

Temporal evolution of beta bursts in the parkinsonian cortical and basal ganglia network

Cagnan ea., PNAS, 2019

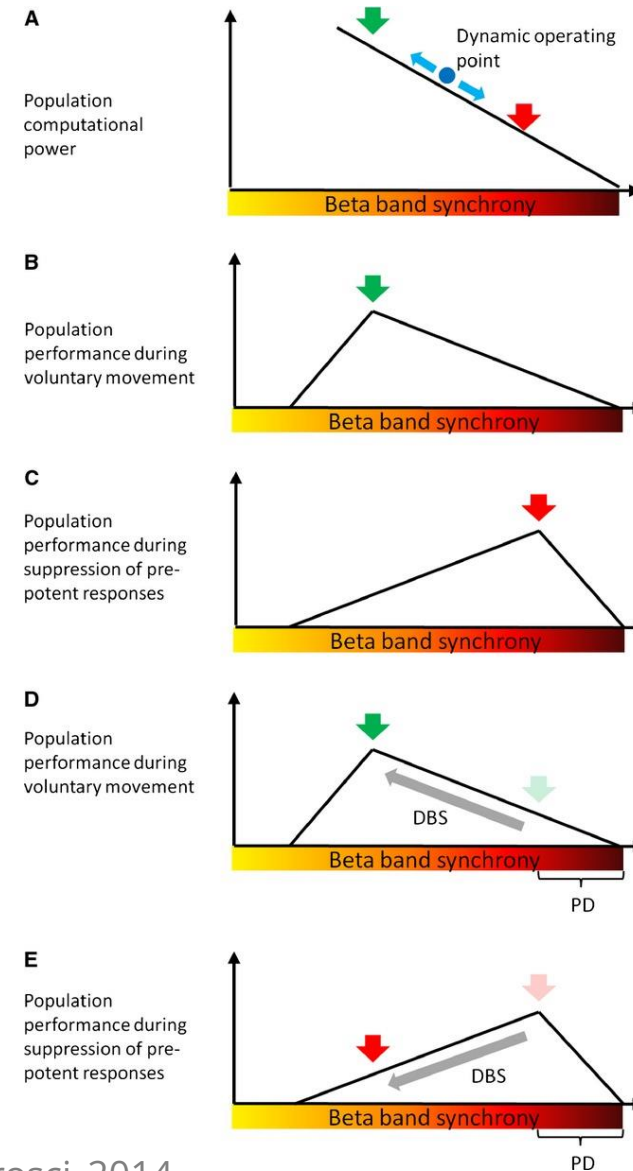
StepUp Journal Club

15th March 2023



Location	Research Area	H-Index
Group Leader at MRC BNDU Oxford	-Neuromodulation - PD & ET	25 Bilateral adaptive deep brain stimulation is effective in Parkinson's disease (~290)

- Beta oscillations in cortical and basal ganglia circuits become abnormally synchronized in PD
- How excessive beta oscillations emerge in these circuits is unclear
- How change the firing properties of basal ganglia neurons around the emergence of cortical beta bursts



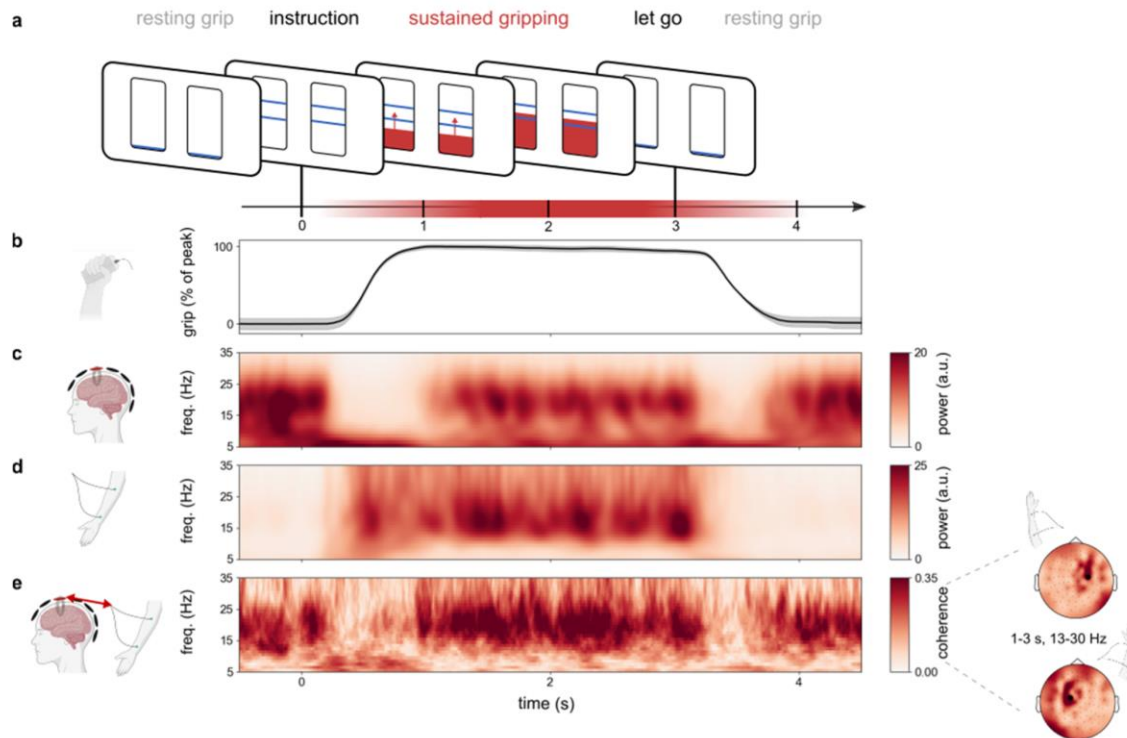
a certain motor response becomes inappropriate or has to be cancelled

a treatment that drives beta synchronization down may improve limb bradykinesia in PD

