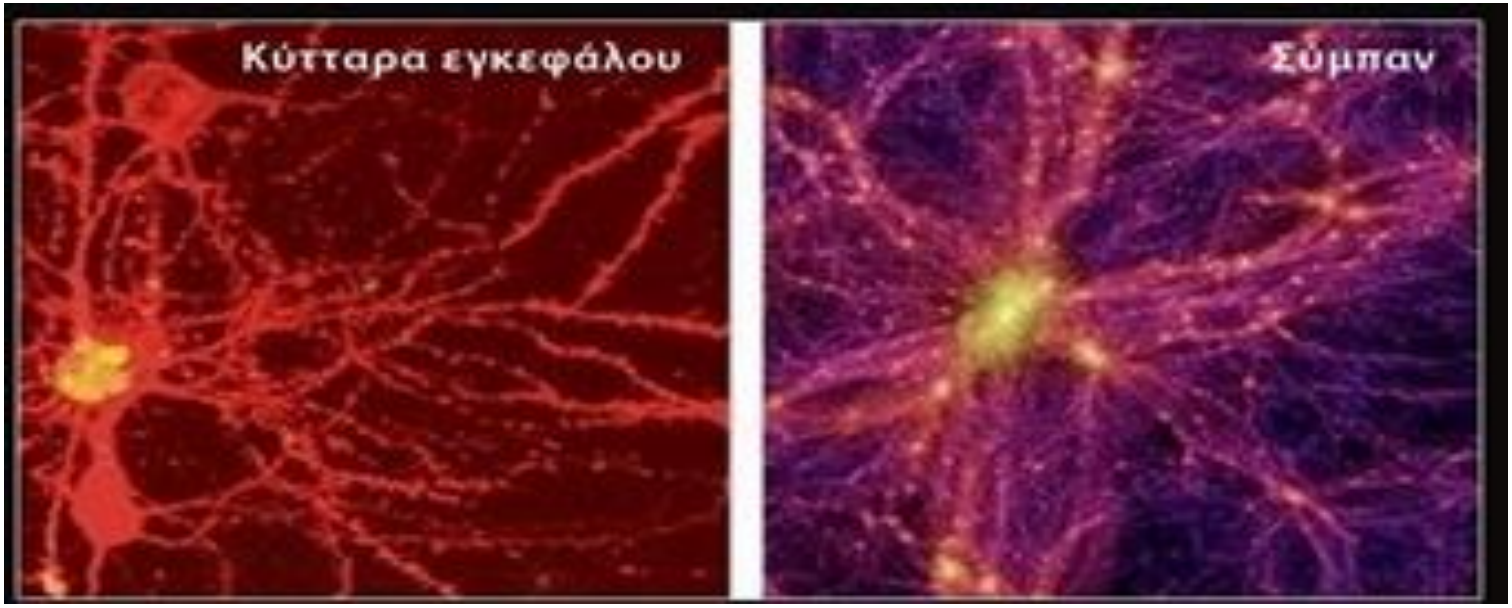
University General Hospital of Alexandroupoli, Greece

EVALUATION OF THE EFFECT OF PICO-TESLA TRANSCRANIAL MAGNETIC STIMULATION TO PATIENTS WITH VARIOUS CNS DISORDERS USING THE SQUID

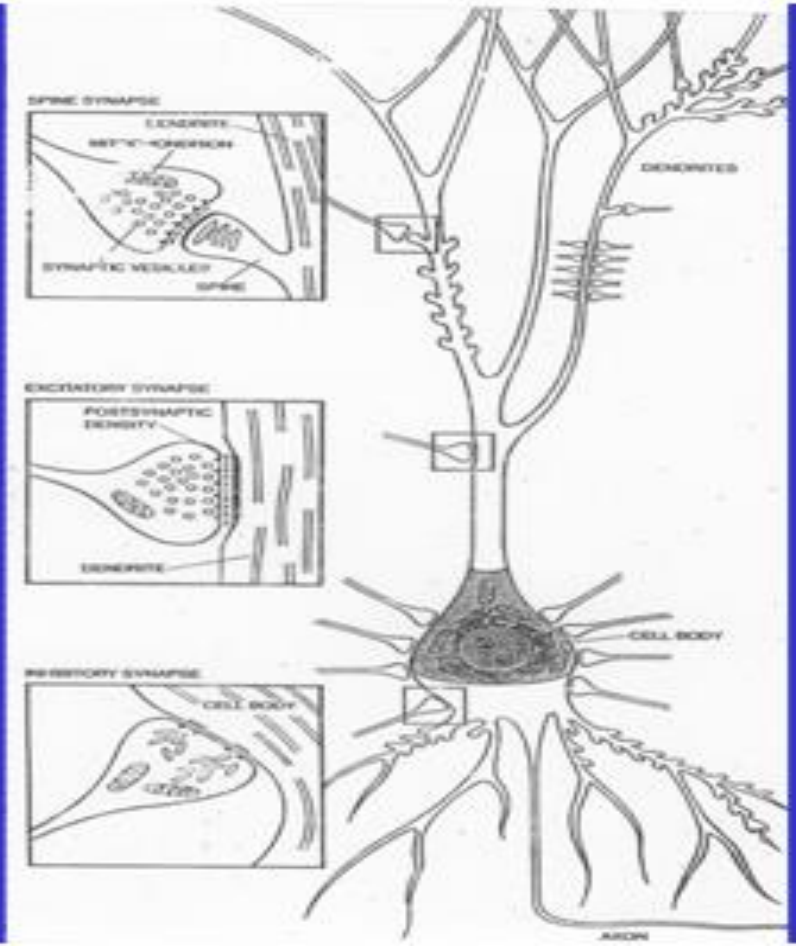
Emeritus Professor P.Anninos

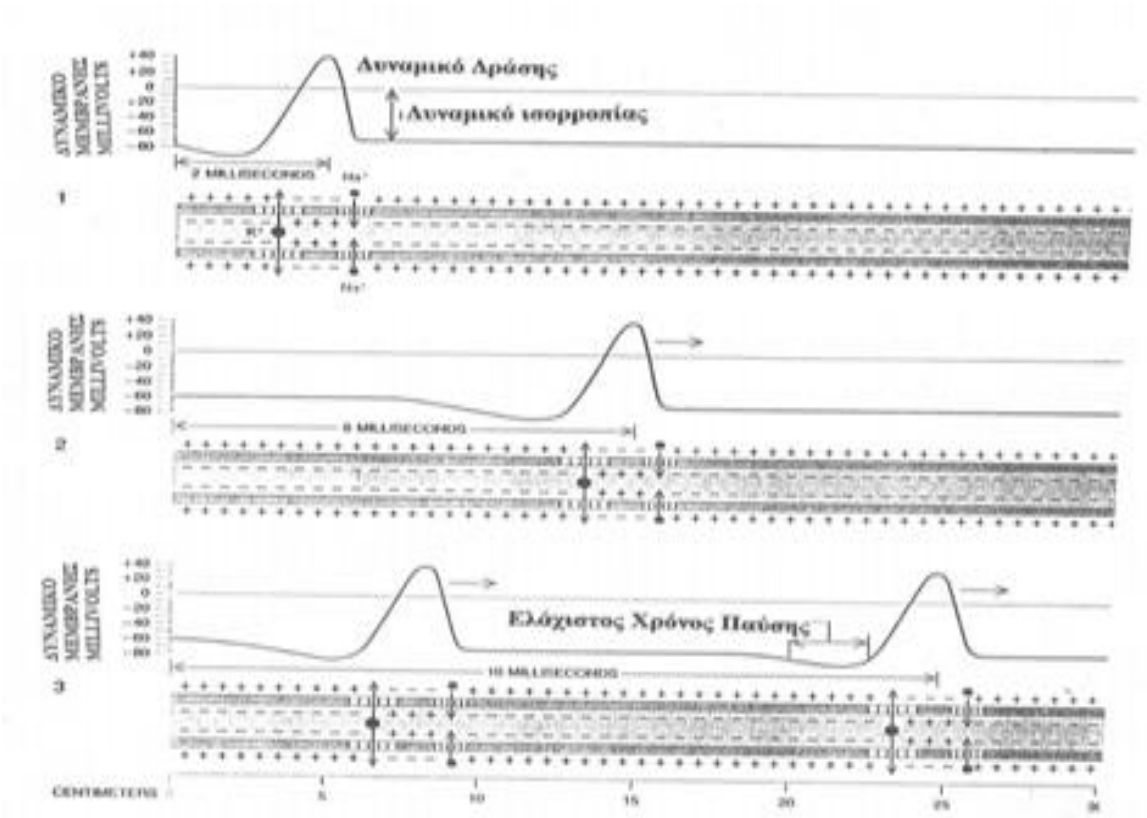
THE NEURONS IN THE BRAIN AND THE UNIVERSE



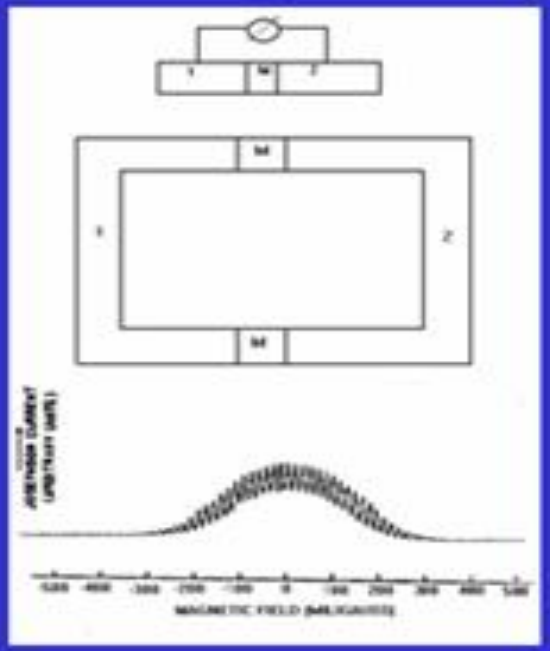
- The magnetic activity of the brain is produced by cellular micro-currents, which are emerged from ionic movements, due to the dynamical variations of the membrane potentials

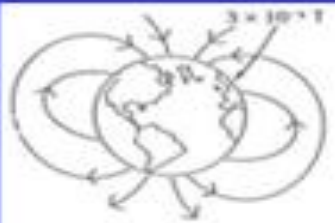
- These micro-currents can be realized by considering the unit component that make up the brain : the “NEURON”. The Neuron consists from the cell body and two processes namely the dendrites by which receives signals from other neurons and the “AXON” which generates the main signal the “ACTION POTENTIAL” which travels along the axon and to all of its branches to change the membrane potential to all the neurons which are connected with it.


