Title: Biophysics: Dynamics across Scales

Abstract:
Not just for humans life is eventful and full of dynamics. Look at any dictionary and one of the descriptions of 'lively' will be something like: bustling with activity, astir. The dazzling multiscale dynamics of living systems is one of the striking features that sets them apart from inanimate matter. This session will explore how different modes of movement contribute to the dynamics and organization of living systems. Laura Filion will introduce active colloidal particles as a non-biological model system to explore the out-of-equilibrium dynamics of active particles. Harold MacGillavry will demonstrate how the dynamics of individual molecules in neurons contribute to brain functioning and can be observed and analyzed using advanced microscopy. Allessandra Cambi will discuss the molecular machinery that enables individual cells to move in order to repair wounds or organize into specialized tissue. Finally, Florian Muijres will discuss the biomechanics and aerodynamics of flapping wing flights in birds, bats and insects.

Convener: Lukas Kapitein (UU)

Speakers (in order of appearance)

Laura Filion (UU)
Title: The self-assembly of model systems of active colloidal particles
Abstract: "Active" particles continuously convert energy from their local environment into directed motion, and as such are inherently out-of-equilibrium. While traditionally such particles occurred solely within the realm of "natural systems" (e.g. bacteria, transport inside a cell), recent experimental breakthroughs in the synthesis of colloidal particles have led to many novel types of artificial colloidal swimmers. Similar to their passive counterparts, these systems can self-assemble into a wide variety of phases. In this talk I will use computer simulations to explore the intriguing self-assembly of perhaps the simplest such system, namely active repulsive Brownian particles.

Harold MacGillavry (UU)
Title: Mapping the dynamic organization of the neuronal plasma membrane
Abstract: Neurons communicate via highly specialized contact sites, called synapses, that are essential for brain functioning. At synaptic sites, neurotransmitter receptors are concentrated in small, dynamic domains to efficiently respond to neurotransmitters released from contacting neurons. Because these small-sized membrane domains cannot be readily resolved by conventional light microscopy techniques, we use advanced fluorescence-based microscopy techniques, and single-molecule tracking methods, that enable the study of membrane organization at synapses at high temporal and spatial resolution. The aim is to understand how receptor complexes are spatially organized in the synaptic membrane to sustain efficient neuronal communication in the brain.

Alessandra Cambi (RUN)
Title: How cells drill their way in our body
Abstract: In every living organisms, cell motility is crucial to support life. Embryonic development, wound healing and immune responses rely on cell motility. When dysregulated, cell motility can lead to cancer. The molecular mechanisms by which cells move are an area

of intense investigation. This lecture will provide a nanoscale view on the cellular structures used by cells to cross tissue boundaries in patho-physiological processes.

Florian Muijres (WUR)
Title: The aerodynamics of flapping wing flight in birds, bats and insects
Abstract: Flying animal flap their wings to generate aerodynamic lift and thrust. This flight style is very different from that of conventional human-made flying devices that often have separate systems for lift and thrust production. The use of flapping wings for aerodynamic force production has many benefits. It enables flying animals to use unsteady aerodynamic mechanisms, such as leading-edge vortices, to boost and control aerodynamic forces produced by the beating wings. As a result, flapping flight enables flying animals to operate efficiently within a wide range of flight speeds, from hovering flight to fast forward cruising flight. And it makes natural flyers extremely manoeuvrable, because small adjustments in the wingbeat pattern leads to large changes in the production of aerodynamic forces and torques. In my talk I will discuss the biomechanics and aerodynamics of flapping flight in birds, bats and insects, and how these animals adjust their wingbeat kinematics to precisely control aerodynamic force production.