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Electrophysiological correlates of basal forebrain and visual cortex activity during different behavioural states

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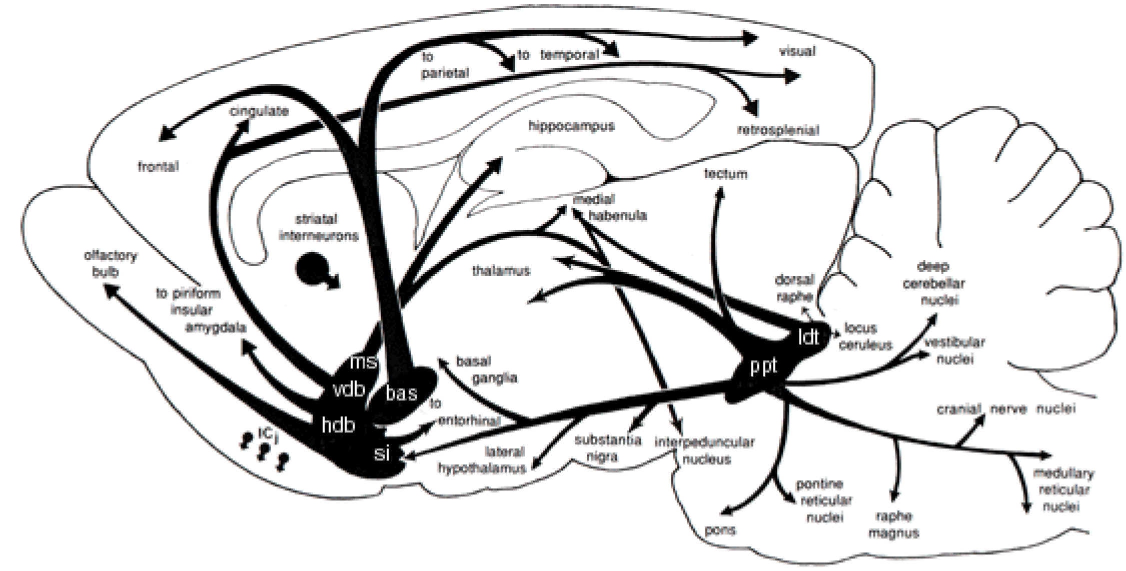
Introduction

- The basal forebrain cholinergic corticopetal system is a regulator of cerebral cortical function.

- The basal forebrain provides the major source of cholinergic input to the neocortex.

- Probably related to its activational effect on cortex , the basal forebrain cholinergic system have been shown to play an important role in attention, cognition and motivational processes.

Anatomy of Basal Forebrain



After Woolf, 1991

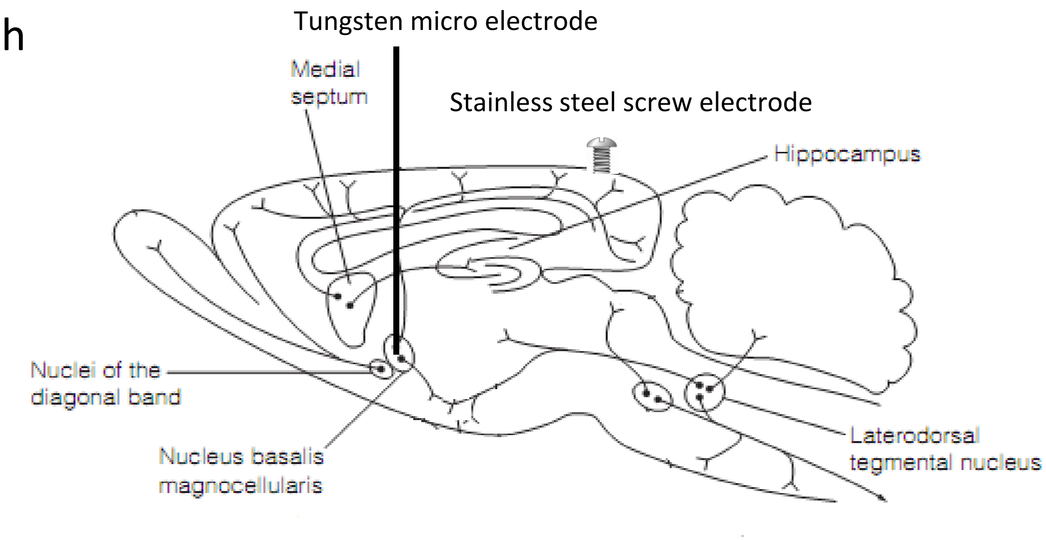
Aim : To assess the interactions between primary visual cortex (V1) and basal forebrain during behaviour.

