

Specialty area: Multidisciplinary Neuroradiology, part 2

Speaker: Louis Lemieux, University College London l.lemieux@ucl.ac.uk

Highlights:

- Networks are a central concept in Epilepsy; at the whole-brain level, they are more accurate than the focus model in many patients;
- Advances in multimodal imaging allow improved identification of the regions involved in seizure generation and propagation and their interrelationships, and can provide important information for surgical treatment;
- The nature of epileptogenic networks and biophysics of epileptic generators remain to be fully elucidated, with important implications for diagnosis and treatment.

Talk title: “Epilepsy – a Physicist’s Outlook”

Target audience: Neuroradiologists, Neurologists, MR physicists, Biomedical engineers, Neuroscientists, MR technicians, Physicists

Outcome/Objectives: The audience will be able to better understand the role of Physics in many aspects of Epileptology, from the neuronal level up to the diagnosis (localisation) and treatment of epilepsy

Purpose: To review important concepts on the nature of epileptogenic networks, the biophysics of seizure generation and propagation, in the context of improved (multimodal) imaging and characterisation of structural and brain activity connectivity and the mapping of brain networks involved during epileptic activity over the whole brain.

Methods: We will illustrate important developments in the field of epilepsy with a particularly important input from the physical sciences. These will include recent work on the mapping of epileptic networks and the characterisation of connectivity in the resting state, during and between seizures using mainly functional MRI but also with reference to electrophysiological techniques, and advances in diffusion-weighted imaging and tractography. Ongoing research into models of effective connectivity in epileptic networks and the basic biophysics of epileptogenic regions will be presented, as motivation for future developments in network mapping with implications for the treatment of seizures.

Discussion: Because of its manifestation as paroxysmal events (namely seizures) epilepsy is often described as a (or THE) network disorder, with numerous underlying causes that can all lead to disruption of brain networks at one spatial scale or another. Beyond its fundamental role in MR imaging, applied physics can and should play a fundamental role in improving our understanding of Epilepsy and devise new diagnostic and therapeutic approaches.