

Context & Objective

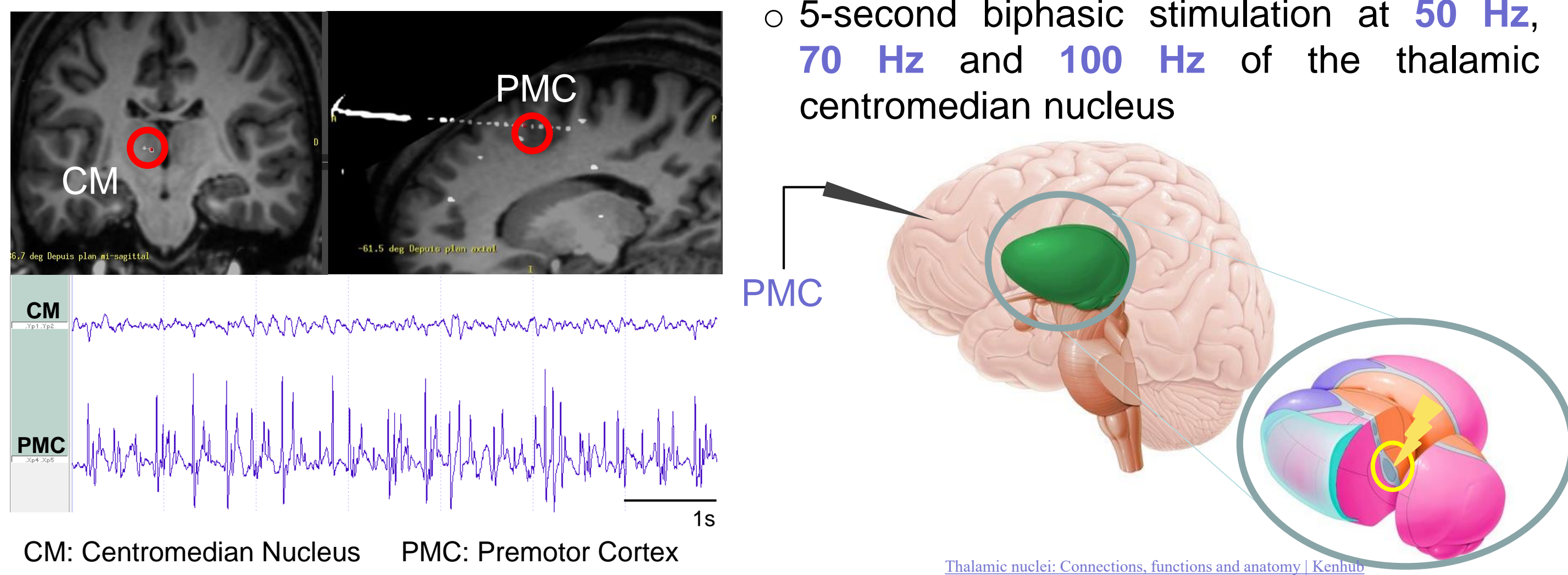
- SEEG recording of prefrontal cortex during **thalamic centromedian nucleus** stimulation in patient with drug resistant epilepsy

- To explain frequency dependent effects of thalamic stimulation on neocortical dysplasia
- To propose a **novel neurophysiologically-plausible computational model**

SEEG Data

Age/ Gender	Condition
34 y.o./ M	<ul style="list-style-type: none"> • Drug resistant partial epilepsy • Left-sided premotor epilepsy close to the frontal eye field • Probable focal cortical dysplasia (FCD) located in an abnormal supernumerary sulcus

