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Simulation of light propagation through spray systems using a novel open-access software "*Multi-Scattering*"

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Optically dense sprays contain a large amount of small droplets, which are responsible for multiple light scattering phenomena. When detected, photons that have been scattered multiple times blur the shape of liquid bodies and the structure of the spray. In addition to those issues on spray visualization, multiple light scattering introduces large errors in quantitative measurements extracted from image ratio techniques (e.g. LIF/Mie droplet sizing, two-color LIF thermometry, *etc*). The simulation of light propagation and scattering through spray systems is thus very relevant to understand the effects introduced by multiple scattering and to efficiently tackle those issues. A reliable and predictive simulation tool can allows for:
-Predicting the amount of multiple light scattering.
-Estimating the errors introduced by multiple scattering in quantitative spray measurements.
-Testing strategies for suppressing the intensity contribution of multiple scattering light.
-Optimizing and assisting the development of various spray imaging approaches.

We present a novel open-access software called "Multi-Scat". It is a versatile online Monte Carlo simulation tool where photons are tracked through a cloud of spherical droplets where each scattering event is described by the Lorenz-Mie theory. The numerical simulation is accelerated with the use of parallel processing of modern computer graphics cards -known as general-purpose computing on graphics processing units- making those Monte Carlo simulations particularly fast (within <1 min).

The simulations exemplified here demonstrate the use of Multi-Scat for spray imaging applications and opens up for the possibility of using the simulation tool to a variety of other applications related to light propagation through turbid media. This open-access software is freely accessible to any researcher who would like to use it for its own spray application at: www.multi-scat.com

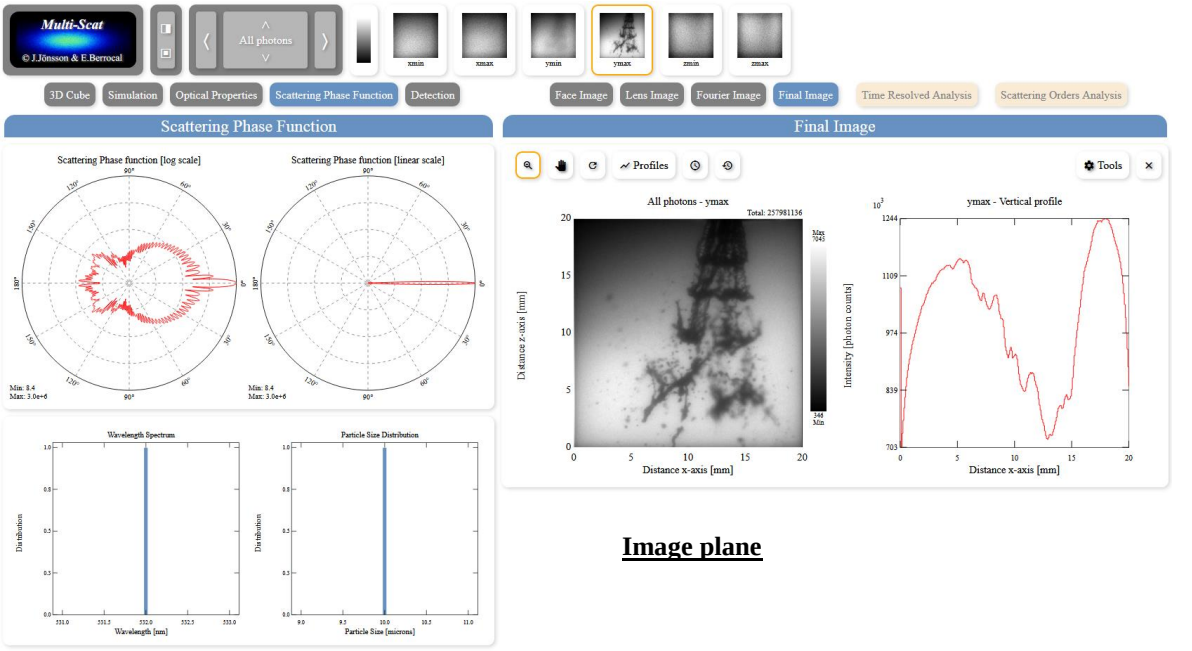
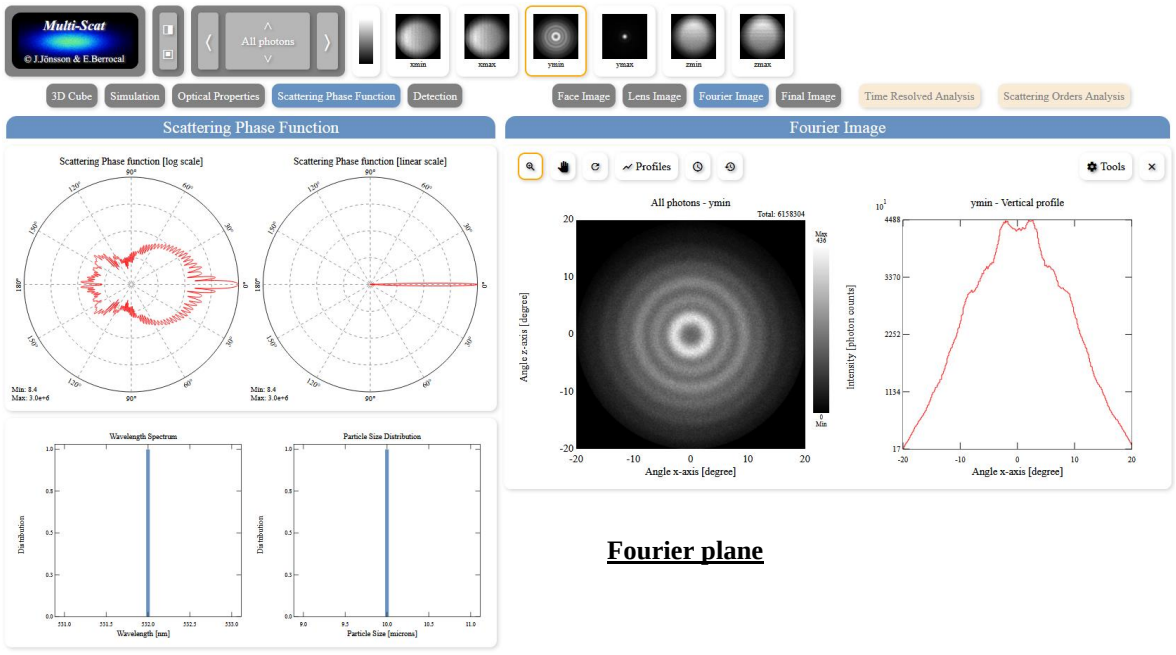


Image plane



Fourier plane

Fig. 1. Screen-shot of the online Monte Carlo simulation "***Muti-scat***".