

# Correlated Disorder, Hyperuniformity and Local Self-Uniformity: From Biomimetics to Photonic Integrated Circuits

25<sup>th</sup> - 26<sup>th</sup> June 2018, University of Surrey

## Summary

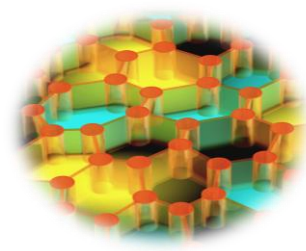
---

“Correlated Disorder, Hyperuniformity and Local Self-Uniformity: From Biomimetics to Photonic Integrated Circuits” was a two-day workshop held at the University of Surrey from 25<sup>th</sup> -26<sup>th</sup> June 2018. The event was organized by Dr Marian Florescu (University of Surrey), Dr Riccardo Sapienza (Imperial College) and Prof Stephen Sweeny (University of Surrey). The workshop brought together 35 international experts to explore the consequences of hyperuniformity and local self-uniformity across diverse research fields and to unravel the fundamental impact of correlated disorder concepts on biomimetic and nanophotonic applications. The topics covered by the workshop ranged from fundamental aspects of localization in hyperuniform structures to fabrication challenges and applications including photonic circuits, solar cell absorbers and integrated spectrometers. The workshop attracted presenters from seven countries and all the key groups in the field were represented. In addition to the various groups working in this area in the UK (Surrey, Imperial, Southampton and Cambridge), there were representatives from four groups in Germany, three groups in Spain, three groups in Switzerland, three groups in the US, two groups in France and two groups in the Netherlands. The workshop included 20 talks and 10 poster presentations. All speakers made an effort to communicate with as wide an audience as possible and the poster session gave some early career researchers the chance to present their results in a more informal environment. The panel discussion organized at the end of the workshop was lively and provided a good opportunity for the attendees to gather a more horizontal perspective on the correlated disordered research field and to discuss a future strategy for advancing the field.

## Workshop Aims

---

The subtle interplay between composition, morphology, topology and structural uniformity present in correlated disordered structures and, in particular, in the newly introduced hyperuniform and local-self-uniform materials has a direct impact on a wide range of directions from more efficient solar-cell platforms and structure of amorphous silicon, to optical functionalities in avian feather barbs and butterfly wings. The impact of these new concepts on many different areas of fundamental and applied science appears to be important and yet our current understanding of these novel types of structuring is in early stages. The workshop aims were to explore the fundamental connection between structure and physical response suggested by the hyperuniformity and local-self uniformity concepts and to identify direct routes towards engineering designer materials with on-demand, unprecedented physical functionalities.



## Programme and Event themes

---

The workshop has attracted 35 participants and proved to be an ideal forum to explore the latest developments in the field of correlated disorder with a specific focus on hyperuniform and local self-uniform materials.

The technical and social programme offered ample opportunities for active discussions and debates aspects on the most recent developments in the field. The programme included

- 4 scientific sessions with 20 talks
- A poster session (10 poster presentation)
- A discussion session on current status and future directions in the field
- Dinner at The Ivy (first day) and Weyside (second day)

The meeting was truly multidisciplinary and covered a large number of recent advances in the field including:

- Theory of stealthy hyperuniform materials and bounded-hole size properties
- Transparency and enhanced absorption in hyperuniform disordered materials
- Photonic band gaps in local self-uniform networks
- Gyroid photonic crystals and pigmentation in butterflies
- Self-assembly of hyperuniform disordered materials
- Anderson localization and transport phase-diagrams in stealthy structures
- Photonic integrated circuits on hyperuniform platforms
- Lasing in disordered networks
- Fano resonance in correlated disordered colloids
- Phase-separated disordered nanostructures for energy applications
- Mie glasses and optoelectronic applications
- Disordered platforms for integrated spectrometers

## Outcomes

---

It was widely agreed that the meeting was very successful. Another meeting covering similar topics will be organized later this year in France where updates on current issues will be discussed. Plans for a third meeting next year (possibly a special session at the CLEO conference) are also explored. Some important new collaborations and joint research proposals have been explored. Many of the presentations are already or will be published in high impact journals including Nature Communications, Physical Review Letters, Optica, Physical Review B.

The feedback from all the participants has been overwhelmingly positive. They all felt that the meeting has been very timely, the programme was interesting and the workshop was well-organized. They have appreciated the open nature of the meeting with many opportunities to discuss their ideas and debate the new directions in the field.

## Acknowledgements

---

The Institute of Advances Studies at the University of Surrey, the Engineering and Physical Sciences Research Council (EPSRC) and the Department of Physics at the University of Surrey were the sponsors of this meeting. The organizers would like to thank Mrs Mirela Dumic for her dedication and excellent administrative support in the organization of this meeting. Richard Spalding is gratefully acknowledged for his help in the conference set up.

