

# Common ICA components

This Document contains frequency and time patterns of common ICA components.

Note that these data are relative to 129-channels recordings in eyes-closed rest condition (only for heart beating the recordings are from a system with fewer electrodes).

Some artifacts are more evident for specific channels location (i.e. eye channels, sensori-motor channels).

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## 1. Alpha Oscillations

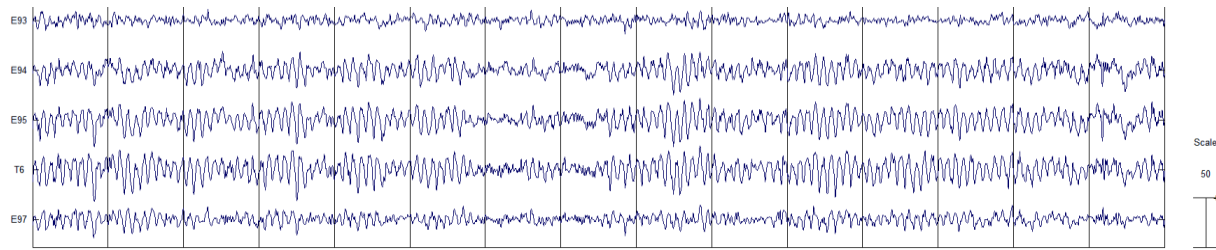


Figure 1. **EEG signal in time**: each interval in the axis corresponds to 1 second epoch; on the yaxis channels labels are reported (please refer to the next figures to see how some artifacts are visible only in certain channels); on the right side the scaling number is indicated, as a measure of the amplitude of the EEG signal.

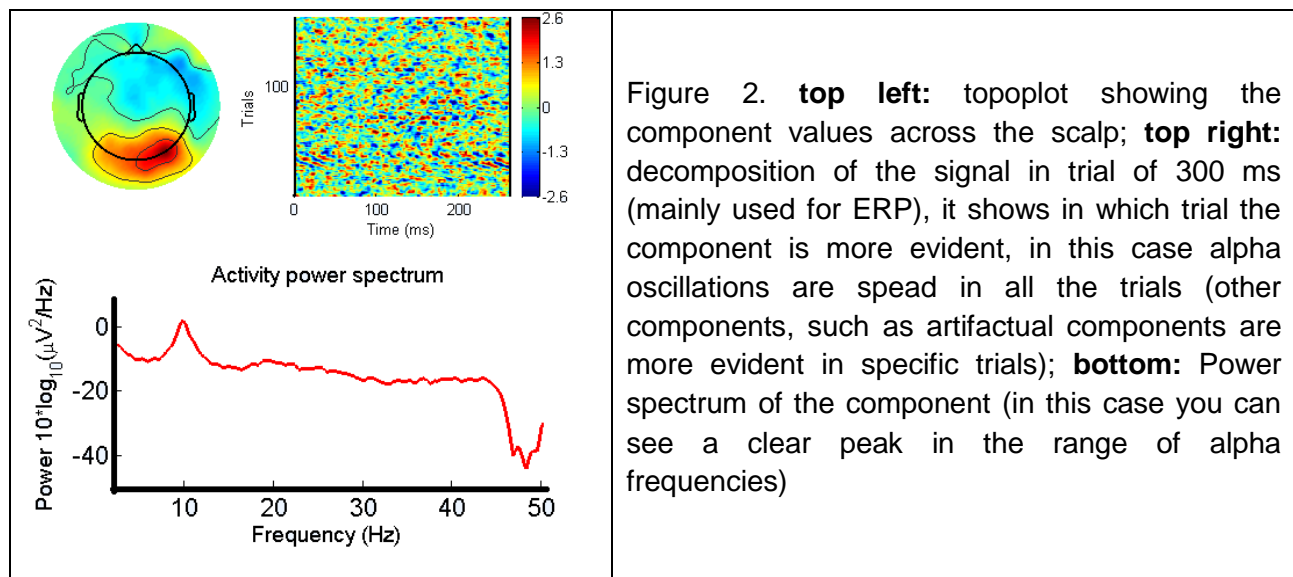
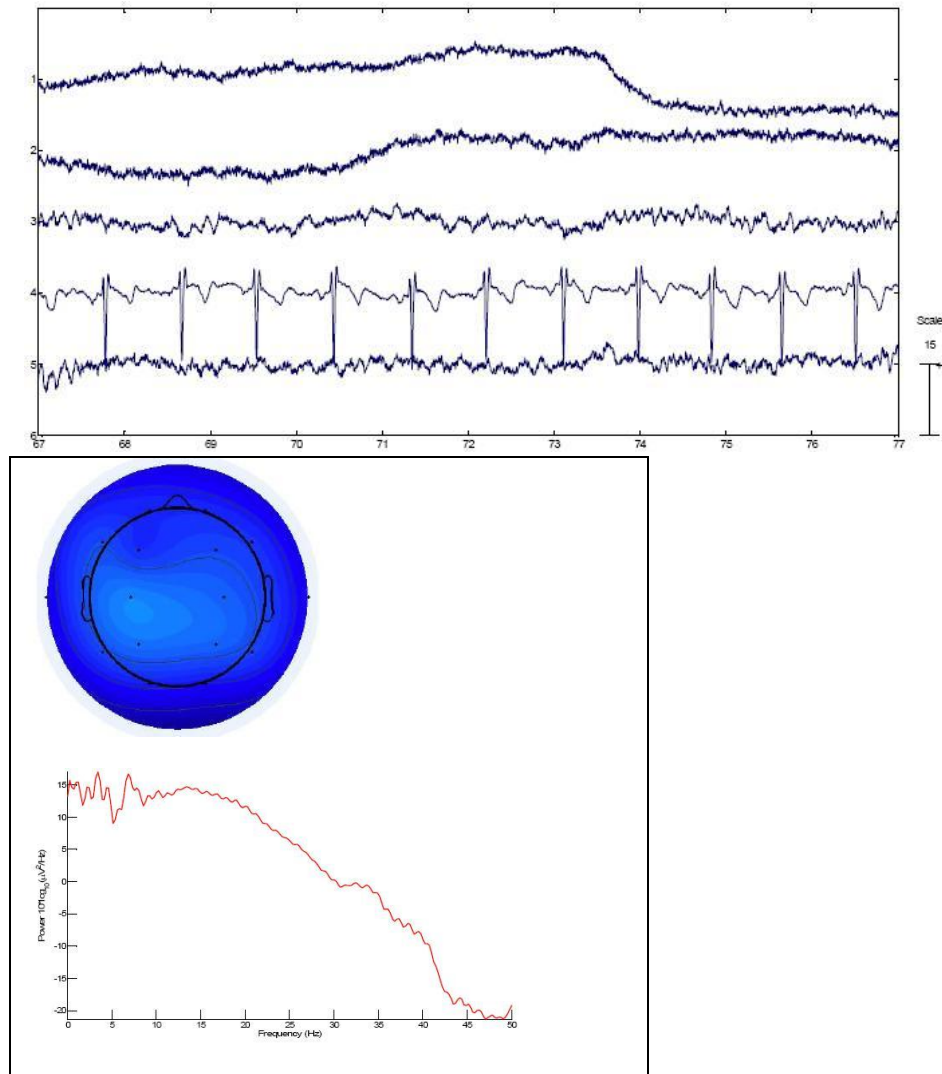