DENDRITES
CELL BODY
AXON


Δυναμικό Δράσης
Δυναμικό ισορροπίας
Ελάχιστος Χρόνος Παύσης

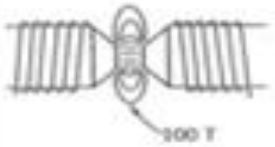
The Josephson effect



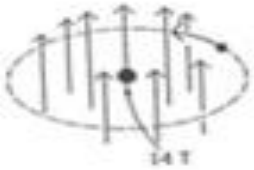


The magnitude of the earth's magnetic field at sea level is about 3 × 10⁻⁵ T

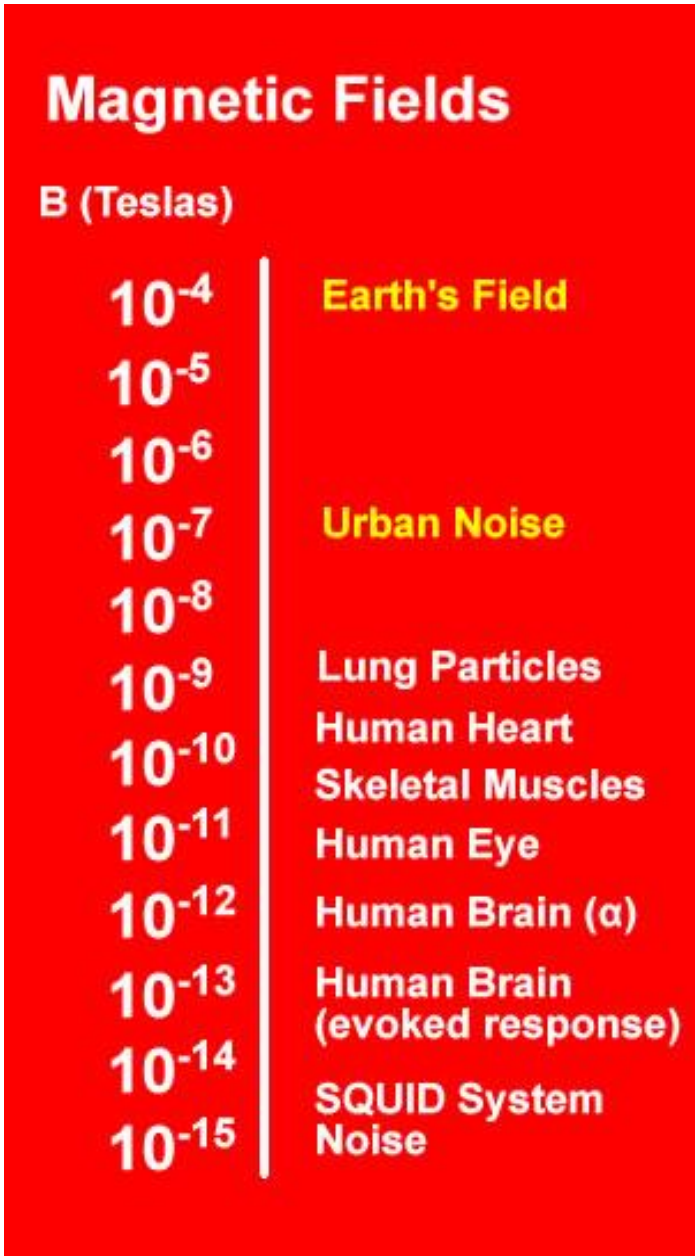
The magnetic field near a strong permanent magnet is about 1 T



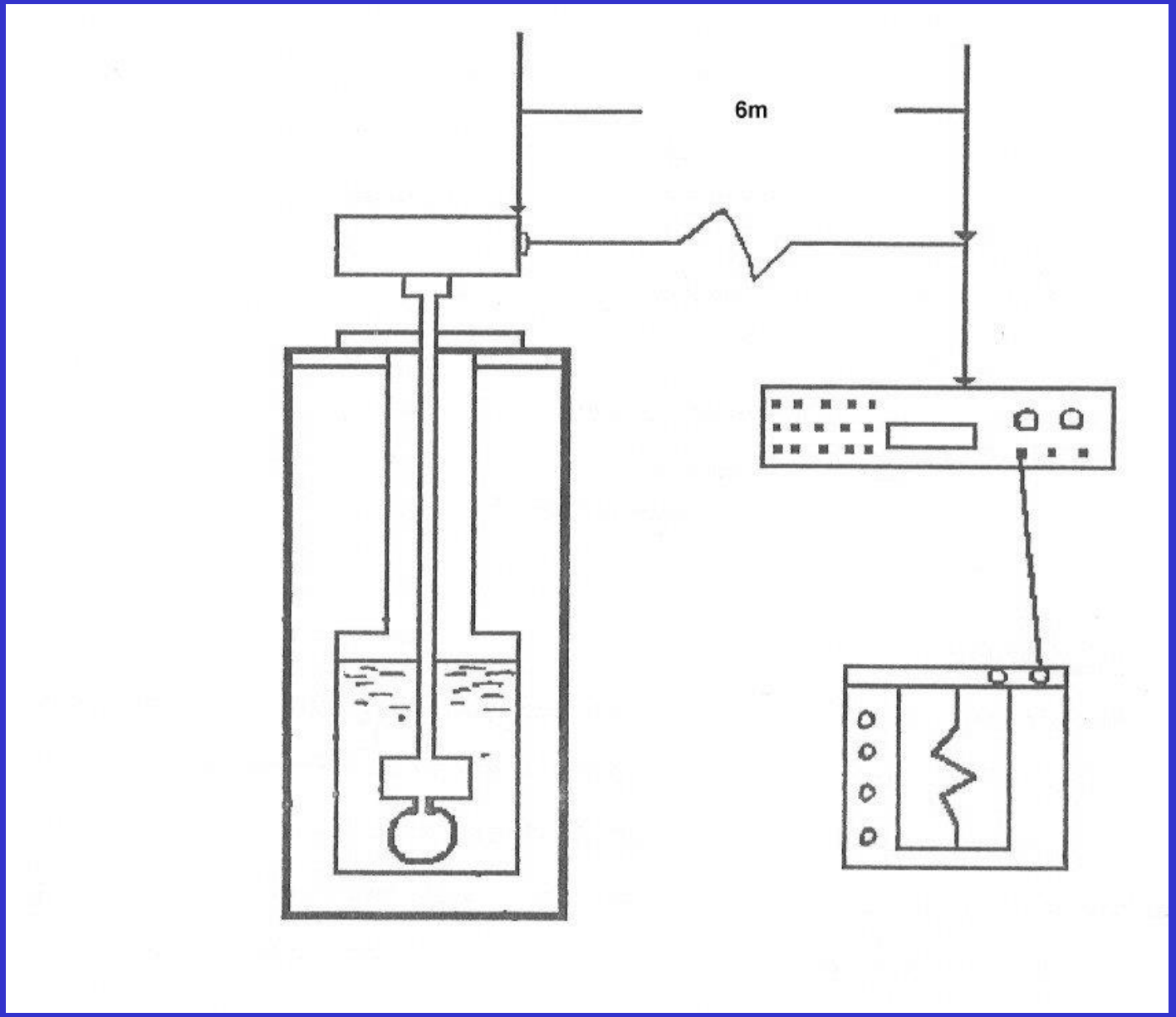
The most power magnetic fields achieved in the laboratory have magnitudes in the neighborhood of 100 T



The magnetic field produced at the nucleus of a hydrogen atom by the electron circling around it is about 14 T


Magnetic Fields
B (Teslas)
10^{-4}
10^{-5}
10^{-6}
10^{-7}
10^{-8}
10^{-9}
10^{-10}
10^{-11}
10^{-12}
10^{-13}
10^{-14}
10^{-15}
Earth's Field
Urban Noise
Lung Particles
Human Heart
Skeletal Muscles
Human Eye
Human Brain (α)
Human Brain (evoked response)
SQUID System Noise

