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Control of growth and adaptation to nutritional shifts for bacteria exposed to amino acid-limiting environments EDUARD M. MATEESCU, TERENCE HWA, Center for Theoretical Biological Physics, UCSD — In order to grow at the highest rate sustainable by the environment, bacteria turn on different metabolic pathways and utilize a myriad of adaptive strategies. The macromolecular composition (RNA, DNA, protein) and overall cell size (mass) can be very different in different environments. Surprisingly however, these differences appear to depend only on the growth rate and not on the growth medium itself. As the nutritional environment changes in time, the cells quickly adapt their composition to the one corresponding to the new conditions. Here, we propose a phenomenological model of growth and adaptation control for the bacterial cell, based on a simplified formulation of the central dogma and a simplified implementation of the stringent response. The core model contains no free parameters and provides a simple intuitive understanding of cell growth control. The results generated by the model, physiological state of the cell as well as the characteristics of the transition between optimized states of growth, are in qualitative and semi-quantitative agreement (i.e. within a factor of 2) with the experimental observations.

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