We will examine BF activity as well as BF coupling with V1 during general behavioural states such as locomotion, quiet wakefulness and sleep.

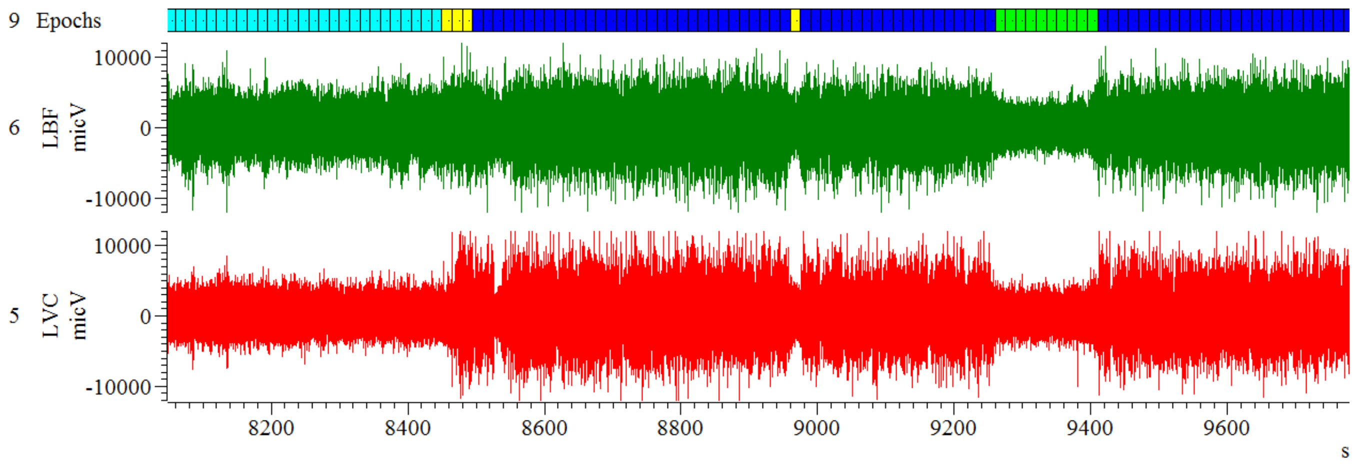
Animals : Long Evans Rats