Schematic Block of the SQUID



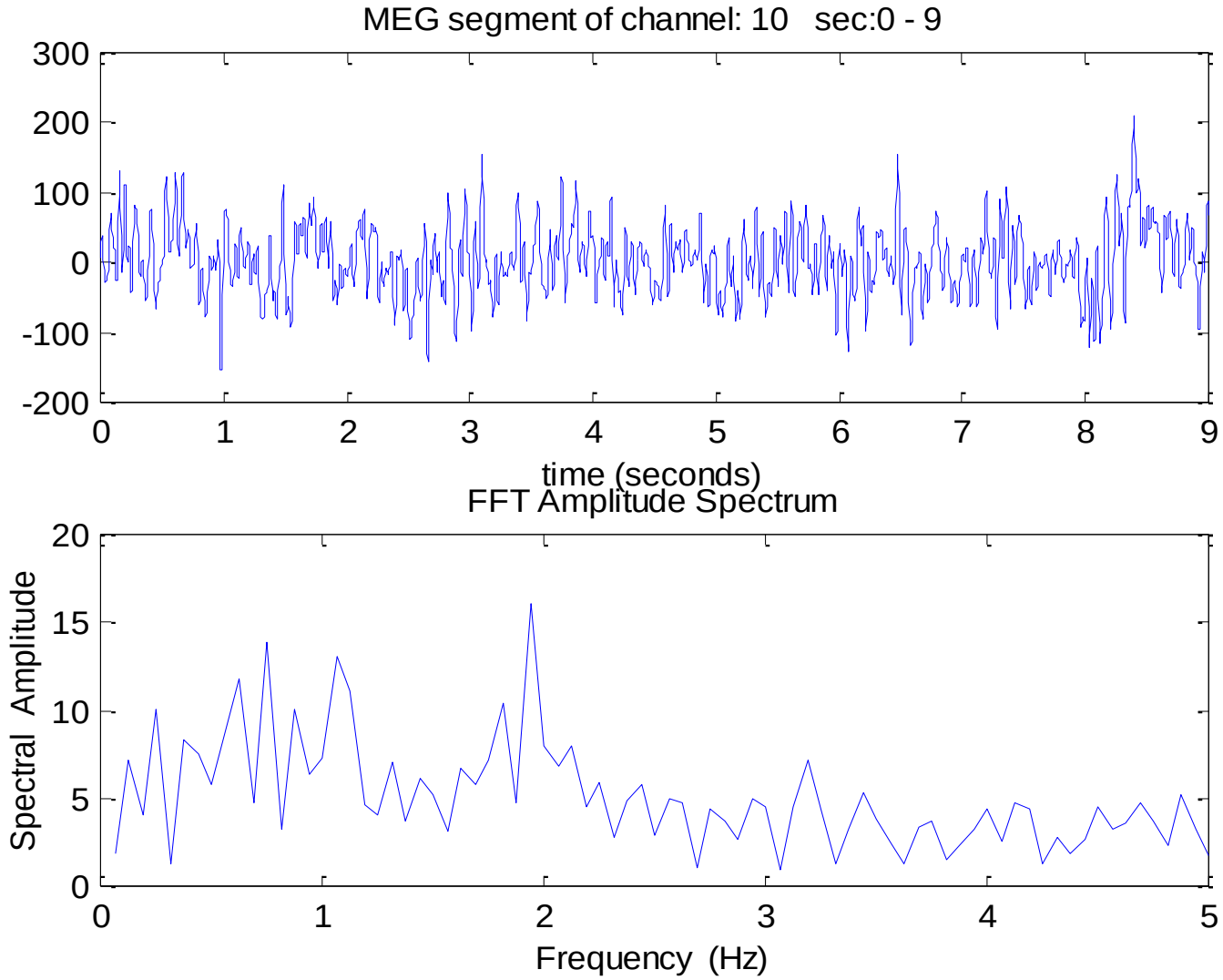
- The MEG is regarded as the most efficient method for recording brain activity in real time.
- The MEG has unique sensitivity to the CNS disorders and normal brain functions.
- The MEG offers functional mapping information and measurement of brain activity in real time, unlike CT, MRI and fMRI which only provide structural, anatomical and metabolic information.

- With the MEG the brain is seen in “action” rather than viewed as still image.
- Finally the MEG has the ability to resolve msec temporal activity which is associated with the information processing which is the main task of the brain.


Neuromag

- The MEG recordings were taken in an electromagnetically shielded room in order to avoid extraneous electromagnetic noise.
- The MEG recordings were obtained with sampling frequency of 256 Hz and filtered with cut-off frequencies of 0.3 and 40 Hz. The time taken for each MEG recording was 2 min to ensure alertness for each subject.

- A software program was developed in our lab to detect the first dominant frequency of all power spectra obtained from each patient after the application of the Fast Fourier Transform.



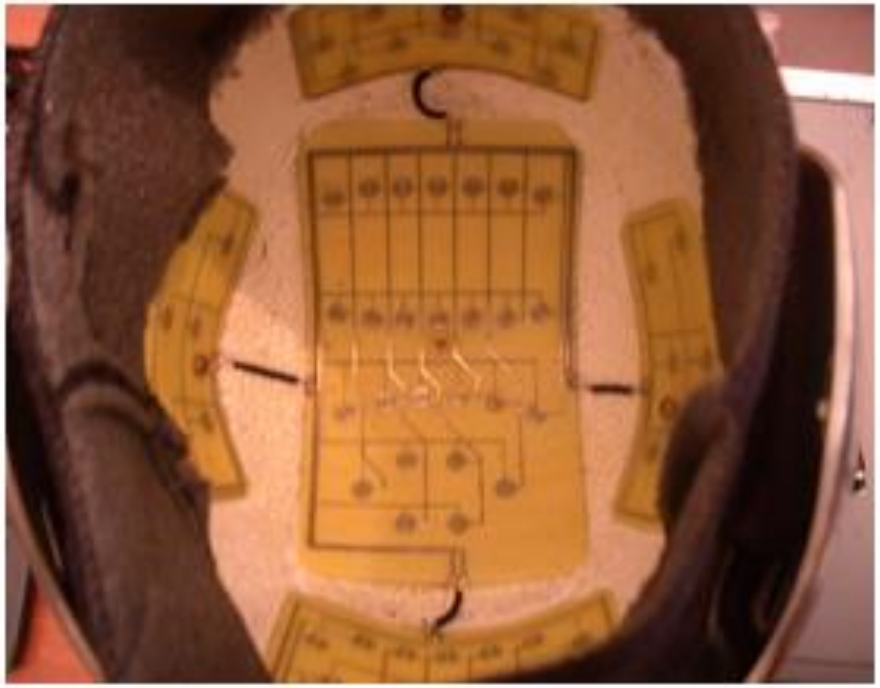
- A) An MEG record of 9 sec obtained from a patient from which B) after FFT analysis the primary dominant frequency is 2Hz.

THE USE OF AN ELECTRONIC DEVICE

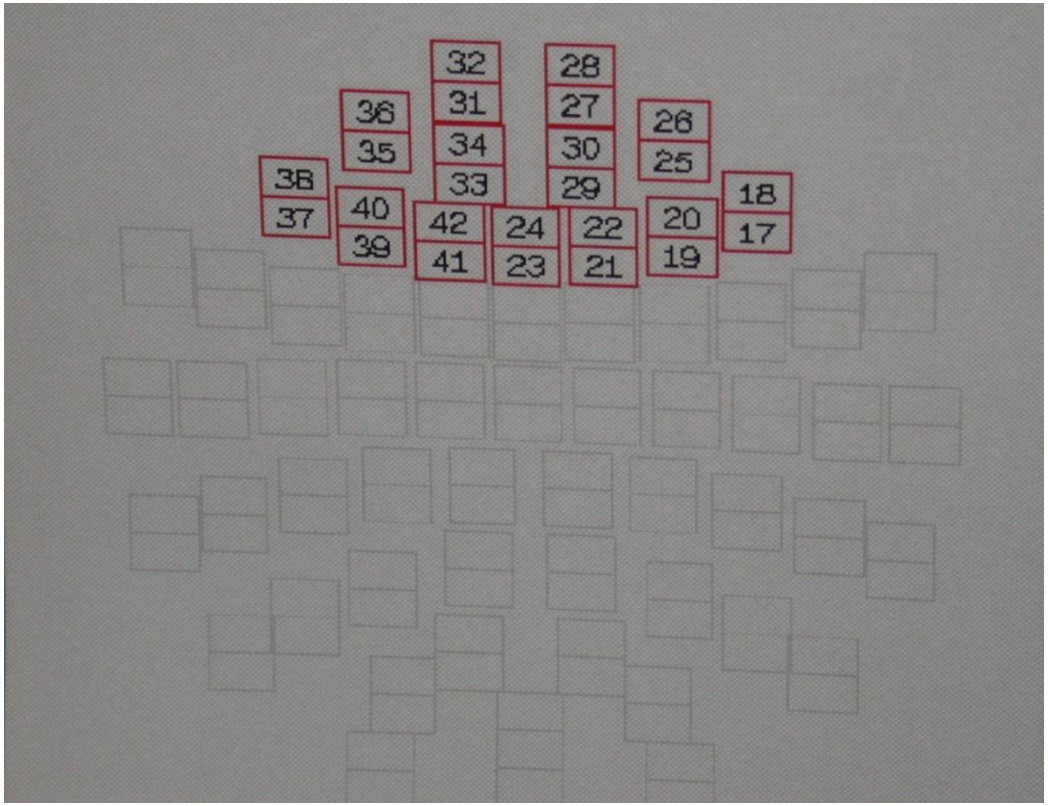
- The electronic device produces weak magnetic fields with proper characteristics: intensity 1-7.5 pT and frequency 8-13 Hz.