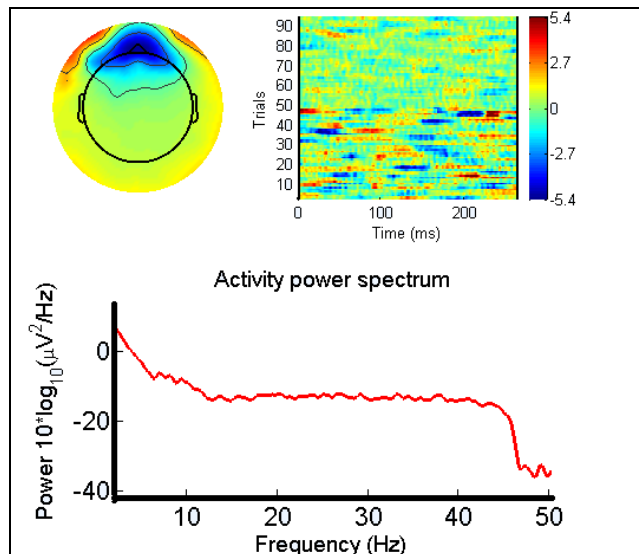
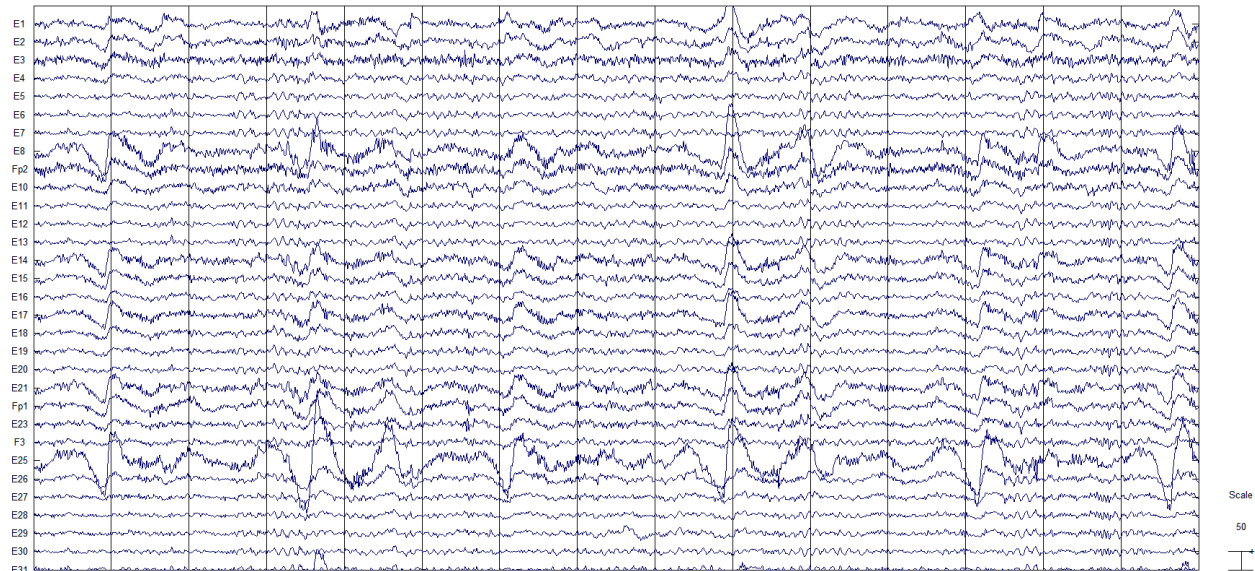
Figure 2. **top left**: topoplot showing the component values across the scalp; **top right**: decomposition of the signal in trial of 300 ms (mainly used for ERP), it shows in which trial the component is more evident, in this case alpha oscillations are spread in all the trials (other components, such as artifactual components are more evident in specific trials); **bottom**: Power spectrum of the component (in this case you can see a clear peak in the range of alpha frequencies)

