Talk Titles and Abstracts – Monday 9 January

14.30-14.50: **Isabella Marinelli** (University of Birmingham)

Talk Title: Investigating candidate mechanisms underlying circadian distributions of epileptiform activity: a mathematical approach

Abstract: Recent research has provided compelling evidence that epileptiform discharges (including both ictal activity and interictal epileptiform activity) show a temporal organization over periods ranging from hours and days through months. Despite these observational studies, at present relatively little is known about the physiological mechanisms that underline these patterns.

To determine patterns of ultradian and circadian variation we analysed epileptiform discharge distributions derived from 24-hour EEG recordings from a cohort of 107 people with idiopathic generalized epilepsy, finding two dominant subgroups with distinct distributions of epileptiform discharges.

To explore possible physiological contributors to these distinct variations in seizure likelihood, we developed a mathematical model (so-called dynamic brain network) that describes the transitions between background activity and seizure-like states in large-scale brain networks. The model included a time-dependent forcing term to simulate the impact of possible physiological factors on the excitability of the dynamic brain network. Parameters of the model were informed using: the distributions of epileptiform discharges (from EEG), sleep-stages (from EEG), and hormone dynamics (from blood samples).

We found that sleep accounted for the majority of observed variability in one group, whereas the dynamic variation in cycling hormone levels accounted for the majority of observed variability in the second group. We further found that combining both measures improved the explained variability in the first group, whereas it did not in the second group.
Our findings provide conceptual evidence for the presence of underlying physiological drivers of rhythms of epileptiform discharges. We propose that future research should explore these mechanisms in carefully designed experiments using animal or human models.

14.50-15.10: **Jemima Tabeart** (University of Oxford)

Talk Title: Numerical linear algebra for weather forecasting

Abstract: TBC

15.10-15.30: **Layla Sadeghi Namaghi** (Cardiff University)

Talk Title: Least squares PGD methods for solving elliptic PDEs

Abstract: The Proper Generalised Decomposition (PGD) is a numerical method for solving differential equations based on a dynamic construction of the basis functions. This is achieved by computing a separated series approximation of the solution using successive enrichments of the basis. The PGD algorithm is combined with least-squares methods, where the approximate solution is defined to be the minimizer of an appropriate least-squares functional. The minimisation problem is solved directly rather than the mathematically equivalent Euler-Lagrange equations. An optimal least-squares formulation that satisfies ADN theory is used. The discretization is based on the spectral element method which combines the generality of finite element methods with the accuracy of spectral methods, allowing us to obtain approximations that are extremely accurate due to the use of high-order basis functions. Numerical results are presented for elliptic systems which demonstrate the efficiency and accuracy of this approach.