

## SEMINAR ANNOUNCEMENT

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING  
COLLEGE OF DESIGN AND ENGINEERING  
Website: <https://cde.nus.edu.sg/ece>

**Area: Microelectronic Technologies & Devices**

**Host: Professor Yang Hyunsoo**

|         |   |                                                                                           |
|---------|---|-------------------------------------------------------------------------------------------|
| TOPIC   | : | Nucleation and Dynamics of Chiral Solitons in Topological Materials                       |
| SPEAKER | : | Dr. Oleg A. Tretiakov<br>School of Physics, UNSW Sydney                                   |
| DATE    | : | Tuesday, 11 April 2023                                                                    |
| TIME    | : | 11.00AM to 12.00PM                                                                        |
| VENUE   | : | Block E1, E1-06-05<br>College of Design and Engineering, National University of Singapore |

### ABSTRACT

Skyrmions are topologically protected chiral solitons [1], which may serve as elements of future spintronic memory and logic devices. Therefore, skyrmion nucleation in topological systems such as topological insulator (TI)/ferromagnet is important to study, especially as in these systems the skyrmions are shown to move much faster. I will discuss skyrmion nucleation induced by spin-transfer torques specific for a TI interface with a ferromagnetic insulator based on micromagnetic simulations and diagrammatic techniques [2]. I will show that the nucleation time is inversely proportional to the applied electric field and will identify temperature dependences of the critical nucleation field. Furthermore, I will discuss the effect of the Dzyaloshinskii-Moriya interaction and demonstrate that the temperature dependence can be explained by the reduction of a magnon excitation gap due to the self-energy corrections. I will also discuss topological chiral solitons in numerous in-plane magnetized materials. These solitons are called bimerons and they are in-plane analogues of skyrmions as they have the same topological charge. I will first describe their stability, static and dynamics properties in ferromagnets [1]. Then I will turn to antiferromagnets, where I will show that in analogy with skyrmions [3], these topological solitons possess no skyrmion Hall effect, and among other exciting properties demonstrate chaotic behaviour when driven by ac currents.

1. B. Göbel, I. Mertig, O. A. Tretiakov O. A., Phys. Rep. 895, 1 (2021).
2. D. Kurebayashi and O. A. Tretiakov, Phys. Rev. Research 4, 043105 (2022).
3. J. Barker and O. A. Tretiakov, Phys. Rev. Lett. 116, 147203 (2016).

### BIOGRAPHY

Dr. Tretiakov has completed his PhD from Duke University (USA) and postdoctoral studies from Johns Hopkins, New York and Texas A&M Universities (USA). He then worked as an assistant professor at Institute for Materials Research, Tohoku University in Japan. Currently Oleg Tretiakov is the head of the Topological Spintronics and Quantum Nanomagnetism Theory group at the University of New South Wales (UNSW), Australia. He has published over 80 articles and has been serving as an associate editor of Frontiers in Physics journal. His research interests are centered on skyrmions and other topological solitons in magnetic systems, spin-orbit torques, topological antiferromagnetic spintronics including non-collinear antiferromagnets, topological thermoelectrics, as well as strongly correlated low-dimensional systems with spin-orbit interaction.

<https://cde.nus.edu.sg/ece/highlights/events/>