frequency programming
ON / OFF
program mode
out to helmet
low battery
time active
time setting
power on

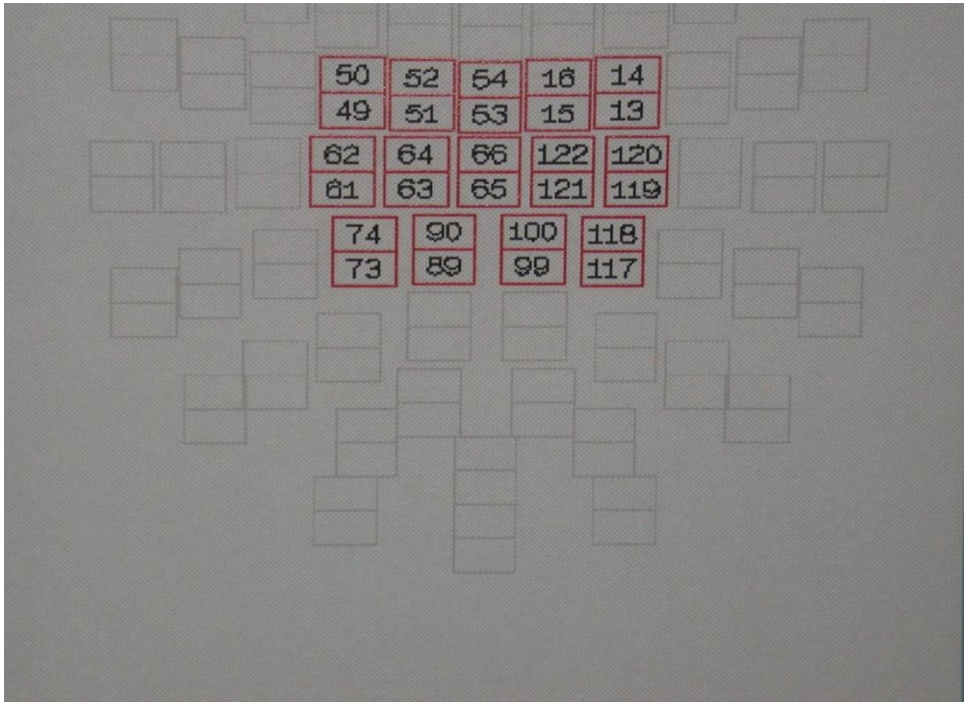
THE HELMET FOR THE DEVICE



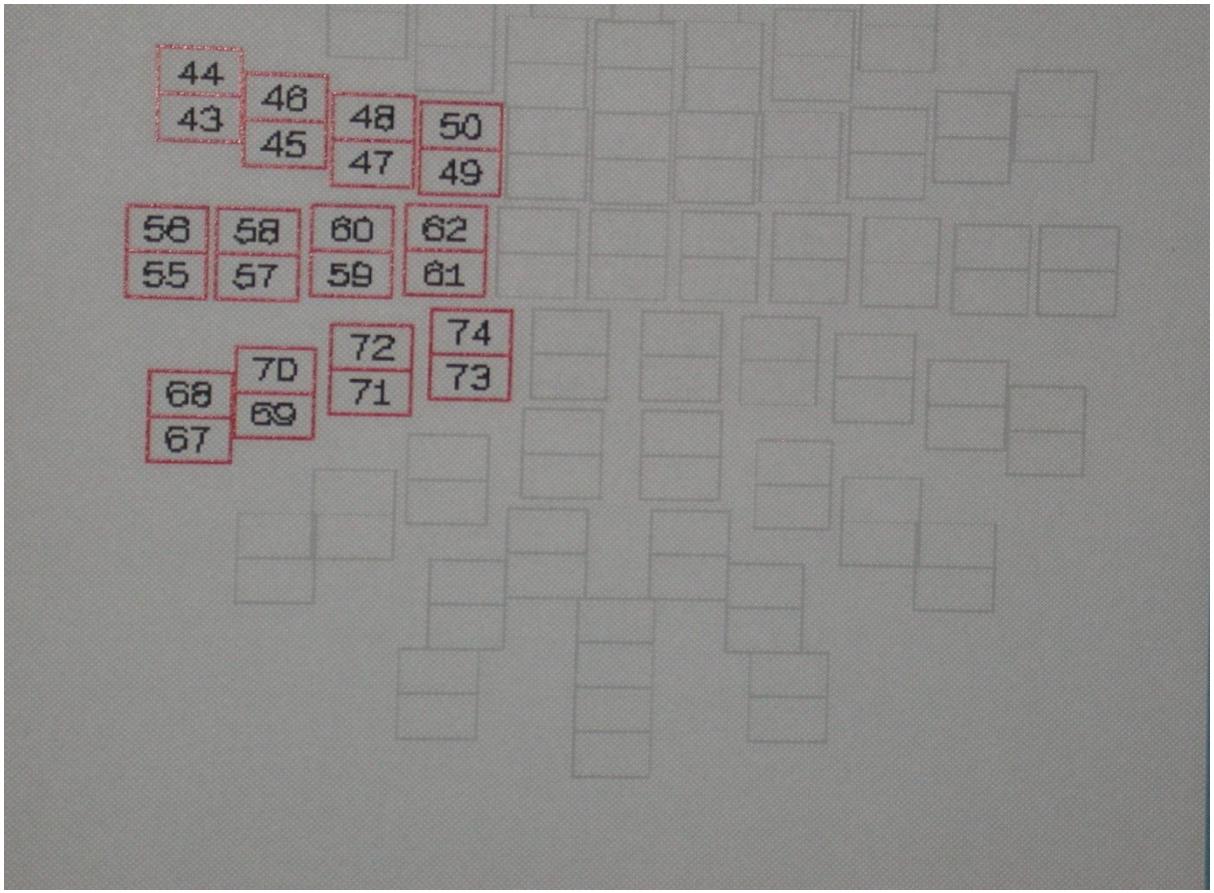
THE FRONTAL BRAIN CHANNELS



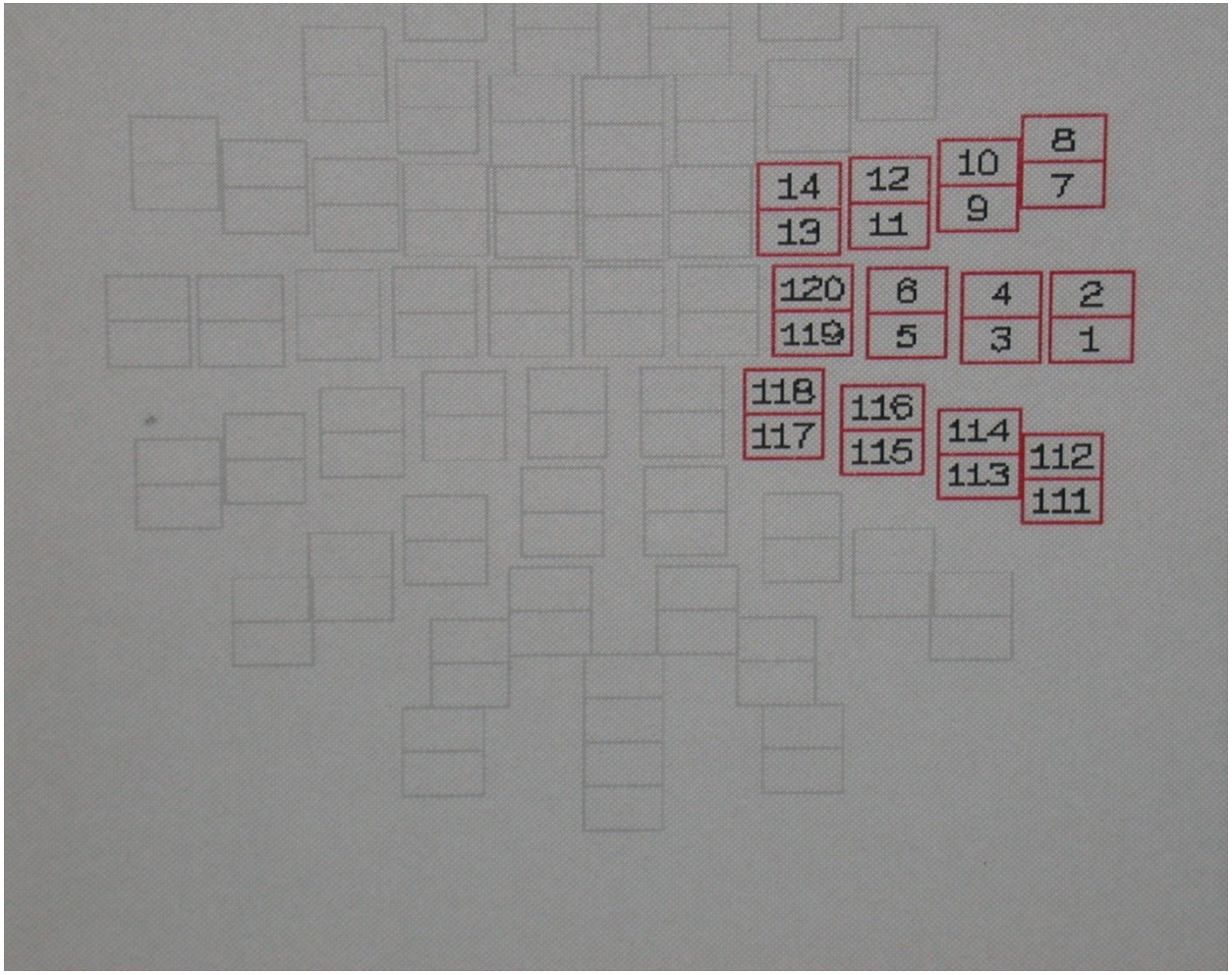
THE VERTEX BRAIN CHANNELS



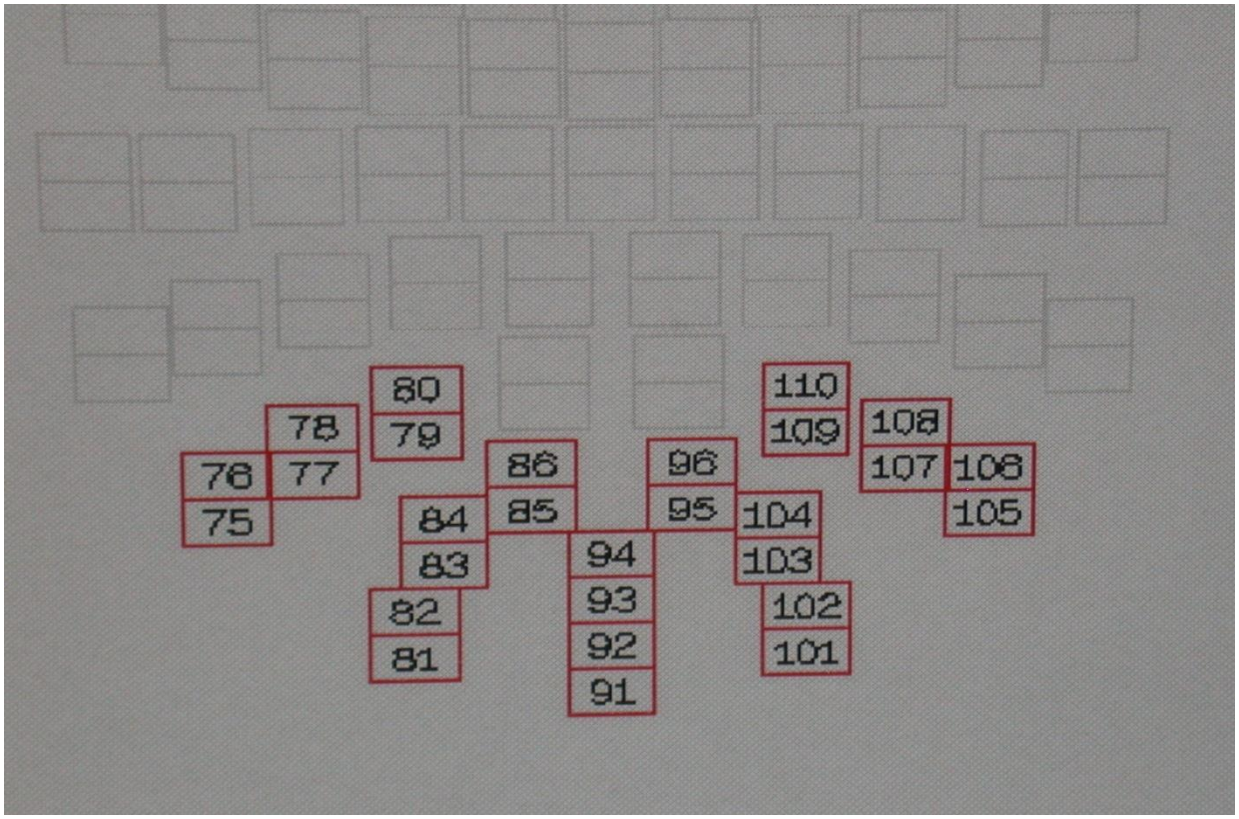
