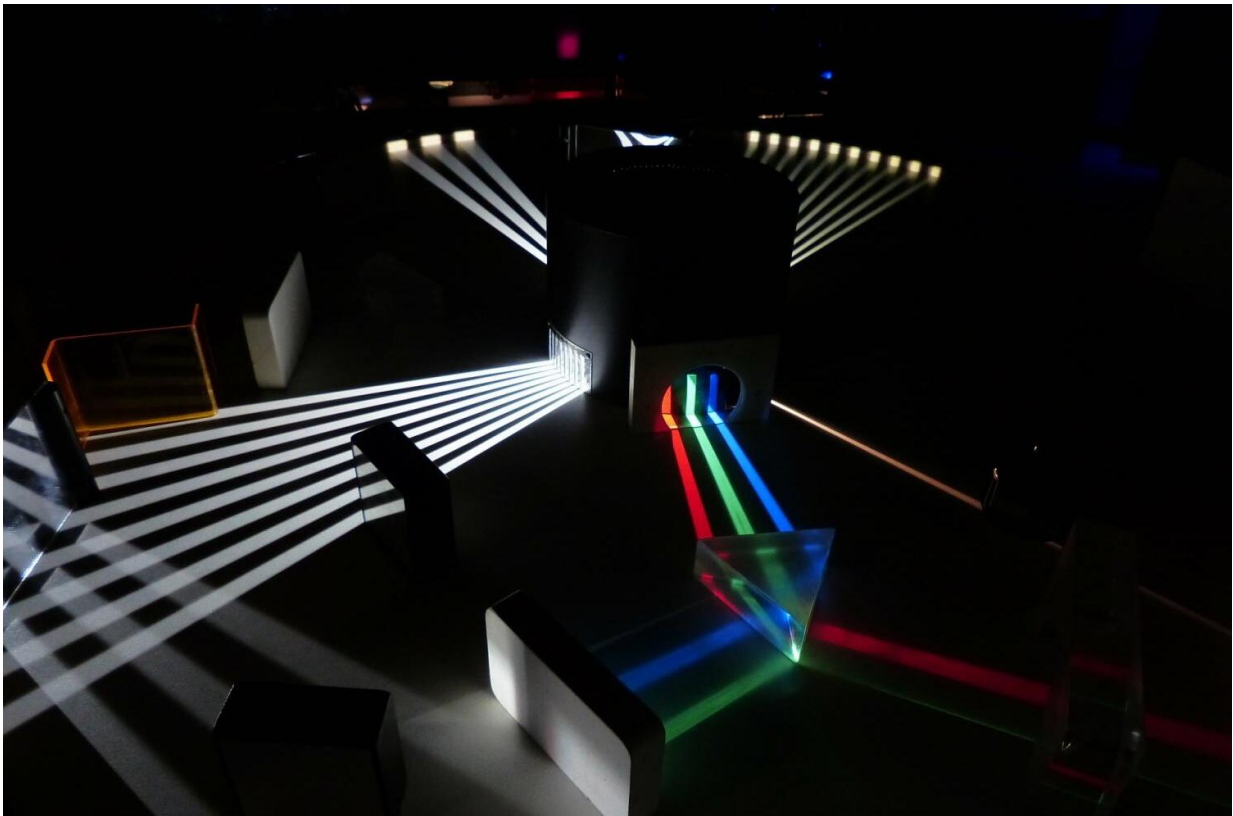


# New photonic technology effect could speed drug development

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Twisted nanoscale semiconductors manipulate light in a new way, researchers at the University of Bath and the University of Michigan have shown. The effect could be harnessed to accelerate the discovery

and development of life-saving medicines as well as photonic technologies.

Specifically, the photonic effect could help enable rapid development and screening of new antibiotics and other drugs through automation—essentially, robotic chemists. It offers a new analysis tool for high-throughput screening, a method to analyze vast libraries of chemical compounds. A tiny sample of each compound fills a well on a microplate. The wells can be as small as a cubic millimeter, and a plate the size of a chocolate bar can contain a thousand of them.

"To meet the requirements of the emerging robotized chemistry, wells are getting really tiny—too small for current analytical methods," said Ventsislav Valev, professor of physics at the University of Bath in the U.K. and co-corresponding author of the paper in *Nature Photonics*. "So, fundamentally new methods are needed to analyze would-be drugs."

One of the key measurements in drug analysis is [chirality](#), or which way the molecule twists. Biological systems, including the human body, typically prefer one direction over the other, a right-handed or left-handed curl. At best, a drug molecule with the wrong twist does nothing, but at worst, it can cause harm. The effect discovered by the researchers allows chirality to be measured in volumes that are 10,000 times smaller than a cubic millimeter.

"The small volumes possible for registration of these effects are the game changing property that enables the researchers to use very small amounts of expensive drugs and collect thousands times more data," said Nicholas Kotov, the Irving Langmuir Distinguished University Professor of Chemical Sciences and Engineering at the University of Michigan and co-corresponding author of the paper.

The method relies on a structure inspired by biological designs,

developed in Kotov's lab. Cadmium telluride, a semiconductor commonly used in solar cells, is shaped into [nanoparticles](#) resembling short segments of twisted ribbon. These assemble into [helices](#), mimicking the way proteins assemble.

"Being illuminated with red light, the small [semiconductor](#) helices generate new light that is blue and twisted. The blue light is also emitted in a specific direction, which makes it easy to collect and analyze," Kotov said. "The trifecta of unusual optical effects drastically reduces the noise that other nanoscale molecules and particles in biological fluids may cause."

To use these effects in high-throughput screening for drug discovery, the nanoparticles assembling into helices may be mixed with a drug candidate. When the nanohelices form a lock-and-key structure with the drug, simulating the drug target, the twist of the nanohelices will change dramatically. This change in the twist can be measured through the blue light.

"Applications to drugs are now only a question of technological development. Our next step is to seek funding for this development," said Valev, who led the photonic experiments at Bath.

The generation of the blue light from red is also helpful in drug development in samples approaching the complexity of biological tissues. The separation of two colors of light is technically easy and helps reduce light noise, false positives and false negatives. While the team attempted experiments testing the biological concept, COVID-19 closures and delays caused the protein samples to spoil each time.

"The postdoc on my side, Ji-Young Kim, and Ph.D. student Lukas Ohnoutek on the Bath side, they are heroes. They were trying to work in some night shifts, even when it was very restricted," Kotov said.

The University of Michigan has filed for patent protection and is seeking partners to bring the new technology to market.

**More information:** Lukas Ohnoutek et al, Third-harmonic Mie scattering from semiconductor nanohelices, *Nature Photonics* (2022).

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