

MATH-615

**Gaussian free field through random walks**

Lupu Titus

Cursus	Sem.	Type
Mathematics		Opt.

Language of teaching	English
Credits	1
Session	
Exam	Oral
Workload	30h
<b>Hours</b>	<b>14</b>
Courses	14
<b>Number of positions</b>	

**Frequency**

Only this year

**Remark**

April 6th - June 1st

**Summary**

In this lecture series some important objects of random geometry are introduced and studied. In particular, the relation between the Gaussian free field and random walks / Brownian motions is explored. This provides a toolbox of techniques for studying mathematical problems in probability theory.

**Content**

The Gaussian free field (GFF) is an ubiquitous object in statistical physics. In this lecture we will present how its intrinsic geometry can be described through random walks in discrete and Brownian motions in continuum. This kind of representations emerged in the 1980s in the study of interacting bosonic fields, such as the  $\Phi_4$ . New developments on the topic appeared in the last 10 years, that emphasized the role of clusters of random walk or Brownian trajectories.

In this lecture we will cover the following topics:

- \*What is a GFF and why is it natural to study.
- \*How the square of the GFF is related to occupation times of random walks (discrete) and Brownian motions (continuum).
- \*The technique of metric graphs and the importance of the clusters of Markovian trajectories.
- \*The GFF in the presence of a gauge field and its relation to the holonomy along Markovian trajectories.
- \*A glimpse on the relation between the clusters of Brownian loops in dimension 2 and the SLE processes.
- \*Some conjectures in higher dimensions.

**Learning Prerequisites****Required courses**

Solid background in probability