Griffiths phases in infinite-dimensional, non-hierarchical modular networks

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Griffiths phase (GP) generated by the heterogeneities on modular networks has recently been suggested to provide a mechanism, rid of fine parameter tuning, to explain the critical behavior of the brain. One conjectured requirement was that the network of modules must be hierarchically organized and possess finite topological dimension[1, 2]. We investigate the dynamical behavior of an activity spreading model evolving in heterogeneous random networks with highly modular structure, organized non-hierarchically. We observe that loosely coupled modules act as effective rare-regions slowing down the extinction of activation. As a consequence, we find extended control parameter regions with continuously changing dynamical exponents for single network realizations in the thermodynamic limit, as in a real GP. The avalanche size distributions of spreading events exhibit robust power-law tails. Our findings relax the requirement of a hierarchical organization of the modular structure, which can help to rationalize the criticality of modular systems in the framework of GPs [3].

References

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