Abstract. Theory of Dirichlet forms is one of the main achievements in modern probability theory. It provides a powerful connection between probabilistic and analytic potential theory. It is also an effective machinery for studying various stochastic models, especially those with non-smooth data, on fractal-like spaces or spaces of infinite dimensions. The Dirichlet form theory has numerous interactions with other areas of mathematics and sciences.

This workshop brought together top experts in Dirichlet form theory and related fields as well as promising young researchers, with the common theme of developing new foundational methods and their applications to specific areas of probability. It provided a unique opportunity for the interaction between the established scholars and young researchers.

Mathematics Subject Classification (2010): Primary 31C25, 60J45, 60J25, 60H15, 60H30.

Introduction by the Organisers

The workshop *Dirichlet Form Theory and Its Applications*, organized by Sergio Albeverio (University of Bonn, Germany), Zhen-Qing Chen (University of Washington, USA), Masatoshi Fukushima (Osaka University, Japan) and Michael Röckner (University of Bielefeld, Germany) was well attended with 52 participants with broad geographic representation from Canada, China, France, Germany, Italy, Korea, Romanian, Spain, Japan, UK, and USA. Women and young researchers had a strong presence among the invited participants. This workshop was a nice blend of researchers with various backgrounds, but sharing a common interests in the subject of this workshop. The workshop had 27 invited talks with 7 short communications, leaving plenty of time for discussions. To accommodate the travel
delay caused by the Germany train driver strike on the day of arrival for the workshop, we shifted and started the program Monday afternoon of October 20, 2014. It worked out well. Most young researchers at the workshop were invited to present their work.

To create some focus for the very broad topic of the workshop, we had chosen a few areas of concentration, including (i) Theory of Dirichlet forms; (ii) Stochastic analysis and potential theory on infinite dimensional spaces; (iii) Analysis on fractals and percolation clusters; (iv) Jump type processes and non-local operators. Many talks and discussions were directly related to these themes, and covered diverse topics and areas including the following:

- Fukushima decomposition for quasi-regular semi-Dirichlet forms (Zhi-Ming Ma)
- Heat kernel estimates: for strongly local regular Dirichlet forms (Alexander Grigoryan), for killed symmetric Lévy processes in half spaces (Panki Kim), for Liouville Brownian motion in $\mathbb{R}^2$ (Naotaka Kajino), and for Brownian motion on a space of varying dimension (Shuwen Lou).
- Invariance principle for random walks in ergodic random media and for ergodic random conductance models, and for random walks on trees (Jean-Dominique Deuschel, Takashi Kumagai and Anita Winter).
- Geometric and functional inequalities for Dirichlet forms, and curvature-dimension conditions with applications including optimal mass transport (Michel Ledoux and Karl-Theodor Sturm)
- Trace Dirichlet forms for random walks on trees associated to $p$-adic numbers (Jun Kigami) and for reflected Brownian motion in Euclidean domains (Lucian Beznea).
- Dirichlet forms on the cone of random measures with applications in ecology (Yuri Kondratiev and Diana Putan)
- Intrinsic ultracontractivity for skew product diffusion processes (Matsuyoshi Tomisaki)
- Criticality and subcriticality for (generalized) Schrödinger forms as related to properties of the spectrum of time changed processes (Masayoshi Takeda)
- BV functions and Skorohod equations on Wiener spaces (Masanori Hino)
- Sticky reflected distorted Brownian motion for the wetting model (Robert Vosshall)
- Long time asymptotics for the paths of symmetric Markov processes (Yuichi Shiozawa)
- Instability properties of sequential limits of Dirichlet forms (Toshihiro Uemura)
- Local Dirichlet structure on the Poisson space associated with an energy form and a lent particle method (Laurent Denis)
- Stochastic averaging via Dirichlet forms (Max von Renesse)
• Differential calculus for Dirichlet forms on noncommutative spaces (Fabio Cipriani)

Several talks were related to or motivated by mathematical physics: scaling limit of interface models (Torben Fattler), Dirichlet forms related to the stochastic quantization (Hiroshi Kawabi), magnetic energy forms and Feynman-Kac-Ito formulae, including non-local setups (Michael Hinz).

There were three talks devoted to stochastic partial differential equations and infinite dimensional stochastic functional equations (Wilhelm Stannat, Rongchan Zhu and Xiangchan Zhu).

Potential theory for stochastic processes was also covered during this workshop. The topic includes minimal thinness of symmetric Lévy processes (Renming Song), ergodicity of infinite dimensional Feller-Markov processes (Fuzhou Gong), regularity of harmonic functions for non-local operators (Moritz Kassmann), Malliavin smoothness for SDEs with singular coefficients (Tusheng Zhang). Andreas Eberle presented a talk on a random walk Metropolis algorithm in high dimension, while Cheng Ouyang talked about a geometric derivation of Lévy’s arcsine law for occupation time on hypersurfaces of a Riemannian manifold.

The diversity of the topics and participants stimulated many in-depths discussions. In particular, it became clear how vividly the approach of the Dirichlet form theory interacts with other areas of analysis and probability, as well as geometry and mathematical physics. Also the interplay of theory and applications was greatly enhanced. The workshop helped not only strengthening the exiting connections but also making new friends and fostered new collaborations among the participants who came from diverse fields of mathematics and geographic locations.

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