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Mutation induced infection waves in diseases like COVID-19

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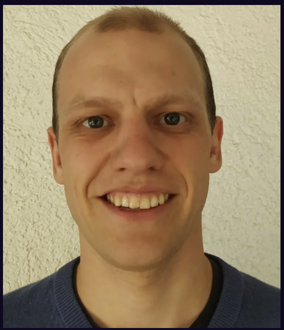
Abstract:

After more than 4 million deaths worldwide, the ongoing vaccination to conquer the COVID-19 disease is now competing with the emergence of increasingly contagious mutations, repeatedly supplanting earlier strains. Following the near-absence of historical examples of the long-time evolution of infectious diseases under similar circumstances, models are crucial to exemplify possible scenarios. Accordingly, in the present work we systematically generalize the popular susceptible-infected-recovered model to account for mutations leading to repeatedly occurring new strains, which we coarse grain based on tools from statistical mechanics to derive a model predicting the most likely outcomes. The model predicts that mutations can induce a super-exponential growth of infection numbers at early times, which self-amplify to giant infection waves which are caused by a positive feedback loop between infection numbers and mutations and lead to a simultaneous infection of the majority of the population. At later stages -- if vaccination progresses too slowly -- mutations can interrupt an ongoing decrease of infection numbers and can cause infection revivals which occur as single waves or even as whole wave trains featuring alternative periods of decreasing and increasing infection numbers. Our results might be useful for discussions regarding the importance of a release of vaccine-patents to reduce the risk of mutation-induced infection revivals but also to coordinate the release of measures following a downwards trend of infection numbers.

Date:
10/11/2021

Time:
9:00 AM-10:15 AM (PT)

About the speaker:



Dr. Fabian Schwarzendahl is a Postdoctoral Scholar working at the Heinrich-Heine-Universität in Düsseldorf with Prof. H. Löwen. His research focuses on microswimmers, active matter and statistical mechanics.

Dr. Schwarzendahl received his PhD from the Georg-August-University in Göttingen, where he worked at the Max-Planck-Institute for dynamics and self-organization studying the collective behavior of micoswimmers in complex environments. Afterwards he joined Prof. D. Beller and Prof. K. Dasbiswas at UC Merced, where he worked on self organization of cytoskeletal filaments and growth of bacterial colonies.

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