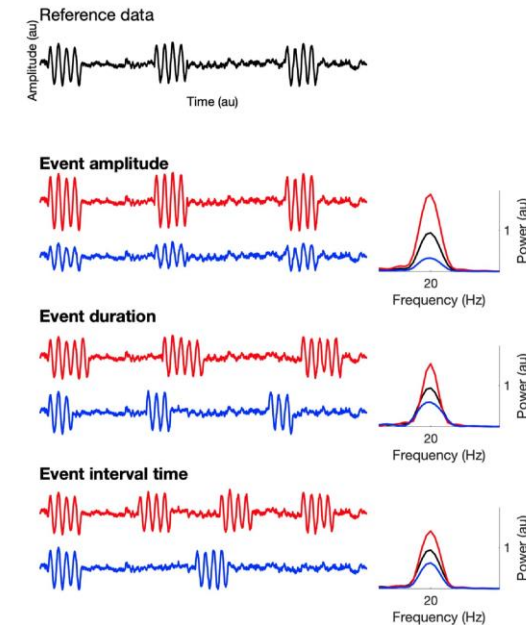
lead to impulsive action when inhibition of limb movement is more behaviourally relevant

“[...] how **beta oscillations** are **propagated** and **amplified** can potentially be approached by identifying the neuronal interactions that occur **before, during, and after** these transient **events**. “

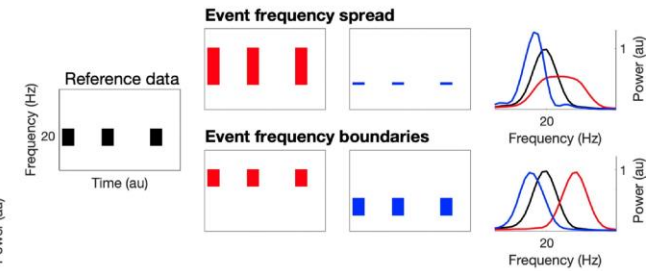
what are beta bursts?



