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The Alpha rhythm is continuously investigated due to its prominence in the resting-state brain. Amongst the many endeavours that pursue its understanding, Shimoura et al. (2023) employed a spiking neuron-based cortical column model based on the previous work of Potjans and Diesmann (2014) to test the validity of two different hypotheses for generating alpha rhythm: 1.- pyramidal cortical neurons of layer 5. 2.- A thalamocortical loop delay. It was observed that both mechanisms could generate alpha rhythm. Regarding whole-brain models based on neural masses, such as the Jansen-Rit model, alpha rhythm is intrinsically generated by each individual population (see Cabrera-Álvarez et al., 2023). This model agreed with Shimoura's et al. hypothesis of alpha being generated inside each column through cortical neurons in layer 5.

In this work, we aim to further explore the possible generation of the alpha rhythm using a simple motif of interconnected cortical columns and a thalamocortical layer. With this aim, we build upon the design of a spiking cortical column by Potjans & Diesmann (2014). We implemented an interconnected set of full-spiking columns encompassing 80000 neurons and 0.3 billion synapses. The connections have been derived from experimental data, utilising diffusion Magnetic Resonance Imaging data and tractography techniques. We explore both hypotheses including a more biologically comprehensive thalamic model, characterising its impact on column synchrony, irregularity,

and power spectral density and how these measurements change in the presence or absence of the thalamus. An increase in alpha frequency in layer L4E is observed once the thalamus is connected to the column, but further research needs to be conducted to properly understand and characterise the underlying mechanisms. In this work we explore the effects of delay of thalamocortical synapses to the activity of the column, and the propagation of signals from the thalamus to the column.