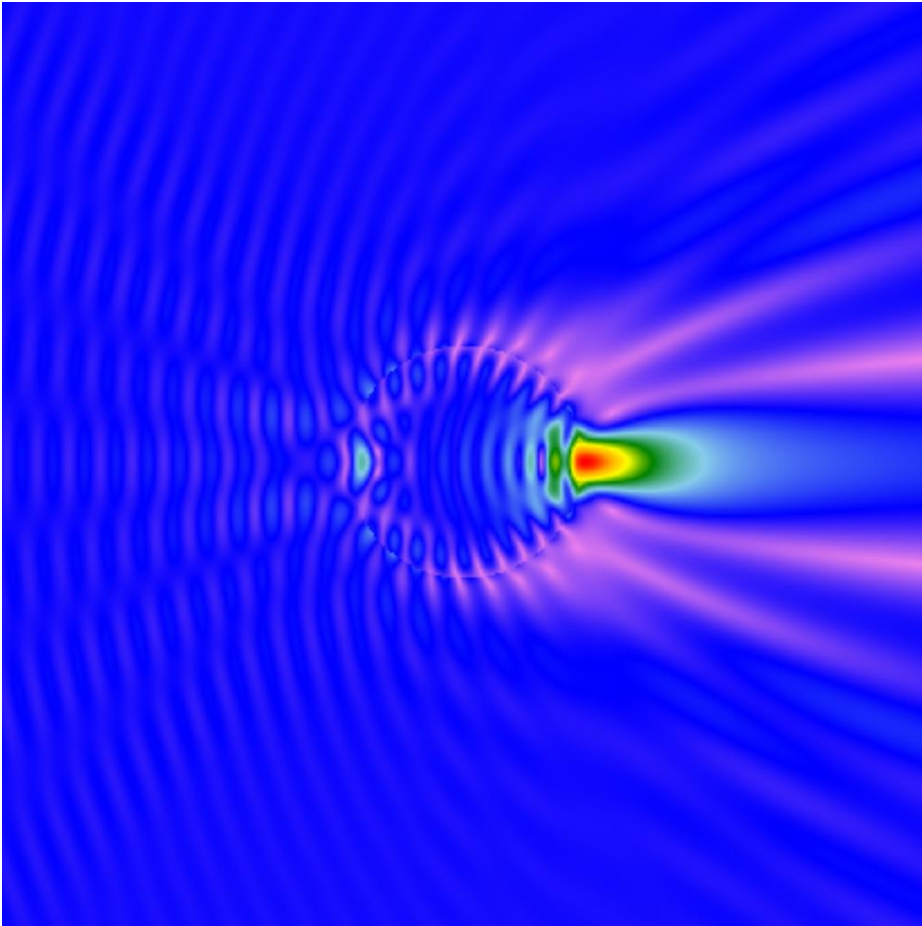


Mie Solution to Maxwell's Equations for Scattering of an Electromagnetic Plane Wave

