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Clique of functional hubs orchestrates population bursts in developmentally regulated neural networks[1] ALESSANDRO TORCINI, STEFANO LUCCIOLI, Istituto dei Sistemi Complessi - CNR, Sesto Fiorentino (Italy), PAOLO BONIFAZI, ESHEL BEN-JACOB, Beverly and Sackler Faculty of Exact Sciences School of Physics and Astronomy, Tel Aviv University, 69978 Ramat Aviv, Israel, ARI BARZILAI, Department of Neurobiology, George S. Wise Faculty of Life Sciences and Sagol School of Neuroscience, Tel Aviv University, Israel — It has recently been discovered that single neuron stimulation can impact network dynamics in immature and adult neuronal circuits. Here we report a novel mechanism which can explain in developing neuronal circuits, typically composed of only excitatory cells, the peculiar role played by a few specific neurons in promoting/arresting the population activity. For this purpose, we consider a standard neuronal network model, with short-term synaptic plasticity, whose population activity is characterized by bursting behavior. The addition of developmentally regulated constraints on single neuron excitability and connectivity leads to the emergence of functional hub neurons, whose stimulation/deletion is critical for the network activity. Functional hubs form a clique, where a precise sequential activation of the neurons is essential to ignite collective events without any need for a specific topological architecture. Unsupervised time-lagged firings of supra-threshold cells, in connection with coordinated entrainments of near-threshold neurons, are the key ingredients to orchestrate population activity.

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