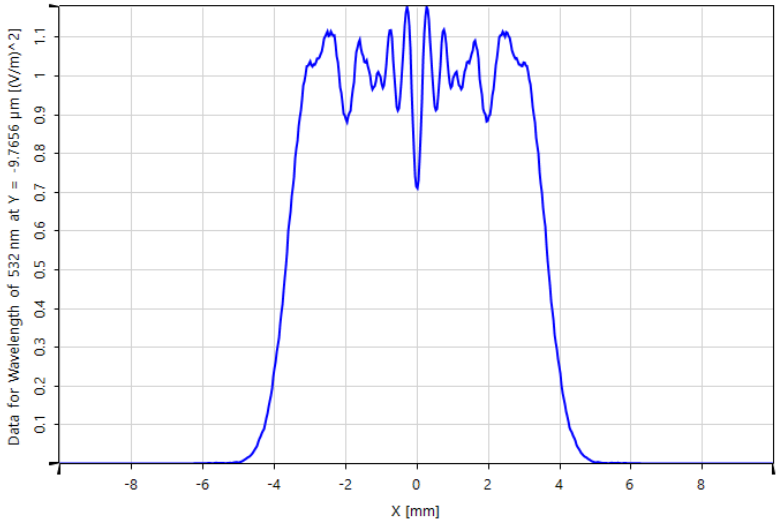
Without apodizer



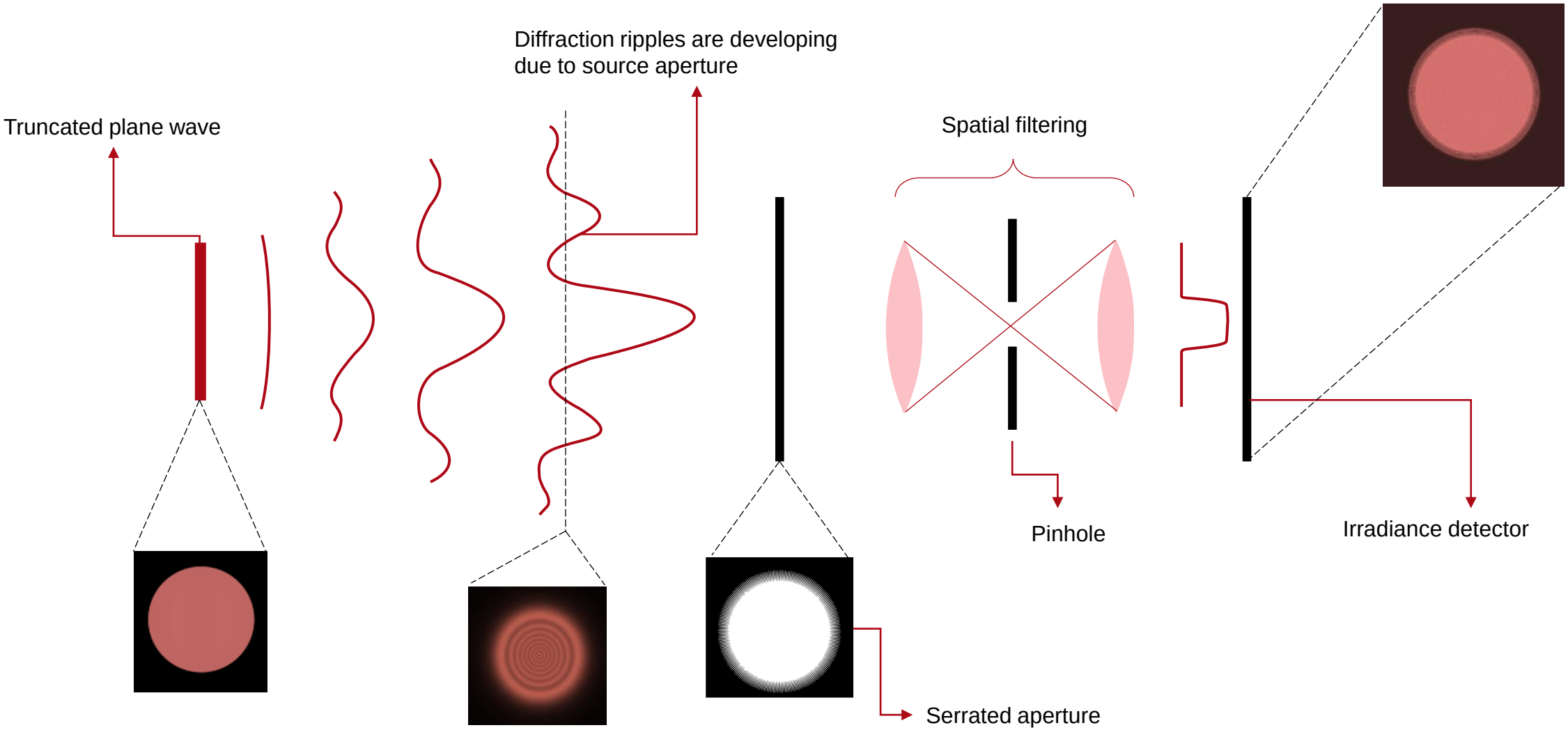


With apodizer

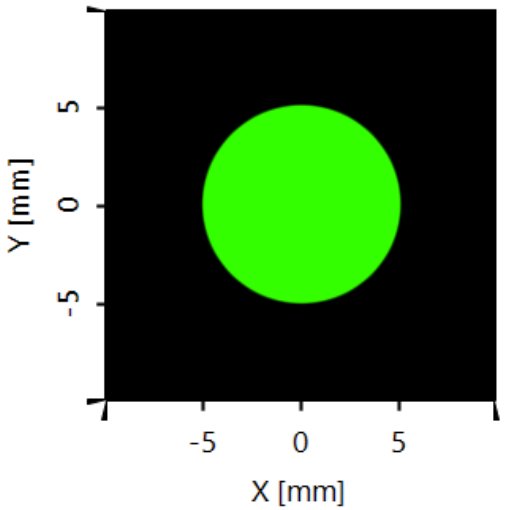


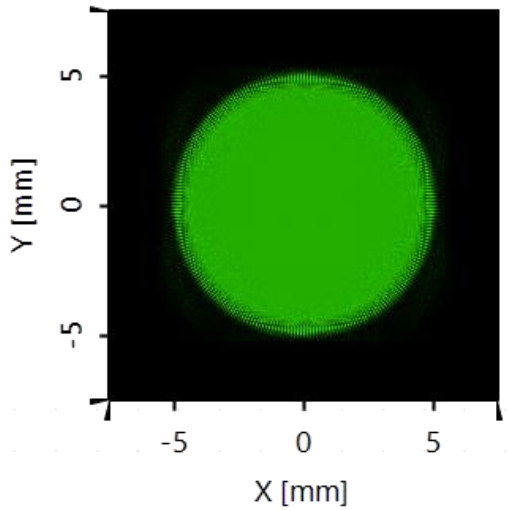


Setup with Spatial Filtering



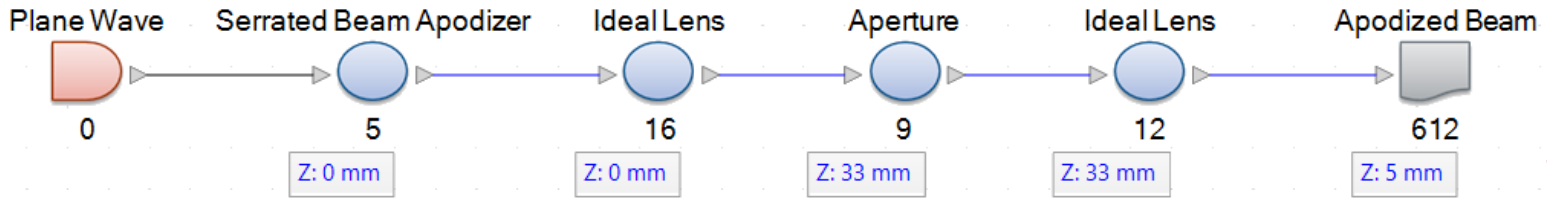
Results: Beam Apodization with Spatial Filtering



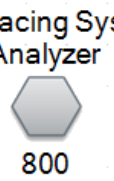


Source Parameters

Shape: Elliptic
Diameter: 10x10 mm
Wavelength: 532 nm
Polarization: Linearly polarized



Beam profile in 5 mm



Results Comparison with Literature

Aperture Parameters

Shape: Rectangular
Serrating amplitude: 1 mm
Outer boundary: 1x1 cm
Period size: 160 µm
5X Magnification after aperture

