



## Theoretical Statistics and Mathematics Unit

Indian Statistical Institute

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# COLLOQUIUM

Date: February 04, 2026

Time: 04:30 P.M.

Venue: L-infinity, Stat-Math Unit (5<sup>th</sup> Floor, A.N. Kolmogorov Bhavan), ISI Kolkata

**Prof. Felix Otto**

Max Planck Institute, Germany

### TITLE:

**Random-field Ising problem, optimal matching, and curves in a Brownian potential**

### ABSTRACT:

*Even at vanishing temperature, the presence of a random external field in the Ising model may enforce a unique Gibbs state, up to and including the critical dimension two (Aizenman-Wehr). How does the typical diameter  $L$  of the resulting domains scale in the non-dimensional prefactor  $\epsilon \ll 1$  of the field term? Recent work suggests  $\ln L \sim \epsilon^{-4/3}$  (Ding-Wirth).*

*For good reasons, the same exponent came already up when maximizing the “isoperimetric” ratio  $R \int_{\Sigma} \xi |\partial \Sigma|$  of an integral of white noise  $\xi$  over a subset  $\Sigma$  of the plane and the length of its boundary  $\partial \Sigma$  (Leighton-Shor). This problem in turn is dual to an optimal matching problem – and motivated Talagrand to develop a systematic theory for maxima over families of correlated Gaussian variables.*

*We study a (1+1)-dimensional semi-discrete random variational problem that can be interpreted as a geometrically linearized version of either problem:  $\Sigma$  is restricted to the subgraph of a function  $h = h(x)$ , the length  $|\partial \Omega|$  is replaced by the Dirichlet integral of  $h$ , and  $R \int_{\Sigma} \xi$  is replaced by  $R \int W(x, h(x)) dx$  with  $\{W(x, \cdot)\}_x$  a family of independent two-sided Brownian motions.*

*Appealing to ideas from Leighton-Shor, we show that at every dyadic scale from the system size down to the lattice spacing, the minimizer  $h^*$  contains at most order-one Dirichlet energy per unit length, naturally leading to the logarithmic scaling of the minimal energy. Using super-additivity in the scales, this allows us to establish a (quantitative) quenched homogenization result in the sense that the leading order of the minimal energy becomes deterministic as the ratio system size / lattice spacing diverges.*

*This talk relies on F. Otto, M. Palmieri, C. Wagner, On minimizing curves in a Brownian potential, arXiv:2503.12471.*

**ALL ARE CORDIALLY INVITED**