MONTE CARLO SIMULATION OF THE RADIATION OUTGOING FROM A WINDOW OF AN INTERNALLY ILLUMINATED BOX

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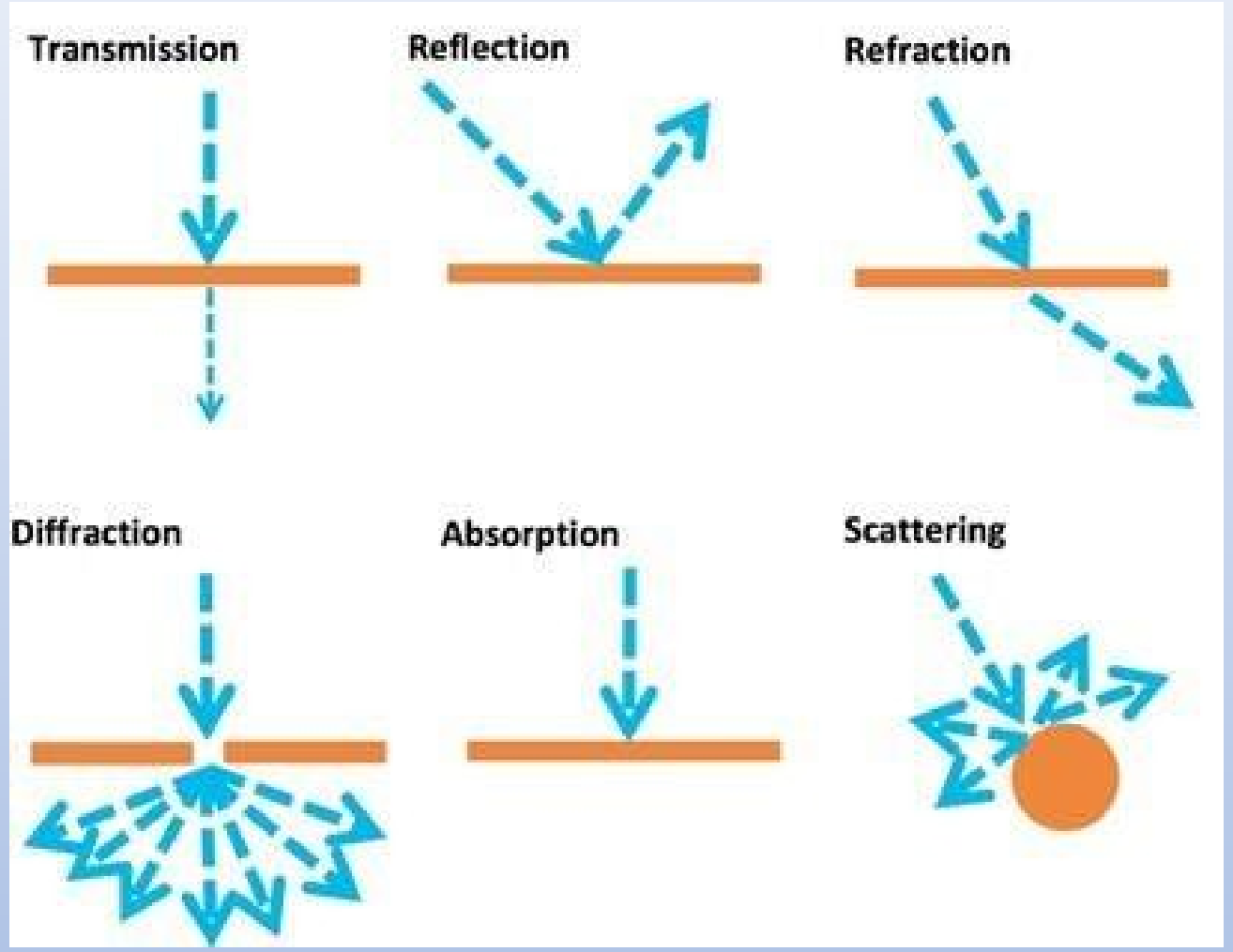
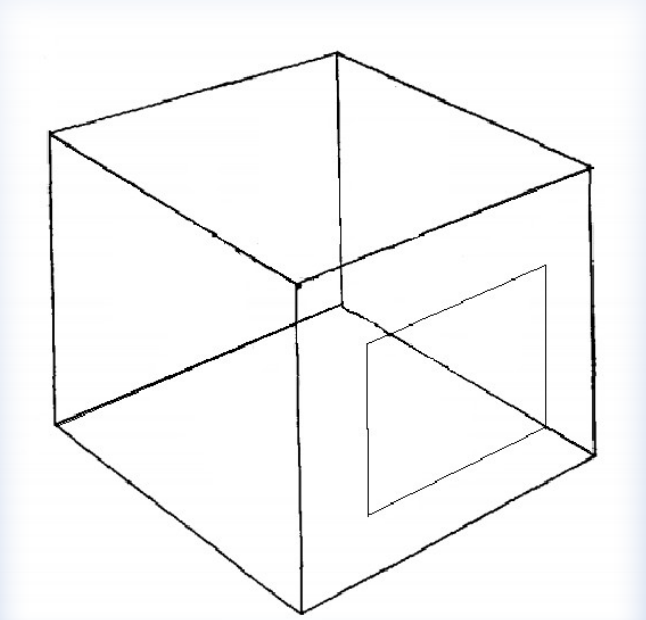
LIGHT-MATTER INTERACTION



