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Cascades of Particles Moving at Finite Velocity in Hyperbolic Spaces

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A branching process of particles moving at finite velocity over the geodesic lines of the hyperbolic space (Poincar\'e half-plane and Poincar\'e disk) is examined. Each particle can split into two particles only once at Poisson paced times and deviates orthogonally when splitted. At time t, after $N(t)$ Poisson events, there are $N(t)+1$ particles moving along different geodesic lines. We are able to obtain the exact expression of the mean hyperbolic distance of the center of mass of the cloud of particles. We derive such mean hyperbolic distance from two different and independent ways and we study the behavior of the relevant expression as t increases and for different values of the parameters c (hyperbolic velocity of motion) and λ (rate of reproduction). The mean hyperbolic distance of each moving particle is also examined and a useful representation, as the distance of a randomly stopped particle moving over the main geodesic line, is presented.

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