

Modeling Plasticity-led Evolution by Developmental Gene Regulatory Networks: Overcoming Modern Evolutionary Synthesis



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Dec. 18 (Wed.) 14:00 – 15:00

IPR Main Building 4th Seminar room

The Modern Evolutionary Synthesis, the standard theory of evolution, seemingly fails to explain how a population can evolve under a large environmental change: the pre-existence of heritable variants adapted to the novel environment is too opportunistic, whereas the search for new adaptive mutations after the environmental change is so slow that the population is likely to go extinct. Plasticity-led evolution, the initial environmental induction of a novel adaptive phenotype followed by genetic accommodation, has been proposed to solve this problem. However, its mechanism remains unclear. Here, we present computational models that exhibit behaviors compatible with plasticity-led evolution. Our simulations suggest plasticity-led evolution is a universal property of complex developmental systems and emerges as the robustness of the developmental process against environmental and genetic fluctuations breaks down with larger environmental changes.

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