

## PRESIDENT'S SCIENCE AWARD 2020

### Team comprising:

#### **Professor Nikolay I. Zheludev**

Director, Centre for Disruptive Photonic Technologies, Nanyang Technological University Singapore (NTU)

Co-Director, The Photonics Institute, NTU

President's Chair in Physics, School of Physical & Mathematical Sciences and School of Electrical & Electronic Engineering, NTU

#### **Associate Professor Chong Yidong**

Division of Physics & Applied Physics, School of Physical & Mathematical Sciences, NTU

Associate Chair (Students), School of Physical and Mathematical Sciences, NTU

#### **Associate Professor Zhang Baile**

Associate Professor, Centre for Disruptive Photonic Technologies & School of Physical and Mathematical Sciences, NTU

***“For their global leadership in, and fundamental contributions to, topological nanophotonics research, which underpins the development of a new generation of light-based technologies”***

Professors Nikolay Zheludev, Yidong Chong, and Baile Zhang, are pioneers in topological nanophotonics, a new field in the science of light that has emerged in the past decade. They use the branch of mathematics known as topology to design nanophotonic devices and applications with unprecedented functionalities. Their work has led to breakthroughs in the fundamental science of light, as well as new technological applications underpinned by the topology of light.

Photonics, the science of generating, harnessing and manipulating light, is a critical enabling technology of the 21st century. It underpins numerous other areas of technology, including telecommunications, energy harvesting and conversion, lighting and displays, advanced manufacturing and metrology, security and defense, imaging, microscopy and more. Nanophotonics is a subfield of photonics that involves using nanotechnology to create devices, such as artificial designer materials or “metamaterials”, to control light at the nanoscale. Topology, on the other hand, is a branch of mathematics that deals with the properties of objects that are invariant under continuous deformations (such as bending, stretching, and shrinking), without regard to geometrical details.

Topological nanophotonics exploits the topological properties of light, which are unaffected by continuous perturbations of the system and hence are more robust than ordinary geometric features. The team has designed artificial structured materials in which light waves can flow around corners and obstacles without scattering, unlike ordinary light waves. They have also found ways to use topologically structured light in advanced optical metrology and imaging, to resolve objects that are too small for conventional optical microscopes.

The team's contribution to the discipline include fundamental advances in understanding the role of topology in light, new topological photonic media for lasers and photonic chips with robust-in-use and tolerant-in-manufacturing features, light pulses with unique topological properties, and the use of topologically structured light for super-resolution microscopy and nano-metrology.

The team's research is conducted at the Centre for Disruptive Photonic Technologies (CDPT) founded and directed by Professor Nikolay Zheludev. Since its formation in 2012, CDPT, a part of the Photonics Institute at Nanyang Technological University Singapore, has become one of the world's foremost centres of nanophotonics research. Since 2016, the team has been spearheading research on the fundamentals of topological nanophotonics and currently focuses on developing technological applications of the new concepts.

The team has an exceptional scientific publication record which includes 36 papers in the *Science* and *Nature* families of journals; delivery of 23 plenaries and keynotes, and 85 talks at major international conferences. Their papers have received more than 5,000 citations a year. They have won major research awards globally, and Professor Zheludev has been awarded fellowships of the Royal Society (UK) and the National Academy of Engineering (USA).