

**Mercredi 10 janvier 2018 à 14h (IAS, bâtiment 121, salle 1-2-3)**

## **Structural Complexity and Dynamics of the Megaparsec Universe**

**R. van de Weygaert (Kapteyn Institute/Groningen)**

The Cosmic Web is the fundamental spatial organization of matter in the Universe on scales of a few up to a hundred Megaparsec, scales at which the Universe still resides in a state of moderate dynamical evolution. Galaxies, intergalactic gas and dark matter exist in a wispy weblike spatial arrangement consisting of dense compact clusters, elongated filaments, and sheetlike walls, amidst large near-empty void regions. The weblike pattern is marked by prominent anisotropic features, a distinct multiscale character, a complex spatial connectivity of its various morphological components and a clear asymmetry between voids and overdense regions.

This seminar will describe recent work on the structure and dynamics of the Cosmic Web. For the analysis of its complex and multiscale structural pattern, we invoke concepts from computational topology and computational geometry. We apply the explicit multi-scale -- parameter-free and scale-free -- Nexus/MMF Multiscale Morphology formalism to dissect the cosmic mass distribution into clusters, filaments, walls and voids. This results in a systematic study of the evolving size and volume distribution of these structural components. Subsequently, we assess the mass and halo distribution in the filaments and walls, and follow their evolution.

To study the dynamical evolution of the cosmic web, we describe our adhesion model of cosmic structure formation based on Voronoi and Delaunay tessellations. Subsequently, we will shortly describe how a full phase-space analysis allows us to understand the growth of structural complexity in terms of the emergence and spatial connectivity of singularities and caustics. Finally, we will discuss the migration flows of matter and galaxies along the cosmic web and prospects of using voids to constrain dark energy and dark matter.