Abstract

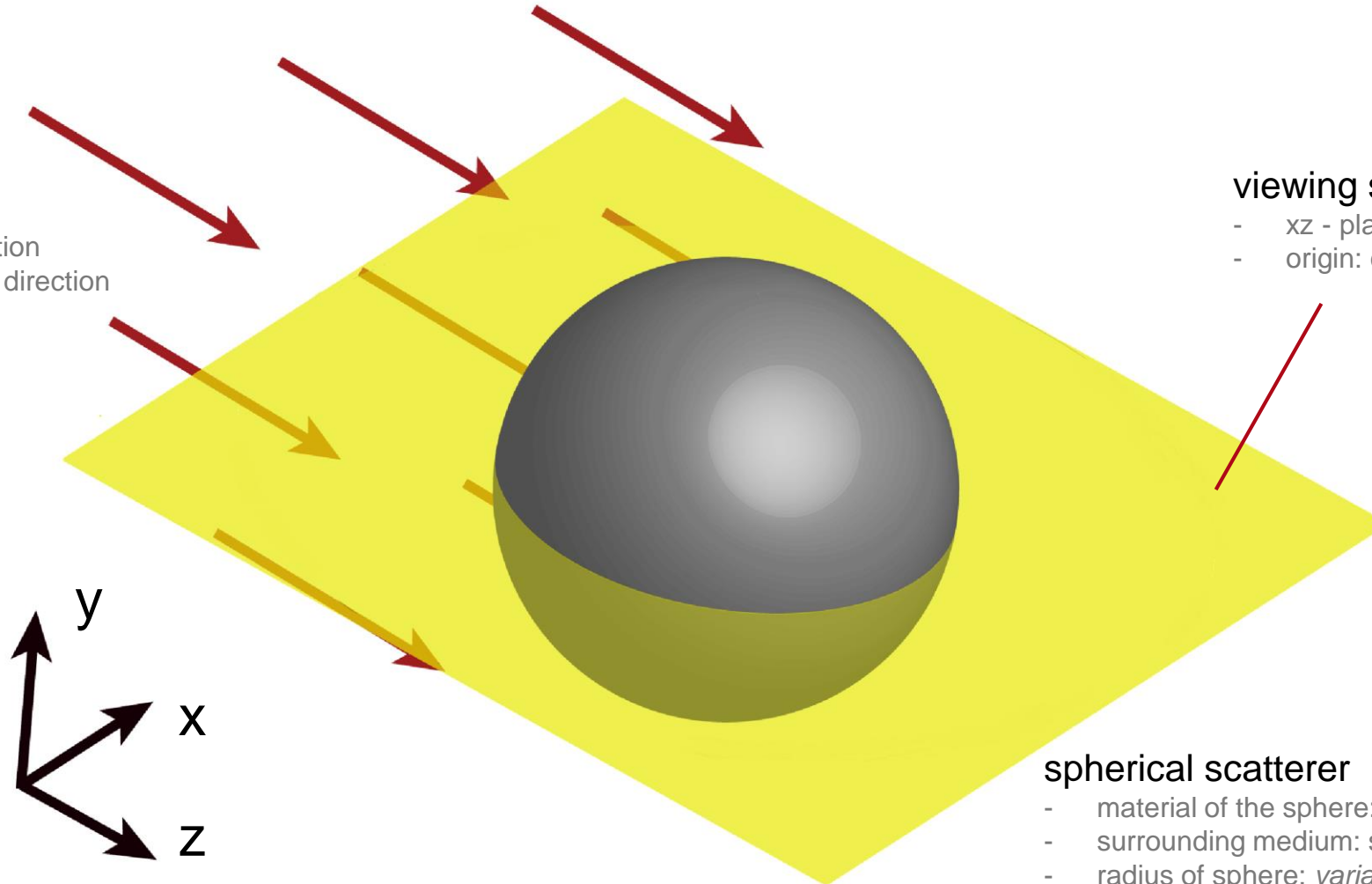


Mie solution is a rigorous Maxwell's solver for the problem of absorption and scattering of an electromagnetic plane wave by a spherical particle with an arbitrary radius and refractive index. The resulting scattering effect is highly dependent on the size of the particle. According to its characteristics, scattering can be classified into Rayleigh scattering, Mie scattering, and Geometric Optics. The full Mie solution is included in VirtualLab Fusion, and the scattering by spherical particles with different radii of spheres is investigated.

Modeling Task

input plane wave

- wavelength: 532nm
- propagate along z direction
- linearly polarized along x direction