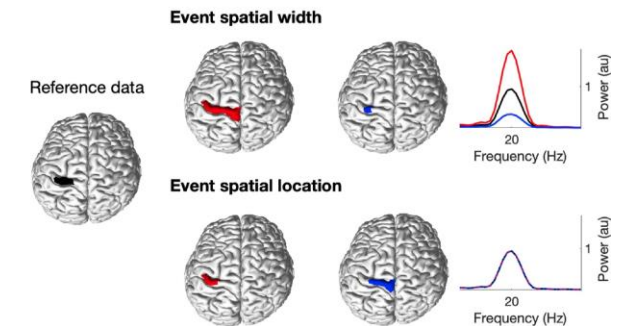
(A) Temporal domain



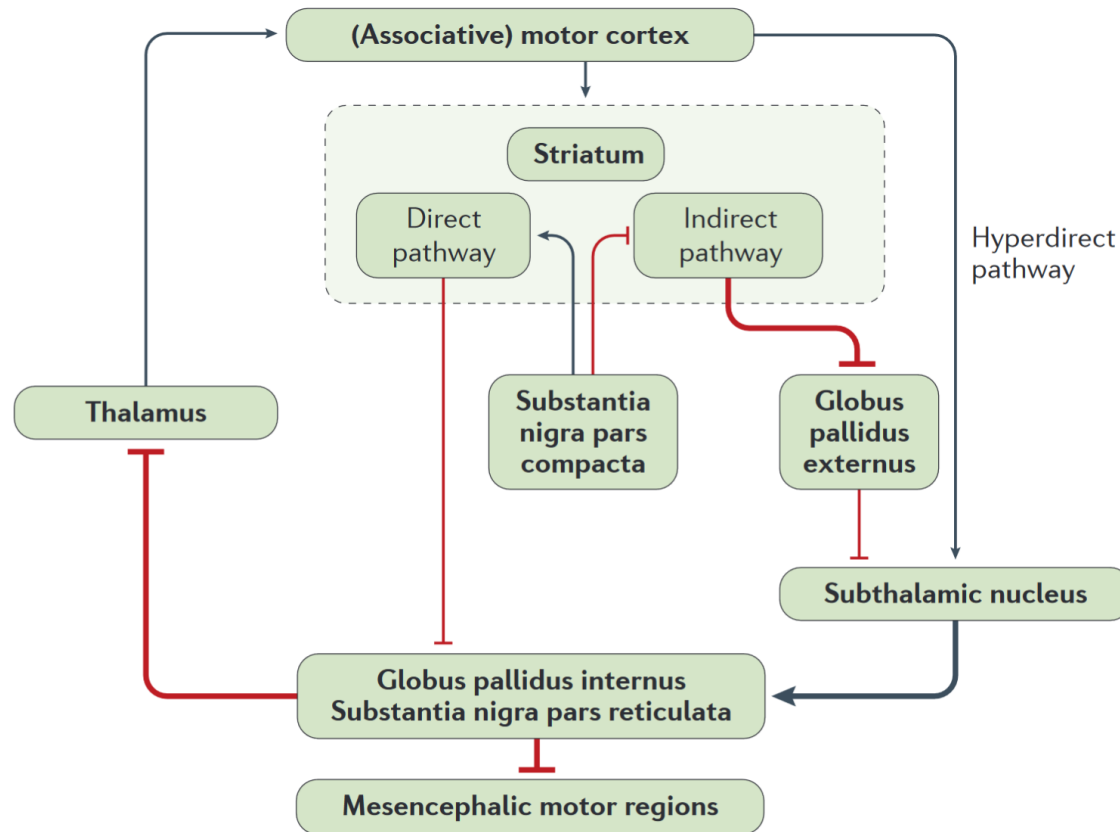
(B) Spectral domain



(C) Spatial domain



Trends in Cognitive Sciences

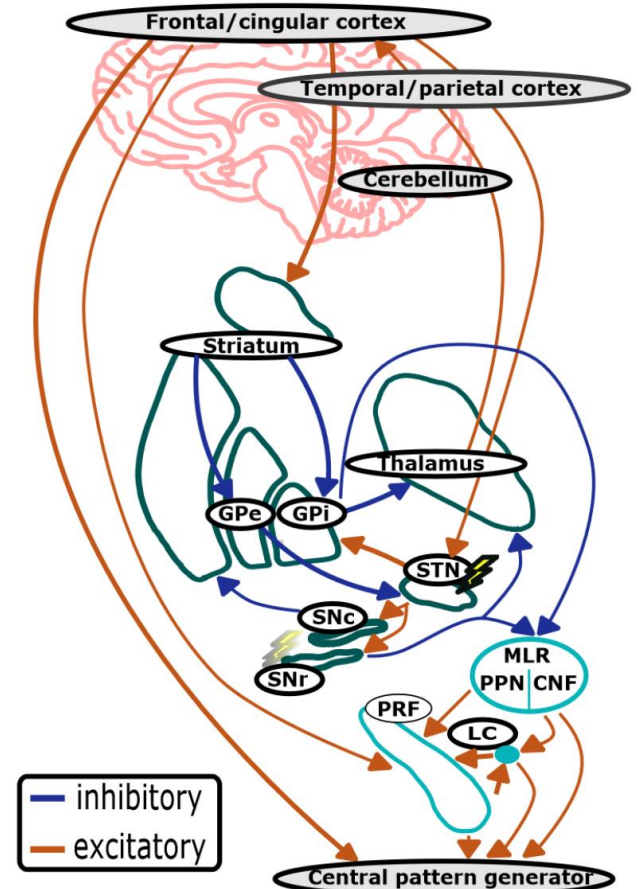


→ Increased excitatory activity
→ Reduced excitatory activity

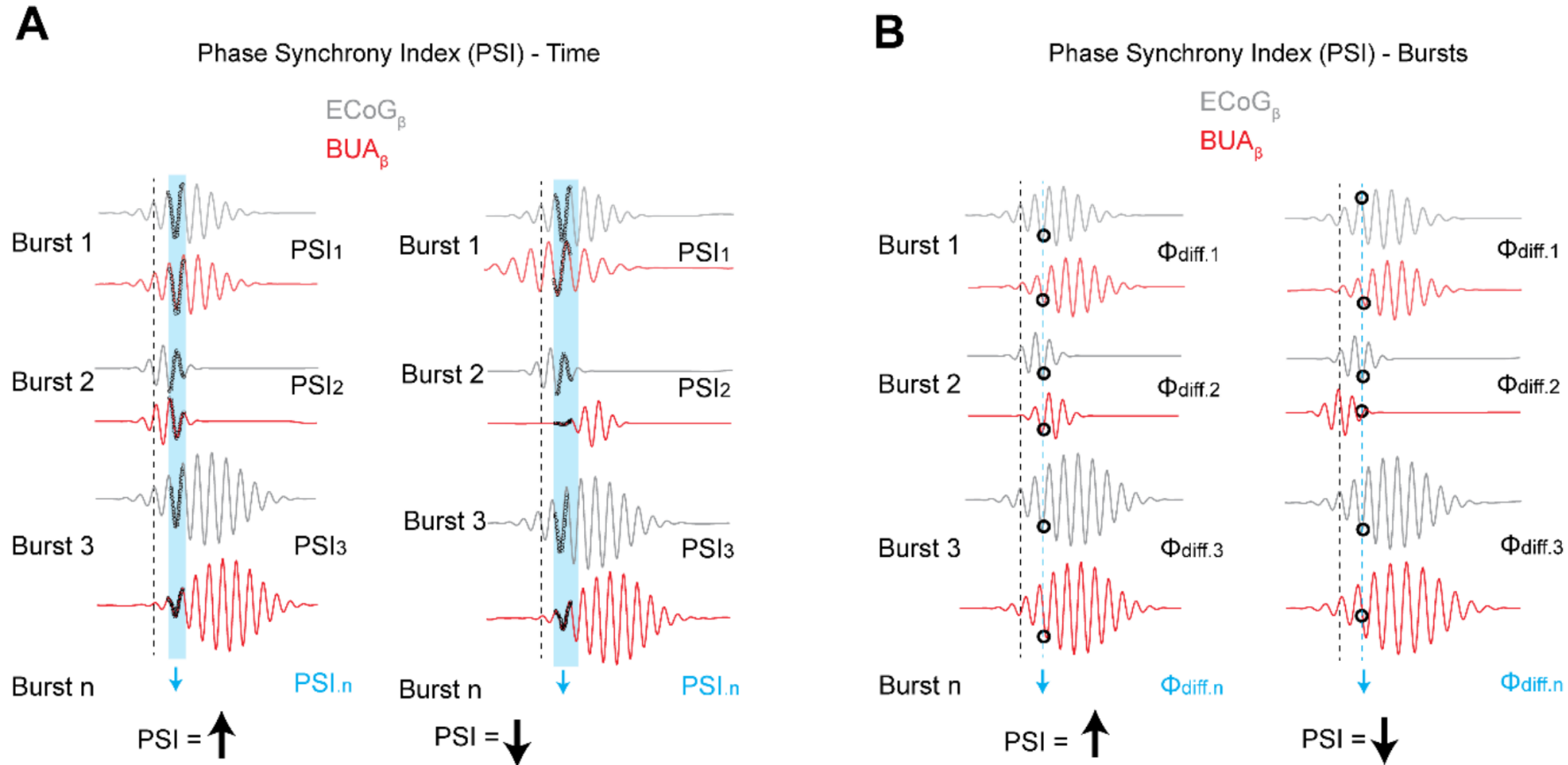
— Increased inhibitory activity
— Reduced inhibitory activity

