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The spreading of viruses by airborne aerosols: lessons from a first-passage-time problem for tracers in turbulent flows[1] DHRUBADITYA MITRA, NORDITA , AKHILESH KUMAR VERMA, Indian Institute of Science , AKSHAY BHATNAGAR, NORDITA , RAHUL PANDIT, Indian Institute of Science — We study the spreading of viruses, such as SARS-CoV-2, by airborne aerosols, via a new first-passage-time problem for Lagrangian tracers that are advected by a turbulent flow: By direct numerical simulations of the three-dimensional incompressible, Navier-Stokes equation, we obtain the time $t_{\rm R}$ at which a tracer, initially at the origin of a sphere of radius R, crosses the surface of the sphere for the first time. We obtain the probability distribution function (PDF) and show that it displays two qualitatively different behaviors:(a) for $R \ll L$ where L is the integral scale, the PDF has a power-law tail , with the exponent $\alpha = 4$;(b) for $R \gg L$, the tail of the PDF decays exponentially. We develop models that allow us to obtain these asymptotic behaviors analytically. We show how to use the PDF to develop social-distancing guidelines for the mitigation of the spreading of airborne aerosols with viruses such as SARS-CoV-2.

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