## 2. Heart beat



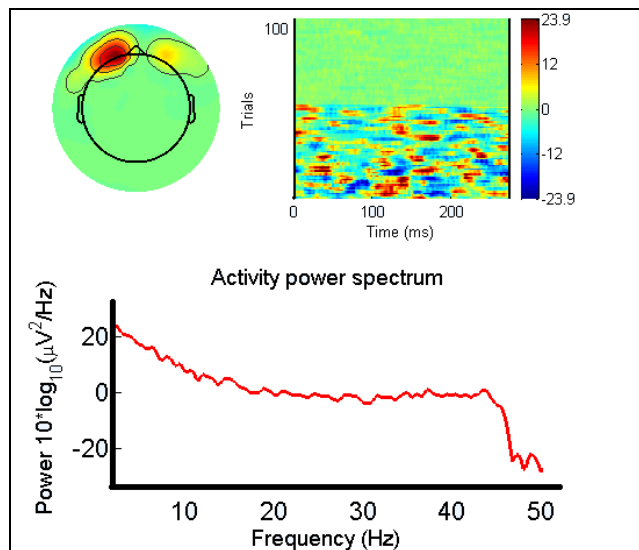
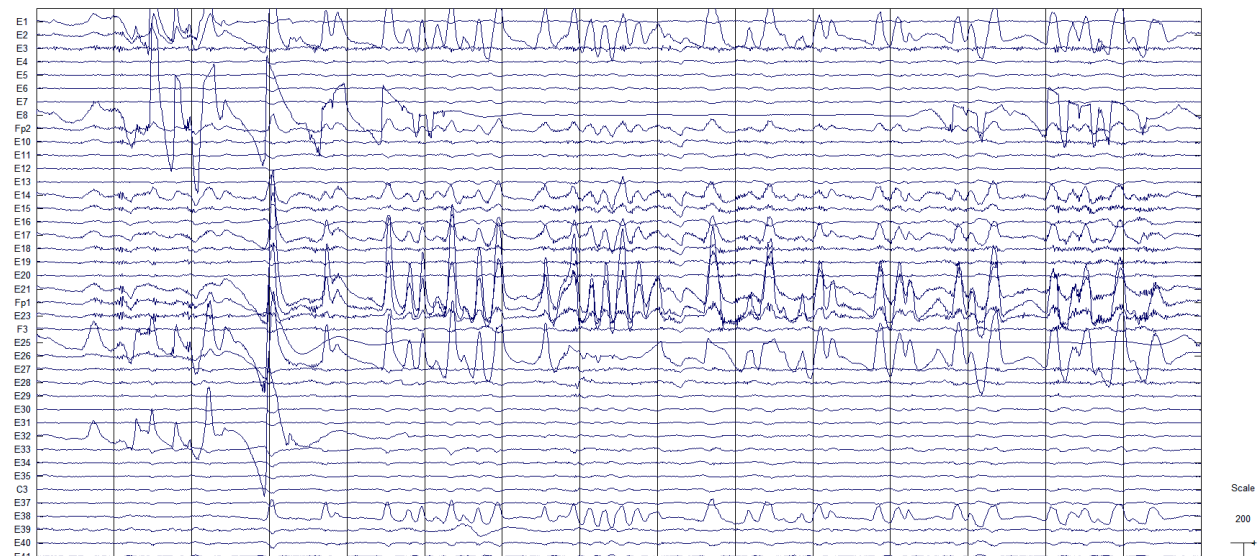
Comments: heart beat has a clear signature, usually present in single channel with typical shape (consisting in a P wave, a QRS complex, a T wave, and a U wave, refer to <http://en.wikipedia.org/wiki/Electrocardiography> for more details) that repeats every about second (typical resting heart rate in adults is 60-90 bpm – beat per minute) with an amplitude range of about [-50 100]  $\mu\text{V}$ . As you can notice from the scalp topography, the heart beat component appears quiet uniform across the scalp.

### 3. Slow Blink

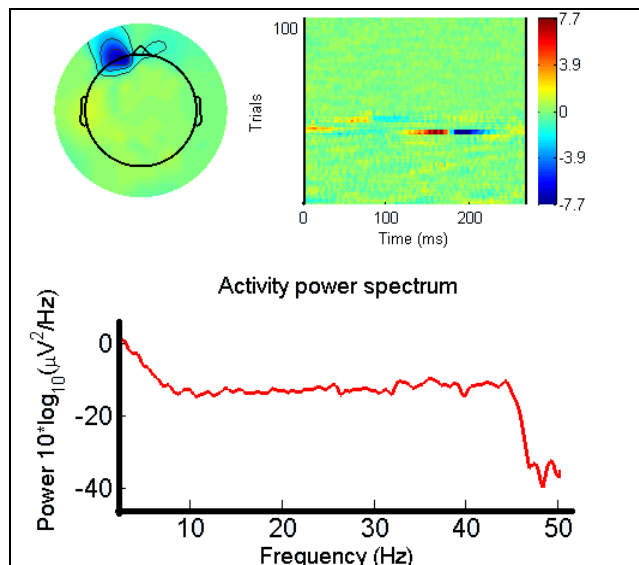
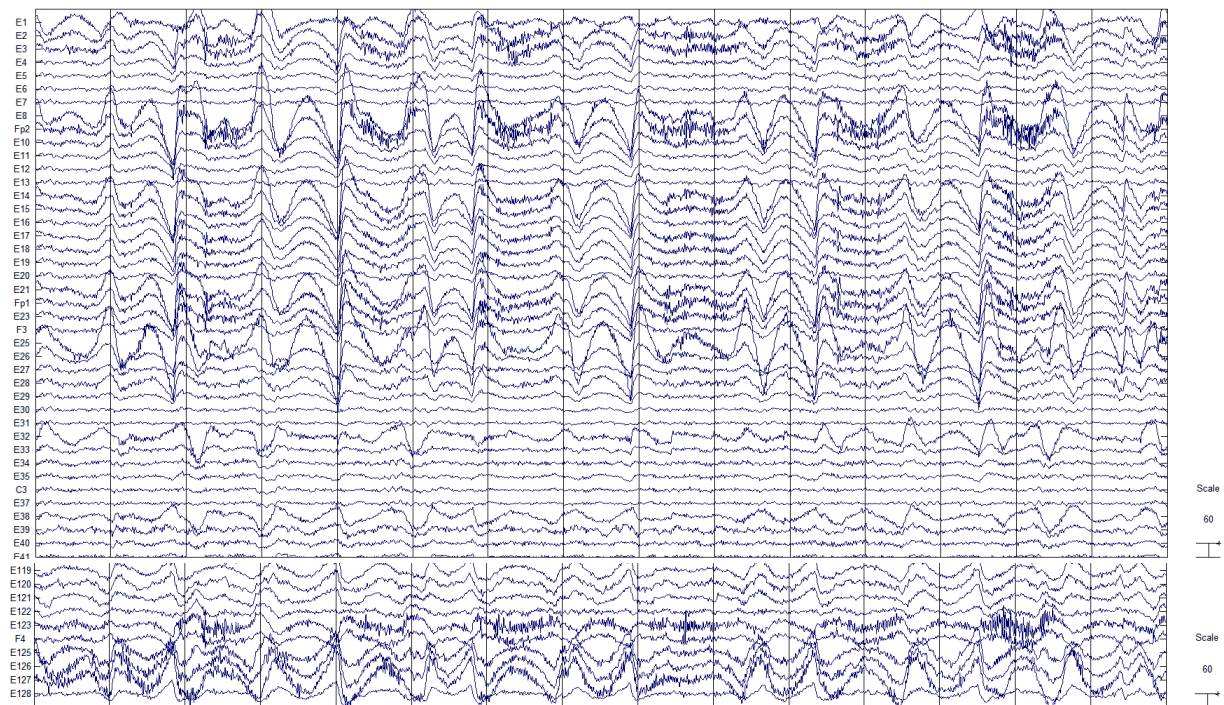


**Comments:** Eye Blinks have typical slow oscillations of about 1 Hz (2 or few more oscillations per second in case of fast blinking – see next component). They are characterized by positive peak lasting a few tenths of a second, mainly visible in the frontopolar region (as shown in the topoplot), but propagating to all the electrodes of the montage, becoming weaker with distance from the front.

