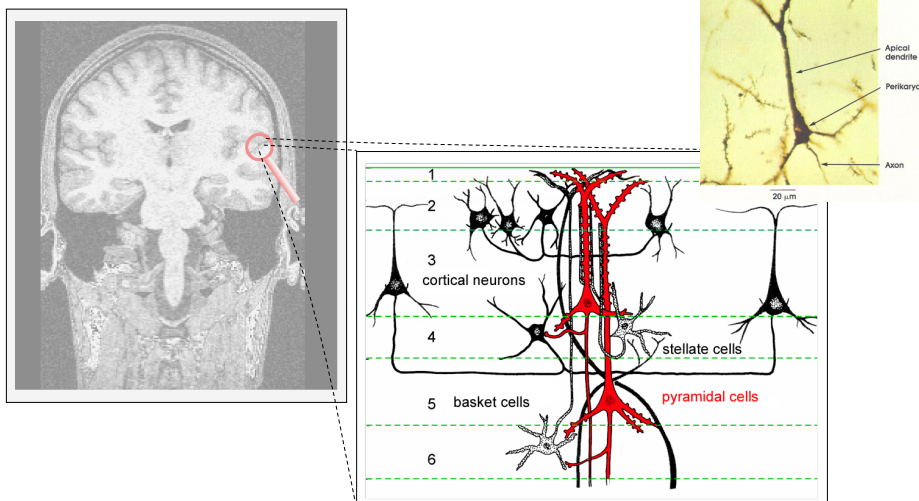


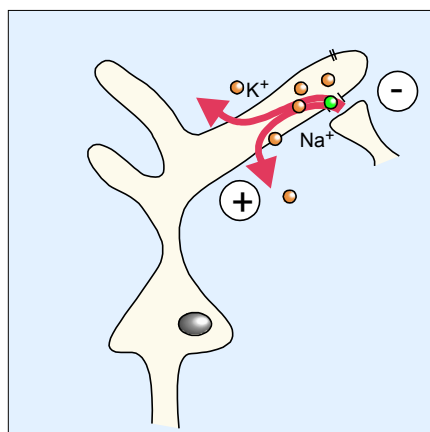
Physiological Background of EEG and MEG



147

Physiological Basis of EEG and MEG

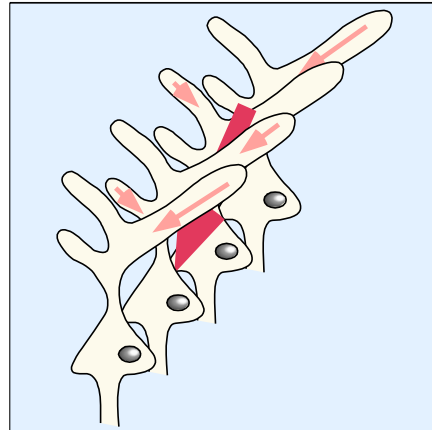
- synaptic activity causes shifts in electrical currents
- a postsynaptic potential emerges
- the polarisation can be described physically by a *Dipole*



148

Physiological basis of EEG and MEG

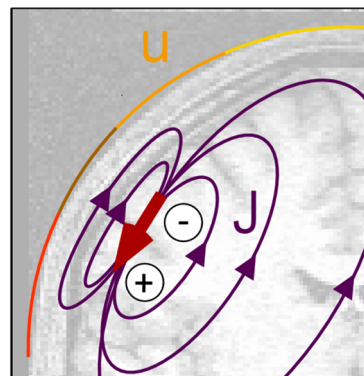
- synaptic activity causes shifts in electrical currents
- a postsynaptic potential emerges
- the polarisation can be described physically by a *Dipole*
- simultaneous activation of multiple neurons superimposes
- a prerequisite for the generation of a measurable EEG- or MEG-signal is the coordinated activity of about 10 000 neurons.



