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Geometrical Optics of Constrained Brownian Motion

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The optimal fluctuation method – essentially geometrical optics – gives a valuable insight into large deviations of constrained Brownian motion, and it achieves this purpose by simple means. I will illustrate these points by revisiting the Airy distribution - the probability distribution of the area under a Brownian excursion - and considering some additional statistics of Brownian excursions.

The geometrical optics immediately gives the large-area tail of the Airy distribution. It also predicts the position distribution of a Brownian excursion at an intermediate time, conditioned on a large area. Finally, it gives the area distribution on a sub-interval of Brownian excursion. The last two distributions exhibit dynamical phase transitions which have a simple geometric origin.

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