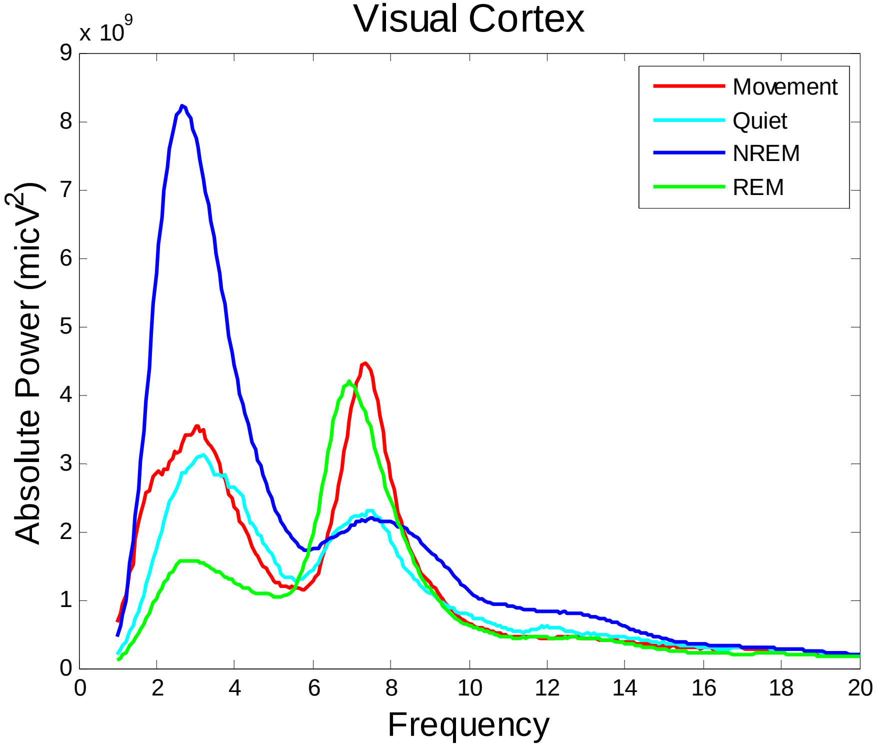
Methods:

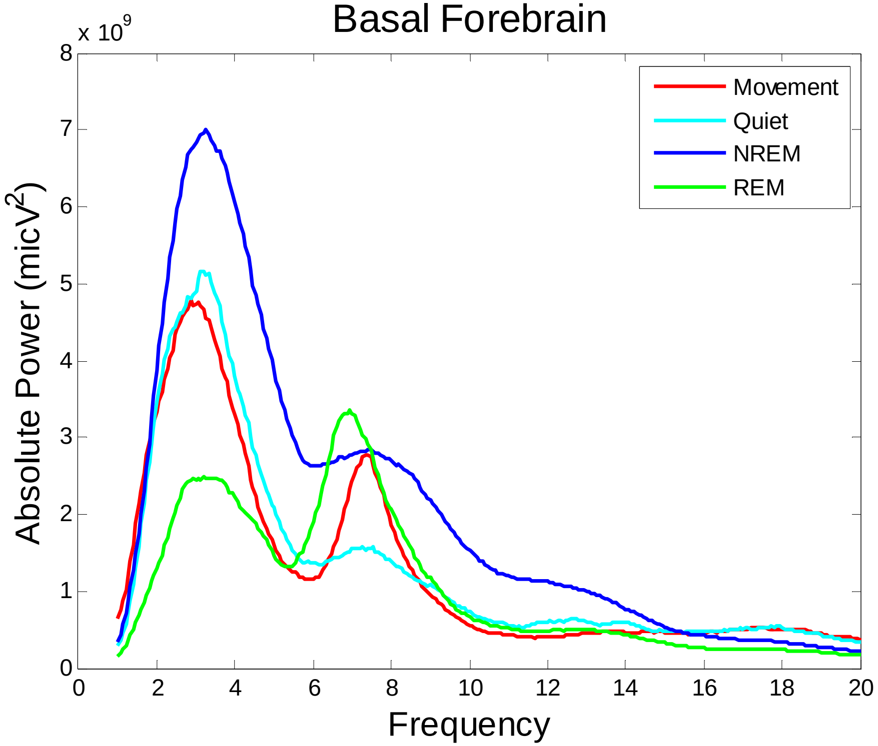
- Chronic implantation of electrodes.
- To record EEG and LFP wireless miniature device Neurologger were used.
- Electrophysiological recordings lasts 6 h



