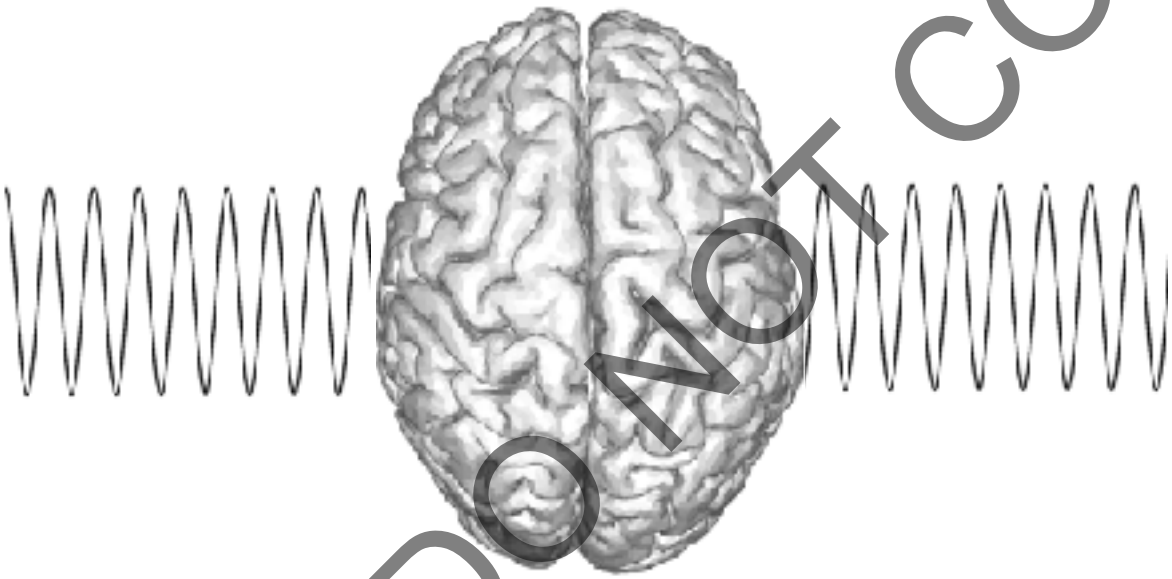
Transcranial Current Stimulation (tCS)



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Boston, 06.26.2019

BA CNBS Berenson-Allen Center For Non-Invasive Brain Stimulation

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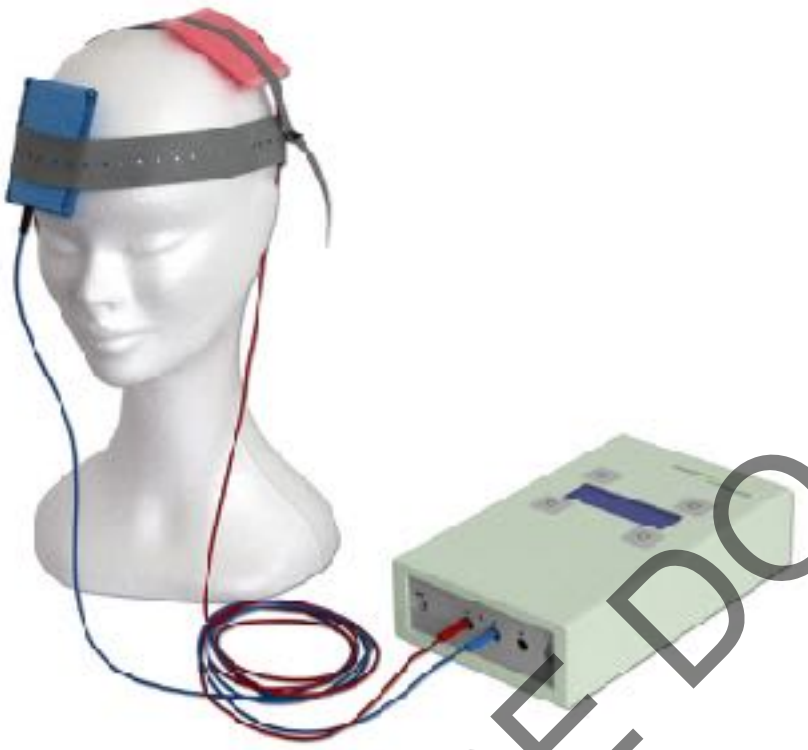
tCS devices



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NIC-Device

- The battery is the core and the control unit of Starstim. Is a battery operated and it is wirelessly paired with the computer using the Nic software. 4-pin slot to connect with the electrode cable.

- The 4 electrode cable contains 32 channels for EEG monitoring or for stimulation, and two reference channels labelled with CMS & DRL.

- The neoprene cap is a comfortable solution to precisely place the electrodes on the scalp based on the 10-10 system.