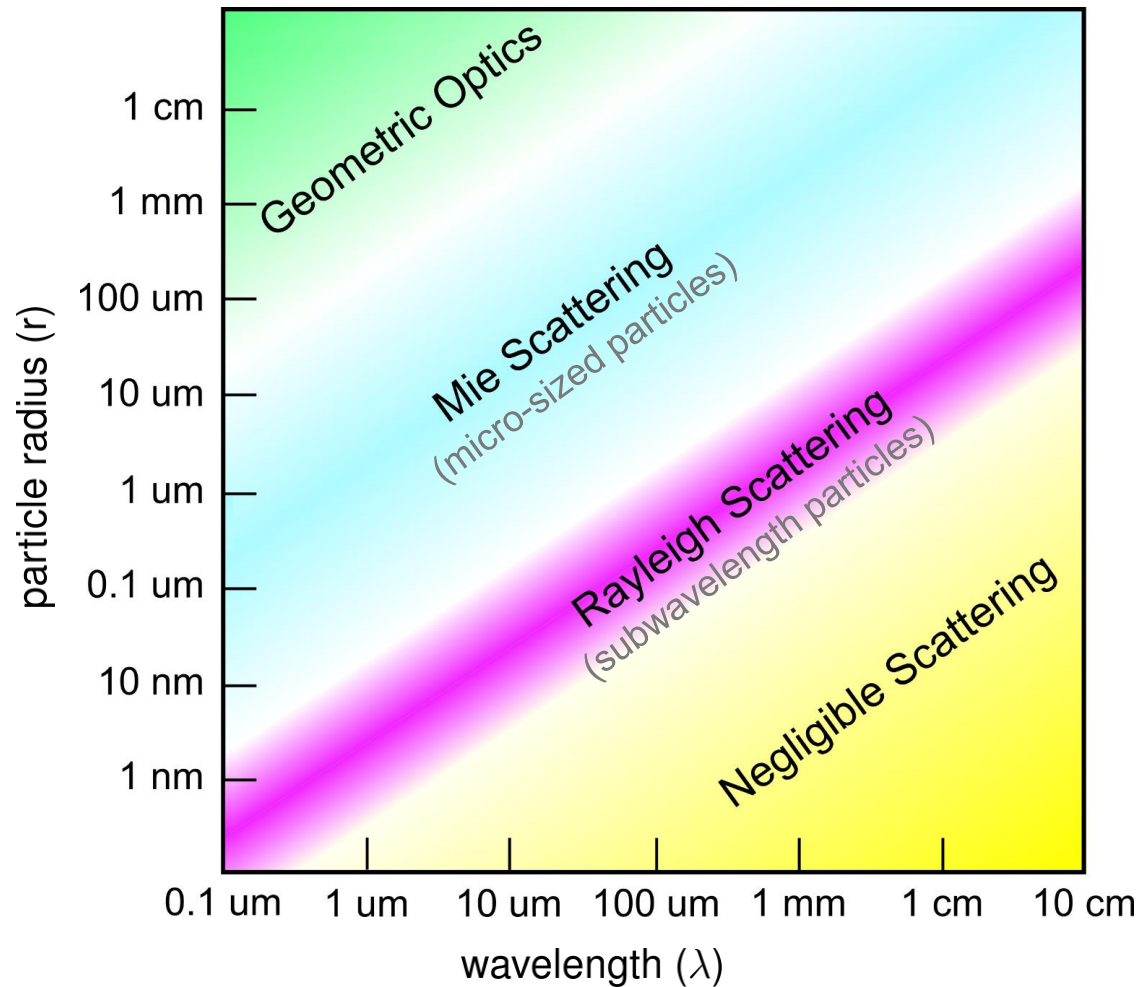
viewing screen

- xz - plane
- origin: center of sphere

spherical scatterer

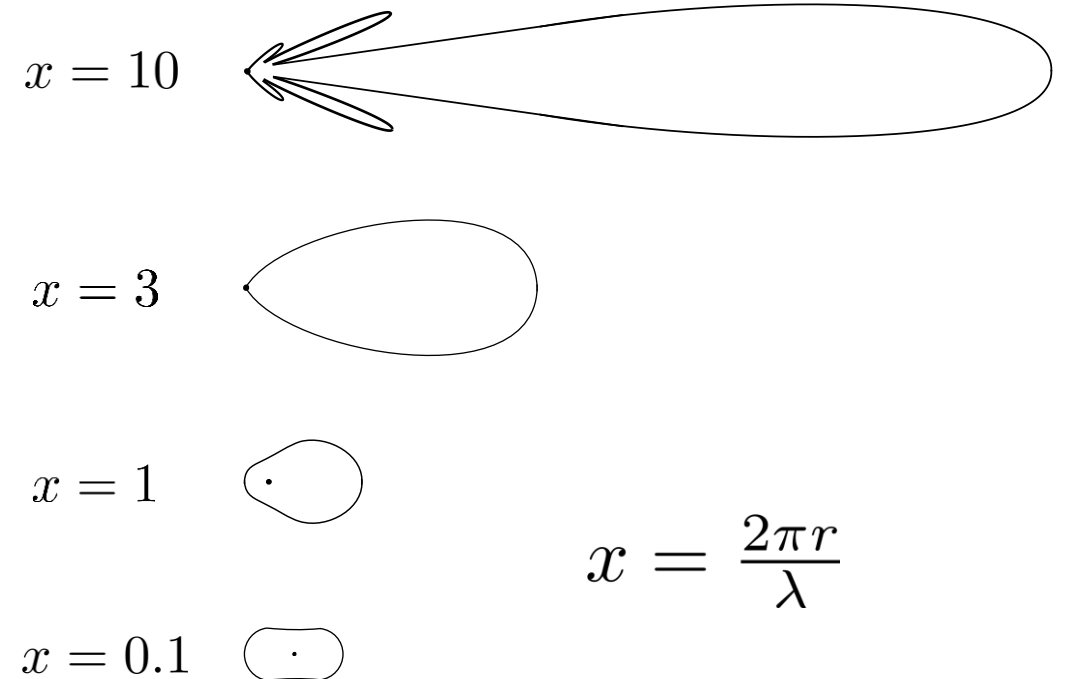
- material of the sphere: *Fused Siica* or *Gold-Au*
- surrounding medium: standard air
- radius of sphere: *variable*