#### 4. Fast Blink



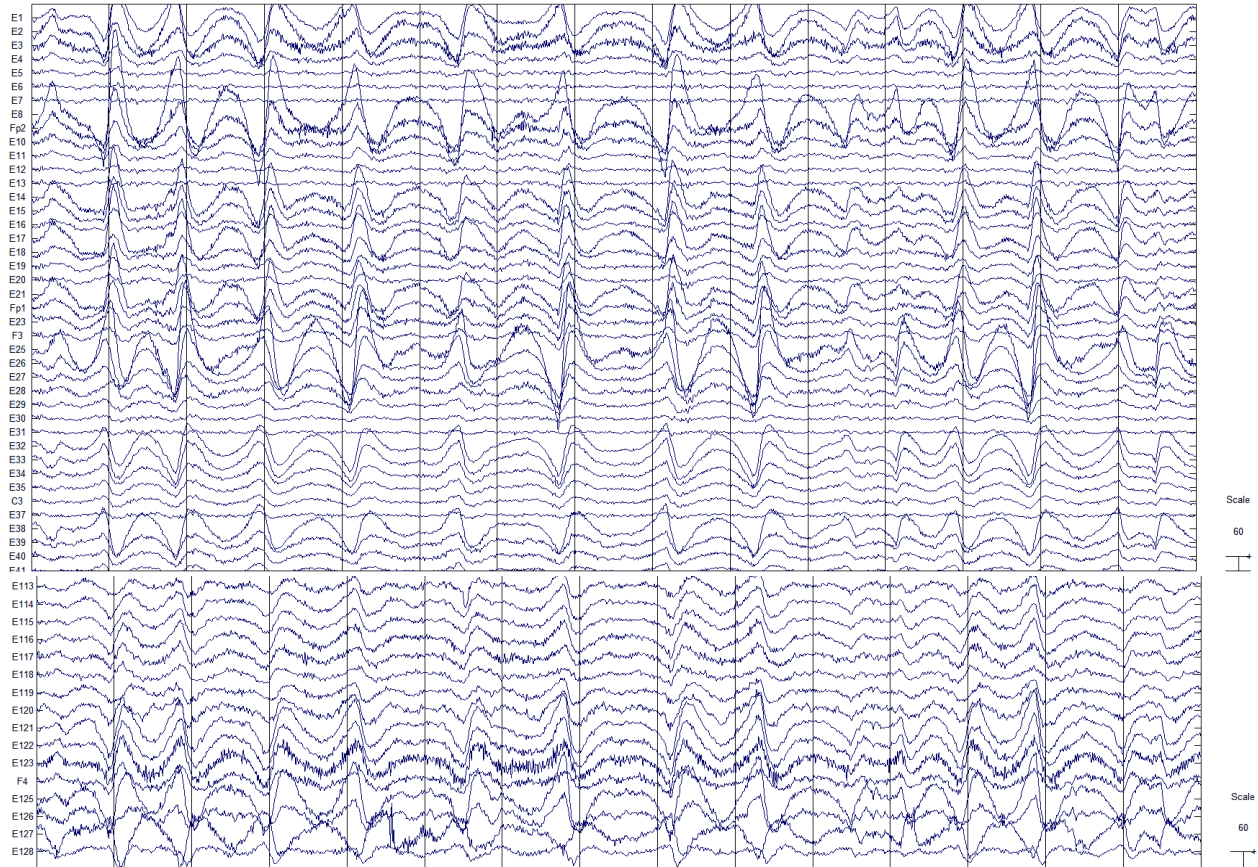
## 5. Vertical Eye Movements

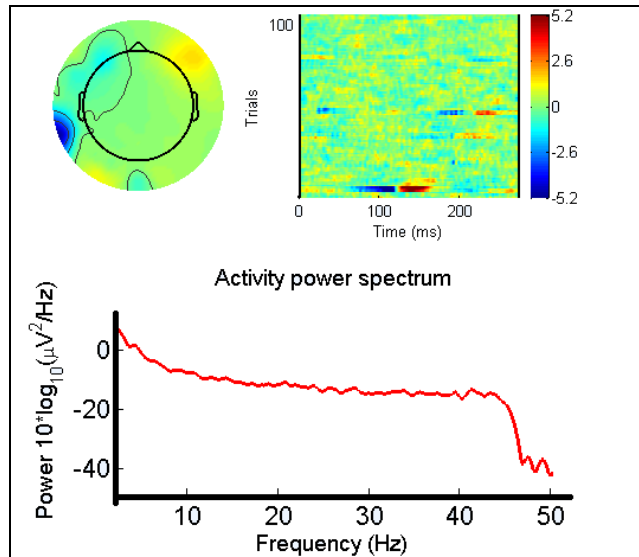




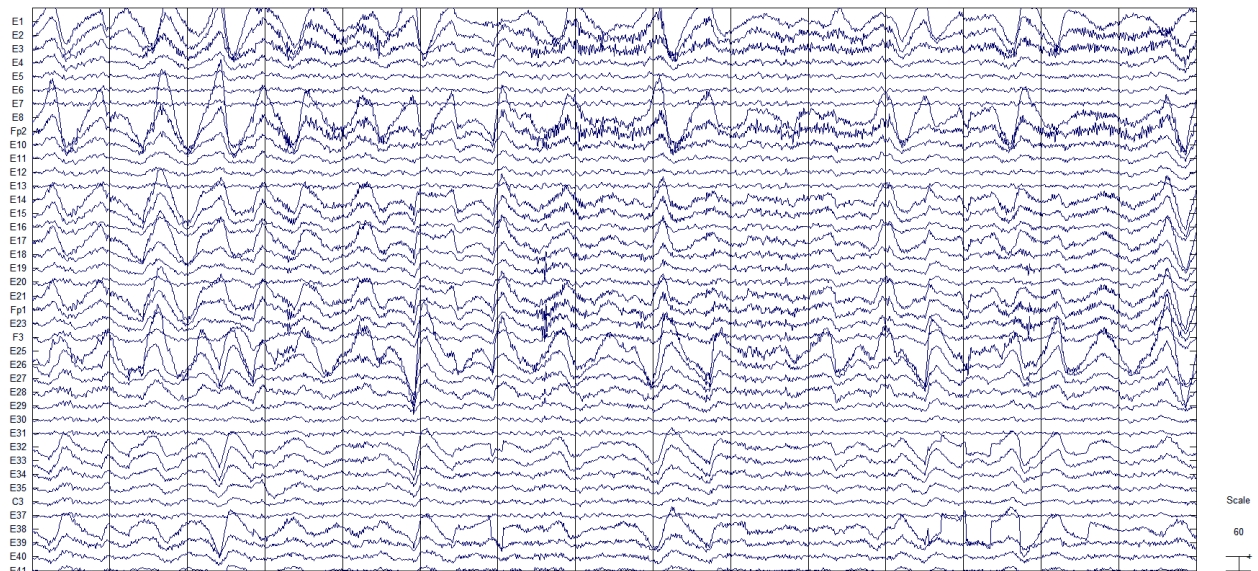
Comments: Vertical and Horizontal Eye Movements (see also next component) have amplitude of the order of tens of  $\mu\text{V}$ . Their effect is visible on frontopolar and frontotemporal electrodes and can be symmetric or antisymmetric, depending whether the movement is vertical or horizontal, respectively. The effect of eye movement artifacts on frequency- or time-domain analysis is quite similar to that of blink artifacts, except that their frequency content is even lower, and amplitudes tend to be larger. Similar observations are valid for rolling of the eyes