Transmission, refraction and diffraction are not going to be considered. Reflection and scattering are classified as

- elastic/anelastic;
- isotropic/anisotropic.

SET-UP DESCRIPTION



- The box is a hollow cubic body filled with gas.
- A source of photons is placed in the center of the cube; the emission is impulsive at the time t=0
- On one face there is a square windows (for photons detection).

Features of photons emission and interaction with walls:

- the injection of photons happen isotropically;
- The el. radiation is monochromatic.

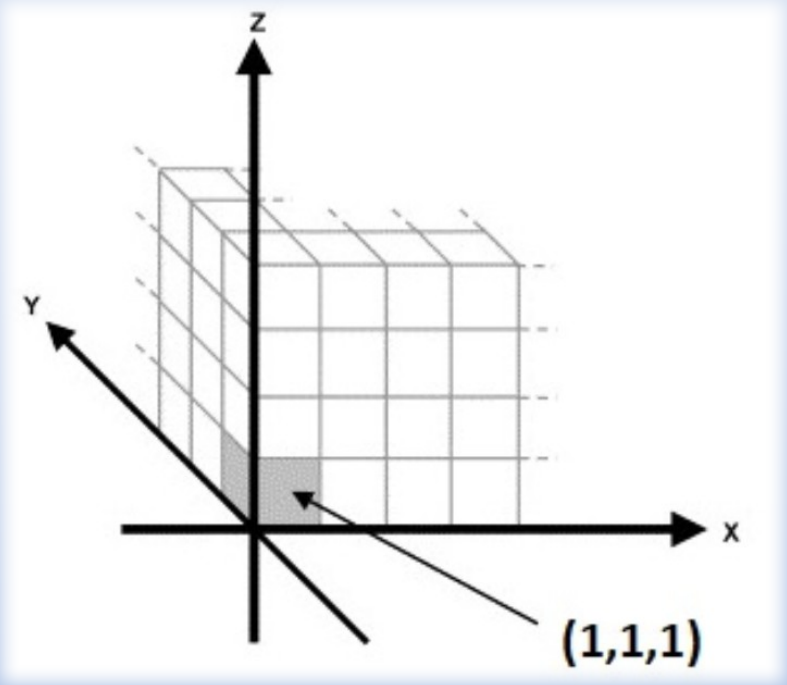
Features of interaction of photons with walls:

- photons interact with gas particles with isotropic and elastic scattering;
- photons interact with walls with isotropic and elastic reflection or with absorption.