A

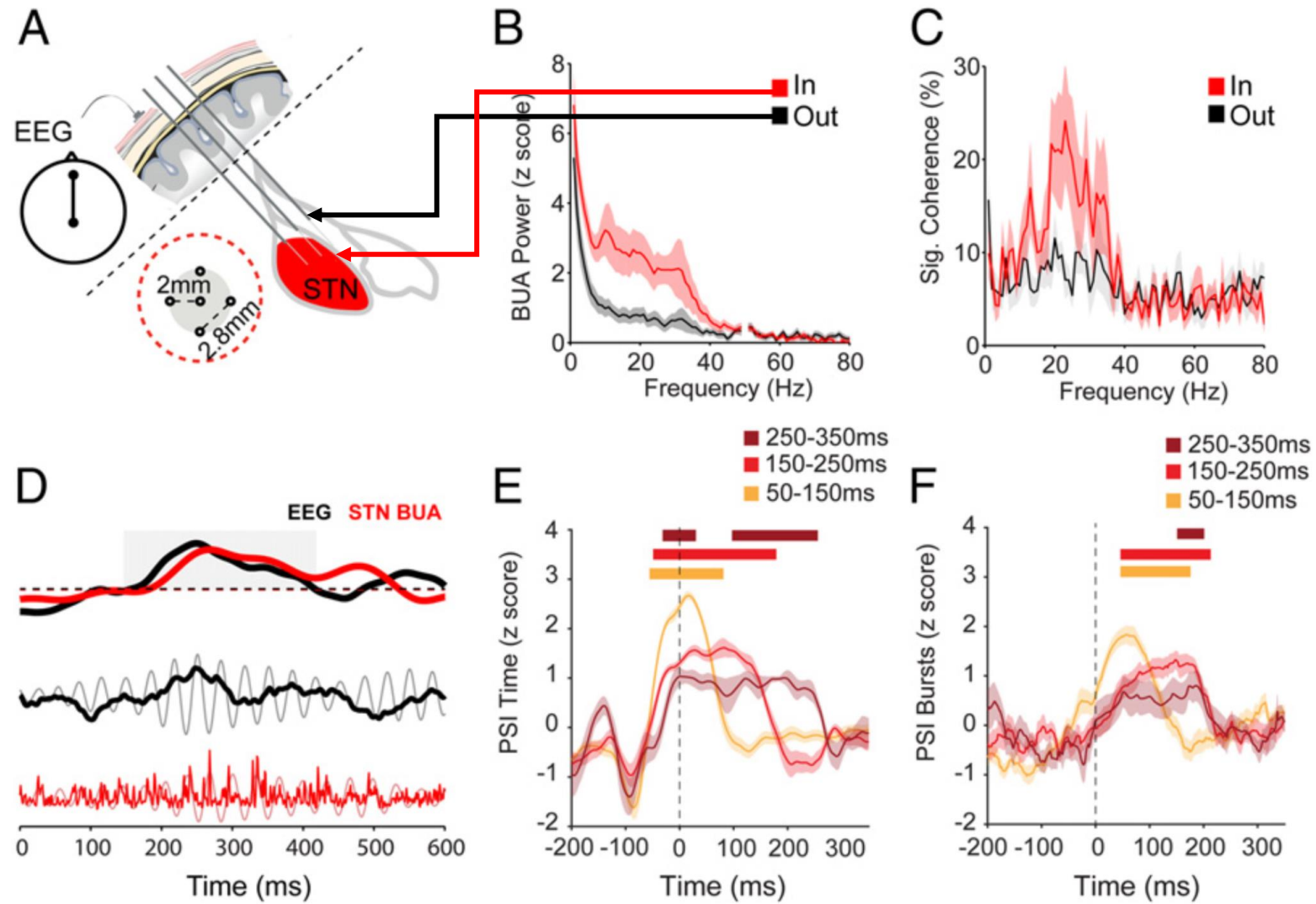
FoG network

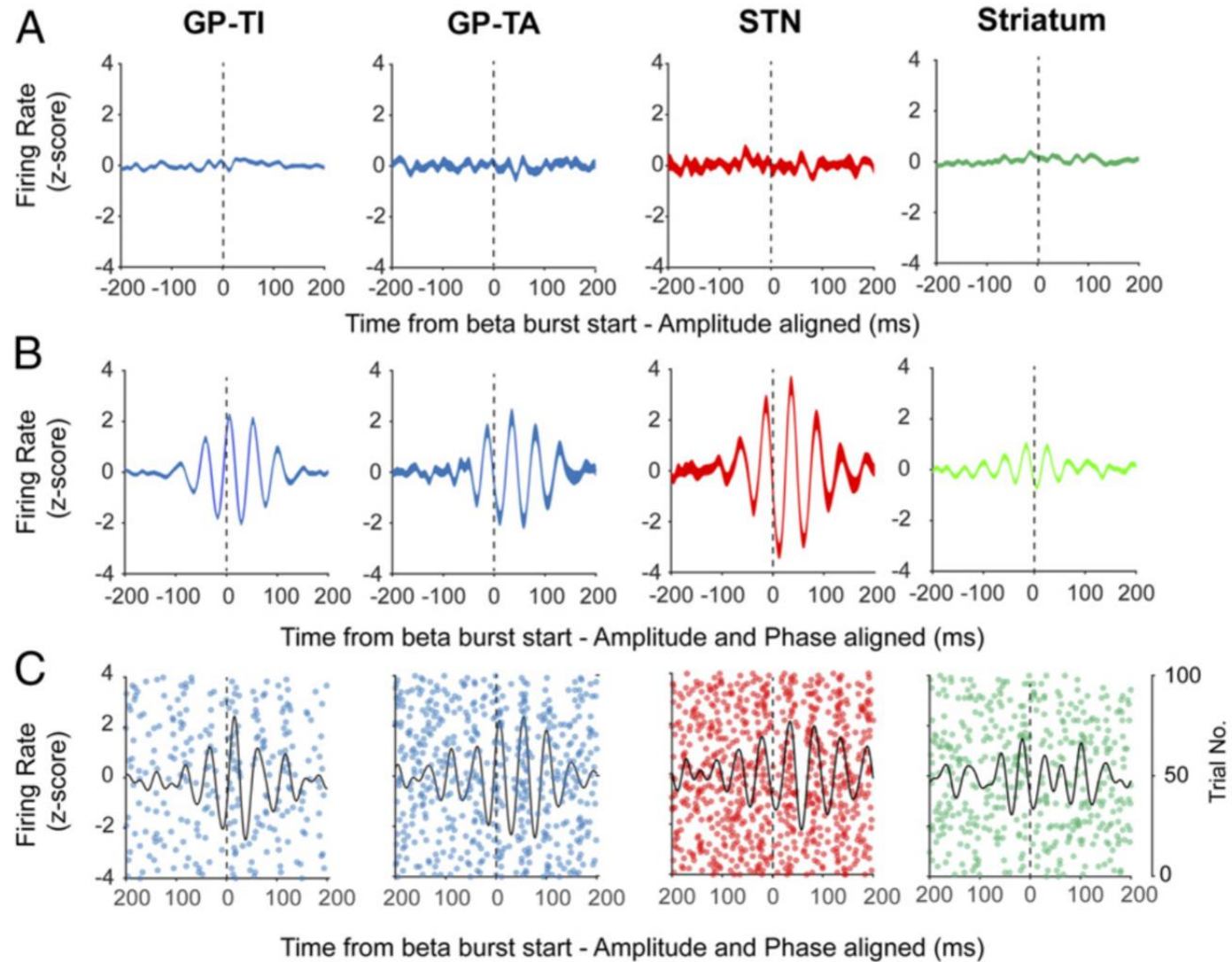


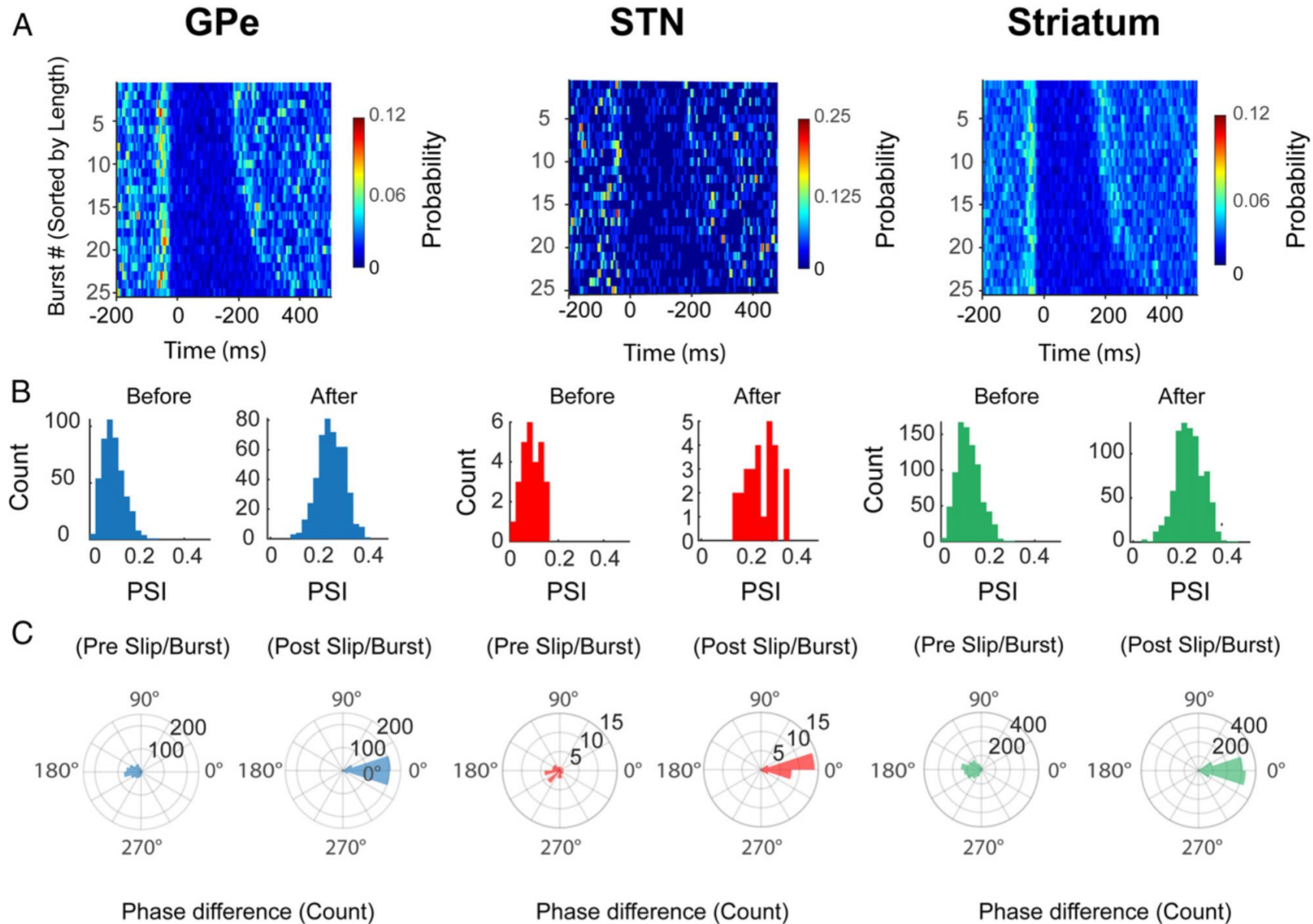
- EEGs (Fz and Cz) and intraoperative STN recordings
- 7 PD patients
- Beta (15-35Hz) down sampled at 512 Hz FFT based power
- Phase synchrony index (PSI) in time and bursts as outcomes