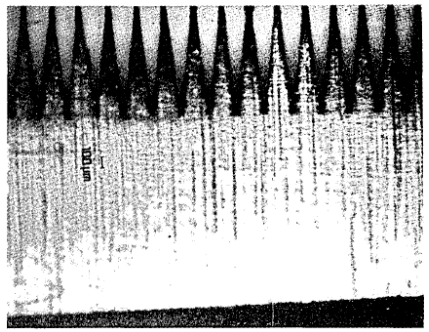
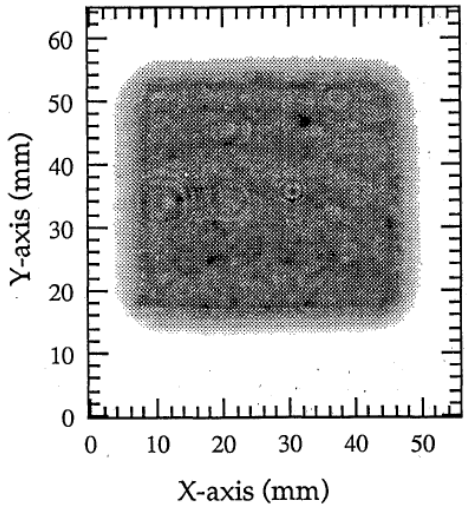
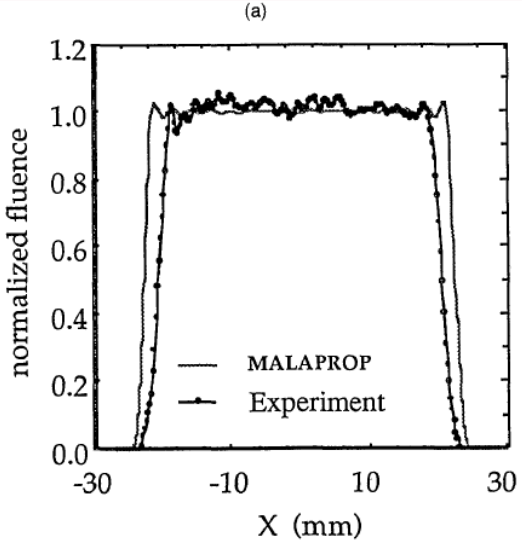


Fig. 4. Photograph of a section of the serrated aperture utilized in the Beamlet laser system. The precision limit on laser cutting has resulted in some roughness on the serrations.

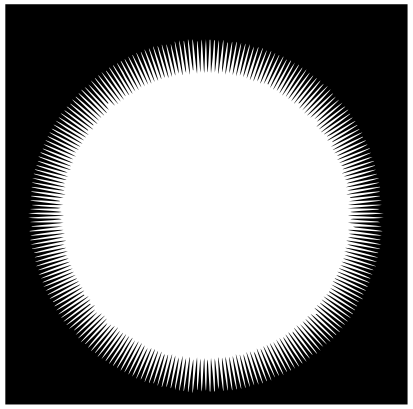


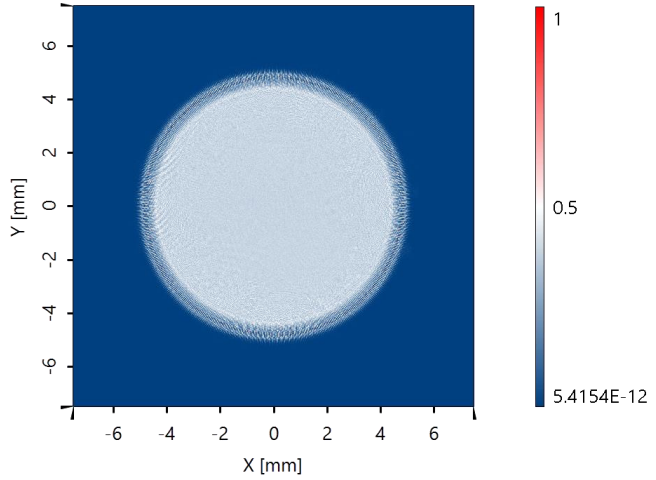


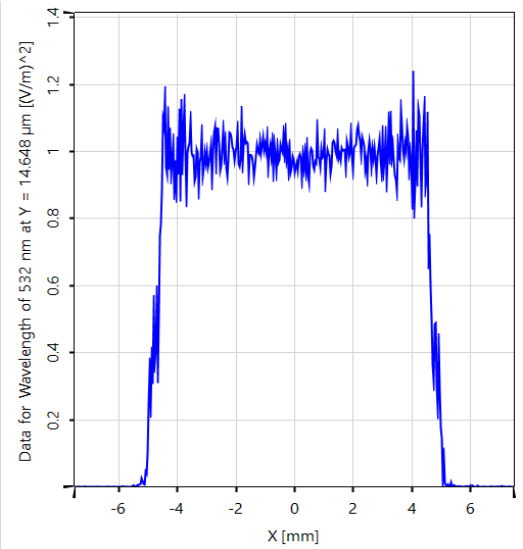
Reference
Jerome M. Auerbach and Victor P. Karpenko, "Serrated-aperture apodizers for high-energy laser systems," Appl. Opt. **33**, 3179-3183 (1994)

Aperture Parameters

Shape: Circular
Serrating amplitude: 1 mm
Average radius: 4.5 mm
Number of periods: 250







Document Information

title	Circularly Serrated Aperture for Beam Apodization
document code	Demo.20
version	1.0
VL version used for simulations	VirtualLab Fusion Spring Release 2020
category	Demo
further reading	- Diffraction Patterns behind Different Apertures