AIM AND METHOD

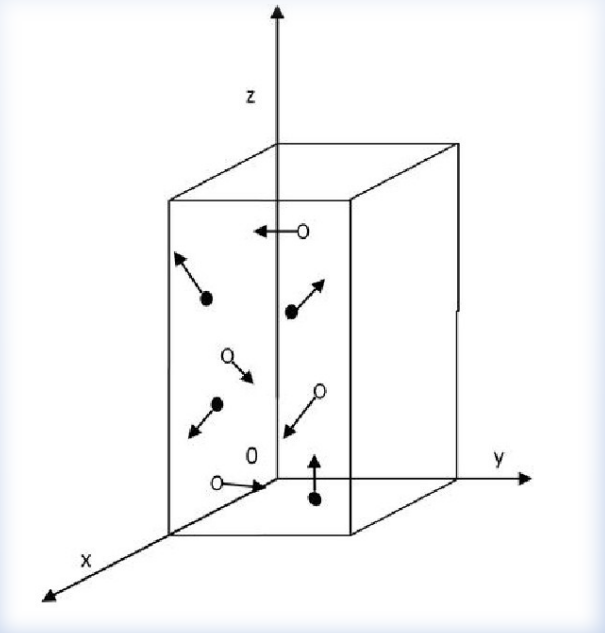
1. Evaluation of the time evolution of the average intensity of the photons crossing the window, where the term “average” is referred to the mean over the two spacial coordinates of the window;

2. evaluation of the distribution of the numbers of events.



1. Discretization of the space;
2. definition of the region variable of the domain and the r. v. of the cavity, implementation of physical phenomena with a fortran 90 source code;
3. analysis of the results.

ASSUMPTION OF NEGLIGIBILITY OF SOME ASPECT QUANTITY



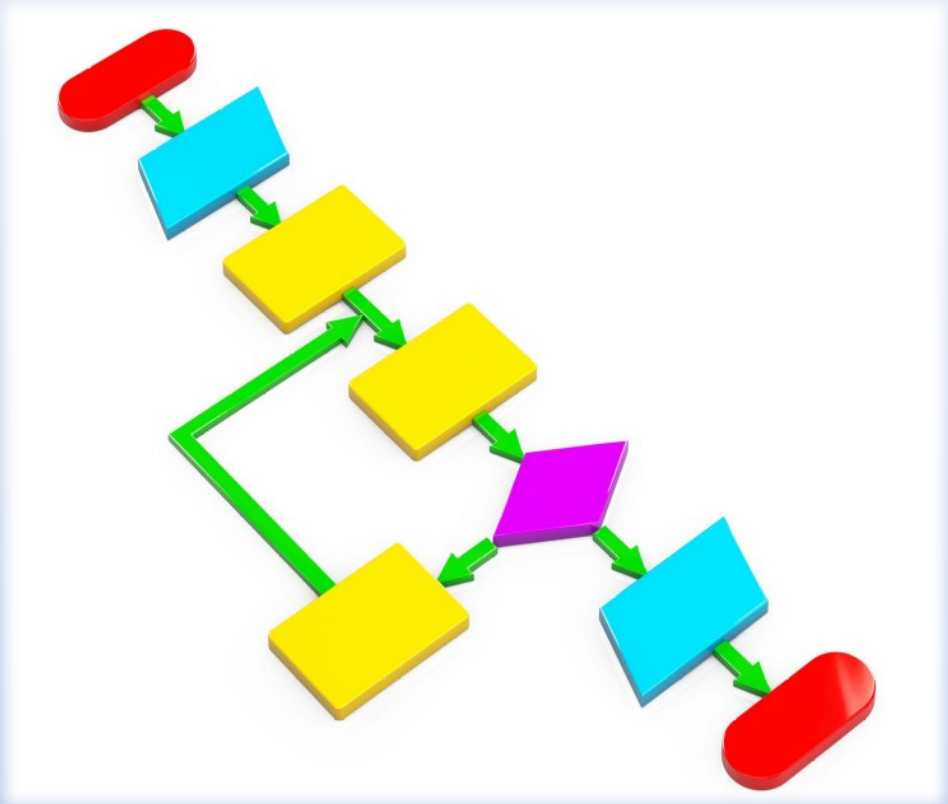
- Negligibility of fluctuations between all the following processes durations:
  - every type of considered interaction;
  - single photon motion without interaction.
- Negligibility of interaction between each photon and all the others.