Case report

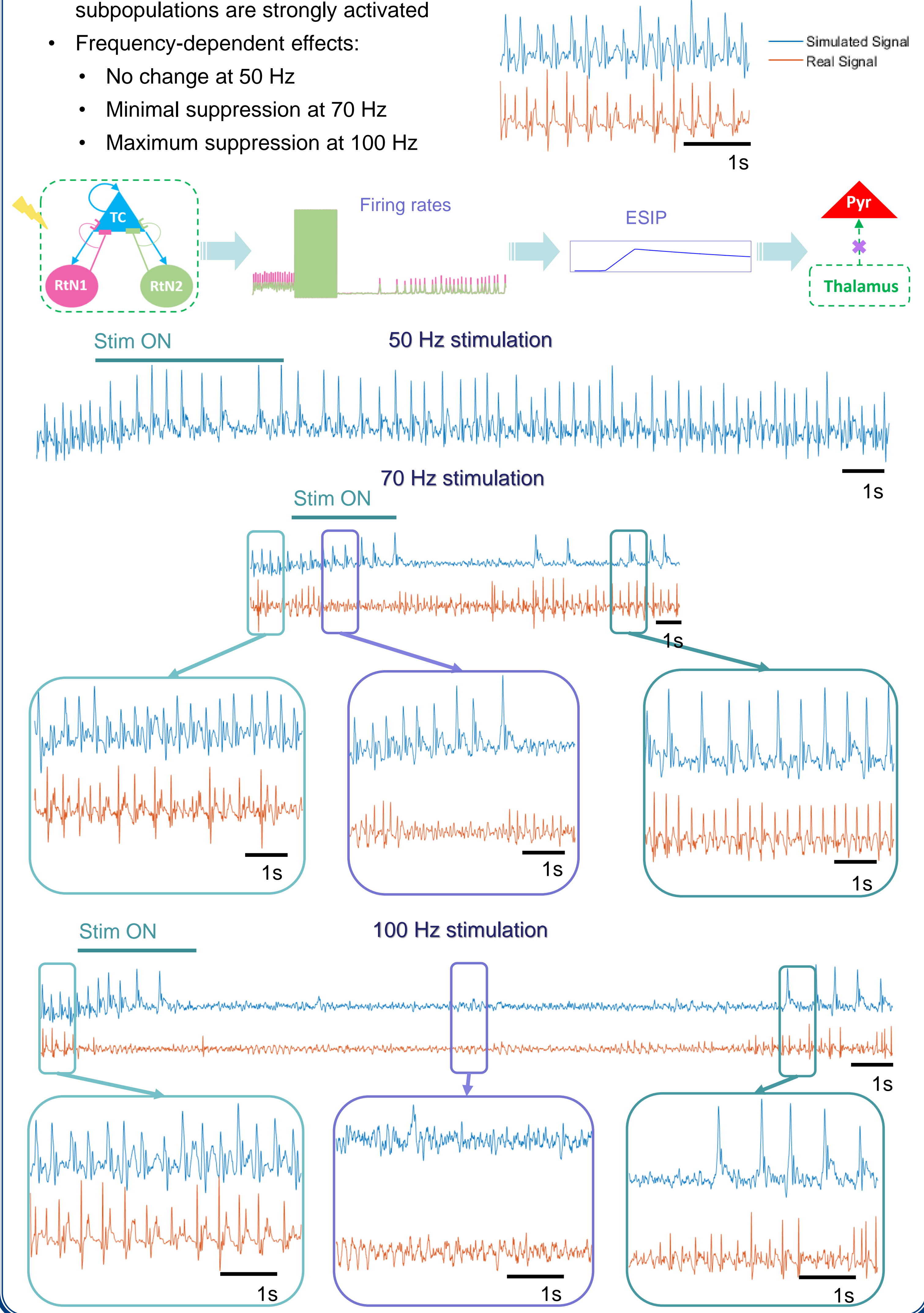


Stimulation Frequency	Suppression of inter-ictal activity				
	Before stimulation	During stimulation	3-seconds post-stimulation	15-seconds post-stimulation	30-seconds post-stimulation
50 Hz	×	×	×	×	×
70 Hz	×	✓	✓	×	×
100 Hz	×	✓	✓	✓	×

