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Three-component homeostasis control JIN XU, Asia Pacific Center for Theoretical Physics and Department of Physics, POSTECH, Pohang, Korea, HYUNSUK HONG, Department of Physics and Research Institute of Physics and Chemistry, Chonbuk National University, Jeonju 561-756, Korea, JUNGHYO JO, Asia Pacific Center for Theoretical Physics and Department of Physics, POSTECH, Pohang, Korea — Two reciprocal components seem to be sufficient to maintain a control variable constant. However, pancreatic islets adapt three components to control glucose homeostasis. They are α (secreting glucagon), β (insulin), and δ (somatostatin) cells. Glucagon and insulin are the reciprocal hormones for increasing and decreasing blood glucose levels, while the role of somatostatin is unknown. However, it has been known how each hormone affects other cell types. Based on the pulsatile hormone secretion and the cellular interactions, this system can be described as coupled oscillators. In particular, we used the Landau-Stuart model to consider both amplitudes and phases of hormone oscillations. We found that the presence of the third component, δ cell, was effective to resist under glucose perturbations, and to quickly return to the normal glucose level once perturbed. Our analysis suggested that three components are necessary for advanced homeostasis control.

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