Contribution ID: **766** Contribution code: **contribution ID 766** Type: **Poster**

# Particle generation trough restrictive planes in GEANT4 simulations for potential applications of cosmic ray muon tomography

The wide angular distribution of the incoming cosmic ray muons in connection with either incident angle or azimuthal angle is a challenging trait led to a drastic particle loss in the course of parametric computations from the GEANT4 simulations since the tomographic configurations as well as the target geometries also influence the processable number of the detected particles apart from the generation strategies. To further detail, the basic parameters such as the scattering angle, the particle displacement, and the particle absorption owing to the volume-of-interest (VOI) de facto dictate the particle penetration trough the multiple sections of the tomographic setup in addition to the VOI. Hence, a number of the loss cases notably come into effect unless the calculation conditions are fulfilled, and not only the computation statistics as well as the numerical outcomes but the initial assumptions like the energy spectrum are also perturbed since the VOI accepts a significantly lower number of particles in the instance of the substantial particle loss. In this study, by attempting to resolve this angular complication during the particle generation, we exhibit an unconventional methodology that is hinged on the direction limitation via the vectorial construction from the generation location to the restriction area rather than using a certain angular distribution or interval. In other words, we favor a momentum direction that is determined by a vector constructed between an initial point randomly chosen on a generative plane and a latter point arbitrarily selected on a restrictive plane of the same dimensions with the basal cross section of the VOI. By setting out such a generation scheme, we optimize the particle loss by keeping an angular disparity that is directly dependent on the VOI geometry as well as the vertical position of the restrictive plane for a tomographic system of a finite size. We demonstrate our strategy for a set of VOI including aluminum, copper, iron, lead, and uranium with a dimension of $40 \times 10 \times 40$ cm$^3$ over three restrictive planes of different positions by using a discrete energy spectrum between 0.1 and 8 GeV and we compute the scattering angle, the number of absorption, and the particle loss. Upon our simulation outcomes, we show that the particle generation by means of restrictive planes is an effective strategy that is flexible towards a variety of computational objectives in the GEANT4 simulations.

## Significance

The particle generation by means of the restrictive planes in the GEANT4 simulations has been demonstrated in this submission for the first time.

## References

https://arxiv.org/abs/2106.14302

## Speaker time zone

Compatible with Europe

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**Session Classification:** Posters: Windmill

**Track Classification:** Track 3: Computations in Theoretical Physics: Techniques and Methods