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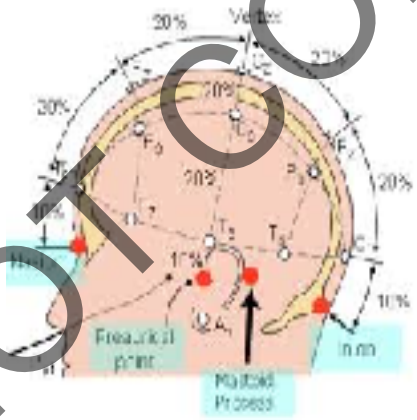
SET-UP

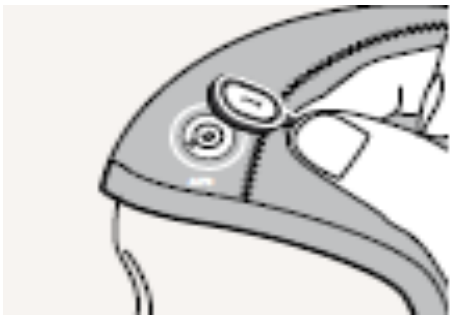
1 Reference electrodes

2 Place cap



3 Reduce impedence

4 Place electrodes



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SET-UP

1

➢ Clean the hard bone behind the ear (Mastoid) with an alcohol wipe;

➢ Place ground electrodes with sticky electrodes (ECG Electrodes) on Mastoid; CMS on top (horizontal, directly on bone), DRL on bottom (vertical, behind ear lobe);

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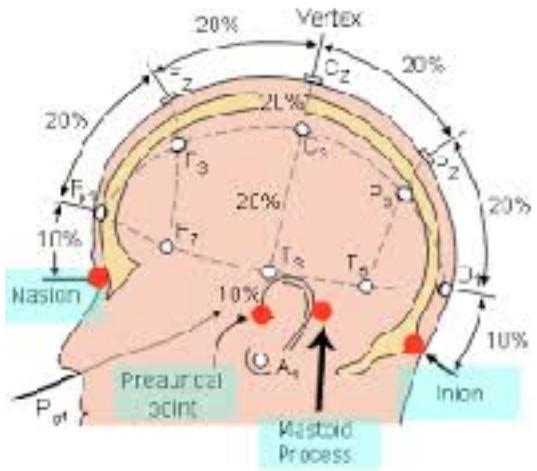
SET-UP

2



- Ensure that cap has channel gauges pre-placed in all channels before-hand (based on subject specific stimulation montage);
- Place cap on head of subject;
- Measure mid-way between the nasion & inion and left tragus & right tragus, and make sure midpoint of skull lines up with CZ channel

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SET-UP

3

- Use cotton-tipped swab and Nu-Prep; clean scalp and push away hair using an up-down at each electrode location, left-right motion (making a cross); do not use a circular motion to clean the scalp with Nu-Prep

- Squeeze signa gel in each electrode channel; fill up ¼ of channel gauge capacity, make sure gel is in direct contact with scalp

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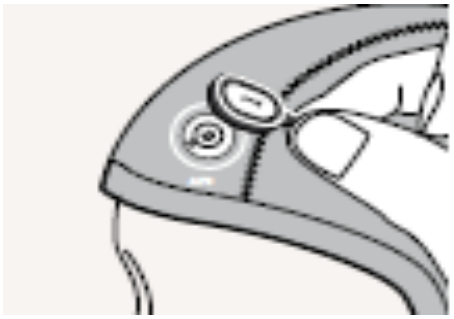
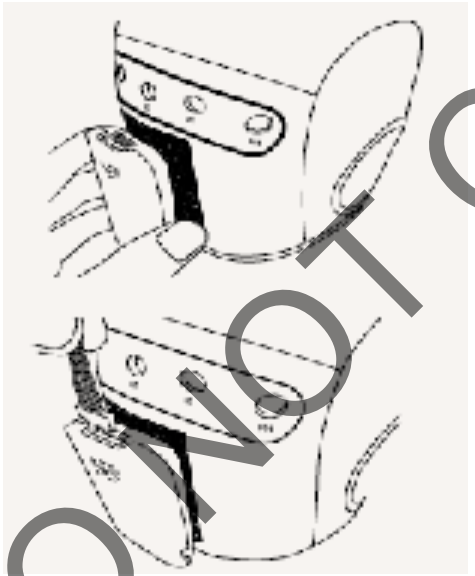
SET-UP

4





- Twist on electrode onto channel gauges; make sure to twist electrode on so that it is level and tight; Note: the electrodes do not click or lock into place, make sure they are secure

- Box is attached to the neoprene cap using the velcro, and it is connected to the electrode cable using the 10-pin connector.