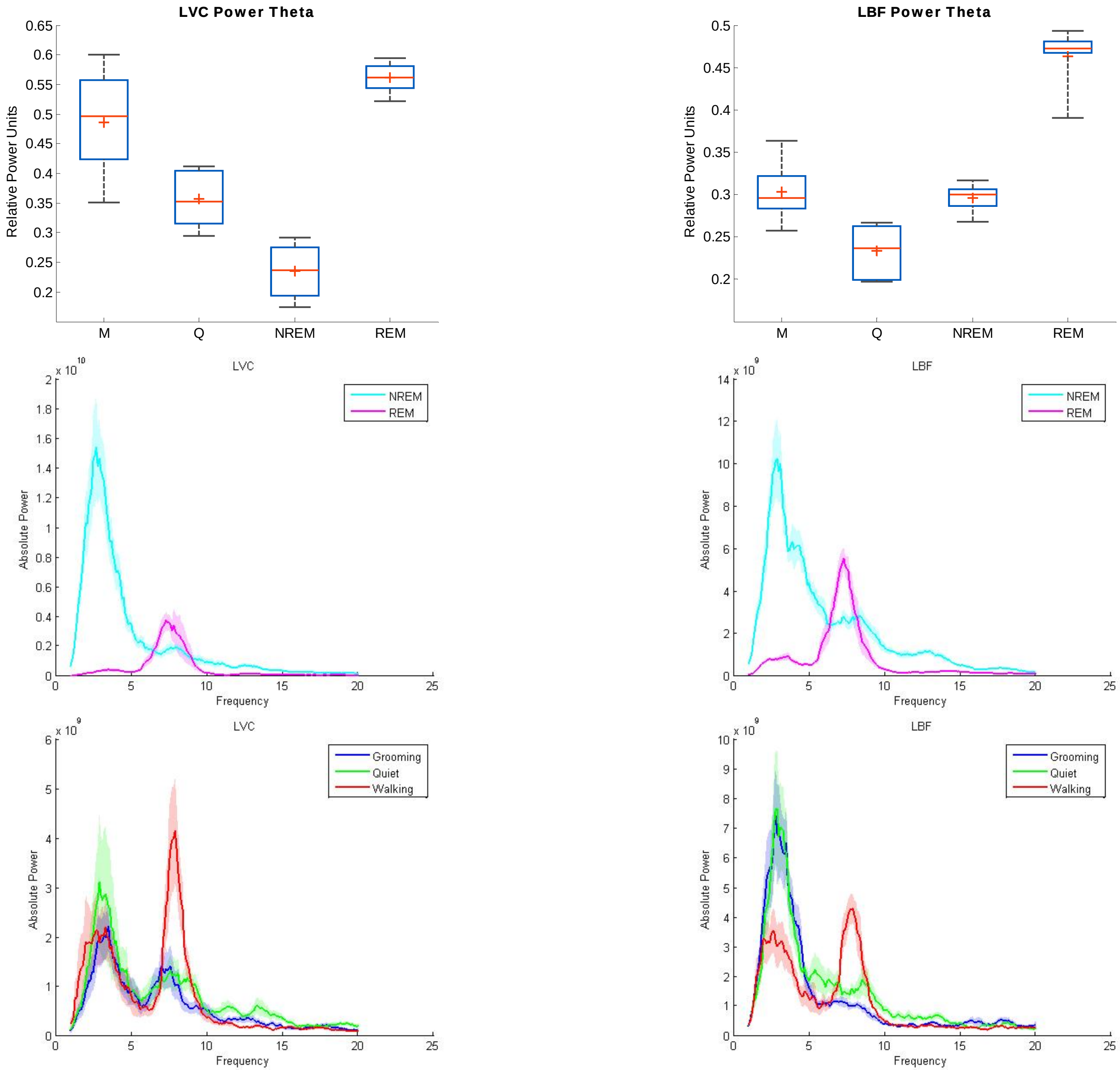
Examples of electrophysiological recordings and general activity patterns across behaviour