THE LEFT TEMPORAL BRAIN CHANNELS



THE RIGHT TEMPORAL BRAIN CHANNELS



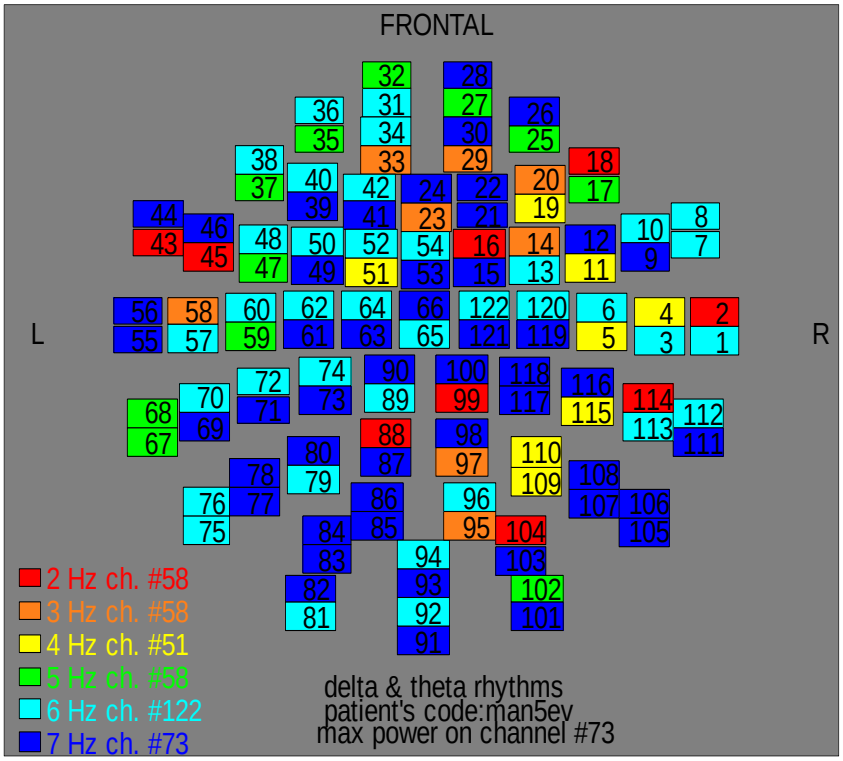
THE OCCIPITAL BRAIN CHANNELS



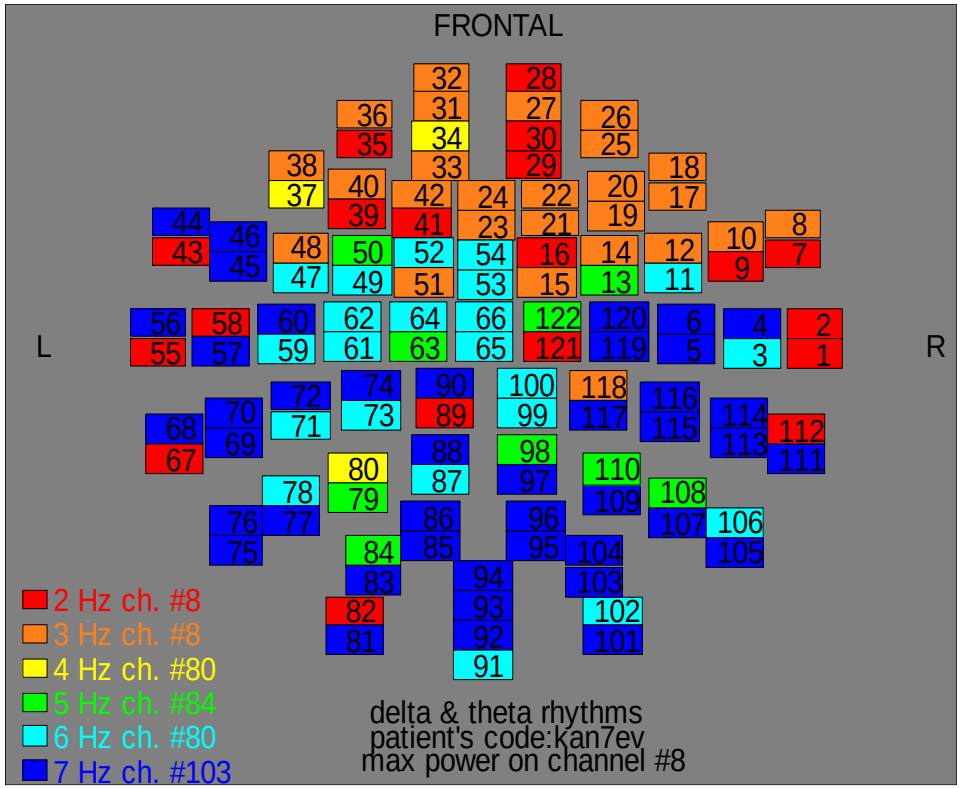

Caber

- Two dimension maps for the spatial distribution of the primary dominant frequencies were constructed over the scalp with different colors.