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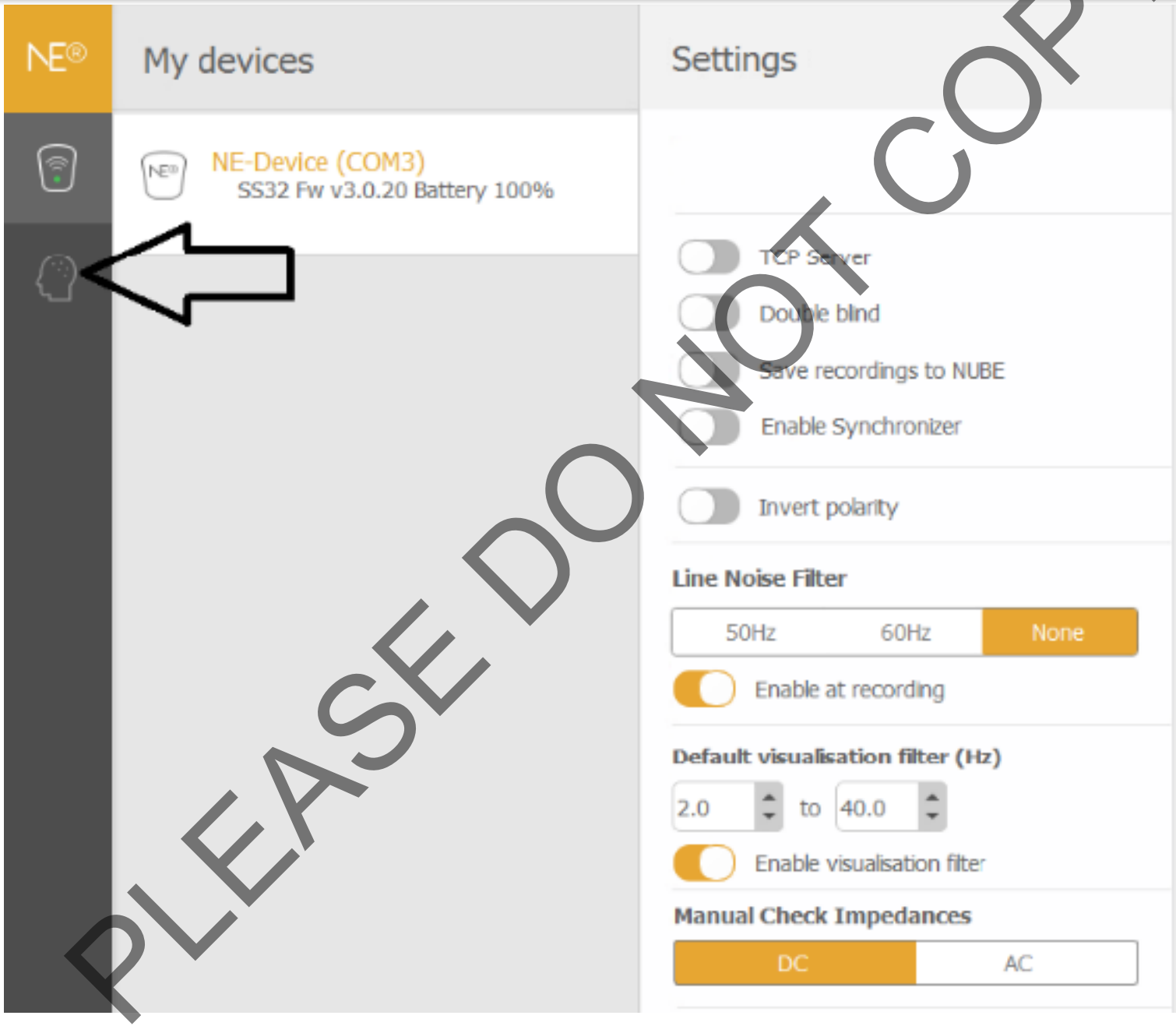
NIC-Software



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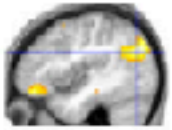
Parameters for stimulation

Where to stimulate?

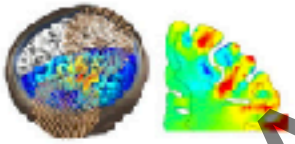
Determine **target site & device position/orientation** for stimulation based on...



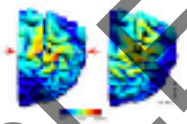
functional localizer

source localization

individual gyral anatomy



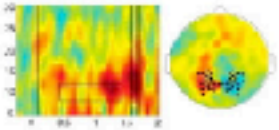
local strength of electric field



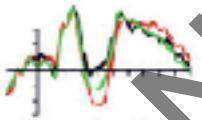
local direction of current flow

When to stimulate?

Determine **target onset/time window** relative to task or spontaneous event for stimulation based on...



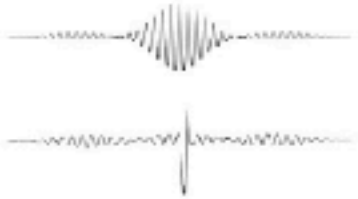
induced power



latency of evoked responses

oscillatory phase

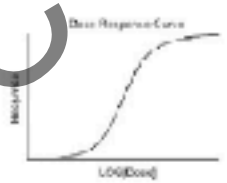
oscillatory power



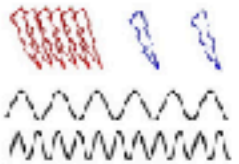
occurrence of specific events

How to stimulate?

Determine **specific parameters** for stimulation such as...