Classification of Scattering

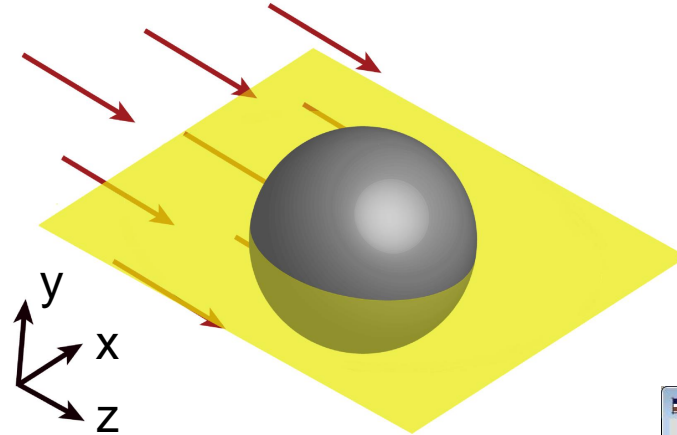
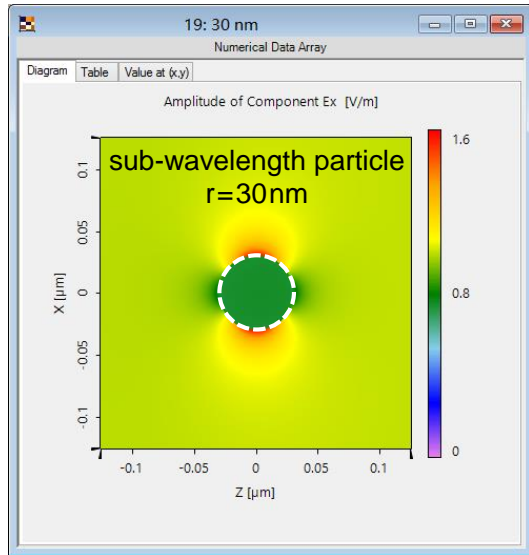