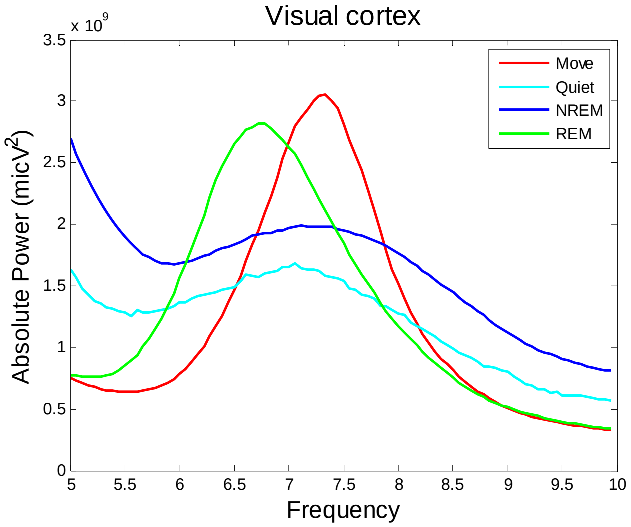


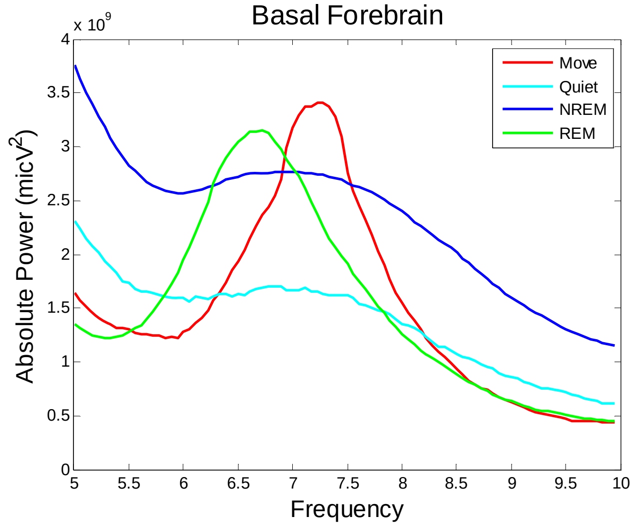


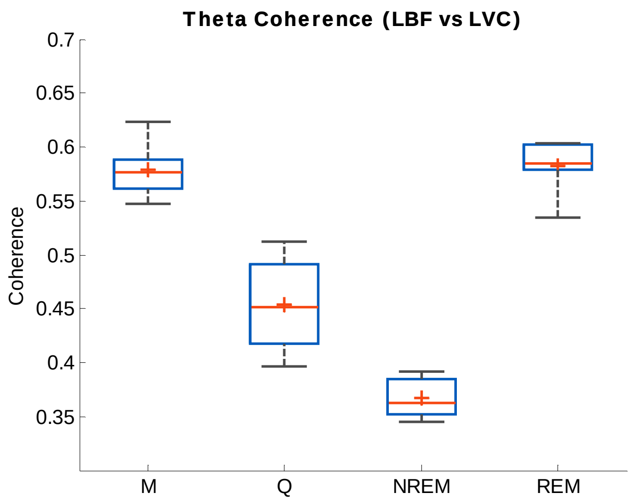
Differences and similarities of theta activity in visual cortex and basal forebrain