If both across time and across burst measures increase at a given point in time/window (in relation to the burst threshold), synchronization is increased in individual bursts, and the phase relationship (conditions of synchronization) is consistent

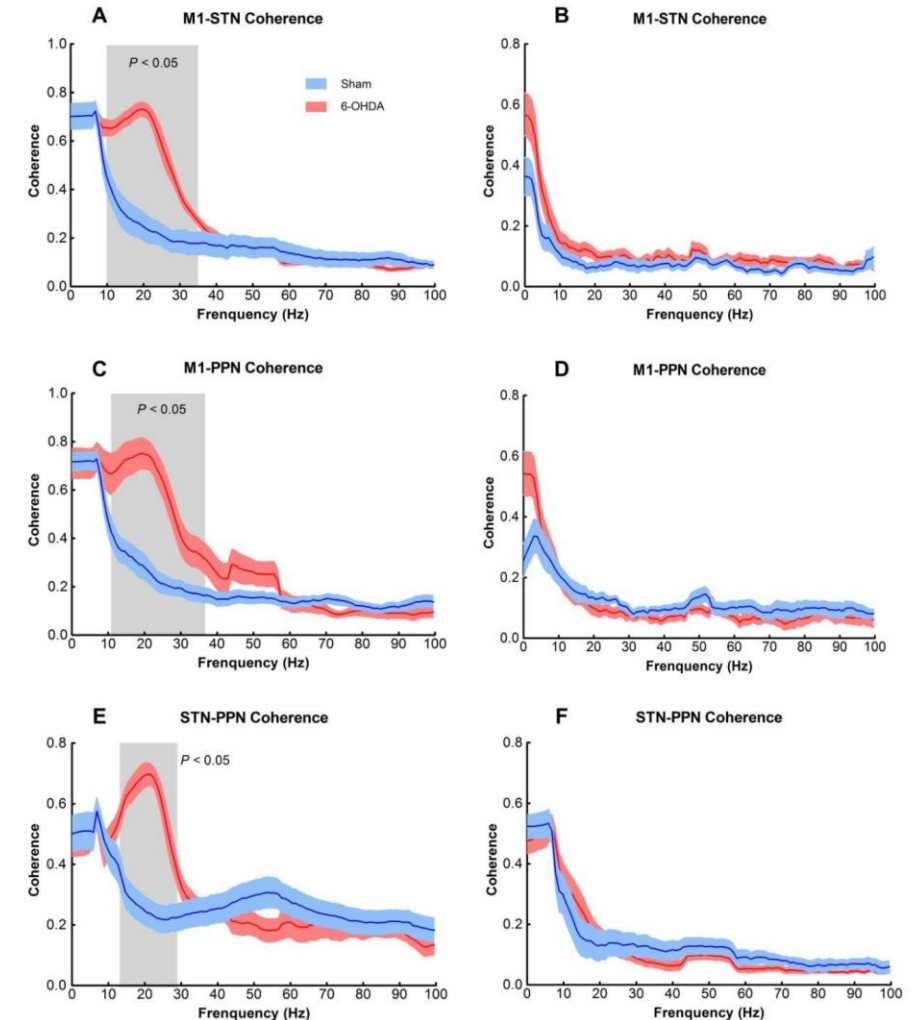
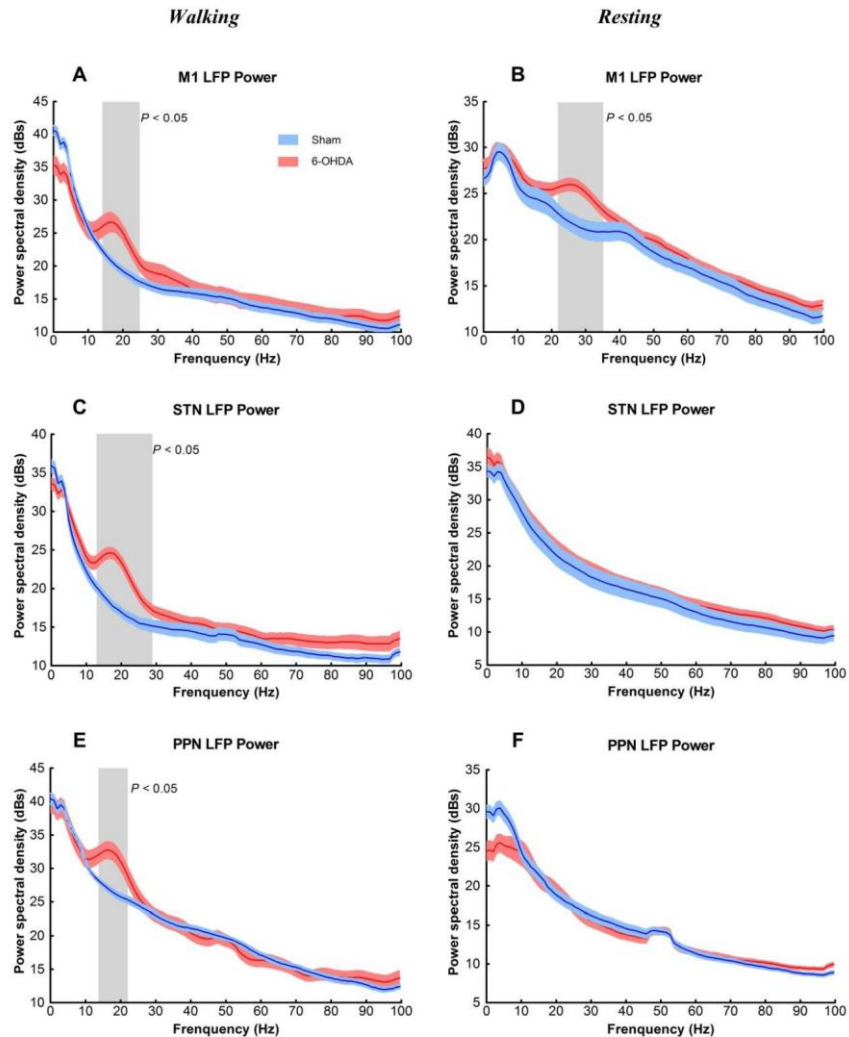






