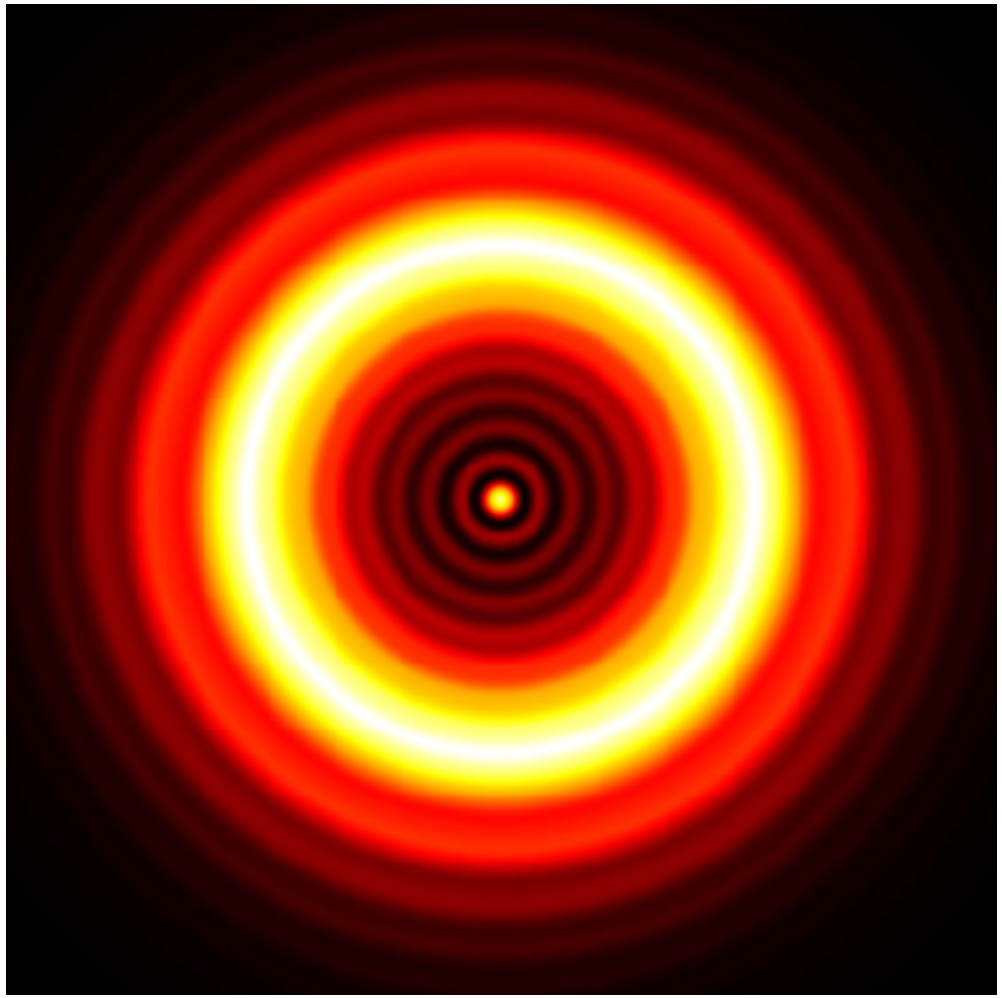
