



NEWS RELEASE

Singapore, 23 Jun 2026

NTU Singapore scientists create optical skyrmions using a two-century-old light phenomenon

The simple Poisson spot can produce complex light patterns known as optical skyrmions

Nanyang Technological University, Singapore (NTU Singapore) scientists have used a classic optical phenomenon known as the “Poisson spot” to create stable patterns of light called “optical skyrmions”.

Optical skyrmions are tiny, swirling configurations in the properties of light – akin to the spikes of a hedgehog.

The team used a laser directed at a small circular disc, instead of the complex and costly engineered materials commonly used to generate these skyrmions.

This new method gives scientists a much simpler way to generate, study and adjust optical skyrmions.

Skyrmions are currently a hot scientific subject as they hold potential to store information, paving the way for future data storage, communications and computing systems.

Published in a leading scientific journal, *Optica*, the discovery was led by **Nanyang Assistant Professor Shen Yijie** from NTU’s **School of Physical and Mathematical Sciences** and **School of Electrical and Electronic Engineering**.

“What is remarkable is that optical skyrmions can now be generated using a simple effect where light bends around an object, without relying on expensive, complex man-made metamaterials or highly specialised techniques,” explained Asst Prof Shen.

“This could make optical skyrmions much more accessible to researchers. By lowering the technical barrier to creating and studying them, the method opens up new possibilities for scientists to study how they could be used in future optical, materials and computing research.”

Using a historic experiment for modern photonics

A Poisson spot is a bright point that appears at the centre of the shadow cast by a circular object when it is illuminated by a coherent light source, such as a laser.

The phenomenon became central to a debate in the early 19th century over whether light travelled only in straight lines as particles or if it could bend and spread as waves.

If light travelled as a wave, a bright spot should appear in the middle of the disc's shadow, where darkness would normally be expected, and the Poisson spot was a landmark experiment that showed light diffraction and its wave-like behaviour.

Light diffraction is the bending and spreading of light when it passes around an object or through a small opening.

Several skyrmion structures generated together

The researchers also found that the Poisson-spot system generated up to four related topological field patterns at the same time.

These include spin skyrmions, Stokes skyrmions, electric-field skyrmions and magnetic-field skyrmions. Spin describes the rotation-like properties of light, while Stokes parameters describe its polarisation state, or the direction in which light waves vibrate as they travel.

This “four-in-one” behaviour could allow researchers to study how different optical skyrmions form, vary and interact within the same light field.

In the researchers' simulations, these structures appear as swirling arrangements of arrows, showing how different properties of light change direction across the Poisson spot.

Light has many properties that scientists can shape, including its intensity, phase, polarisation, spin, and electric and magnetic field vectors.

These properties offer different ways to form topological structures in light, which are patterns that remain unchanged even when they are stretched or distorted.

By changing the conditions that shape the light field, scientists could gain greater control over the size, form and behaviour of the skyrmions.

Asst Prof Shen said: “In the light spot that we created, several types of optical vectors could form topological structures at the same time. These different components of light are closely connected, but they do not necessarily form identical topological patterns.

“Being able to produce and compare several skyrmions within one system could help researchers uncover new links between light’s electric, magnetic and other physical properties.”

Future applications of the knowledge

First proposed in particle and nuclear physics, skyrmions were later studied in condensed matter physics and magnetic materials, and have more recently emerged in photonics as stable, particle-like patterns in light fields.

Previous studies have generated optical skyrmions using metamaterials, which are artificially engineered micro-sized structures designed to control light in ways that ordinary materials cannot.

The fundamental findings lay the groundwork for further research into topological light and could support future physics applications in photonics, advanced materials, information processing and computing.

###

Note to Editors:

The paper titled “***Optical skyrmions in Poisson spots***” was published in *Optica* on 18 June 2026. DOI: [10.1364/OPTICA.591840](https://doi.org/10.1364/OPTICA.591840)

Media contact:

Lester Kok
Senior Assistant Director
Corporate Communications Office
Nanyang Technological University, Singapore
Tel: +65 9741 5593
Email: lesterkok@ntu.edu.sg

About Nanyang Technological University, Singapore

Nanyang Technological University, Singapore (NTU Singapore) is a premier technological university that develops leaders and creates societal impact through education, research, and service.

Ranked amongst the world's top universities, NTU has 40,000 undergraduate and postgraduate students in the Business, Computing & Data Science, Engineering, Humanities, Arts, & Social Sciences, Medicine, Science, and Graduate colleges.

NTU is also home to world-renowned autonomous institutes – the National Institute of Education and S Rajaratnam School of International Studies – and various leading research centres such as the Earth Observatory of Singapore, Nanyang Environment & Water Research Institute, Energy Research Institute at NTU, and Singapore Centre for Environmental Life Sciences Engineering.

The University aspires to shape an AI-enabled future. By bringing together global talent across disciplines and combining technology with human creativity, NTU nurtures AI-ready graduates, drives breakthrough discoveries, and forges partnerships that tackle the challenges of our time.

For more information, visit www.ntu.edu.sg