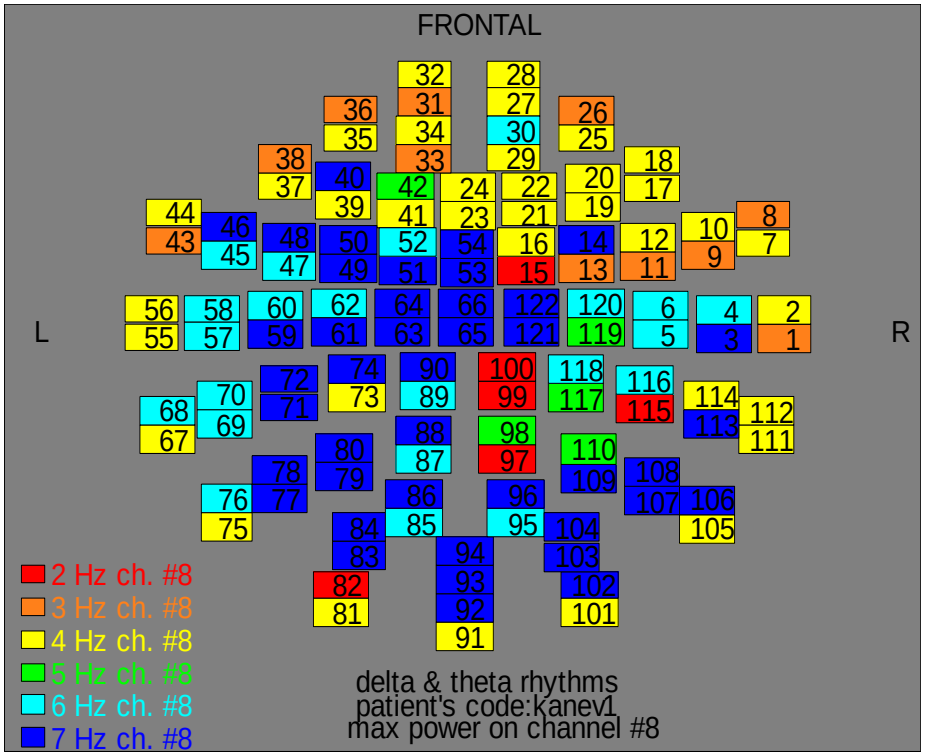
THE PRIMARY DOMINANT FREQUENCIES FROM THE BRAIN OF A NORMAL SUBJECT



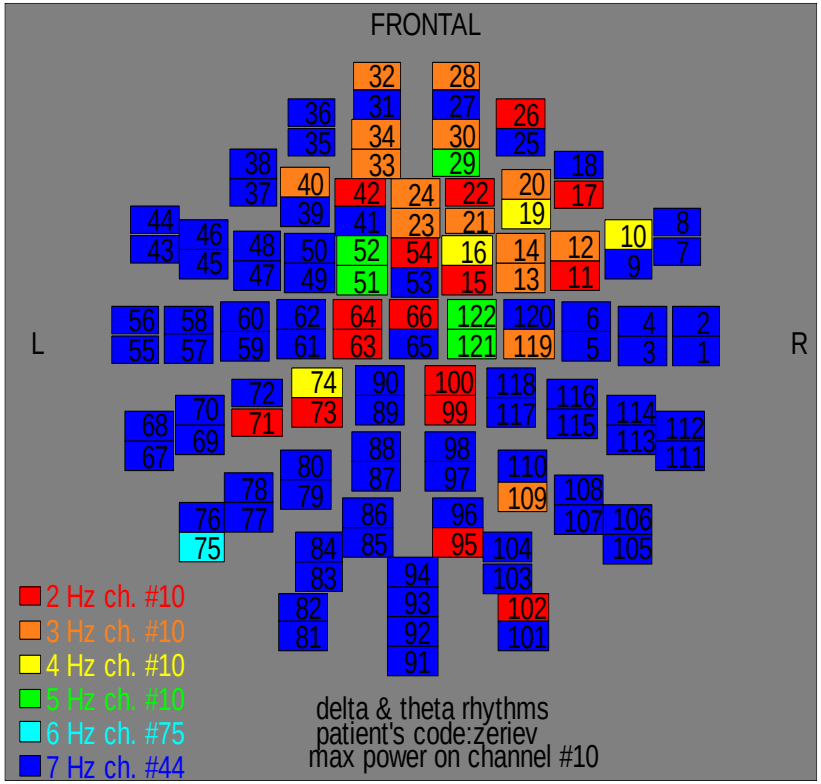
THE PRIMARY DOMINANT FREQUENCIES FROM THE BRAIN OF AN EPILEPTIC PATIENT BEFORE TMS



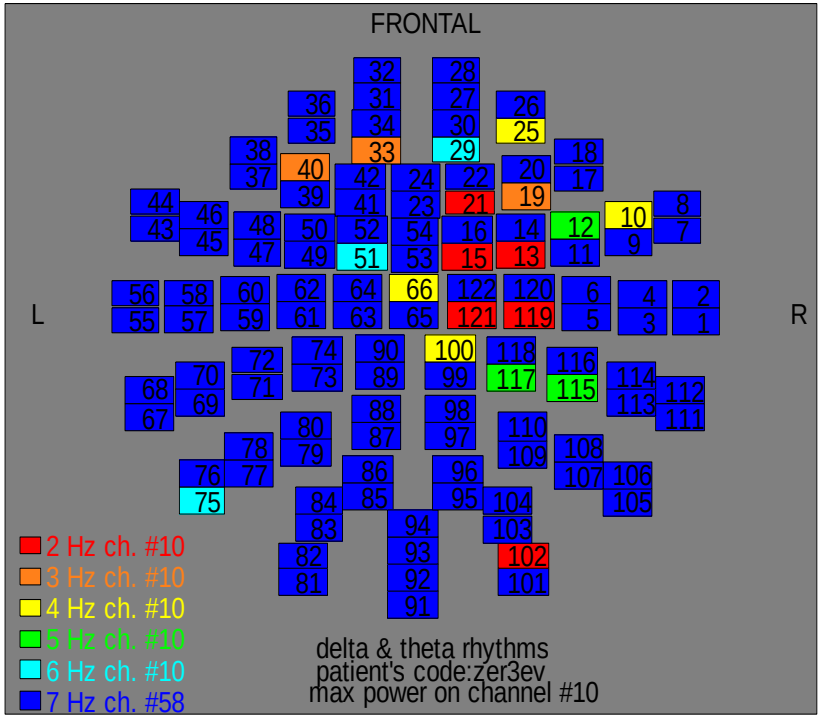
THE PRIMARY DOMINANT FREQUENCIES FROM THE BRAIN OF THE SAME EPILEPTIC PATIENT AFTER TMS



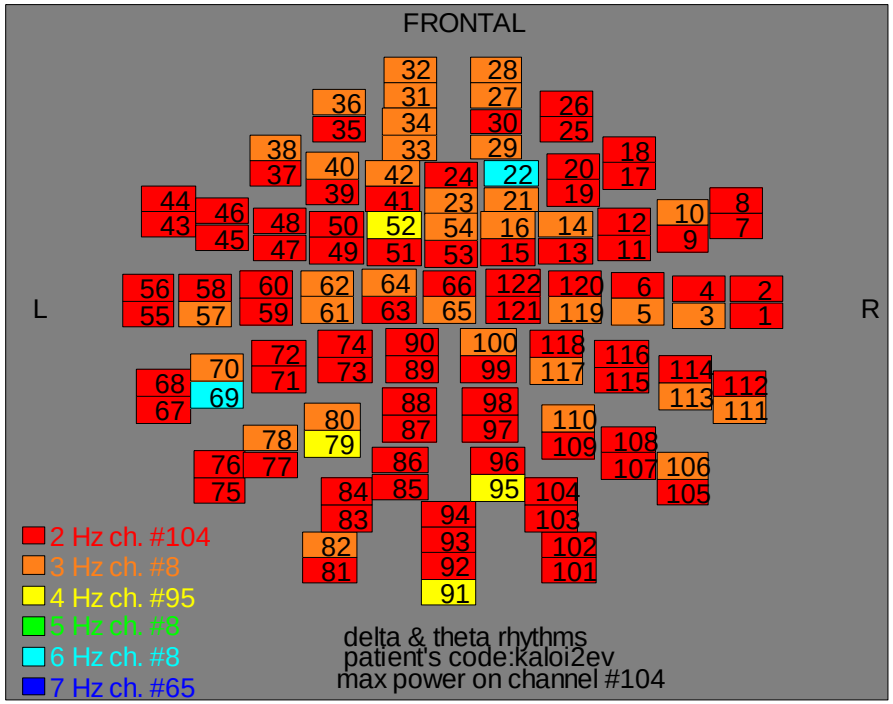
THE PRIMARY DOMINANT FREQUENCIES FROM THE BRAIN OF A PARKINSON PATIENT BEFORE TMS



