Connectivity and plasticity of neocortical basket cells

Alberto Bacci, PhD
Paris Brain Institute (ICM)
INSERM U1127, Paris, France

In the neocortex, perisomatic inhibition onto principal pyramidal neurons (PNs) determines the dynamic range of pyramidal neuron responses during sensory processing and drive several forms of network oscillations, believed to be the network correlate of several cognitive functions. The inhibitory control of the perisomatic region of PNs originates from two GABAergic basket cell (BC) subtypes: parvalbumin (PV)-expressing interneurons and PV-negative BCs, expressing the cannabinoid receptor type 1 (CB1). Whereas the role and function of PV cells within cortical networks has been studied in detail, the properties and function of CB1 BCs are poorly understood.
This presentation will revolve around the specific connectivity and plasticity properties of PV and CB1 BCs. In particular, I will describe a PV cell-specific microcircuit: autaptic self-inhibition, which represents an exceptionally large and fast disinhibitory mechanism, favoring synchronization of PV-cell firing during cognitive-relevant cortical network activity. I will also discuss how activity-dependent plasticity of perisomatic inhibition effectively influences the participation of single PNs to γ-oscillations. Finally, I will show how the morpho-functional properties of CB1 BCs and thus their control of PNs, is cortical area- and layer-specific. This work will highlight specific strategies operated by distinct BCs in controlling the output spikes of PNs during cortical activity.