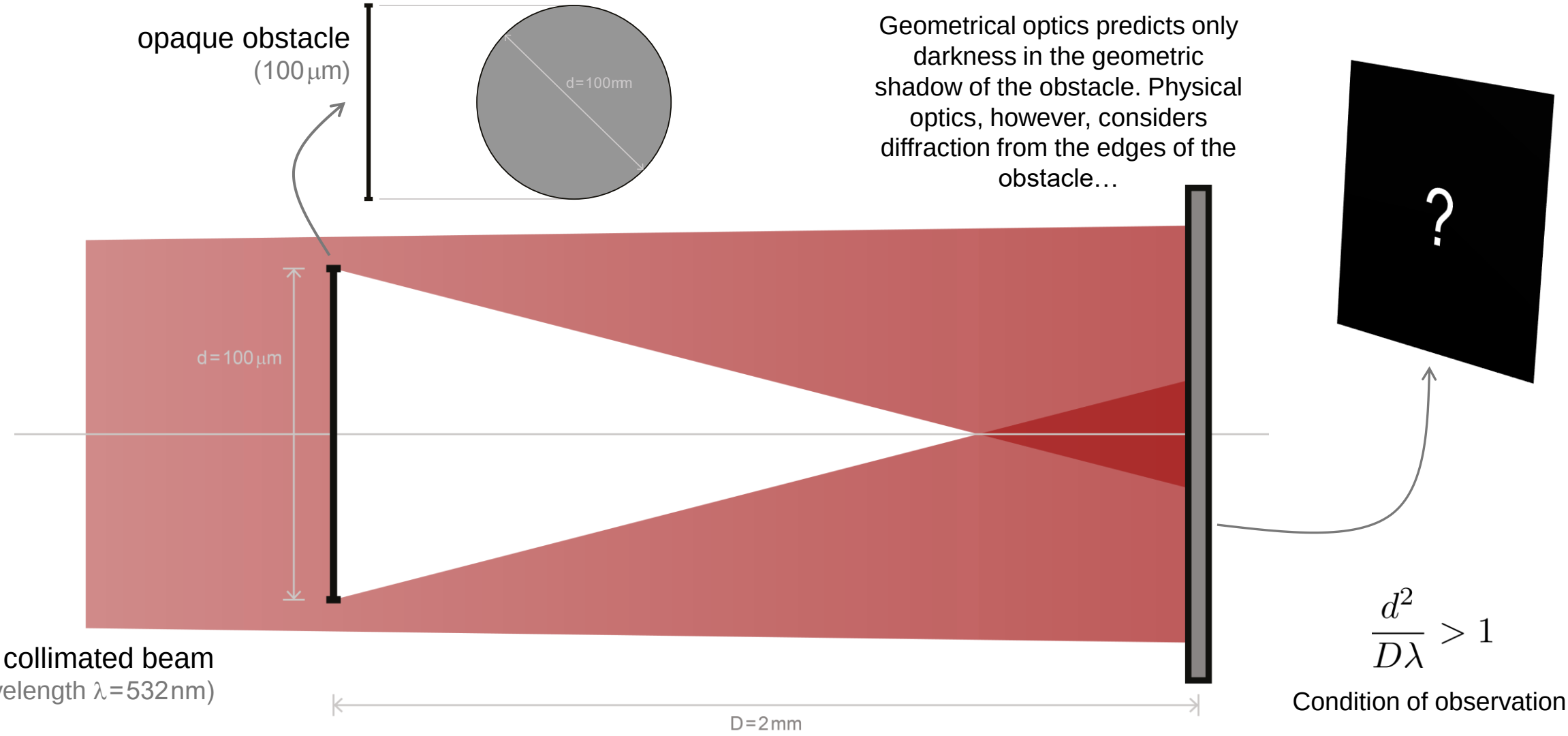
Observation of the Poisson Spot