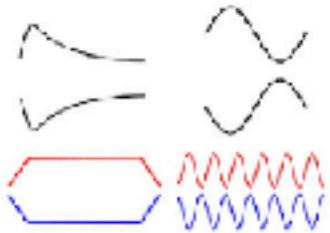


stimulation intensity



stimulation frequency

pulse/wave form



polarity

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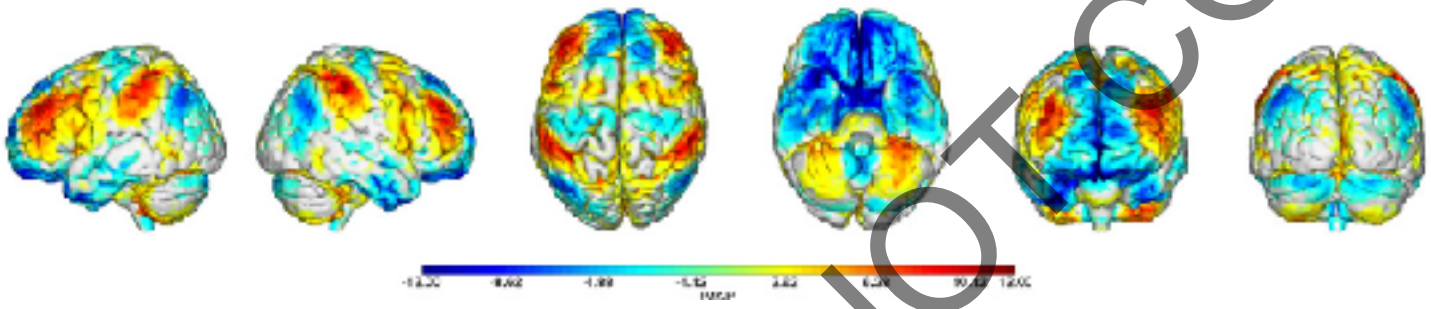
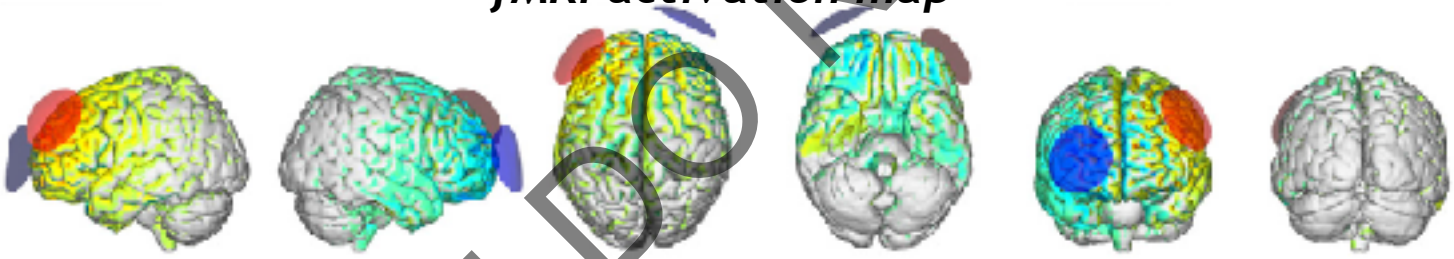
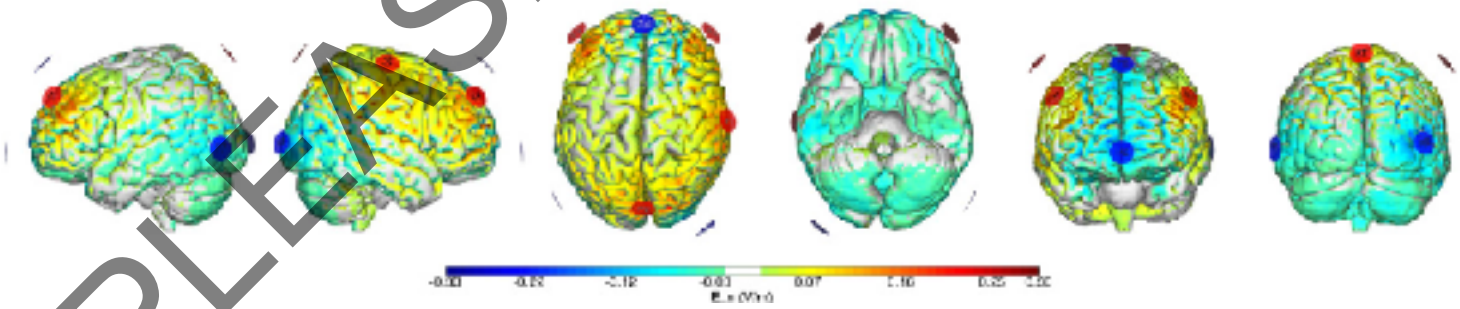
Parameters for stimulation