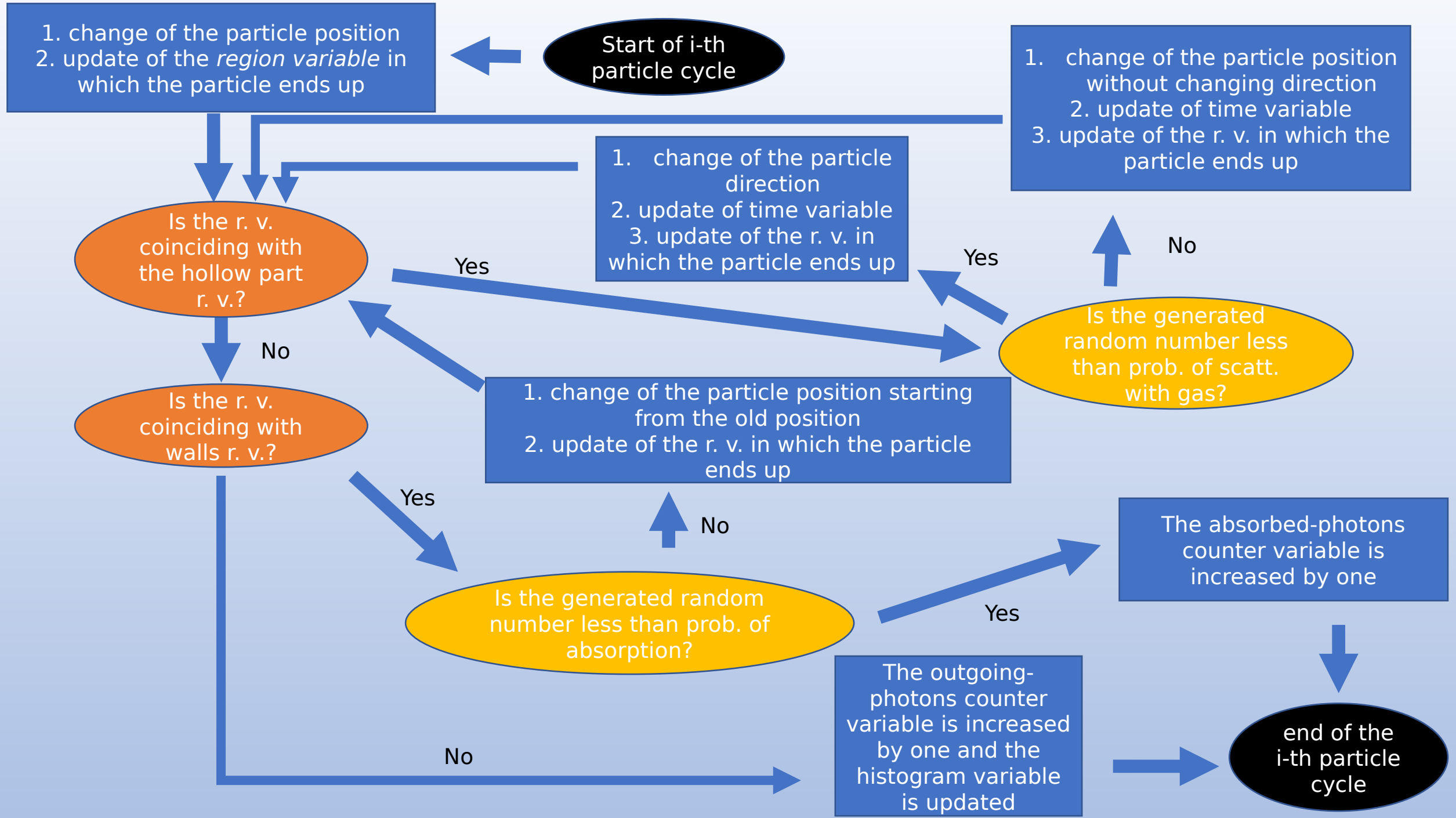
- Negligibility of all quantities associated to photons that are missed for lack of computational time (small part if compared to the total data amount).

ALGORITHM

Structure of the algorithm:

- 1. variable type declarations, variable initialization;
- 2. geometry implementation;
- 3. physical behaviour implementation
  - particle cycle (negligibility of interaction between photons),
  - history cycle;
- 4. average calculation;
- 5. rescaling of the time variable;
- 6. data elaboration for plots.