scattering phase function

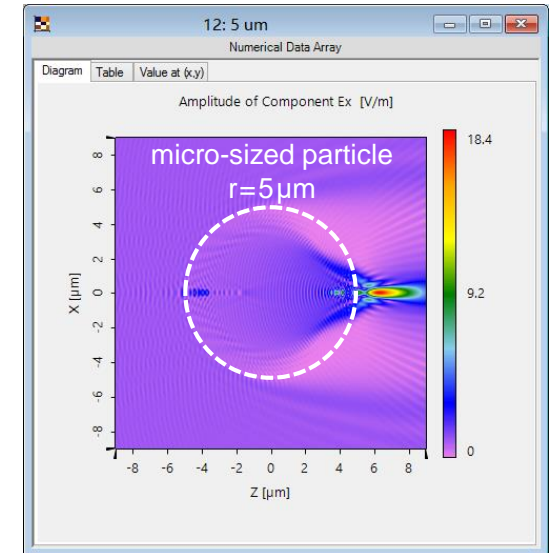
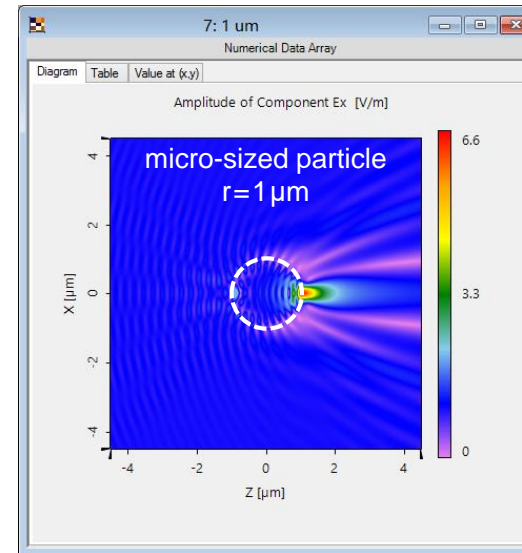
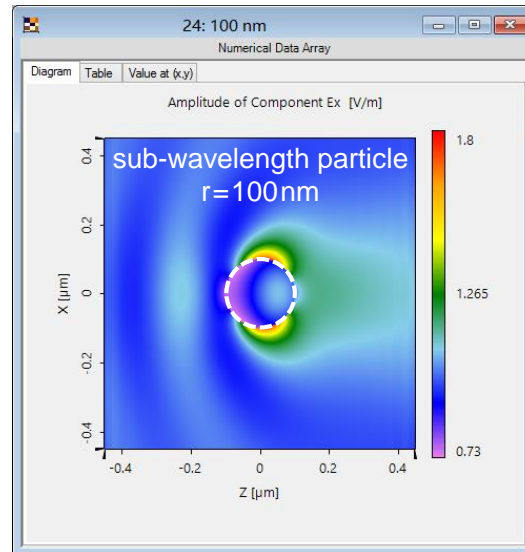
The intensity (radiance) at θ relative to the normalized integral of the scattered intensity at all angles.



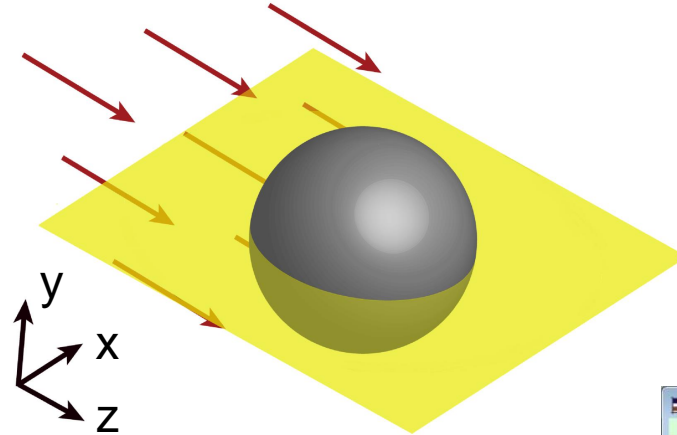
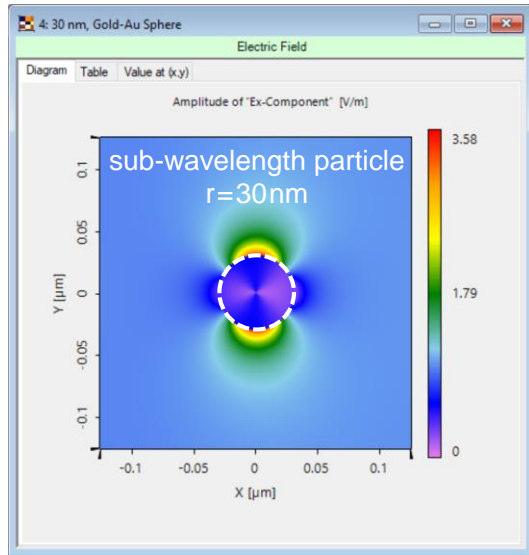
Scattering by a non-absorbent sphere (Fused Silica)



