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A model of the primary auditory cortex response to sequences of pure tones

Ernest Montbrió[1,2], Johan P Larsson*[1], Rita Almeida[1,3] and Gustavo Deco[1,4]

Address: [1]Computational Neuroscience Group, Universitat Pompeu Fabra, 08018 Barcelona, Spain, [2]Center for Neural Science, New York University, New York, NY 10003, USA, [3]Institut d'Investigacions Biomèdiques August Pi i Sunyer (IDIBAPS), 08036 Barcelona, Spain and [4]Institució Catalana de Recerca i Estudis Avançats, 08010 Barcelona, Spain

Email: Johan P Larsson* - johan.petter.larsson@gmail.com

* Corresponding author

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The neurons in the primary auditory cortex (A1) are unable to sustain responses to sequences of stimuli presented at rates exceeding approximately 20 Hz. The ventral medial geniculate body, which provides the main input to A1, is in contrast able to respond to sequences with rates upward of 200 Hz. This filtering of periodic stimuli has been attributed to thalamocortical synaptic depression [1,2]. However, there also exists a frequency-selective filtering below 20 Hz known as differential suppression [3,4]. Such filtering produces a receptive field refinement in A1 neurons, rendering them more selective to the frequency of presented tones as the presentation rate is increased.

This phenomenon is thought to play a fundamental role in auditory grouping (or auditory stream segregation, known as auditory streaming) phenomena, organizing sequential sounds into perceptual streams, reflecting distinct ambient sound sources [5]. Here we propose a simple model of A1 that can account for the differential suppression phenomenon. Our model has constraints compatible with recent physiological findings in A1, such as the approximate balance of inhibition and excitation [6,7], the presence of thalamocortical synaptic depression [1], and the role of intracortical and thalamocortical synapses in the formation of A1's activity pattern [8].

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