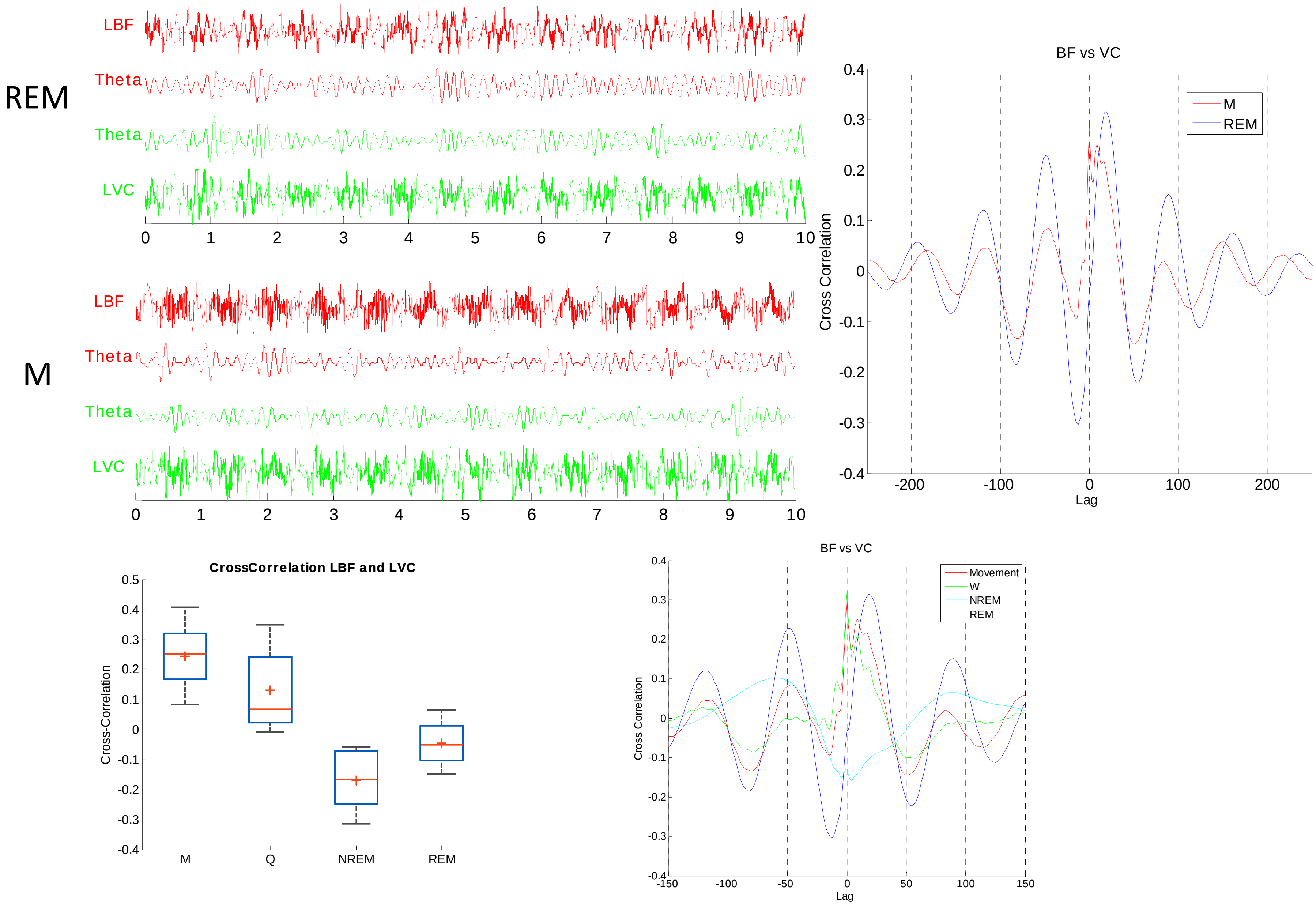
Analysis of synchronisation of basal forebrain and visual cortex







Cross correlation analysis between BF and VC



Principal findings

- Cortical theta was also enhanced during REM sleep as well as during active exploration, as compared to quiet wakefulness and slow-wave-sleep (SWS).
- BF theta activity was significantly high during REM sleep compared to other states.
- Coherence analysis also showed better coupling between BF and VC during active wakefullness and REM, but oscillatory theta synchronisation was more enhanced during REM sleep.
- A correlation analysis revealed that during exploration and quiet wakefulness, BF and visual cortex were positively correlated, whereas and during NREM and REM sleep signals in these two regions were anti-correlated

Significance

Our preliminary results provide novel insights into the functional coupling between the basal forebrain and cortex as a function of behavioural state. These observations provide a basis for studying functional modulations during behavioural task performance.

Thank You