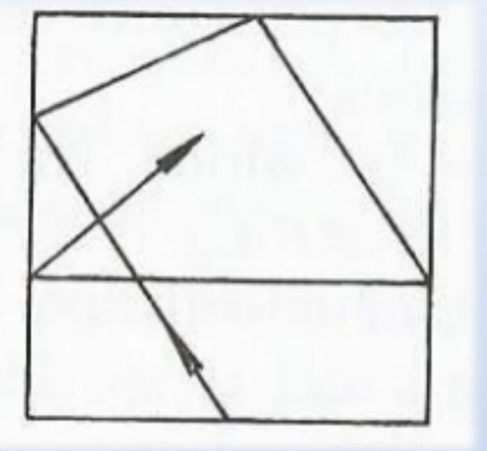



1. change of the particle position
2. update of the region variable in which the particle ends up
Start of i-th particle cycle
1. change of the particle position without changing direction
2. update of time variable
3. update of the r. v. in which the particle ends up
1. change of the particle direction
2. update of time variable
3. update of the r. v. in which the particle ends up
Is the r. v. coinciding with the hollow part r. v.?
Yes
No
Yes
No
Is the generated random number less than prob. of scatt. with gas?
Is the r. v. coinciding with walls r. v.?
1. change of the particle position starting from the old position
2. update of the r. v. in which the particle ends up
Yes
No
Is the generated random number less than prob. of absorption?
Yes
The absorbed-photons counter variable is increased by one
No
The outgoing-photons counter variable is increased by one and the histogram variable is updated
end of the i-th particle cycle

RESULTS

Results are obtained after implementing the following checks:

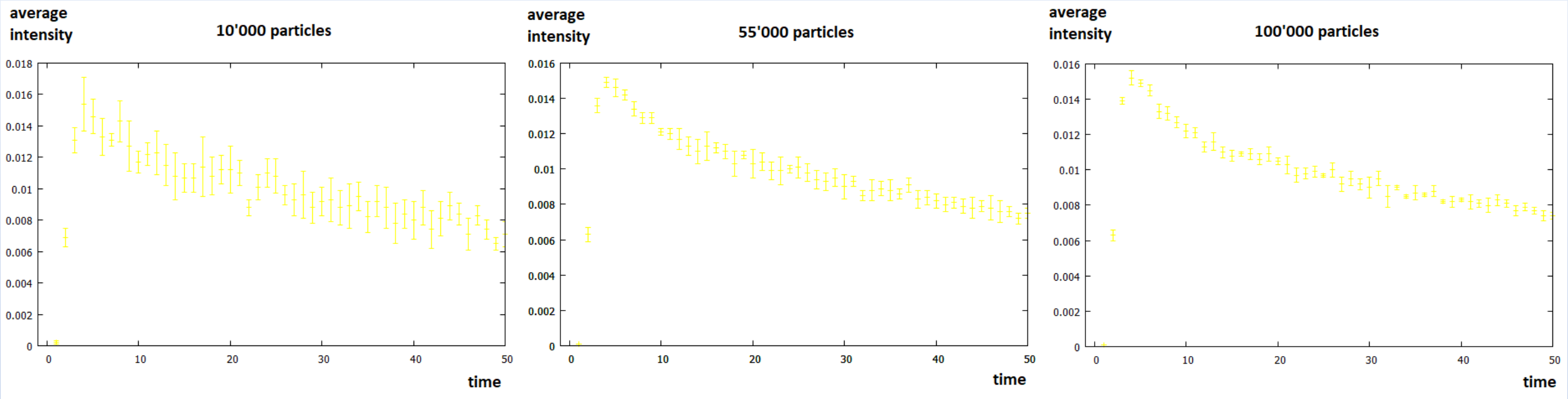
- check for the eventuality of having particles whose particle cycles have total amount of time greater than a value fixed a priori;
- check for eventuality of having particles which go out of the domain.



The photons scattering probability with the gas particles is set such that the mean free path is very large w.r.t. the cube edge length.