fMRI activation map



tCS solution with 2 electrodes



Multifocal tCS solution with 8 electrodes

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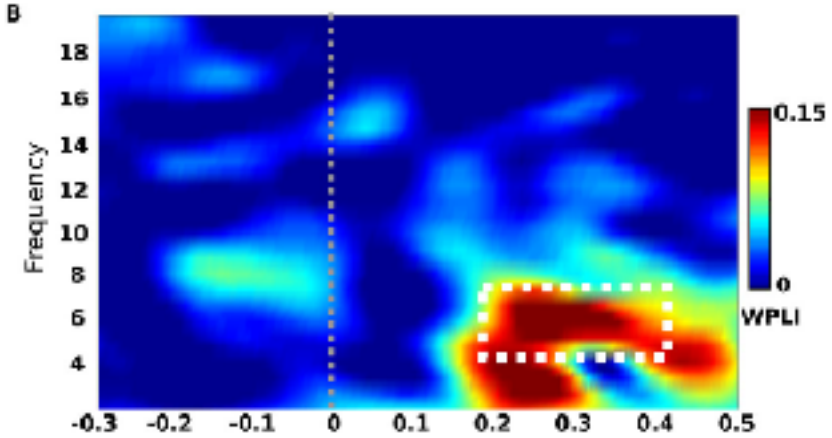
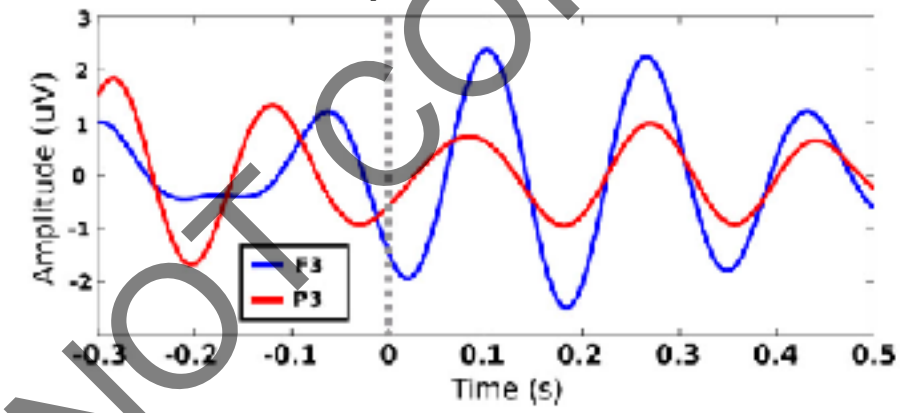
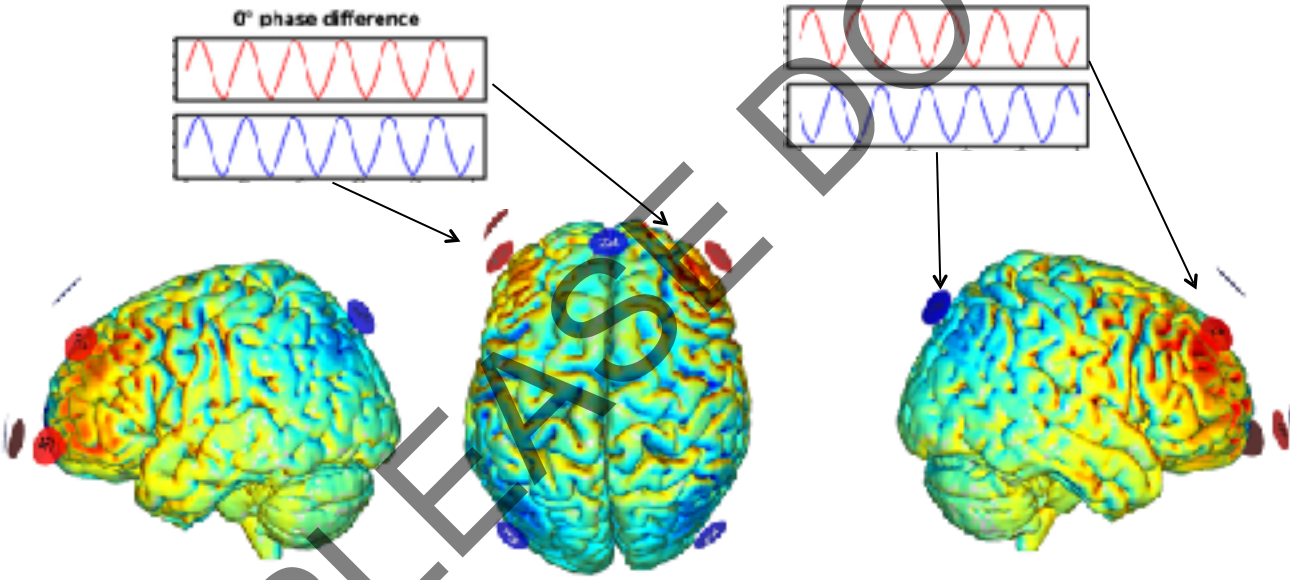
tACS and Phase Coupling: Working Memory

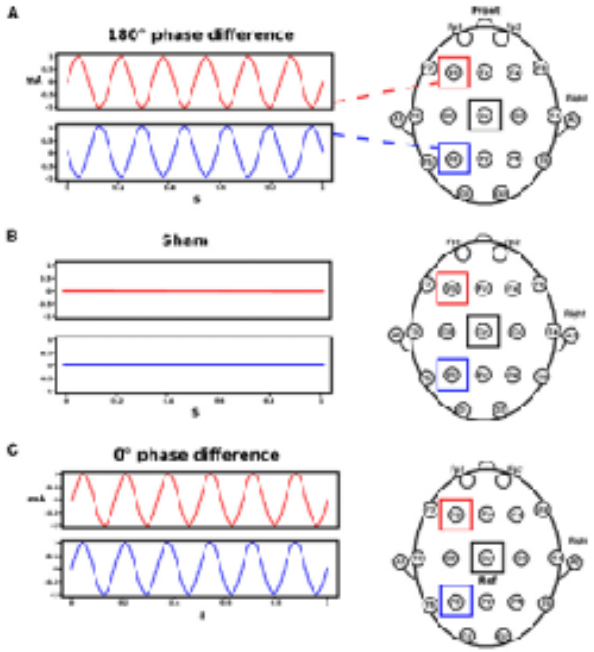
Fronto-parietal Phase-lag



Band-pass 6 +/- 1 Hz







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Parameters_selection_NIC-Software