Abstract

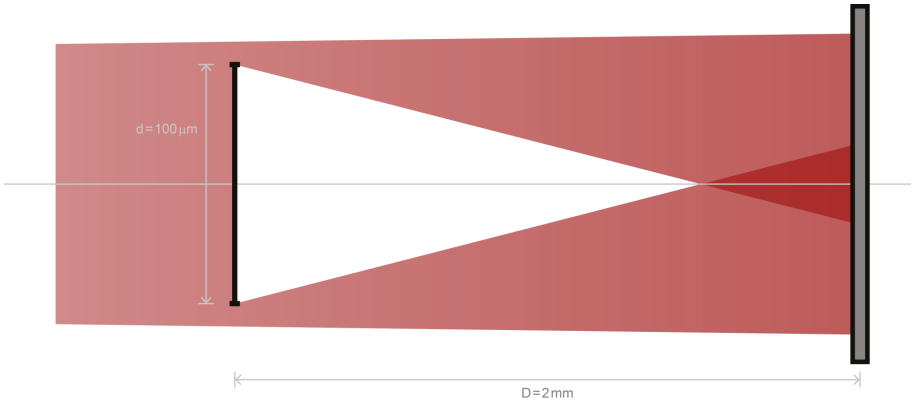


The first-time observation of Poisson's (or Arago's) spot in 1818 constituted one of the most relevant experiments in the history of optics, helping discard the (at the time) favoured position of attributing a corpuscular nature to light. When Fresnel presented his theory of diffraction before the French Academy of Sciences, Poisson, a member of the committee, scoffed at the fact that Fresnel's approach predicted a bright spot in the shadow of a circular obstacle placed in the way of a beam of light. And sure enough, as fellow committee member Arago demonstrated, this spot could be observed experimentally.

Modeling Task



Connected Modeling Techniques: Free-Space Propagation

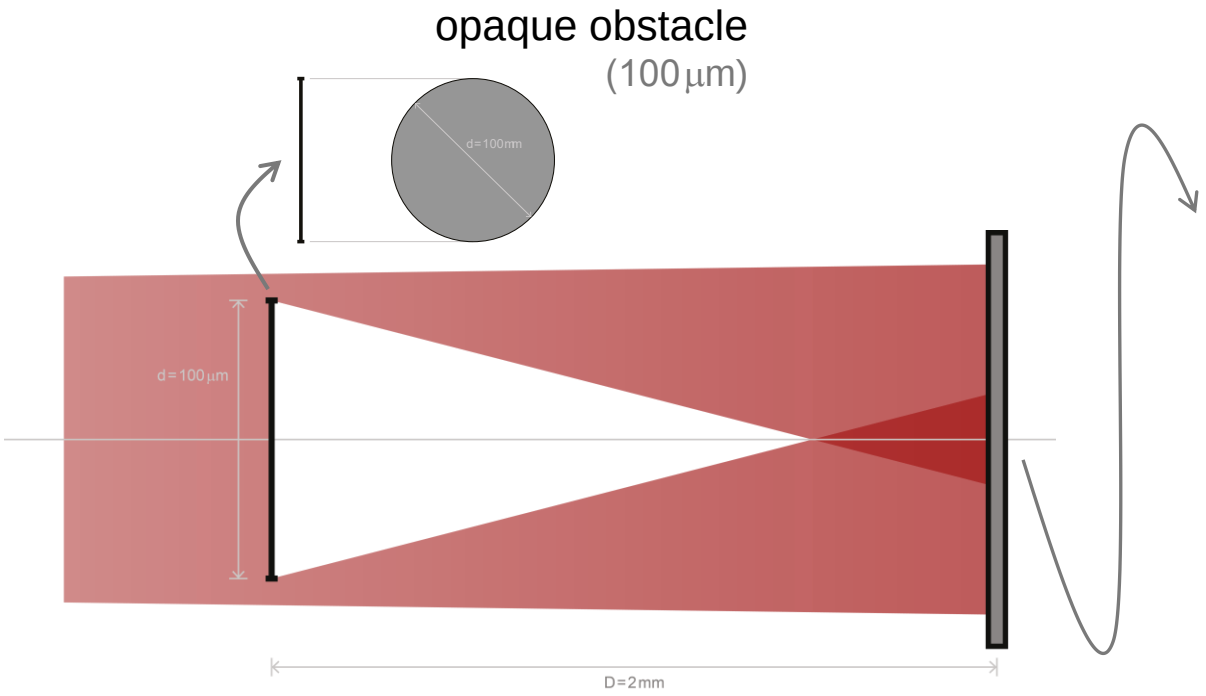


Available modeling techniques for free-space propagation:

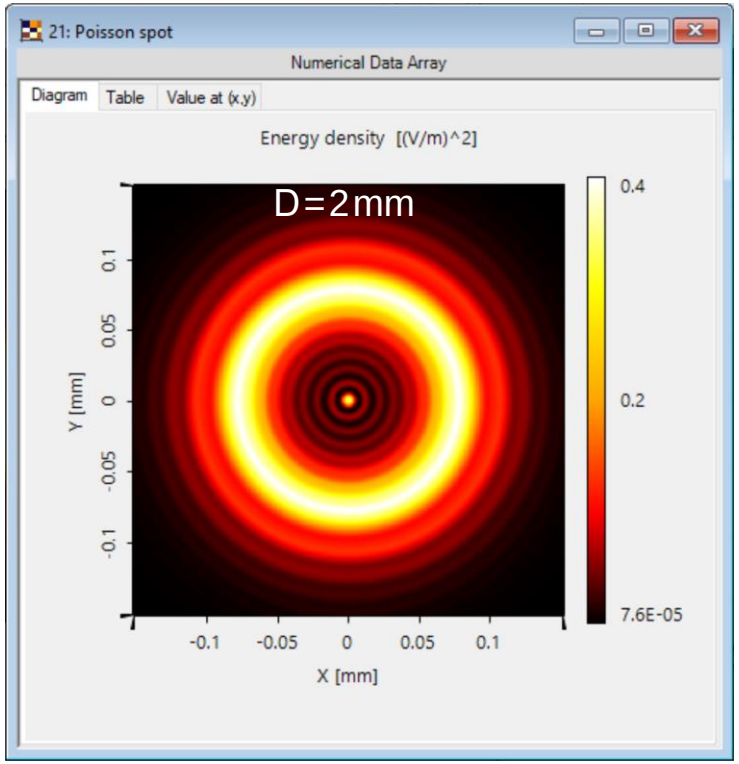
Methods	Preconditions	Accuracy	Speed	Comments
Rayleigh Sommerfeld Integral	None	High	Low	Rigorous solution
Fourier Domain Techniques	None	High	High	Rigorous mathematical reformulation of RS integral
Fresnel Integral	**Paraxial**	High	High	Assumes paraxial light; moderate speed for very short distances
	Non-paraxial	Low	High	
Geometric Propagation	**Low diffraction**	High	Very high	Neglects diffraction effects
	Otherwise	Low	Very high	

In the Poisson spot experiment, the diffraction effect caused by the edge of the obstacle is a proof of the wave nature of light. **Fourier Domain Techniques** are chosen to model the propagation behind the aperture, in order to include the diffraction effects in a fast and accurate manner.

Observation of the Poisson spot



collimated beam
(wavelength λ=532nm)



It is only diffraction from the edges what permits light to travel to the geometric shadow of the obstacle!