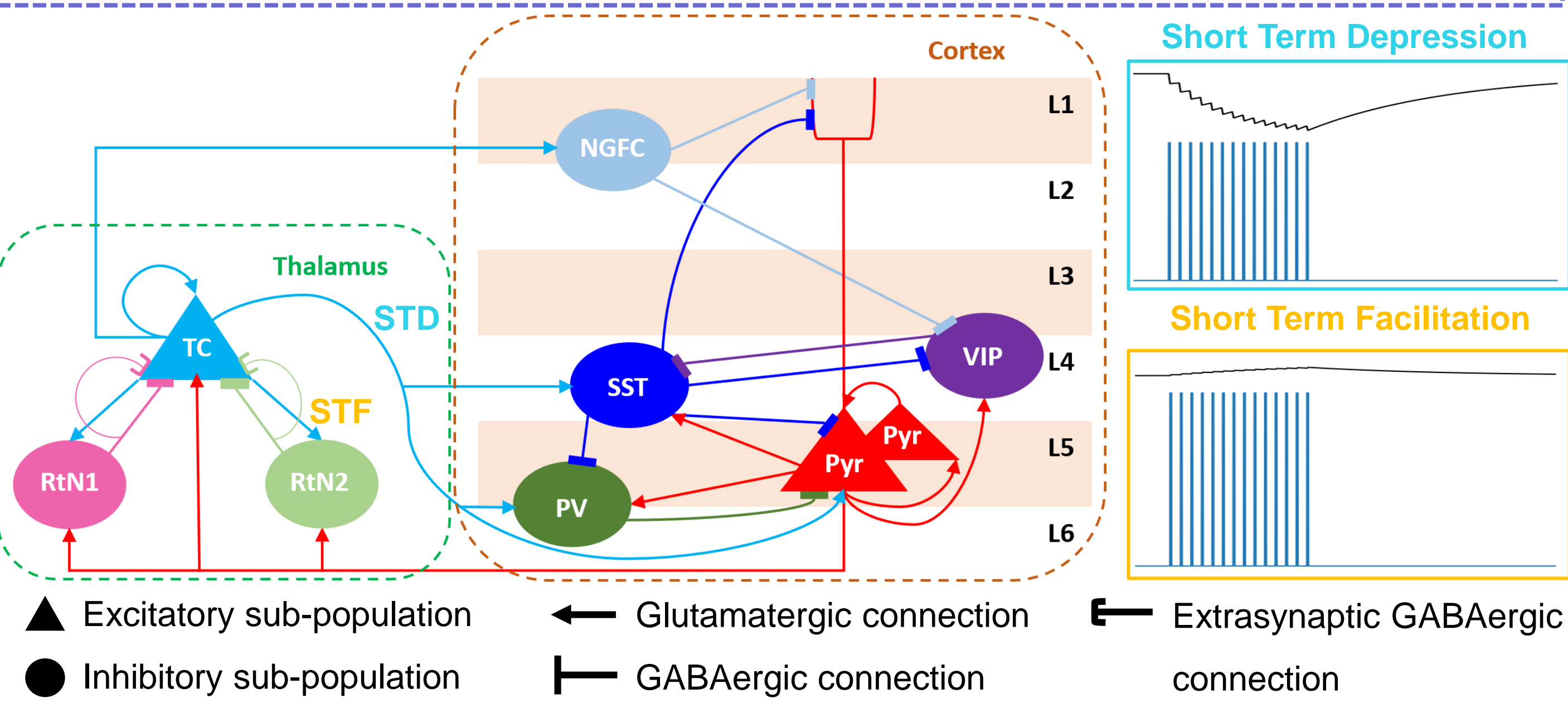
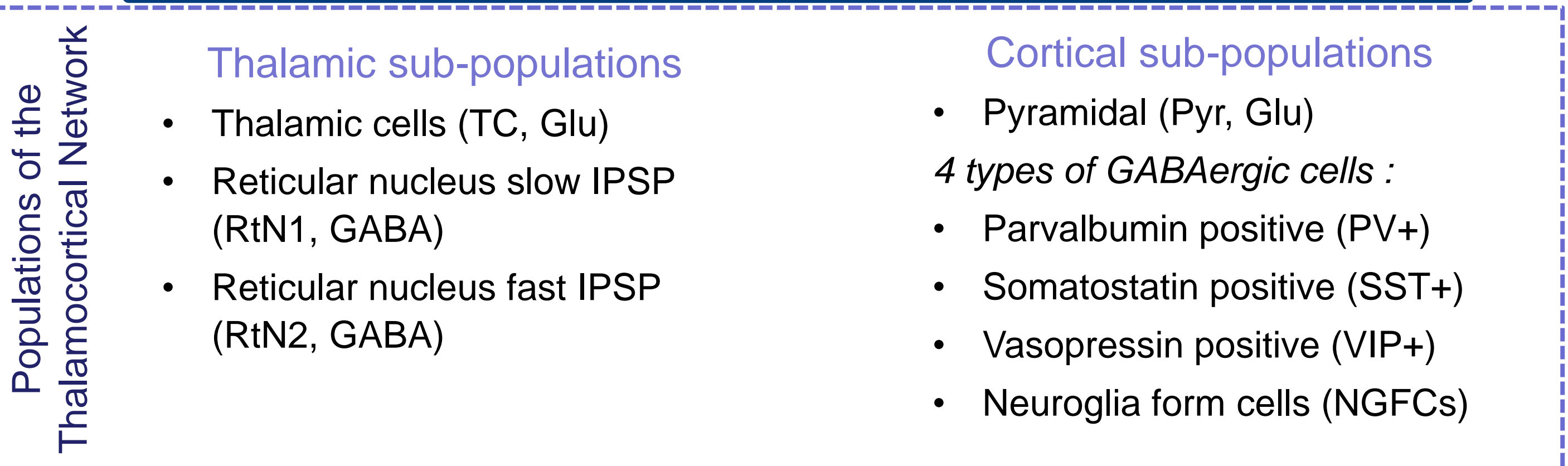
Simulation results