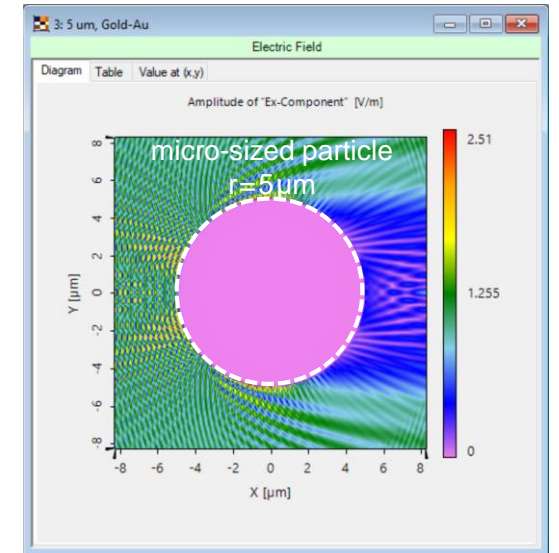
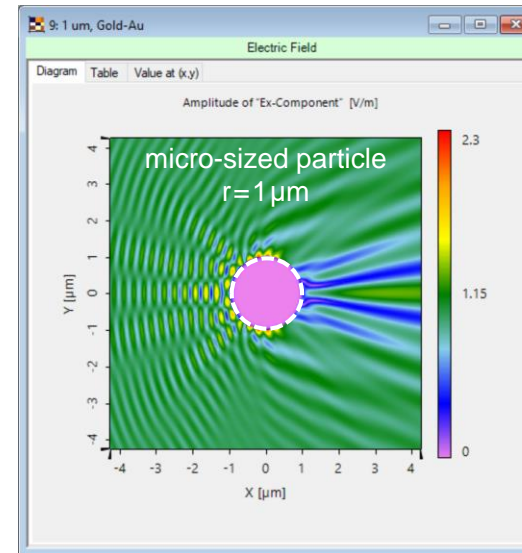
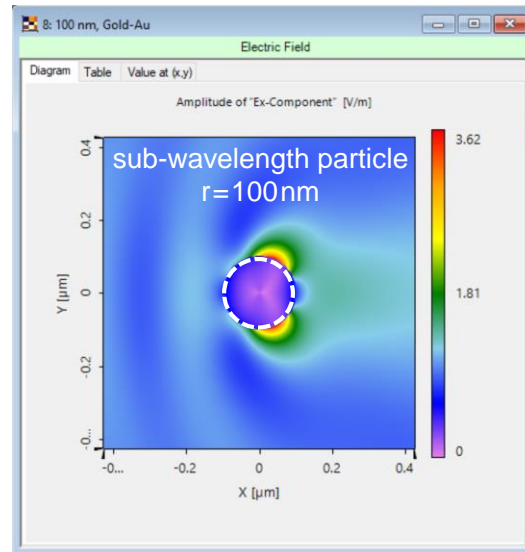
field distribution
amplitude of E_x
component