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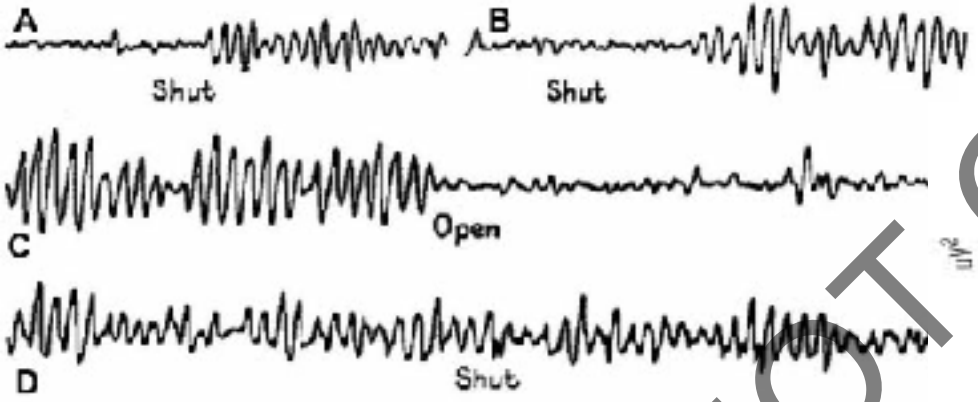
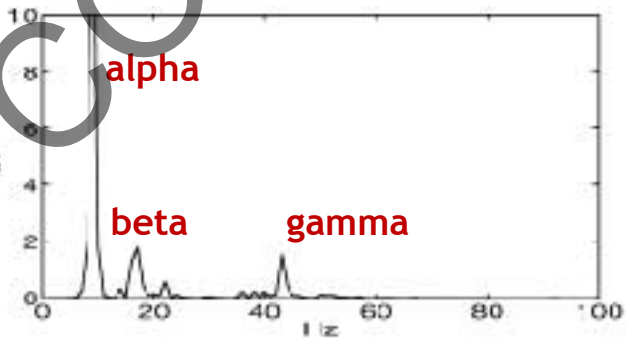
tACS and Phosphene

Rationale



Kanai et al., 2008



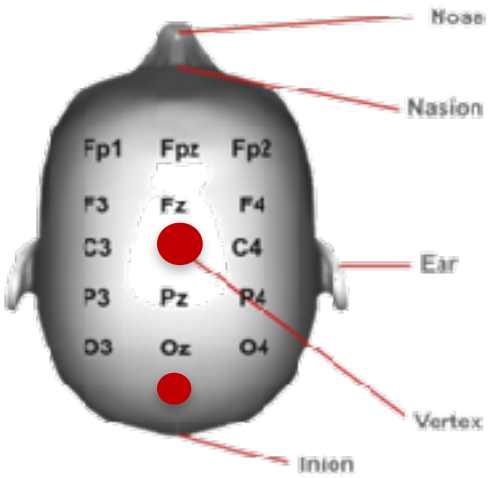
Eye Open/Closed Alpha (Adrian, 1934)

What is frequency sensitivity of tACS evoked Visual Sensation?

tACS Frequency → Phosphene Threshold

Design

Electrodes	Inion (+4cm) - Vertex
Current	0-40Hz, 0-1mA, 5s each
Subjects	8 Healthy



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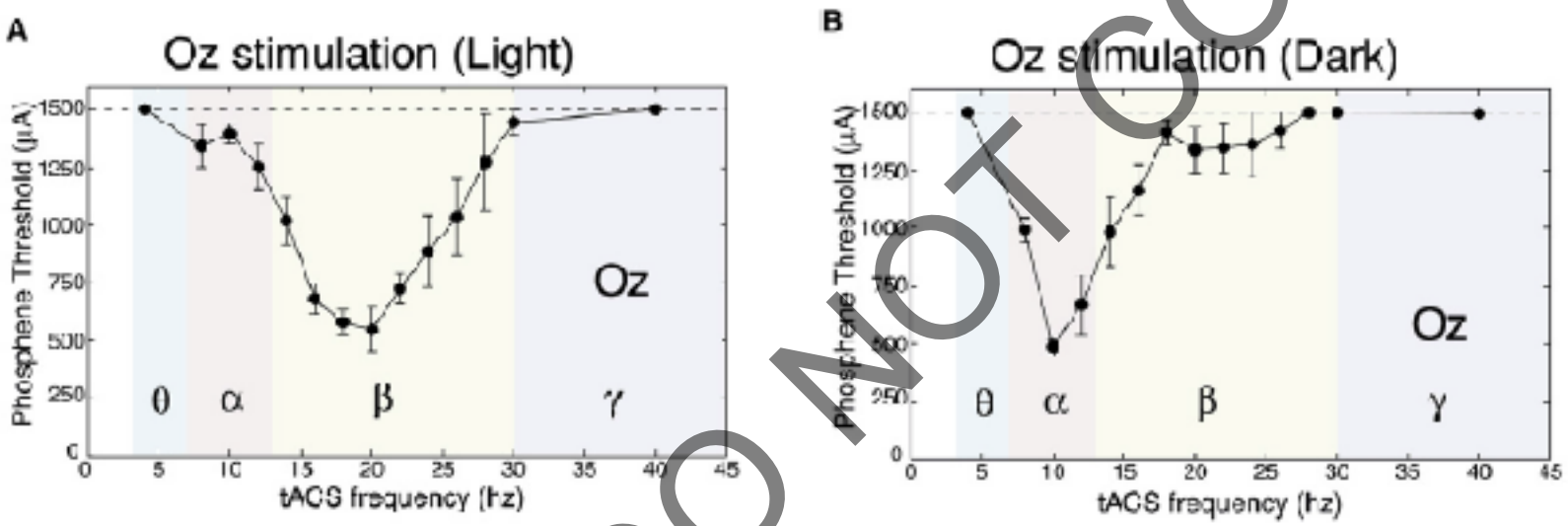
tACS and Phosphene

Results

Kanai et al., 200



- Occipital tACS can evoke phosphene perception
- Efficiency of stimulation is maximal at alpha band (dark) and beta band (light)

But…is it a cortical phenomenon?