## 6. Horizontal Eye Movements

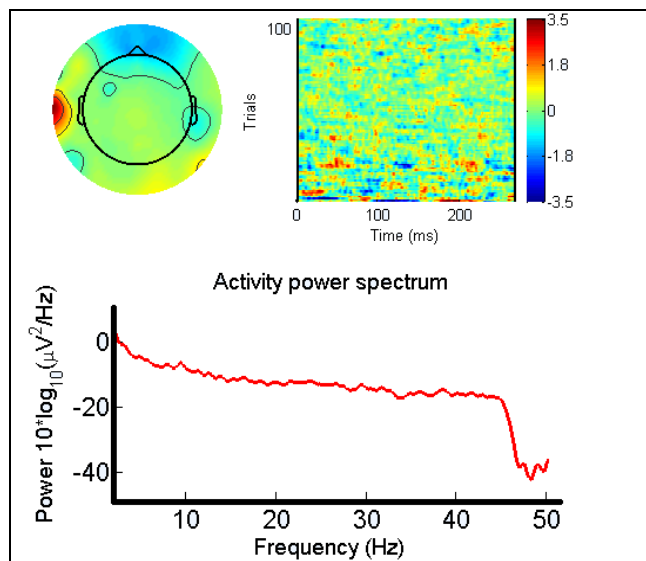




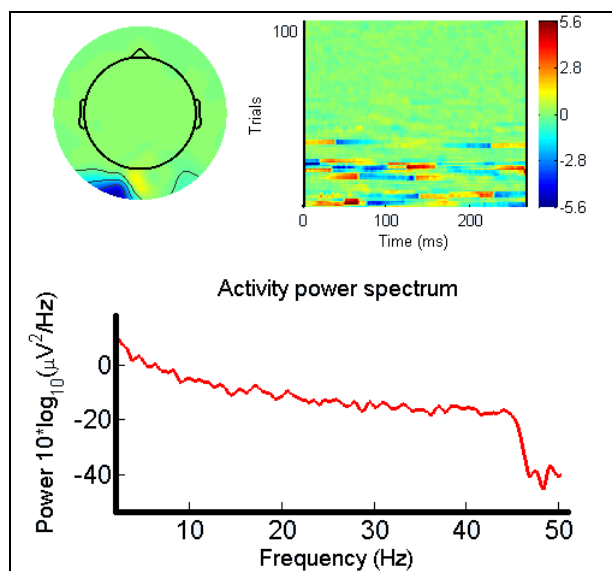
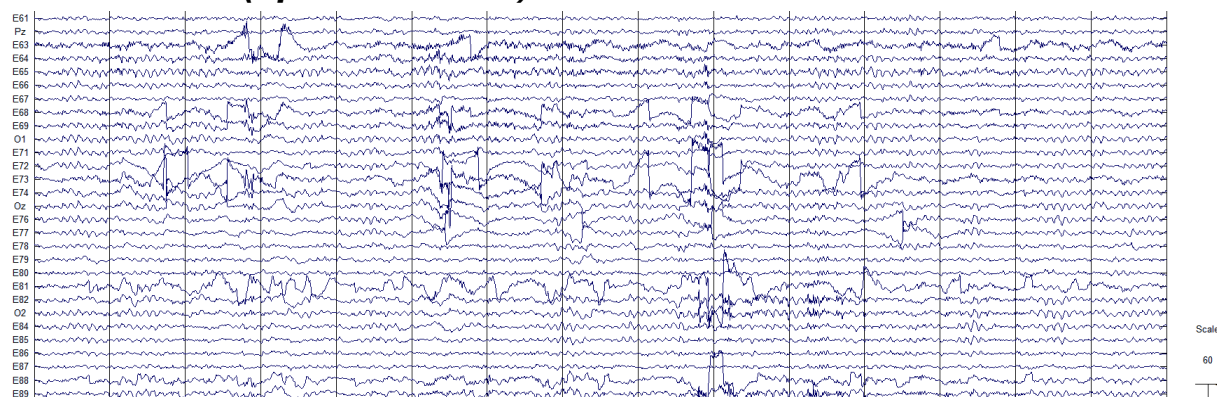
## 7. Slow Rolling of the Eyes