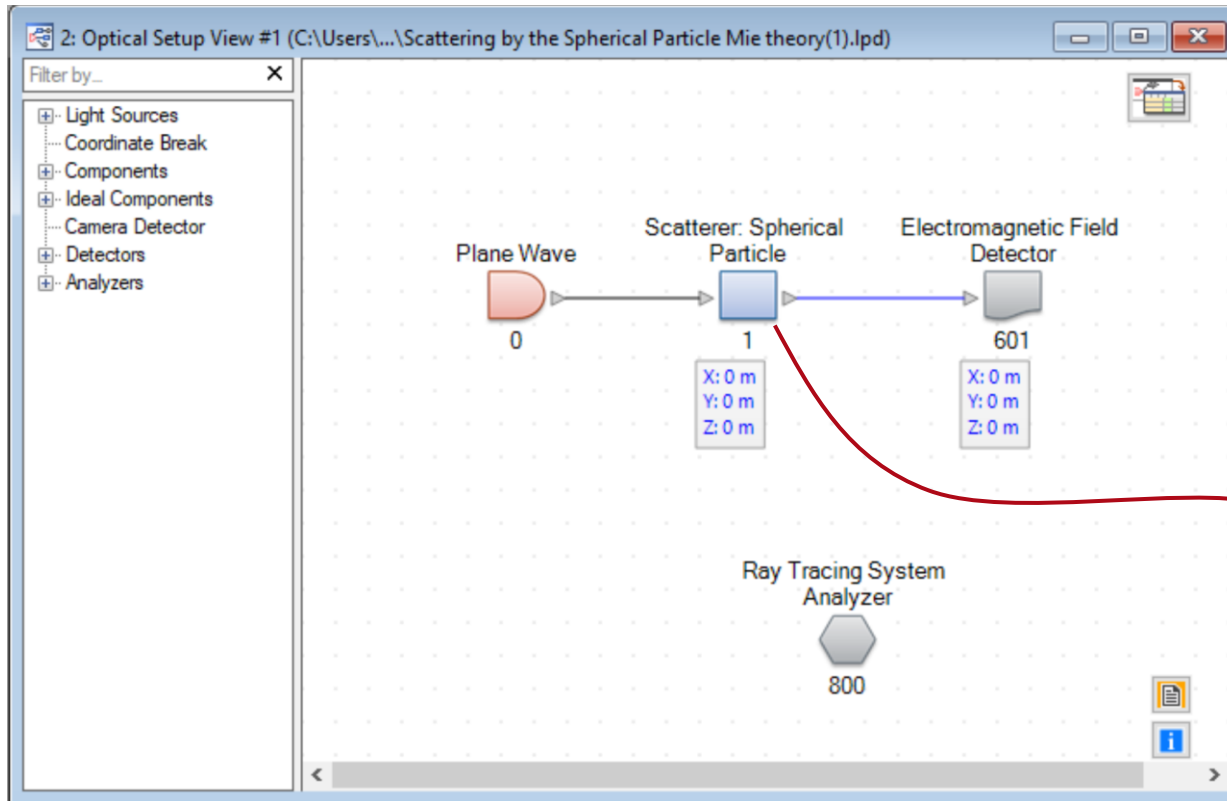
Scattering by an absorbent sphere (Gold-Au)



