Elekta Neuromag® TRIUX
State-of-the-art Magnetoencephalography

The next level in functional mapping
The Path to the Future of MEG Starts Here

As the leader in MEG technology, Elekta is pleased to introduce Elekta Neuromag® TRIUX. The most advanced magnetoencephalography system available, Elekta Neuromag TRIUX takes functional brain mapping to the next level.

Magnetoencephalography (MEG) is rapidly becoming an indispensable brain imaging technology. Using sophisticated instrumentation, MEG detects the weak magnetic activity emanating from groups of neurons in the brain. Only MEG can precisely localize and record these millisecond phenomena that produce signals approximately a billion times smaller than the earth’s magnetic field.

Elekta Neuromag TRIUX is an increasingly vital tool for improving patient management in the evaluation of epilepsy as well as pre-surgical mapping of motor cortex, visual, auditory, somatosensory and language functional areas. Elekta Neuromag TRIUX also offers enormous capability when combined with MRI or fMRI. In these cases, MRI provides the anatomical or vascular information, while MEG provides direct neuronal activity information, be it healthy or pathological.

Unique MEG Benefits

Direct Measure of Brain Activity
Whereas imaging techniques such as fMRI, PET, and SPECT are secondary measures of brain function, MEG provides a direct measure of electrical activity in the brain.

High Temporal Resolution
Unlike most other neuroimaging technologies, Elekta Neuromag is capable of resolving millisecond events and fast oscillations.

Excellent Spatial Resolution and Accuracy
In contrast to EEG, MEG provides excellent spatial resolution and is capable of localizing sources with an accuracy of just millimeters.

Resolves Functional or Dysfunctional Spatiotemporal Networks
Elekta Neuromag TRIUX is uniquely able to determine the spatiotemporal networks involved in epilepsy, stroke, traumatic brain injury (TBI), cognitive impairment (Alzheimer’s disease or dementia), and several other brain disorders. Of these applications, epilepsy is the only approved clinical indication for MEG. The others are currently clinical research applications.

Completely Non-invasive
MEG does not require injection of radioactive material, exposure to X-rays, or magnetic fields. It is completely silent. Therefore, even children, infants, and pregnant women can be studied repeatedly, completely without risk and in relative comfort.

Why Elekta Neuromag® TRIUX?

- Resilient performance even with high-level environmental interference
- Easy to find a suitable site, even in harsh magnetic environments
- Easy to operate
- Comfortable for the patient or subject
- Solid foundation for future upgrades

Elekta Neuromag TRIUX – the definitive platform for launching MEG programs, now and in the future.
Functional Mapping with MEG

Elekta Neuromag® TRIUX is particularly effective in the non-invasive, pre-surgical localization of epileptic foci among epilepsy patients, as well as in the functional mapping of sensory, cortical and autonomic responses. Furthermore, MEG users continue to make breakthroughs in brain research. MEG is finding a role in the detection and diagnosis of psychiatric, developmental and neurodegenerative disorders. It can also help to reveal biomarkers for disease states or treatment responses, and promote a better understanding of the mechanisms leading to these conditions.

Detection of Epileptic Activity for Pre-surgical Evaluation of Patients with Intractable Epilepsy and Other Seizure Disorders

MEG provides a non-invasive method to accurately pinpoint seizure origins by measuring interictal (between seizure) spikes. MEG can also be used to tailor the placement of intracranial electrodes.

Presurgical Functional Mapping (PSFM) to Localize Sensory or Motor Function

MEG enables the delineation of both normally and abnormally functioning regions of the brain to help clinicians remove only abnormal tissue during resections. This is crucial in the cortical regions, particularly when pathological tissues are indistinguishable using other methods.

Using Language Lateralization as an Alternative to the Wada Test

Language and memory functions may reside in either or both brain hemispheres, thus determining laterality is crucial before resective surgery in order to avoid damaging speech centers and memory. While the intracarotid amobarbital (Wada) test has long been standard, the procedure is quite invasive and often followed by complications. Elekta Neuromag® TRIUX provides direct, non-invasive measurement with excellent temporal resolution.

Researchers continue to use MEG to provide new insights into the neural basis of developmental disorders such as autism and dyslexia, as well as psychiatric diseases including depression, bipolar disorder and schizophrenia. Neurodegenerative diseases such as Alzheimer’s are also increasingly studied. Additional applications include:

- The basis of language itself, a uniquely human capacity in which rapid neural processes are not well resolved by fMRI or other neuroimaging technologies
- Brain responses in children and newborns
- Brain activity patterns that might serve as biomarkers for a host of disorders
- Neural effects of educational interventions in areas such as reading or musical development
- Memory, intelligence, thought and emotion
- Development of reading and the remediation of dyslexia
- Neural basis of attention in humans
- Neural basis of perception, especially the neural correlates of tactile perception
- Acceleration of perceptual training in combination with EEG
- Age-related changes in cognition
- Social cognition, and the study of how different individuals process socially significant cues such as faces
- Developing computational models for the probabilistic interpretation of complex visual scenes

Clinical Applications

Now in the clinical mainstream, an increasing number of hospitals use MEG for a variety of applications. Many healthcare policies and programs routinely cover MEG examinations. Common clinical applications include:

Research Applications
Workflow

In clinical applications, MEG scans are typically performed as outpatient procedures. The examination is totally non-invasive and painless. Patient preparation is relatively simple, and the examination is generally well tolerated.