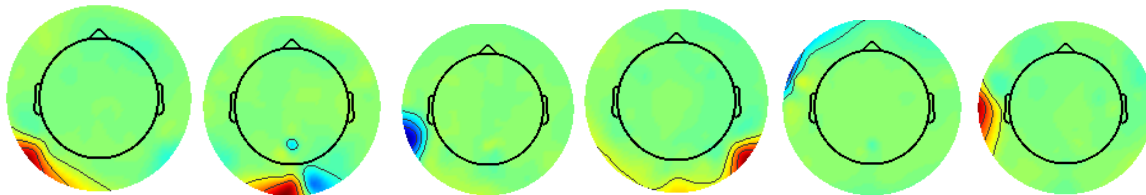




## 8. Shoulders (up/down-tense)

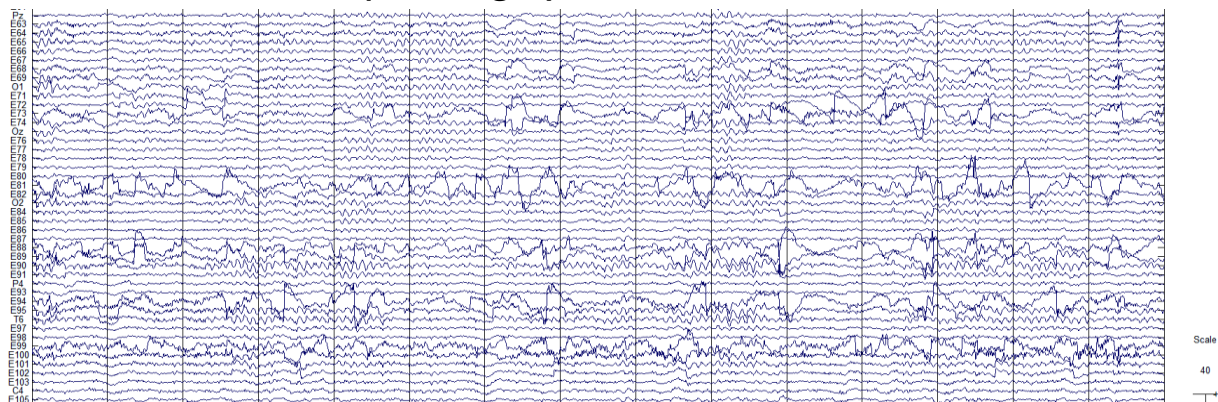


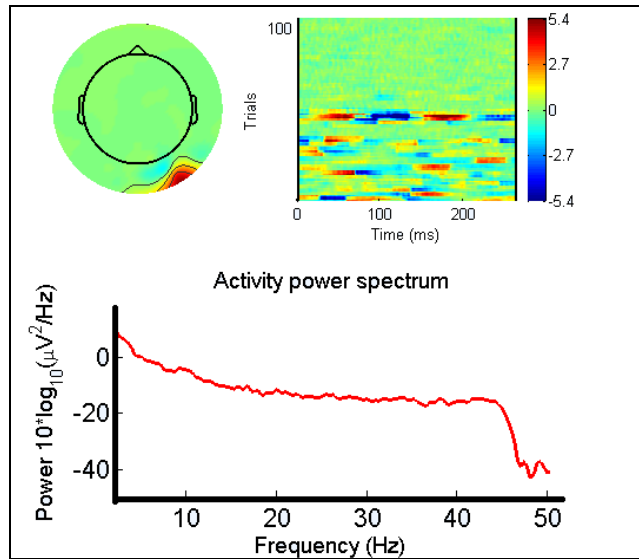
Other Possible Components Topographies for Shoulder movements:



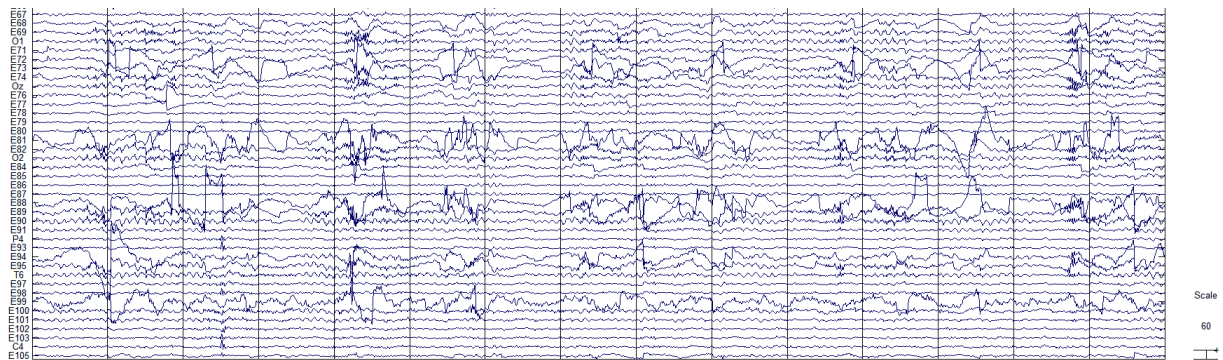
Comments: Shoulder movements, as well as neck movements, legs movements (see next components) can produce both electrodes displacements (mechanical noise) and artifactual oscillations in sensorimotor channels. Usually these movements as well as movements of facial muscles have similar representation in the compoment topographies (sometimes, they are indeed addressed under a common name, e.g. *general discontinuities*)

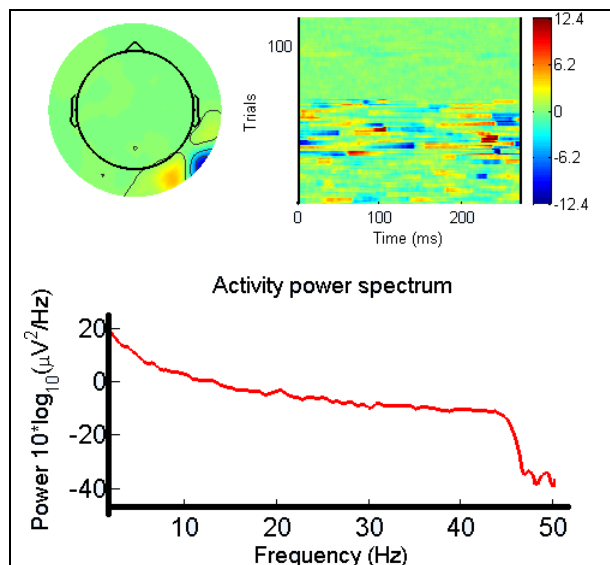
## 9. Neck Movements (Left/Right)



