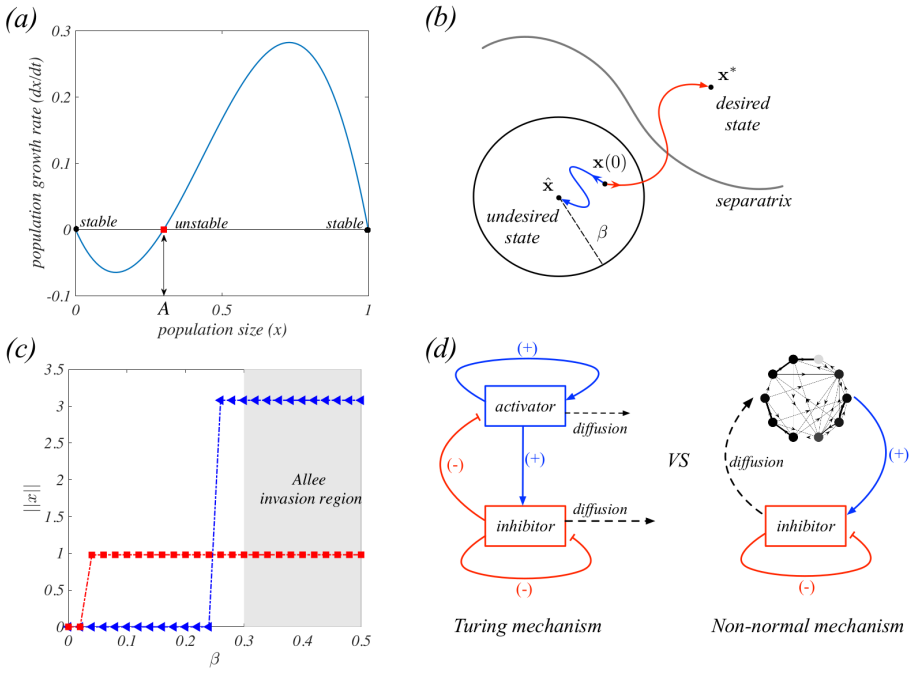
Topological resilience in non-normal networked systems [1]

Malbor Asllani and Timoteo Carletti

Department of Mathematics & naXys, Namur Institute for Complex Systems, University of Namur

The network of interactions in complex systems, strongly influences their resilience, the system capability to resist to external perturbations or structural damages and to promptly recover thereafter. The phenomenon manifests itself in different domains, e.g. cascade failures in computer networks or parasitic species invasion in ecosystems. Understanding the networks topological features that affect the resilience phenomenon remains a challenging goal of the design of robust complex systems. We prove that the non-normality character of the network of interactions amplifies the response of the system to exogenous disturbances and can drastically change the global dynamics (panel (b)). We provide an illustrative application to ecology by proposing a mechanism to mute the Allee effect (panel (c) red curve vs. blue one), the phenomenon according to which for initial low densities the species is not able to survive (panel (a)). This manifestation of unexpected species invasion eventually describes a new theory of patterns formation involving a single diffusing species (panel (d)) inspired by a transient instability principle.



References

[1] M. Asllani and T. Carletti, arXiv:1706.02703, (2017).