Study of bird feathers might lead to better colors in the future

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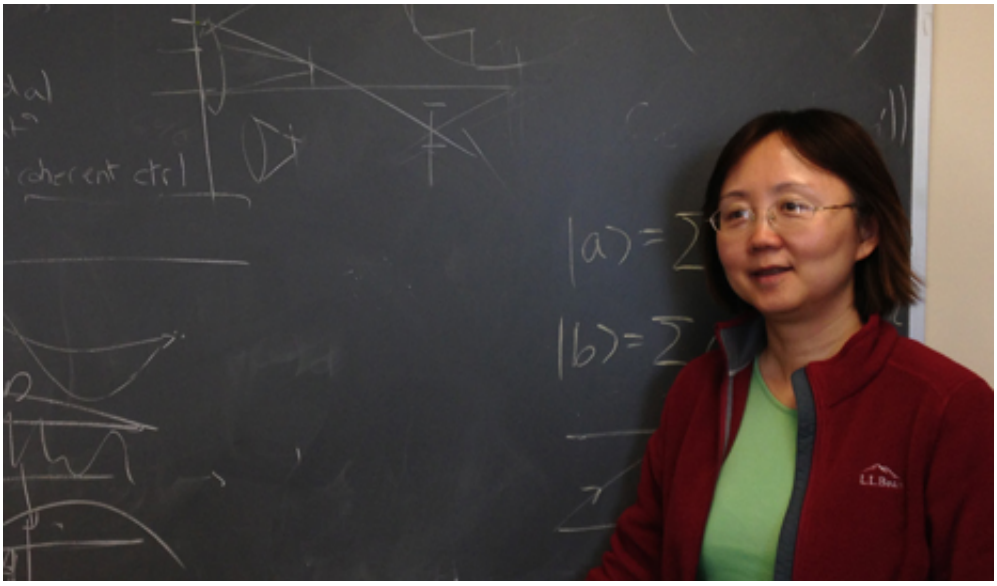

Hui Cao won a Guggenheim Fellowship last spring for her work in biologically inspired photonics. Credit: Brita Belli

Yale professor Hui Cao hopes to replicate the brilliant colors of bird feathers in the laboratory, in this case using lasers.

Cao, professor of applied physics, was one of 175 scholars, artists and scientists awarded a Guggenheim fellowship this past April for her work in biologically inspired photonics. The research honored by the fellowship deals with structural coloration—specifically the way that color is generated in nature, particularly in bird feathers, and how that

might be replicated in the lab using biological nanostructures to produce equally brilliant colors using lasers.

Cao has collaborated with several Yale faculty members on this research, including Richard Prum, the William Robertson Coe Professor of Ornithology, and Eric Dufresne, associate professor of mechanical engineering and materials science and director of the Center for Engineering Innovation and Design.

"We started by studying the color of bird feathers," says Cao, "and how birds produce such brilliant, vivid colors." The research team found that the color in bird feathers comes from combinations of nanostructures and pigments. A blue jay's blue, for instance, comes from nanostructures with melanin underneath; birds with brilliant white feathers have no such melanin.

"We can take what we have learned from nature to make better photonic devices," says Cao. And, she adds: "If we learn how to make artificial colors using nanostructures rather than dyes, we can use environmentally friendly materials."

These artificial colors will have another desirable property—the colors will not fade. As part of her research, Cao studied pigment in 40 million-year-old fossil beetles and 47 million-year-old moths whose coloring had remained intact. Such fade-less, environmentally friendly colors hold great potential for a range of commercial products, including cars, house paint, cosmetics and clothing, as well as holding promising applications for artists. Cao says these biologically-inspired colors may also be used in digital displays, allowing for Kindle and other mobile devices to display colors that don't alter with the viewing angle.

Currently, Cao's group has applied her findings to two-dimensional structures. Next, they will work on creating a three-dimensional bio-

inspired laser. To create it, they intend to use bird feather barbs as a template and infuse an active material. Once the biomaterials are removed, the laser will produce brilliant color in all directions.

Provided by Yale University