- Corticosubthalamic synchronization in patients with PD occurs before the onset and continues throughout the duration of beta bursts (also true for ECoG)
- Basal ganglia and cortical synchrony for beta-oscillations were not affected by changes in firing rate but by the timing of action potentials (Phase)
- A modulation of excitability is necessary to propagate cortical rhythms

relevant for gait?



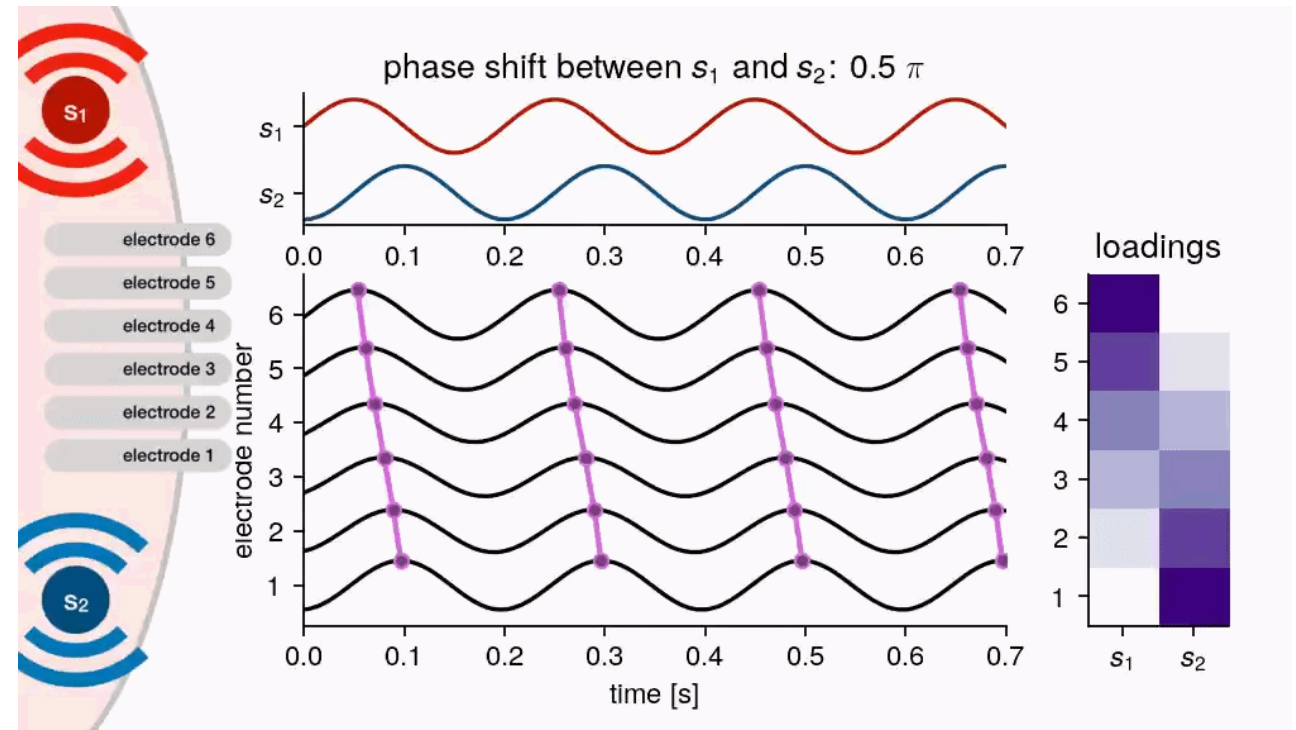
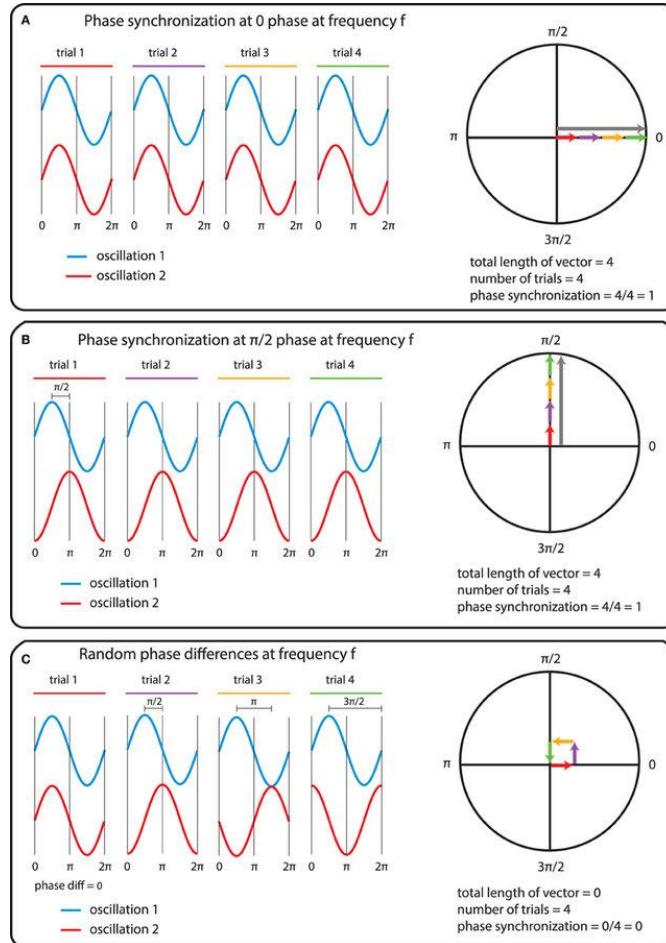
**Thanks for listening
carefully**