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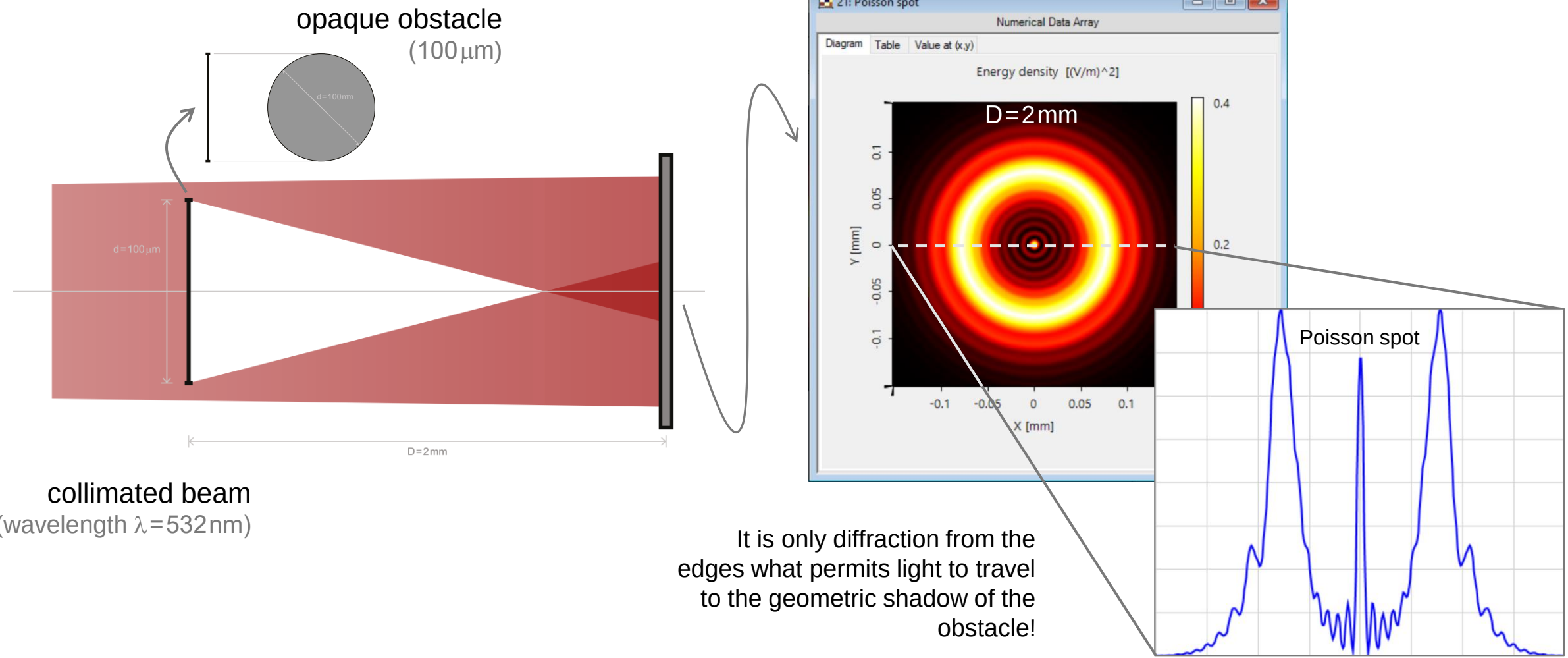

