JSPS Symposium on Nanoscale Physics of Quantum Materials
11th -12th August 2014, Weetwood Hall Hotel & Conference Centre, Leeds
UK Academic Lead: Dr. Oscar Cespedes, Leeds University
Japanese Academic Lead: Professor Yoshinori Tokura, RIKEN
Number of participants: 54

Invited Speakers:

Prof. Yoshichika Otani (RIKEN/U. Tokyo)
Prof. Takahisa Arima (RIKEN/U. Tokyo)
Prof. Yoshihiro Iwasa (RIKEN/U. Tokyo)
Dr. Xiuzhen Yu (RIKEN)
Dr. Wataru Koshibae (RIKEN)
Dr. Naoya Kanazawa (RIKEN/U. Tokyo)
Prof. Eiji Saitoh (Tohoku University).
Prof. Andrew Ferguson (University of Cambridge)
Dr. Andrew Pratt (University of York)
Prof. Arne Brataas (Norway Uni. Sci. & Tech.)
Dr. Joo-Von Kim (Université Paris-Sud)
Ms. May Wheeler (University of Leeds)
Mr. Joseph Batley (University of Leeds)
Dr. David Williams (Hitachi Cambridge Laboratory)
Prof. Bryan Hickey (University of Leeds)
Prof. Gerrit van der Laan (Diamond Light Source)
Prof. Chris Marrows (University of Leeds)
Prof. Stefano Sanvito (Trinity College Dublin)
Dr. Vlado Lazarov (University of York)
Dr. Sandrine Heutz (Imperial College London)
Dr. Nicola Morley (University of Sheffield)
Dr. Jan-Willem Bos (Heriot-Watt University)
Dr. Peter Wadley (University of Nottingham)
Mr. Rowan Temple (University of Leeds)

Objective of Symposium and Outline:

The symposium was focused on fundamental research of nanoscale materials for electronic applications. It had both scientific and collaborative goals. From a scientific point of view, the symposium aimed to bring together scientists from different disciplines (physics, engineering and chemistry) but all working in materials with quantum properties such as skyrmions, topological insulators and hybrid metallo-organics. The final applications of this research will be computing, memories and other electronic devices that consume less power and/or dissipate less heat –benefiting society both from an economic and environmental perspective. On the collaborative side, the symposium aimed to strengthen links between Leeds and RIKEN so that we could apply together for funding opportunities –possibly with other UK institutions, incentivise the secondment of researchers, and share experimental equipment and expertise. One of the main outcomes of the event was the development of a network in spintronics and advanced materials. This network has as leaders Prof. Otani in Japan and Profs. Hickey and Marrows in the UK, and includes also researchers in the University of Cambridge (Prof. Andrew Ferguson). The meetings followed the successful application earlier in the summer by Prof. Marrows to

EPSRC for matching funding in a core-to-core application in spintronics and advanced materials. Prof. Otani has recently submitted his corresponding application for internal review in U. Tokyo. Prof. Saitoh from Tohoku University was also involved in the discussion, with the possibility of a final joint proposal involving other institutions in the UK (Imperial College) and Japan (Tohoku and University of Kyoto).

Following the symposium, the academics involved in this application held a meeting to discuss the scientific objectives and optimum use of researchers and resources for a true intermixing of scientists from Leeds and Japan. Ideas for secondments (i.e. extended research visits where early career researcher perform collaborative work that can lead to a joint publication) were discussed. Several people, from PhD student to lecturer/assistant professor level were identified as being best placed to carry out these secondments. We are currently studying forms of financing these visits, including the fellowship schemes from JSPS. The newly formed consortium combines some of the foremost groups in the world in the fields of spintronics and advanced materials. Its final aim will be to lead at global rather than local scale.

Further to this large scale collaboration, smaller or individual research associations were initiated, such as discussions to develop work in molecular spin dynamics in C_{60} (discussions between Profs. Van der Laan, Otani and Saitoh and Dr. Cespedes), or the formation of skyrmions at room temperature in novel materials –a research idea discussed between Profs. Marrows in Leeds and the group of Prof. Tokura in RIKEN (Drs. Kanazawa, Koshibae and Yu). At an early career researcher and PhD level, the symposium facilitated information and opportunities for PhD students in Leeds, Liverpool, Glasgow and Oxford to get in touch with academic leaders in Japan and consider opportunities as future fellows and/or other placements in Japan. Further to this, Prof. Hickey in Leeds is now collaborating with Prof. Otani in the measurement of lateral spin valves for what could be a first joint publication between our groups.

From a scientific point of view, a clearer vision on the role of phonons and heat in spin conversion for electronics appeared by interactions between Profs. Brataas, Hickey and Otani. Dr. David Williams from the Hitachi Cambridge Laboratory offered an overview of how our research community can contribute significantly to the electronics industry through novel functionalities and a reduction of power consumption. New, organic materials that offer an eco-friendly alternatives to doped semiconductors were discussed on Monday afternoon by Prof. Sanvito from Trinity College Dublin, Prof. Iwasa from RIKEN

and Drs. Heutz, Morley and Cespedes (Imperial College, Universities of Sheffield and Leeds, respectively). Researchers from RIKEN (Koshibae, Kanazawa and Yu), Leeds (Marrows, Temple) and the Université Paris-Sud (Joo-Von Kim) discussed recent advances in their groups for high density storage magnetic nanomaterials. Prof. van der Laan from the Diamond Light Source offered a master class on the use of synchrotron radiation for the study of high frequency spin dynamics –work that could lead to faster computing and electronics. Prof. Arima from RIKEN, and Drs. Lazarov, Pratt, Bos and Wadley (Universities of York, Heriot-Watt and Nottingham) offered a perspective on novel techniques and recent developments such as transmission electron microscopy, helium ion spectroscopy and antiferromagnetic resonance. Profs. Saitoh from Tohoku and Ferguson from the University of Cambridge gave an overview of the main advances in the field of spin conversion and the latest discoveries from their laboratories, including the spin Seebeck effect and the inverse spin Hall effect in an organic semiconductor. **– Dr. Oscar Cespedes**

Symposium Participants