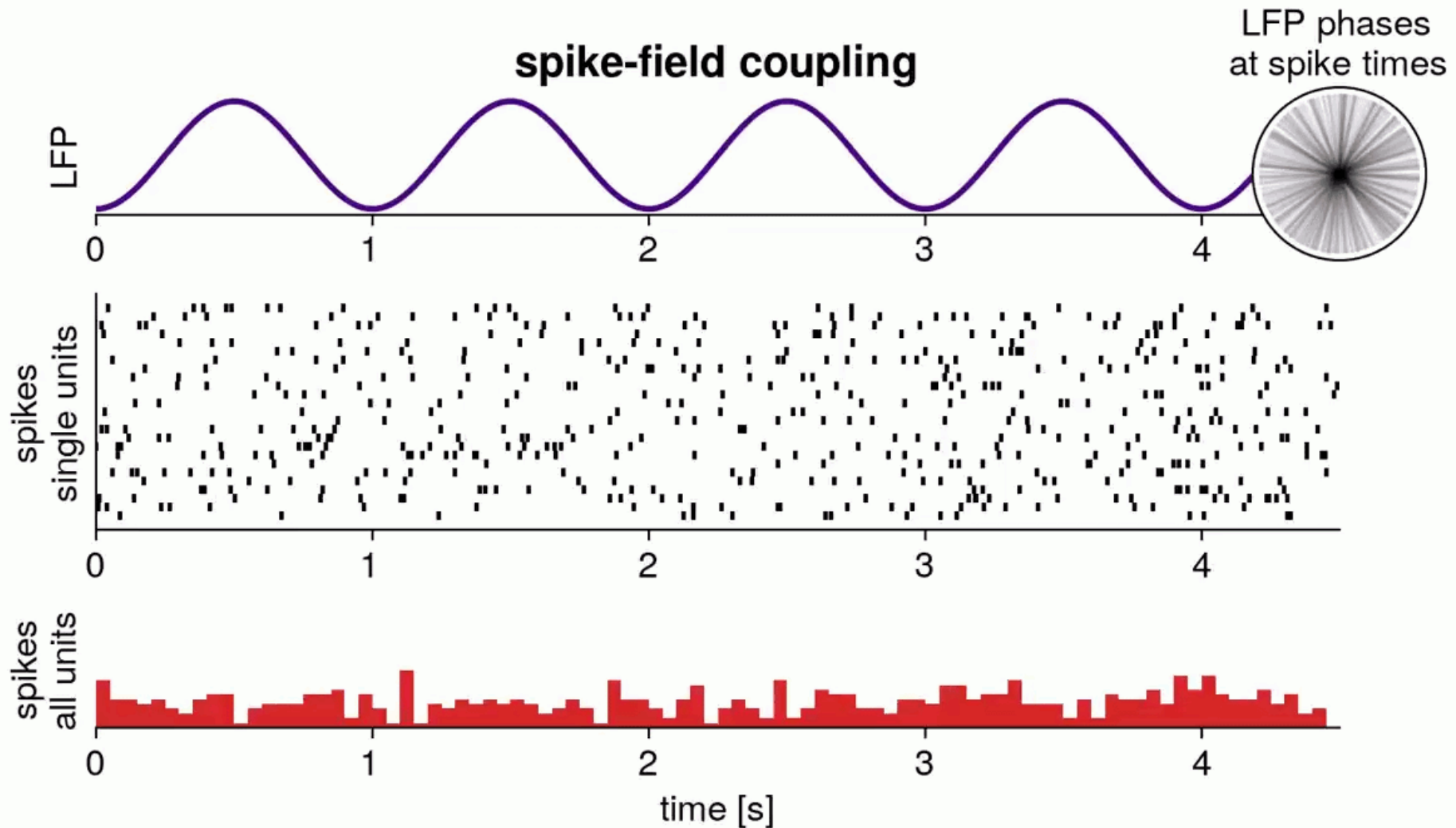
1. We know now, that in human PD patients beta bursts are temporally synchronised between the BG and Cortex. Which information do they exchange?
2. Some studies suggest that excessive beta oscillations may interfere with movement execution, while others propose that beta oscillations may help to stabilize movement or prevent unwanted movements. How much beta do you need?
3. A PD patient walks for 4 meters before being perturbed. What do you think does the probability course of beta bursts look like in M1?
4. How does training effect the number, duration and amplitude of beta bursts in PD patients?

- Next journal club:
 - 19.04.23, 10am (UTC+1)
 - Topics: Cortex during gait, ...
- Slides and code
 - <https://github.com/JuliusWelzel/StepUp-jc>

what is phase



lfp and spikes



firing and PD