(Schwiedrzik, 2009), (Schutter, 2010); (Paulus, 2010).

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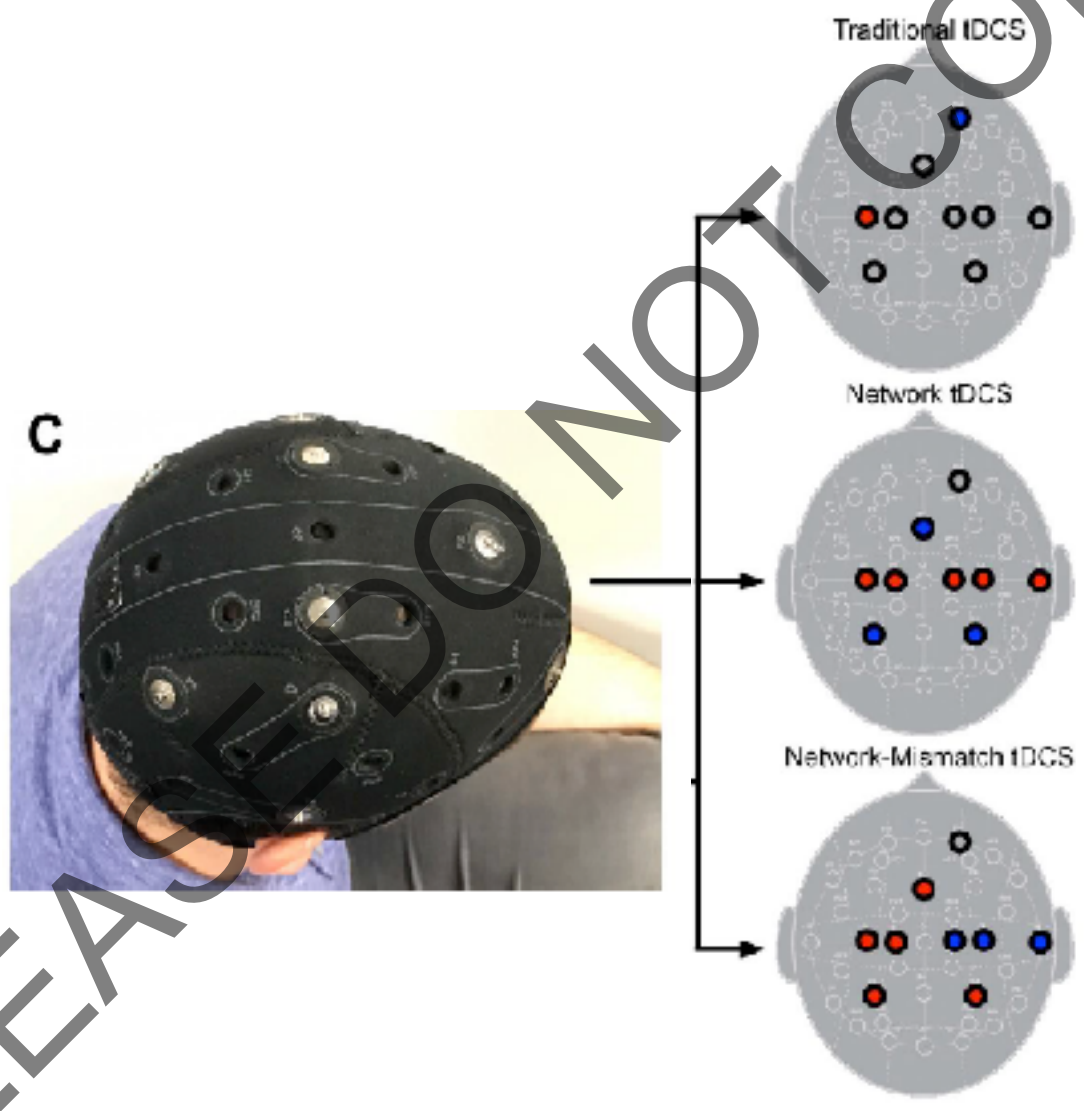
Advance Montages