149

Physiological basis of EEG and MEG

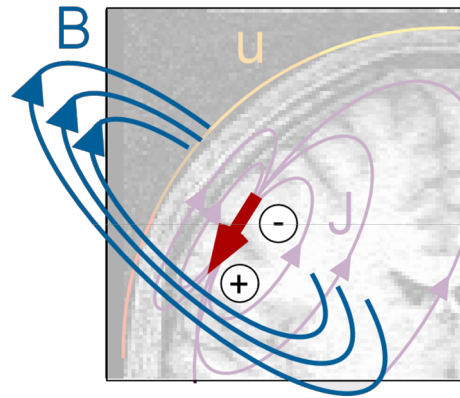
- synaptic activity causes an intra-cellular *primary current* and an extra-cellular *secondary current*.
- EEG measures the voltage changes of the secondary current at the head surface.



150

Physiological Basis of EEG and MEG

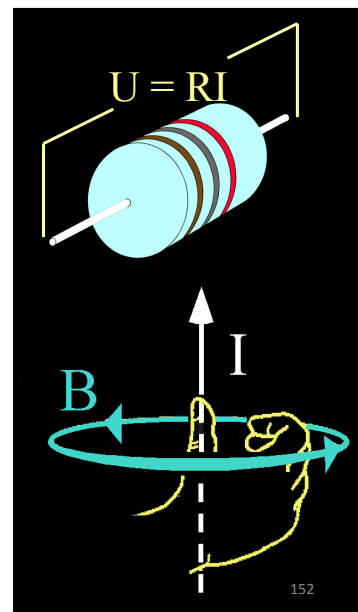
- synaptic activity causes an intra-cellular *primary current* and a extra-cellular *secondary current*.
- EEG measures the voltage changes of the secondary current at the head surface.
- MEG records magnetic fields of the primary currents.



151

Physiological Basis of EEG and MEG

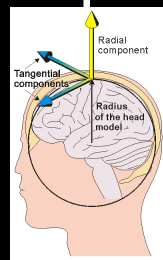
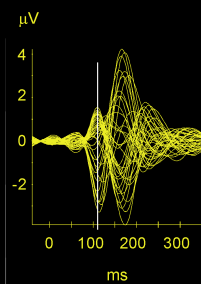
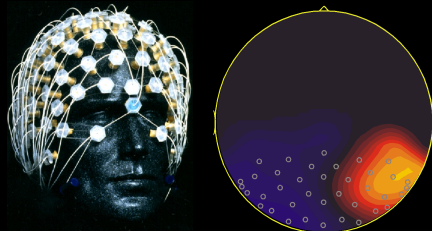
- Neuronal basis of EEG and MEG is an electrical current
- Electrical currents are related to differences in potential (*Ohm's Law*) → EEG
- Elektrical Currents generate magnetic fields (*Biot-Savartsches Gesetz*) → MEG



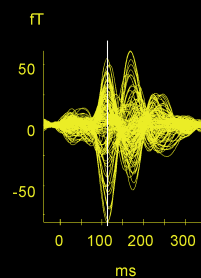
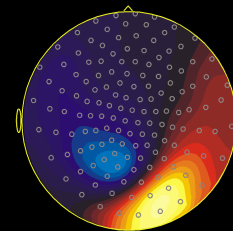
152

Visual Evoked EEG and MEG Responses

EEG



MEG



153

Inverse Problem



Hermann von Helmholtz
(1821–1894)

The estimate of the strength and the location of neuronal sources for a given topography of electrical potential and magnetic field, respectively Magnetfeld:

- ⇒ Problem is not solvable due principal reasons.
- ⇒ Additional assumptions have to be made. Constraints have to be introduced (Anatomy, Physiology).
- ⇒ Limited number of sensors
- ⇒ Estimate of a 3-dimensional source distribution based on a 2-dimensional distribution of the electric brain signal
- ⇒ Combination of MEG and EEG.

Generation of Magnetic Fields

- Depolarisation of the dendritic membrane of pyramidal cells generates extra- and intracellular currents.
- In **EEG** the voltage differences of extra-cellular currents are measured at the head surface (Ohm's law).
- In **MEG** only magnetic effects of the summated intra-cellular currents are measured (Biot-Savart's law, right hand rule).