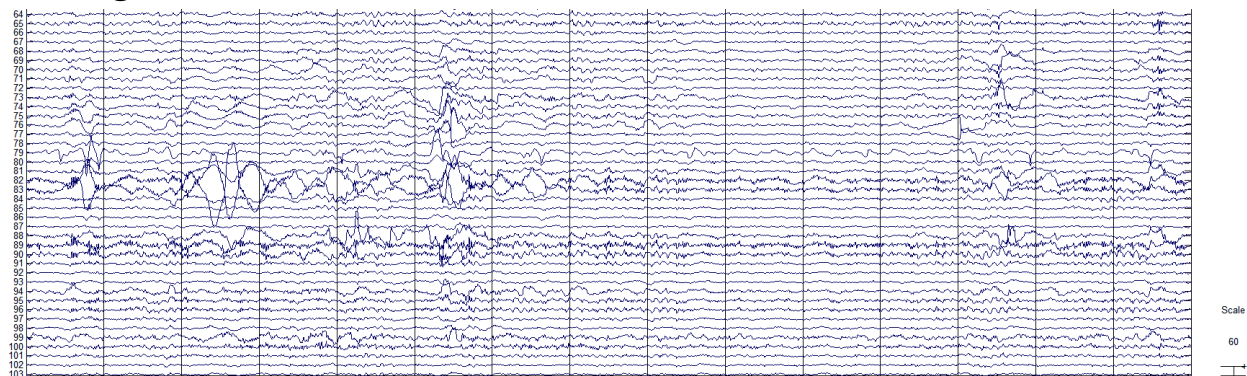


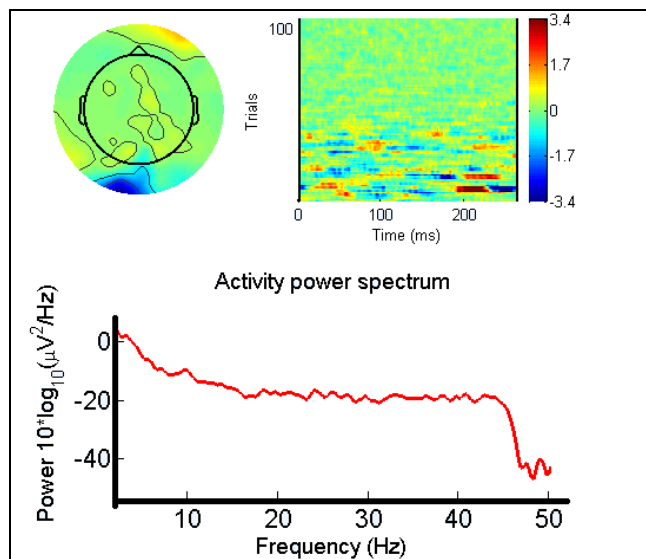
## 10. Neck Movements (Forward/Backward)