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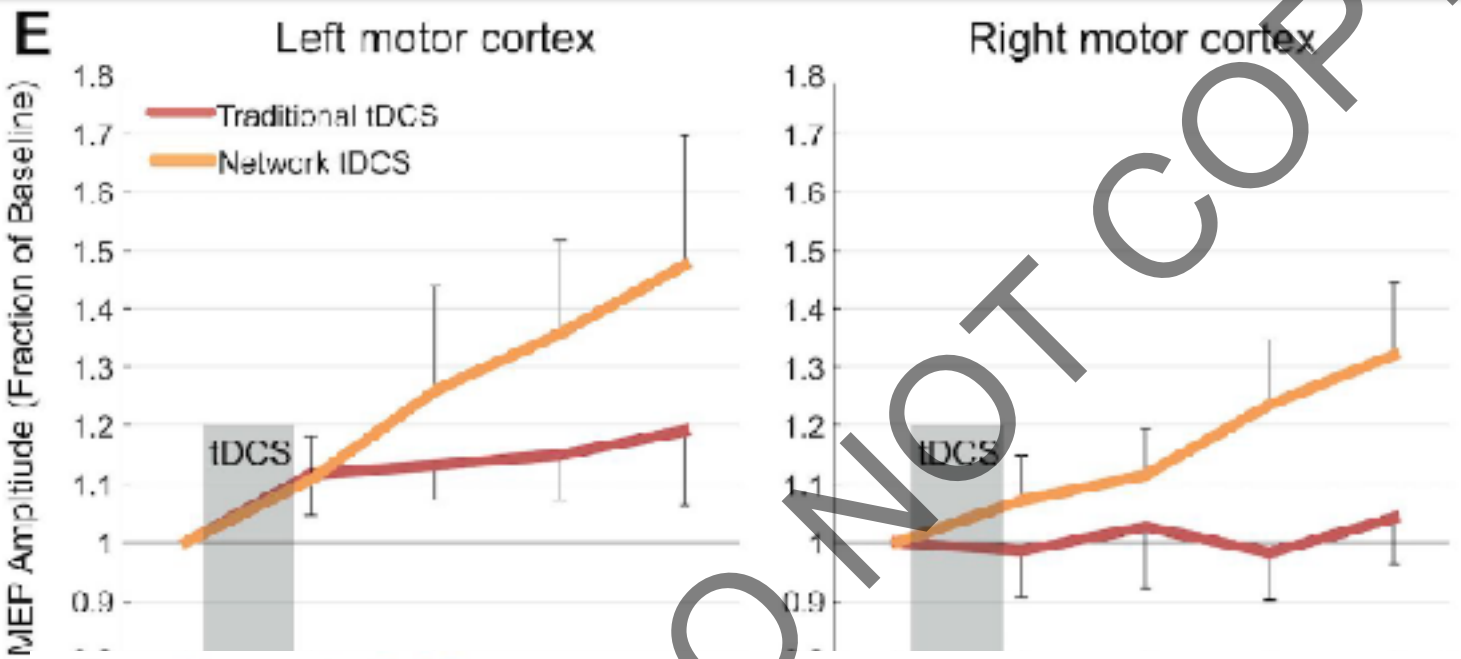
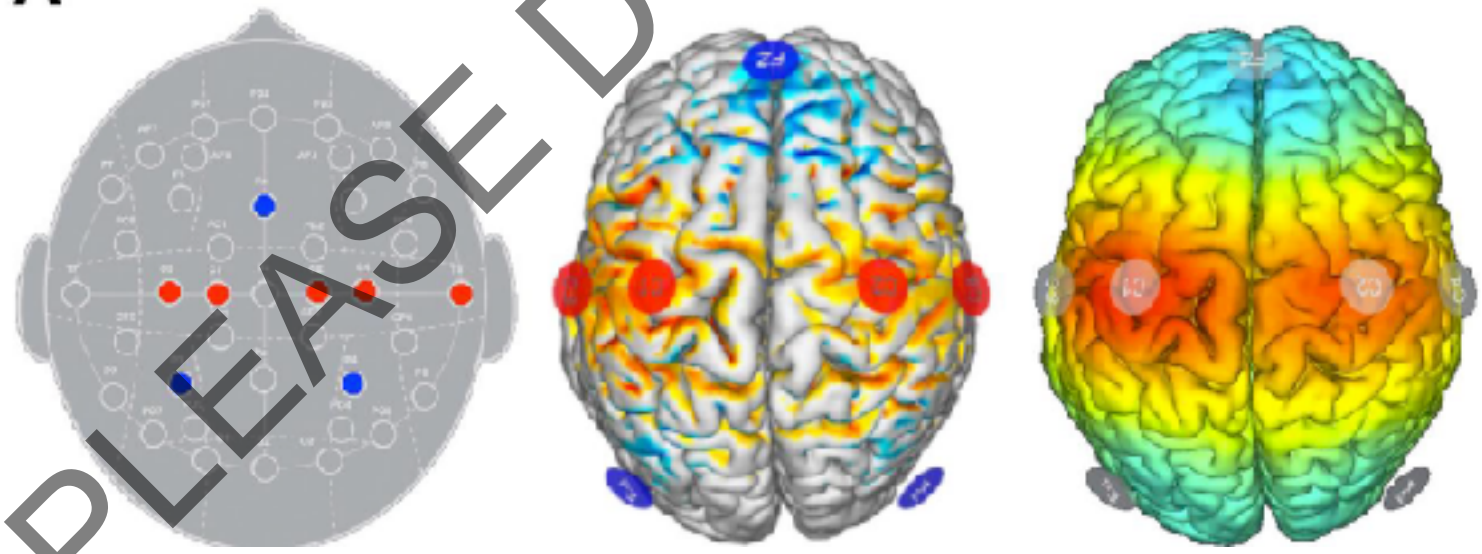
Advance Montages





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