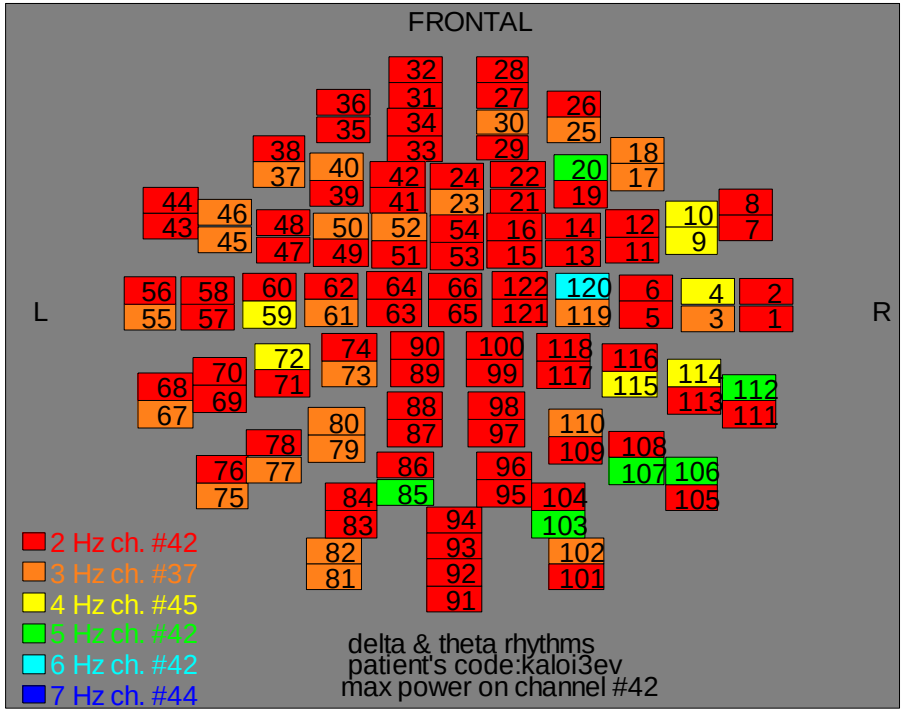
THE PRIMARY DOMINANT FREQUENCIES FROM THE BRAIN OF THE SAME PARKINSON PATIENT AFTER TMS



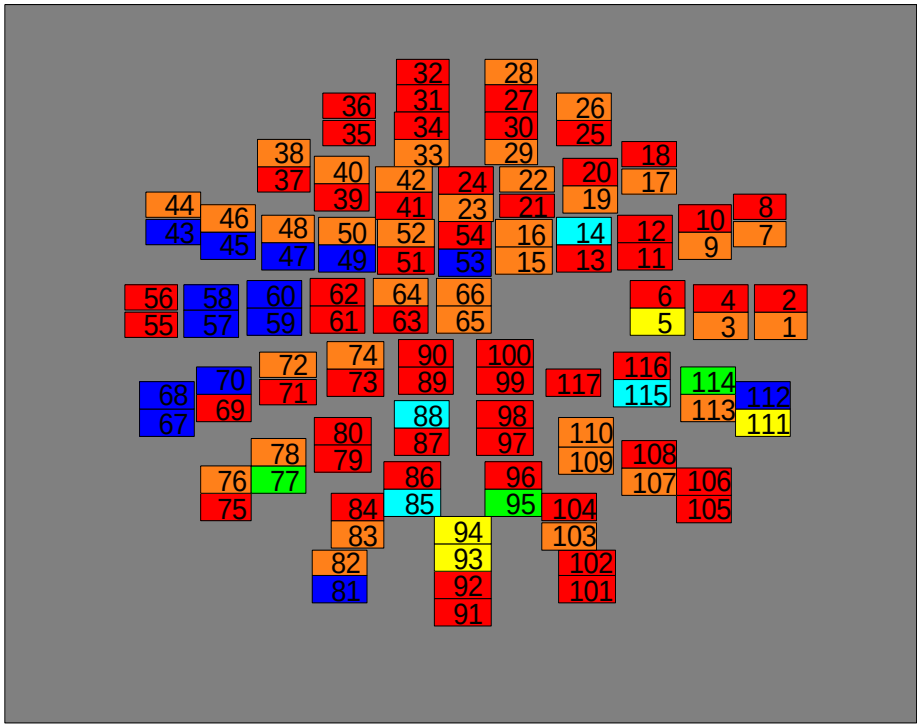
THE MEG MAP FROM AN AUTISTIC PATIENT BEFORE TMS



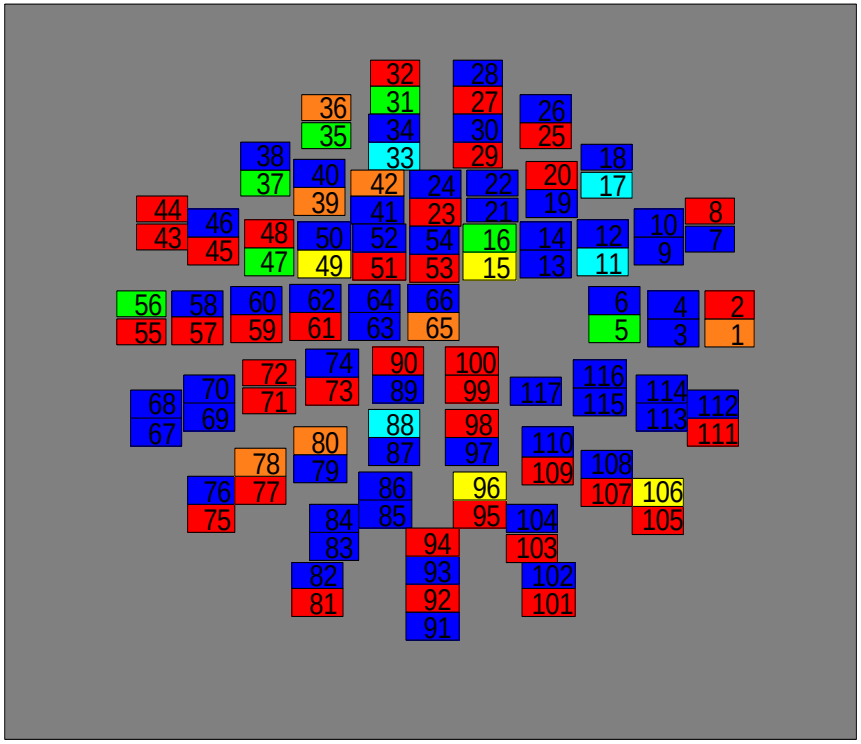
THE MEG MAP FROM THE SAME AUTISTIC PATIENT AFTER TMS



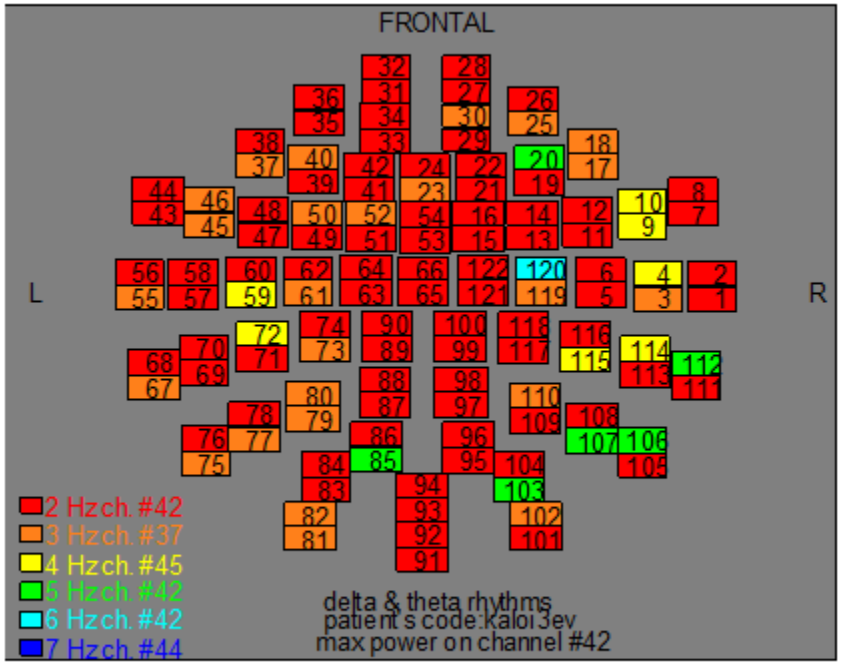
THE MEG MAP FROM A MIGRAINE PATIENT BEFORE TMS



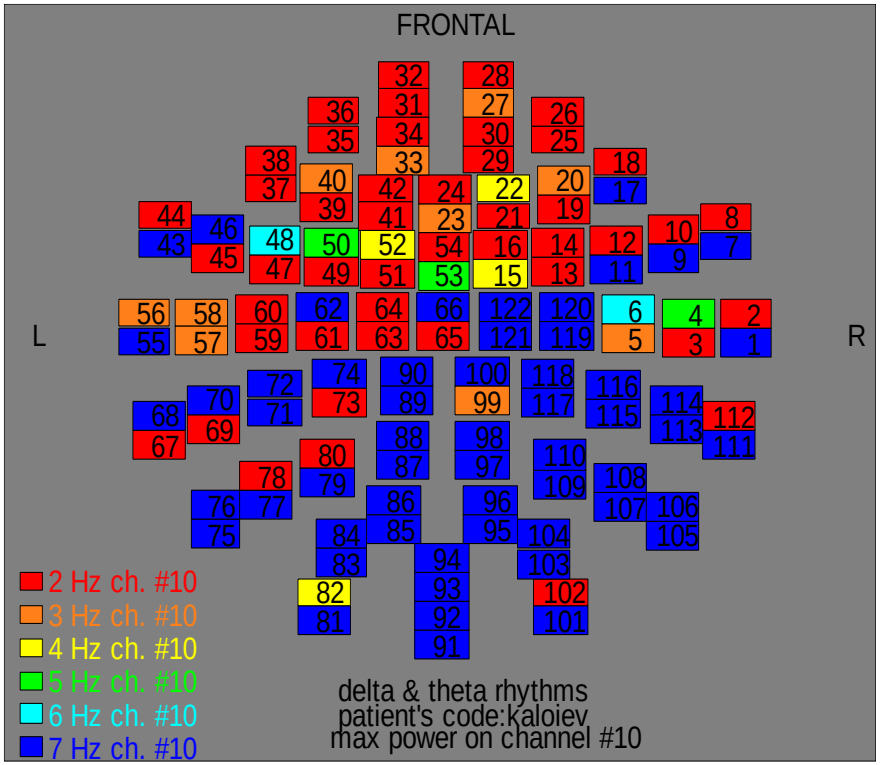
THE MEG MAP FOR THE SAME MIGRAINE PATIENT AFTER TMS