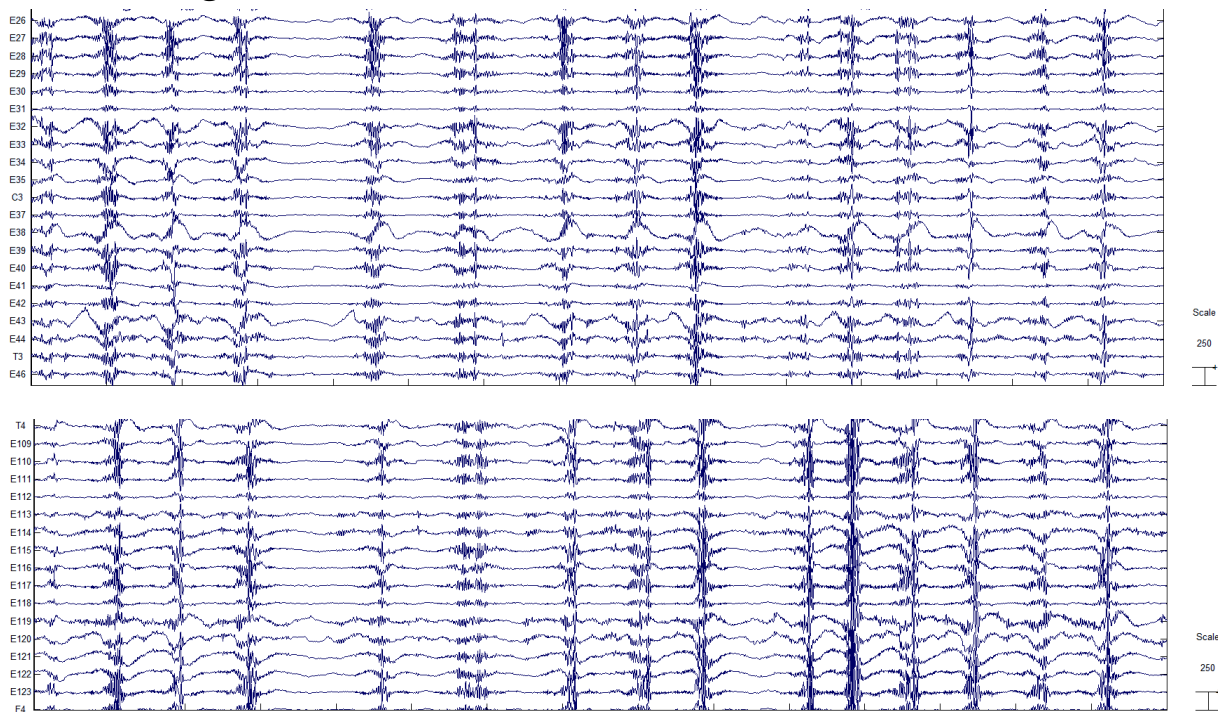


## 11. Legs Movements

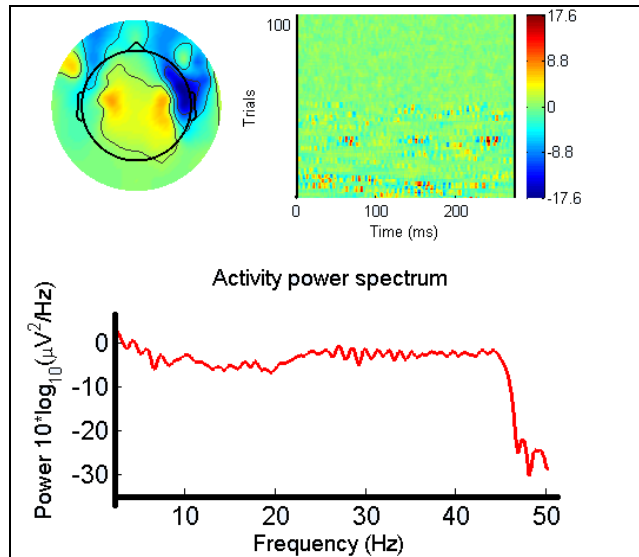




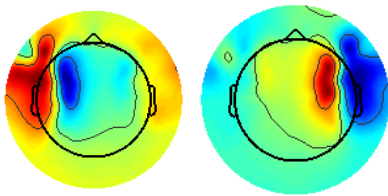
## 12. Chewing





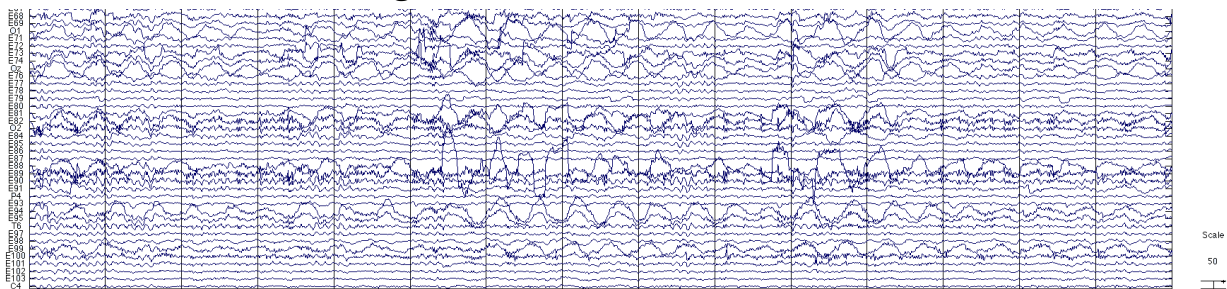


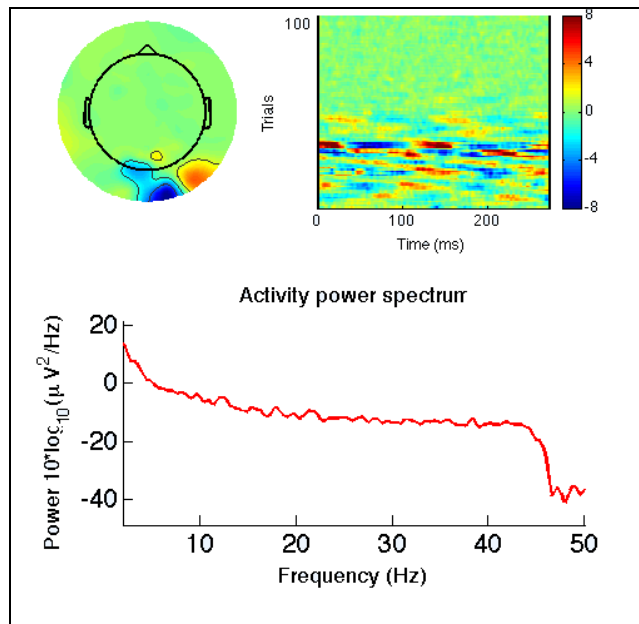
Other Possible Components Topographies for chewing movements:



Comments: chewing movements are typical EMG (muscular) artifacts, characterized but high frequency burst. They are mainly produced by jaw and cheek muscles and as othe EMG artifacts can completely obscure any frequency analysis, they appear indeed in all the EEG channels.

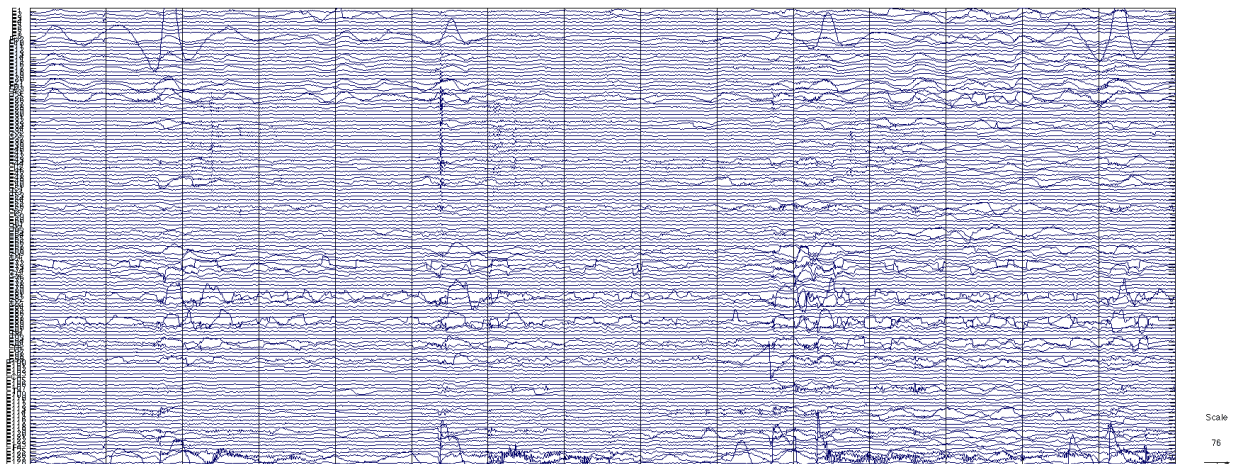
### 13. Lean Chair Rocking

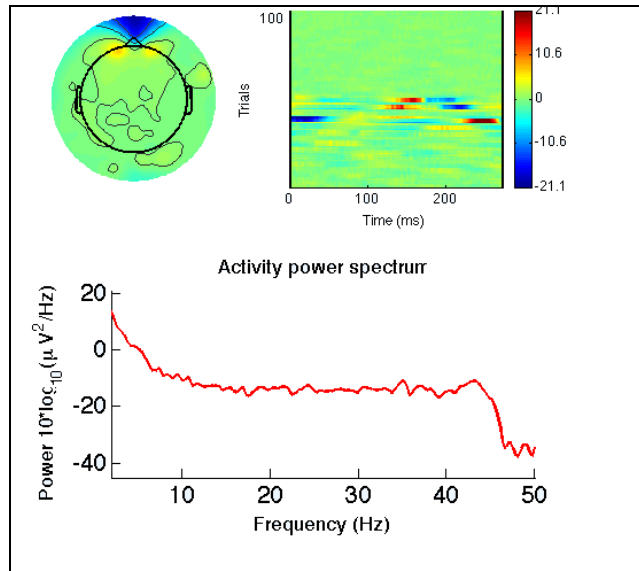




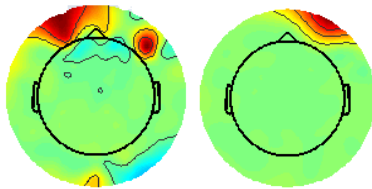
Comments: these artifacts are due to mechanical source of noise: the back of the head is hitting the lean chair, causing channels to move. These effects can be noticed in most of the channels.

## 14. Coughing





Other Possible Components Topographies for coughing:



Comments: coughing during an EEG recording can affect few channels, producing huge jumps in the signal. These jumps slowly dissipate bringing the signal to normal condition or introducing an offset because of electrode displacements.