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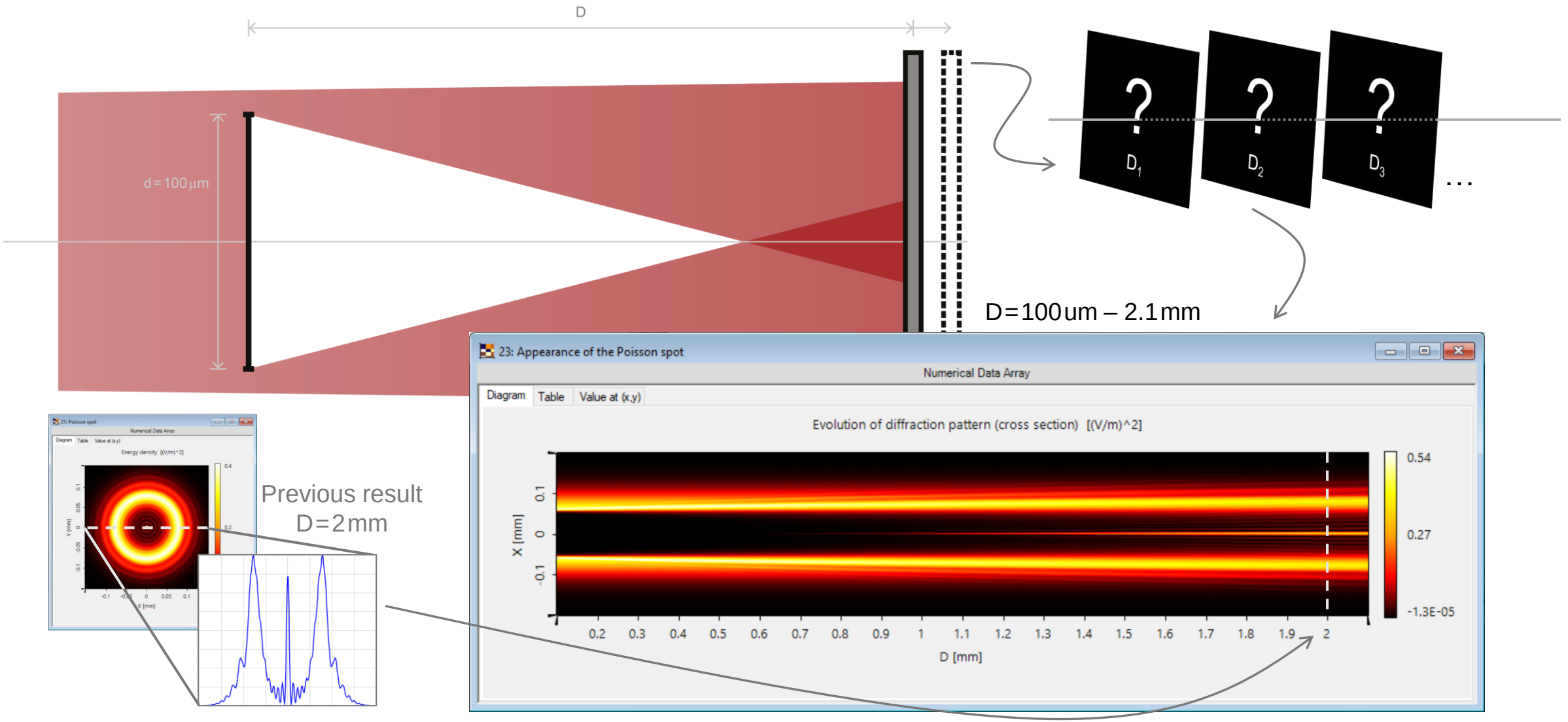
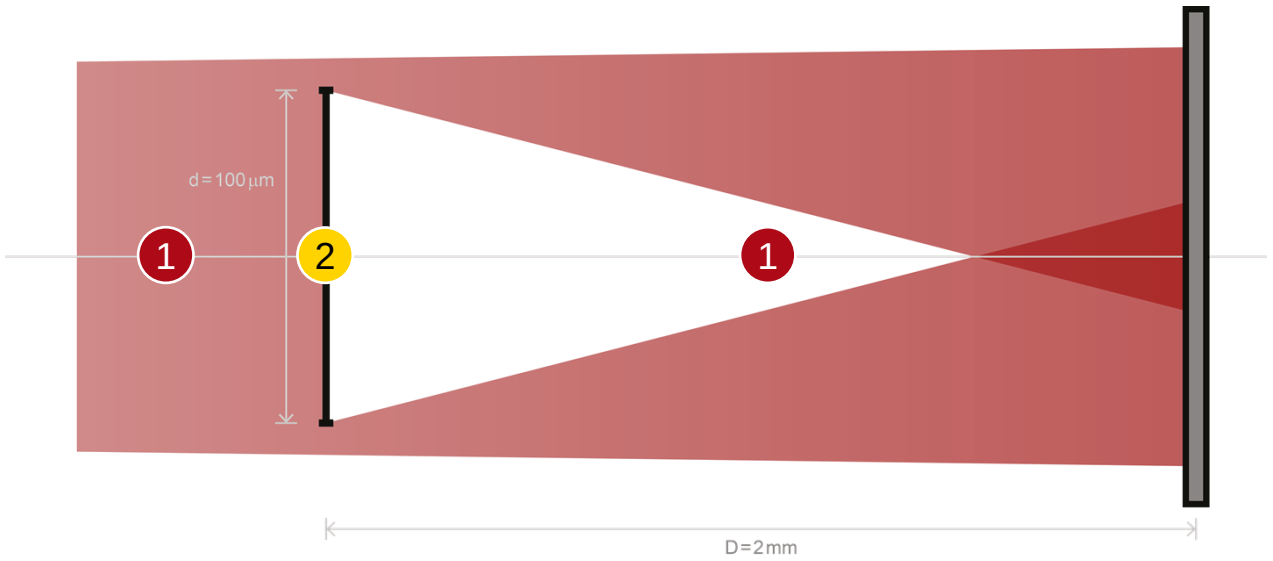
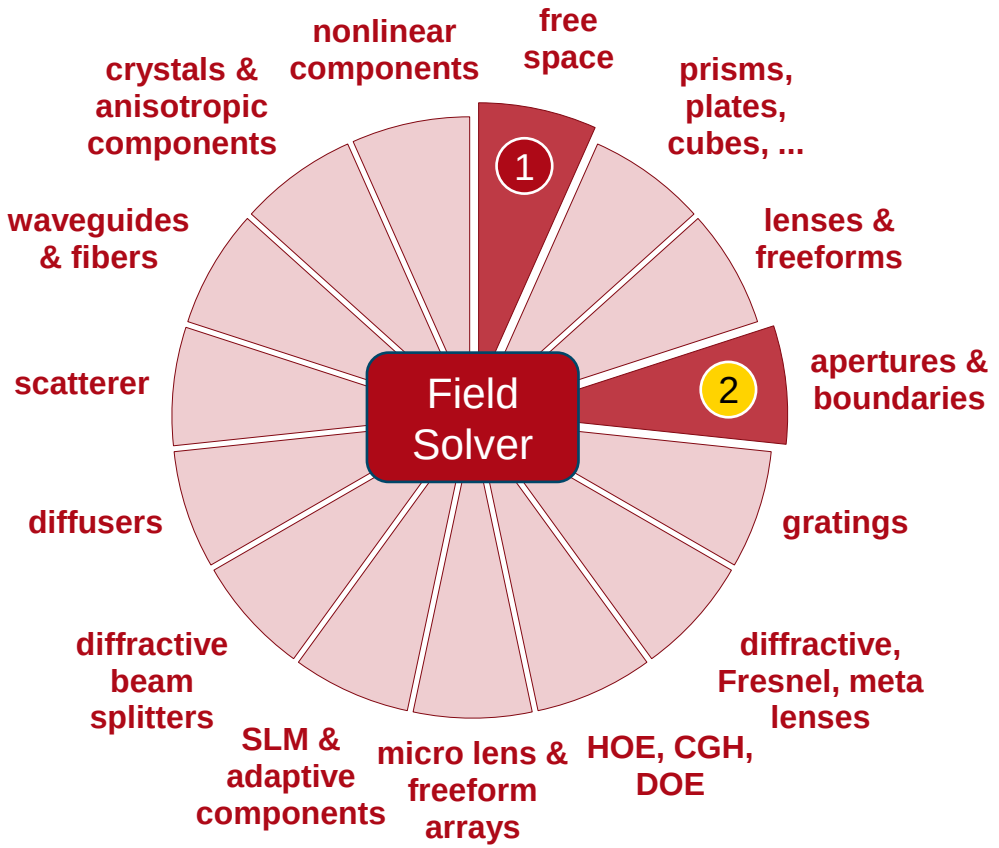
Evolution of Diffraction Pattern and Appearance of the Spot



VirtualLab Fusion Technologies





idealized component

Document Information

title	Observation of the Poisson Spot
document code	MISC.0072
version	2.0
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VL version used for simulations	2023.1 (Build 1.556)
category	Application Use Case
further reading	- Advanced PSF & MTF Calculation for System with Rectangular Aperture