THE MEG MAP FOR A MS PATIENT BEFORE TMS



THE MEG MAP FOR THE SAME MS PATIENT AFTER TMS



- This beneficiary effect of the application of the TMS has been used by more and more scientists using transcranial and intracranial methodologies and have convinced that is proven to be a valuable tool for managing CNS disorders

- ONE POSSIBLE EXPLANATION OF OUR FINDINGS IS PROVIDED VIA THE PINEAL GLAND WHICH IS A MAGNETOSENSITIVE ORGAN OF OUR BRAIN

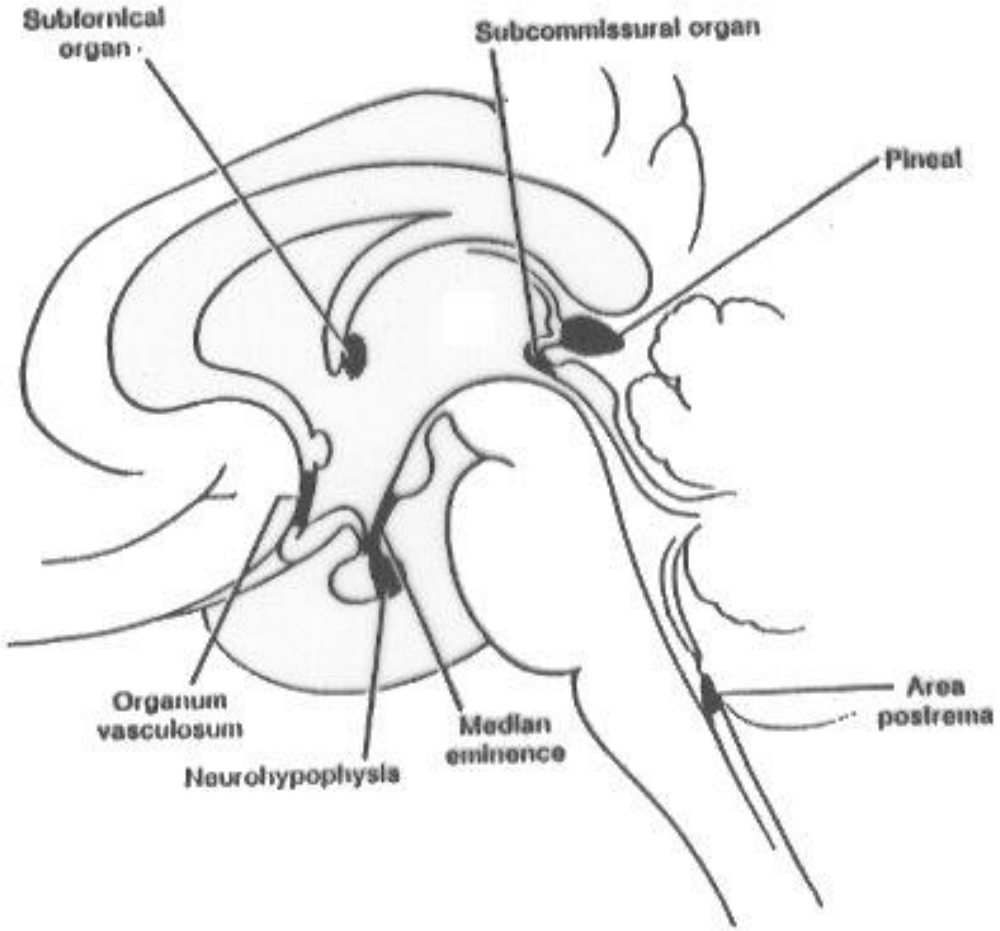
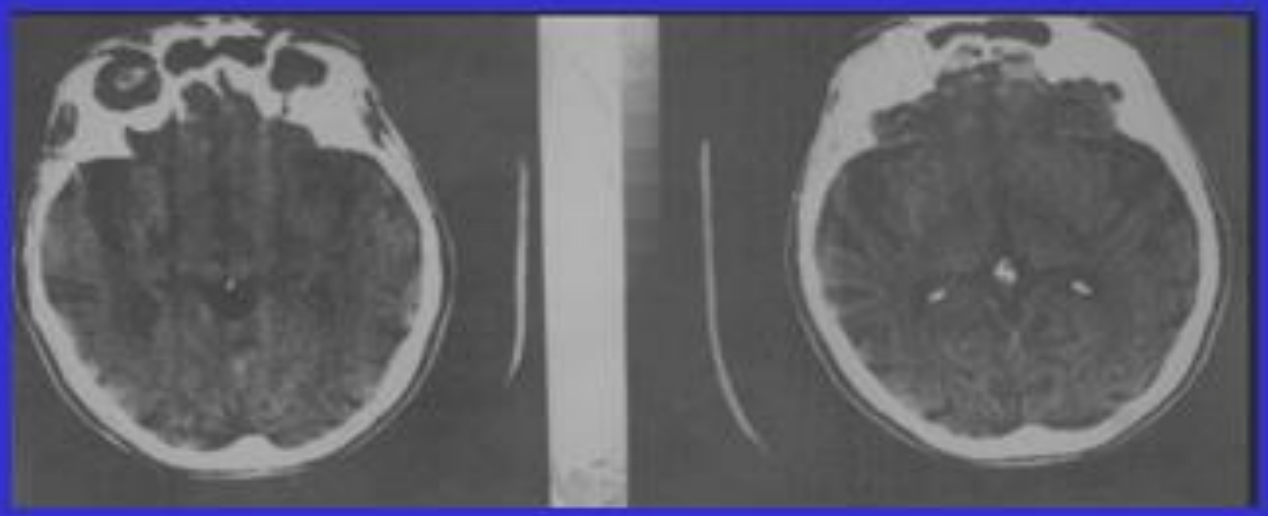


Figure 1-16. Drawing of a midsagittal section of the human brain indicating the locations of the circumventricular organs. All of these structures, except the *area postrema*, are unpaired, situated in the midline, and related to diencephalic structures. All, except the *subcommissural organ*, are highly vascularized and lack a blood-brain barrier. Neuropeptides have limited transport across the blood-brain barrier but can enter and leave the brain, via the CSF, in regions of the circumventricular organs. The *organum vasculosum of the lamina terminalis* (OVLT) resembles the median eminence but its function has not yet been clarified; this structure, particularly prominent in rodents, is also designated as the supraoptic crest. The *median eminence* serves as a neuroendocrine transducer and the final common pathway by which releasing hormones are discharged into the hypophysial portal system (modified from Weindl and Sofroniew, '81). (From Carpenter and Sutin, *Human Neuroanatomy*, 1983; courtesy of Williams & Wilkins.)

CRT



- The PG is involved in the circardian rhythms regulation, it is involved in the regulation of sleep and wake cycles, it is the stabilizer of our neural activity, it is the regulator of our immune system through its action on the thymus gland, it has also analgesic activities and antiepileptic activities. It has been an evidence that regulates calcium and phosphorus metabolism.

- It is also the neural endocrine transducer which transduces the information from the environment, mainly light and magnetic field, into our hormonal system releasing one important hormone the melatonin which is related to the growth, maturation, sexual development, aging and so on. It is also the scavenger of the free radicals responsible for many CNS disorders.

- TAKING THIS INTO ACCOUNT, THE ACTIVITY OF THIS GLAND MAY BE ONE OF THE CRUCIAL FACTORS WHICH DETERMINE AND CONTROL THE NEURAL ACTIVITY OF ALL THESE PATIENTS SUFFERING FROM CNS DISORDERS

- HOWEVER, THE QUESTION IS DIFFICULT TO BE ANSWERED GIVEN THE COMPLEXITY OF CELLULAR, SYSTEMIC AND NEUROENDOCRINE EFFECTS OF THE TMS ON BIOLOGICAL SYSTEMS AND THEIR POTENTIAL IMPACT ON NEUROTRANSMITTER FUNCTIONS.

- DESPITE ALL THESE FACTS, THE APPLICATION OF TMS MAY BE CONSIDERED AS A VERY IMPORTANT NONINVASIVE MODALITY IN MANAGEMENT OF IDIOPATHIC CNS DISORDERS.

THE LIGHTHOUSE OF ALEXANDROUPOLI