# Open-source beam-splitting algorithm for the problem of light scattering by atmospheric ice crystals in geometrical optics approximation

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The problem of light scattering by large non-spherical particles is of keen interest to the world scientific community. At the present time the computational resources allow to solve the Maxwell equations efficiently only for particles comparable to the wavelength. Therefore the problem is usually solved in the framework of geometrical optics approximation. Only recently, the development of physical optics approximation connects the exact solution to the approximate solution [1]. The physical optics approximation allowed determining the limits of applicability of geometrical optics approximation and showed wide range of tasks which can be efficiently solved in the framework of geometrical optics approximation.

Traditionally, the geometric optics approximation is based on the obvious and clear ray-tracing technique. This approach is an easy one but it requires an independent examination of its accuracy because of a random location of initial rays. However, such an implementation of the geometrical optics approximation is widespread due to the freely available open-source ray-tracing algorithm developed by A. Macke [2].

It is obvious that for the case of faceted particles the ray-tracing technique is not optimal. When a plane-parallel wave interacts with facet particles a set of plane-parallel light beams appears. Every ray in the beam has the same optical characteristics, and the tracing of all the rays in this beam is a waste of time. It was A. Popov, who first proposed to trace the light beams instead of rays in 1984. Later M. Del Guasta presented his face tracing algorithm in 1995. Then this idea had been separately implemented by A. Borovoi in 2003 in beam-splitting algorithm and by L. Bi in 2011 in his physical-geometric optics hybrid method. Unfortunately, up to now there was not a freely distributed open-source beam-splitting algorithm.

In this talk the beam-splitting algorithm developed by the authors is presented as open-source free software [3]. The theoretical basis and interface of this algorithm are also presented as well as the comparison of this algorithm to the ray-tracing technique that shows good agreement.

The code of the algorithm is written in C++ as a library that facilitates implementations of the beam-splitting algorithm into a third-party program.

[1] Bi, L., Yang, P., Liu, C., Yi, B., and Baum, B. A. // J.Quant.Spectrosc Radiat.Transfer., 146, 158-174, 2014

[2] Macke, A., Mueller, J., and Raschke, E. // J.Atmos.Sci., 53, 2813-2825, 1996.

[3] https://github.com/sasha-tvo/Beam-Splitting