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**Horacio G. Rotstein\*** (horacio@math.bu.edu), 111 Cummington Street, Boston, MA 02215,  
and **Tim Oppermann, John A. White** and **Nancy Kopell**. *Subthreshold oscillatory activity  
and spiking in medial entorhinal cortex layer II stellate cells.*

Medial entorhinal cortex layer II stellate cells display complex mixed-mode oscillatory (MMO) patterns in which both subthreshold oscillations (STOs) and spikes coexist. We study a biophysical model of such cells which qualitatively reproduces this MMO activity. We show that, during the interspike interval (ISI) where STOs are generated, this seven-dimensional model can be reduced to a three-dimensional one, with two well differentiated time scales. Using dynamical systems arguments we provide a mechanism for generations of STOs. This mechanism is based on a “canard structure”, in which relevant trajectories stay close to repelling manifolds for a significant interval of time. We also show that the transition from subthreshold oscillatory activity to spiking (“**canard explosion**”) is controlled in the ISI by the same structure. A similar mechanism is invoked to explain why noise increases the robustness of the STO regime. (Received September 22, 2005)