Preparation
Metal disturbs MEG measurements (but is not dangerous, as with MRI), so patients should first remove any metallic objects. Most dental work is small enough so as not to cause magnetic disturbances.

Positioning Coils
The patient is fitted with a set of head-positioning coils. These are small and are painlessly affixed with tape. The location of the coils with respect to anatomical landmarks on the head is then determined with a three-dimensional digitizer. This enables precise alignment of the MEG coordinates with the anatomy provided by separate MRI images.

Shielded Room
Next, the patient will be brought to the system. All MEG studies are performed inside a shielded room that is engineered to keep out magnetic interference from the environment. The patient slides his/her head into the helmet of the device. Vision is not restricted and the environment is not claustrophobic. Most subjects, even children, tolerate the exam very well.

Performing the Scan
The actual scanning process can take as little as a few minutes or up to several hours, depending on the procedure and task. During scans, patients will be asked to remain still and minimize eye-movement, muscular clenching or other unnecessary motion.

Data Analysis
After acquisition, MEG data is processed in the software and analyzed by a trained medical professional. From the recorded signals, it is determined where in the brain the activities originated. These locations are then combined with an MRI showing the brain’s structure.
Core Technology

MEG is based on the ability to detect very weak magnetic fields that originate from electrical activity within the brain. These signals are detected with an array of devices known as Superconducting Quantum Interference Devices (SQUIDs) that are placed close to the scalp. SQUIDs can detect tiny magnetic signals, much less than one-billionth the strength of the Earth’s magnetic field, and then convert these into recordable electric voltages. SQUIDs are used in combination with superconducting pickup coils, which act like antennae. When a magnetic signal from the brain traverse the coil, it induces current that is then measured by the SQUID. The SQUID array is mounted in a close-fitting helmet and is cooled with liquid helium.

Neuronal signals may be events lasting from about a millisecond for an action potential, tens to hundreds of milliseconds for postsynaptic potentials or even multiple seconds for modulation of brain rhythms. Only magnetoencephalography covers this entire range of frequencies without the inaccuracies of EEG.

Elekta Neuromag® TRIUX has 306 individual channels and represents the state-of-the-art in sensor design. This, combined with increasingly sophisticated magnetic shielding, interference suppression and analytical methods, leads to constant improvements in spatial resolution and data richness.

Highlights

**Improved Resilience**
The MEG electronics of Elekta Neuromag TRIUX have been overhauled to improve resilience of the system to magnetic interference. The dynamic range of the system has also been increased to ±20 nT to better maintain the magnetometer sensors within their operating range.

**Improved Interference Suppression**
The system is equipped with improved spatiotemporal signal separation - the most effective noise cancellation technology available.

**Increased Number of Analog Channels**
The built-in EEG amplifier of Elekta Neuromag TRIUX has been redesigned and now features 32, 64, or 128 unipolar channels. The system is equipped with 12 bipolar analog channels and 12 auxiliary analog channels.

**Additional Head-position Channels**
Elekta Neuromag TRIUX features hardware support for 12 head-position coils. The additional coils permit improvements in the robustness and accuracy of head-position tracking.

**Improved Comfort and Usability**
The gantry of the Elekta Neuromag TRIUX has been redesigned to further improve ergonomics. The gantry now has an additional, more upright measurement position for improved field of view and comfort.

**Increased Automation**
Several previously manual steps in data acquisition have been automated for convenience and to reduce the chance of operator error.
Sensors
Elekta Neuromag® TRIUX employs thin-film sensors of two different types integrated on 102 sensor elements. Each is equipped with three independent sensors with different sensitivity patterns. Each sensor element contains a magnetometer that measures the normal field component. These sensors are highly attuned to all signals, whether from deep or superficial sources - regardless of orientation. Each sensor element also provides two orthogonal planar gradiometer sensors for measuring the gradient components. These sensors are highly immune to environmental interference. The primary advantage of this triple-sensor design is that it provides a combination of three unique and mutually independent measurements instead of oversampling the same information as would be the case with an axial gradiometer or magnetometer-only system.

The lead fields of the three channels incorporated in each sensor element are orthogonal to one other. The signal in any of the three channels cannot be predicted from the signals of the other two. Conversely, adjacent axial gradiometers view the neural current distribution from nearly the same direction and are less independent.

Service
Elekta Services extend well beyond standard maintenance and support. The Elekta Neuromag TRIUX team is committed to optimizing the entire continuum of care, from improving clinical effectiveness to building staff competence and smoothing patient flow.

Education and Training
Elekta offers training programs, world-wide, to ensure confidence in the use of new equipment. These programs are adapted to individual customer needs, from basic research to advanced clinical applications.

Programs are divided into two parts. The first session takes place at an Elekta Neuromag® training center. The second session is arranged at the customer site, after the final installation and acceptance of equipment. Both sessions consist of lectures as well as hands-on experience. Elekta works closely with all Elekta Neuromag TRIUX users, to better understand their needs and learn from their findings. These exchanges often lead to valuable insights for the development of new innovations in MEG.
A human care company, Elekta pioneers significant innovations and clinical solutions for treating cancer and brain disorders. Elekta provides intelligent and resource-efficient technologies that improve, prolong and save patient lives. We go beyond collaboration, seeking long-term relationships built on trust with a shared vision, offering confidence to healthcare providers and their patients.