ON DETTMANN'S 'HORIZON' CONJECTURES

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ABSTRACT. In the simplest case consider a $\mathbb{Z}^d-$ periodic $(d \geq 3)$ arrangement of balls of radii $< 1/2$, and select a random direction and point (outside the balls). According to Dettmann's first conjecture the probability that the so determined free flight (until the first hitting of a ball) is larger than $t \gg 1$ is $\sim \frac{C}{t}$ where C is explicitly given by the geometry of the model. In its simplest form, Dettmann's second conjecture is related to the previous case with tangent balls (of radii $1/2$). The conjectures are established in a more general setup: for $\mathcal{L}-$periodic configuration of convex bodies with $\mathcal{L}$ being a non-degenerate lattice. These questions are related to Pólya's visibility problem (1918), to the results of Bourgain-Golse (1998-) and of Marklof-Strömbergsson (2010-). The results, joint with P. Nándori and T. Varjú, also provide the asymptotic covariance of the periodic Lorentz process assuming it has a limit in the super-diffusively scaling, a fact if $d = 2$ and the horizon is infinite.