- During CM stimulation, inhibitory subpopulations are strongly activated
- Frequency-dependent effects:
 - No change at 50 Hz
 - Minimal suppression at 70 Hz
 - Maximum suppression at 100 Hz

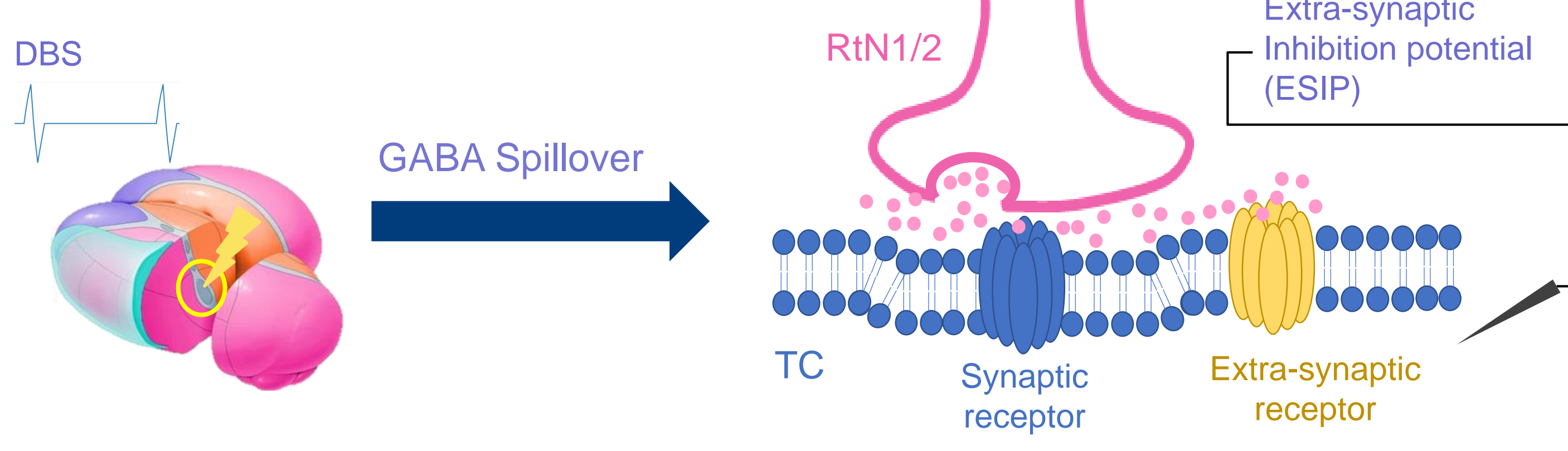
SEEG of Interictal activity: Recorded & Simulated



A novel model integrating neuroplasticity



Extrasynaptic inhibition supplements the connections from RtN1/2 to TC, based on the firing of these sub-populations.



Insights from the model

- ✓ The model shows that the "neuroplastic" behaviour of the cortex is strongly determined by the thalamic input
- ✓ Extra-synaptic GABA release and reuptake dynamics explains the frequency dependent effect of stimulation
- ✓ Recovery of epileptic activity in the PFMC is explained by neuroplasticity in the CM

References

1. Köksal-Ersöz, E., et al. *Journal of Neural Engineering* (2022): 19, 055005.
2. Pasnicu, A., et al. *Epilepsy research* (2013): 104.3, 264-268.
3. Mina, F., et al. *Frontiers in computational neuroscience* (2013): 7, 94.

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