

# A SLOW-FAST DYNAMIC DECOMPOSITION LINKS NEUTRAL AND NON-NEUTRAL COEXISTENCE IN INTERACTING MULTI-STRAIN PATHOGENS

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We consider a multi-type pathogen, transmitted via direct contact, following susceptible-infected-susceptible (SIS) epidemiological dynamics and co-infection. We have grouped the pathogen types in two subsets, denoted by V and N, which yields six compartments: susceptible S, colonized hosts V and N and co-colonized hosts VV, NN and VN. Their dynamics are governed by a system of six ordinary differential equations.

There are two classical ways to analyse this system [1]. The neutral approach, which uses an equivalence assumption for strain interaction at co-colonization, and is easy to study. And the non-neutral approach which does not use the equivalence assumption, but cannot be rigorously analysed.

We follow the study in [2]. Using a slow-fast dynamics approach, we give explicitly an equation which interpolates between the neutral and the non-neutral models for multi-strain coexistence, and quantifies the asymmetries that are important for the maintenance and stabilisation of diversity.

## References

- [1] E. Gjini, C. Valente, R. Sá-Leão, MGM. Gomes. (2016). *How direct competition shapes coexistence and vaccine effects in multi-strain pathogen systems*, Journal of Theoretical Biology, **388**, 50–60.
- [2] E. Gjini, S. Madec. (2016). *A slow-fast dynamic decomposition links neutral and non-neutral coexistence in interacting multi-strain pathogens*, Theoretical Ecology, 13pp.