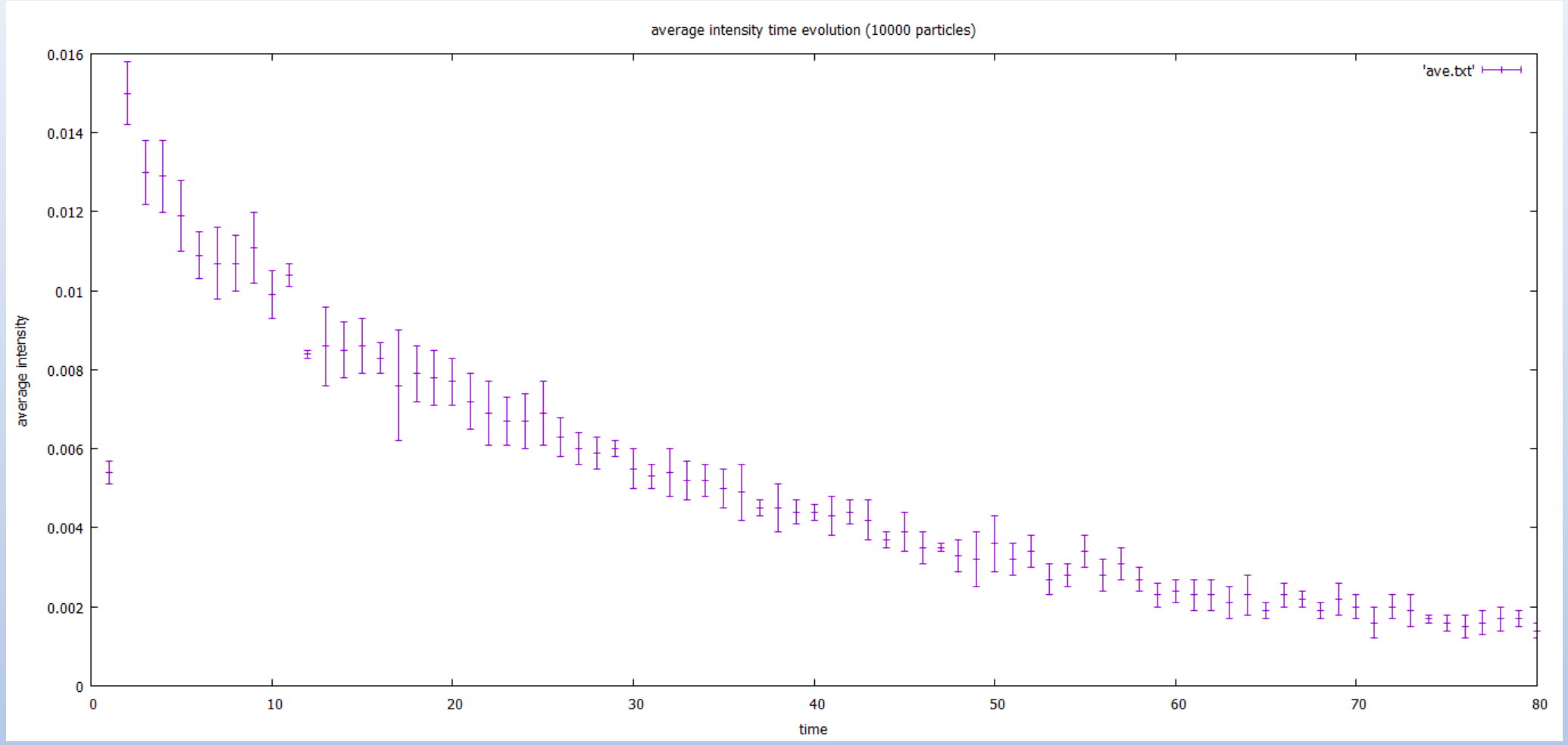
The average intensities time evolution and the distribution the numbers of the events refer to three values of the source intensity: 10’000, 55’000 and 100’000 particles per unit of time increment.

AVERAGE INTENSITIES TIME EVOLUTION



Average intensities in the plots are evaluated as means over an interval of 10 unitary increments of time. No particles out of time are detected.

TIME EVOLUTION ON A LARGER TIME SCALE



Means taken over an interval of 25 unitary increments of time.
No particles out of time are detected.

DISTRIBUTIONS OF THE NUMBERS OF THE EVENTS

```
maxtime, elem time chang, omega0, gas scatt prob   absorb prob
  12000                1    0.996  0.0002014838     0.004000000190

Edge length, Thickness, y-dist, z-dist
 5.00000000 1.00000000 2.00000 2.00000

Numb of part       Num of events: gas scatt, wall absorb., wall scatt, wind cross
      10000                          1813          2637      679736         7363


Numb of part       Num of events: gas scatt, wall absorb., wall scatt, wind cross
      55000                          9696         14832     3682582        40168


Numb of part       Num of events: gas scatt, wall absorb., wall scatt, wind cross
     100000                         17741         27099     6738935        72901
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THANKS FOR YOUR ATTENTION