Title of the course:

## Introduction to Interacting Particle Systems and their Duality Theory.

Lecturers:

Frank Redig, Delft University (1st week) Cristian Giardinà, Università di Modena e Reggio Emilia (2nd week)

Abstract:

Interacting Particle Systems represent a wide class of continuous-time Markov processes that are used in the stochastic modeling of various systems. Examples include non-equilibrium statistical mechanics (Fourier law), population dynamics (coalescence), growth and traffic models (interfaces, queues, spreading of an infection or an opinion. They consist of elementary units ("particles") that evolve by a combination of randomness and local interactions.

In the mathematical study of Interacting Particle Systems a crucial technique is Duality. This technique allows to study the original process using another process (the dual process) that is considerably simpler. Duality theory is in turn related to deeper mathematical properties of the original process such as representation theory of its Lie-algebras and detection of its non-trivial symmetries.

The course will offer:

- (a) an introduction to the mathematical set-up of Interacting Particle Systems and many examples of them, e.g inclusion process, contact process, voter model [6 hours, 1st week]
- (b) an extensive description of Duality Theory, including a new approach for the construction of a dual process and many applications on the use of the dual process [6 hours, 2nd week].

The course will be self-contained and only basic notions of classical mechanics and probability theory will be assumed to be known.