field distribution
amplitude of E_x
component

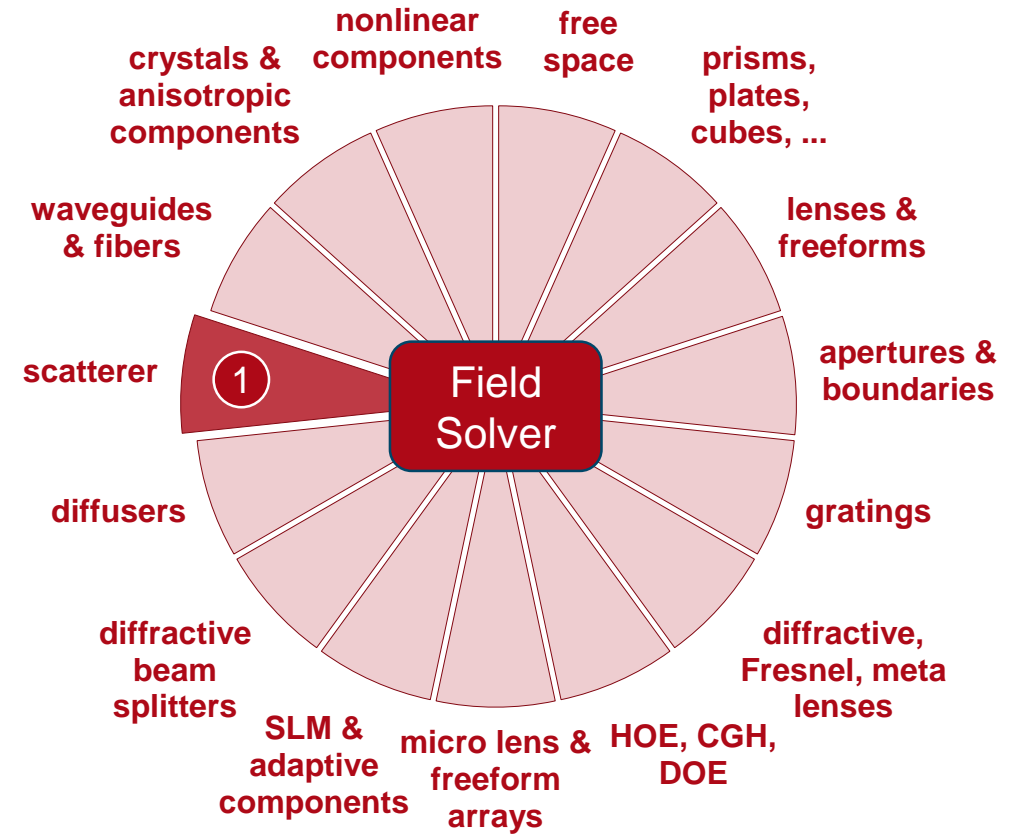
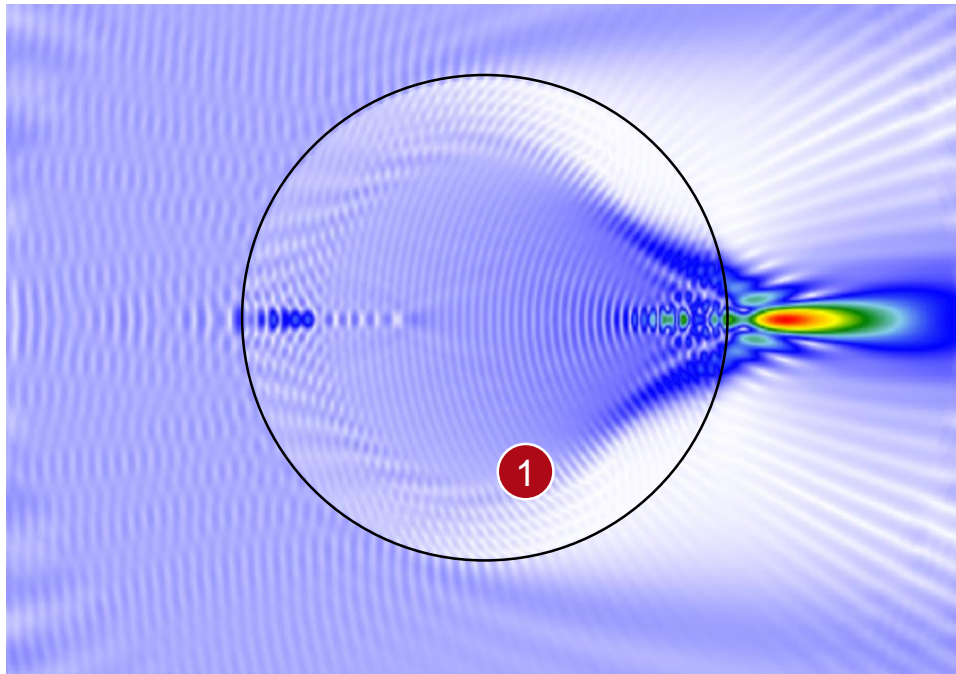


Peek into VirtualLab Fusion



The 'Edit Scatterer: Spherical Particle' dialog box is open, showing various configuration options. The 'Bounding Box' tab is selected. The 'Input Field Preparation (for Field Tracing)' section has 'Relative Position of Field to Position of Input Transface' set to 'Keep Stored in the Field's Coordinate System'. The 'Algorithms' section has 'Input Transface', 'Snippet for Equidistant Field Data', and 'Snippet for Non-Equidistant Field and Ray Data' all with 'Edit' buttons and 'Validity: ✓' indicators. The 'Parameters' section includes 'SamplingPoints' (1001), 'SamplingDistances' (8 nm), 'OriginPosition' (0 m, 0 m, 0 m), 'ObserveDirection' (0, 1, 0), and 'CalculateCompleteField' (checked). The 'FieldExValue' is set to '1 V/m + 0 V/m i Re Im A φ'. A red arrow points from the 'Scatterer: Spherical Particle' component in the main window to this dialog box.

VirtualLab Fusion Technologies



Document Information

title	Mie Solution to Maxwell's Equations for Scattering of an Electromagnetic Plane Wave
document code	MISC.0070
version	1.0
toolbox(es)	Starter Toolbox
VL version used for simulations	7.6.1.18
category	Application Use Case
further reading	- Electromagnetic Field Interaction with Nanocylinders