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Senior researcher Chul-Sik Kee's team discovers that light can be permanently confined in a space smaller than one-thousandth the size of a hair

☐ GIST (Gwangju Institute of Science and Technology, President Kiseon Kim) Advanced Photonics Research Institute (Director Ji-Woong Park) researcher Sun-Goo Lee and senior researcher Chul-Sik Kee proposed a theoretical principle of generating a bound state in the continuum* in a photonic crystal** that traps light almost forever in a space smaller than one thousandth of the size of a hair.

* photonic crystal: a structure whose refractive index changes periodically and strongly reflects light in a specific frequency range

** bound state in the continuum (BIC): electrons with continuous-level energy greater than the confinement energy are spatially constrained quantum mechanical states and recently discovered for light (photons) in photonic crystals

- The theoretical model for generating continuous level bound states in photonic crystals developed by this research team can be applied to various optical structures, so it is expected to be used for optical device design and development of using bound states in the continuum.

☐ Although there has been a lot of research on continuous level velocity conditions using optical crystals, it has been difficult to design a photonic crystal structure that implements continuous level speed conditions and to apply photonic crystal photomultiplier due to the lack of a theoretical model for continuous level speed formation and systematic theoretical exploration.

◦ The research team systematically identified a theoretical model that a bound state in the continuum is generated by combining different waveguide modes in a thin film waveguide* photonic crystal. Bound states in the continuum are created by extinction interference between modes having the same symmetry**. The researchers also found that light is emitted only in the direction above or below the thin film due to incomplete extinction interference between modes having different symmetry.

* thin-film waveguide: a thin film with a thickness of 1 micron (10-6m) or less that can trap and propagate light

** symmetry: In the waveguide mode of the thin film waveguide, there are an even mode and an asymmetric odd mode in which the spatial distribution of the magnetic field is vertically symmetric based on the center of the waveguide.

☐ Researcher Sun-Goo Lee and senior researcher Chul-Sik Kee said, "The results of this study are significant in presenting a theoretical model and a physical understanding of the principle of the formation of a bound state in the continuum in photonic crystals. In the future, it is expected that the theoretical model can be used for the development of photonic crystal nano lasers, high-sensitivity optical sensors, and quantum cryptographic communication technologies using continuous level constrained states."

☐ Senior researcher Chul-Sik Kee led the research that was conducted by researchers Sun-Goo Lee and Seong-Han Kim with support from the Ministry of Science and ICT, Ministry of Education, and the GIST Research Institute and was published on August 3, 2020, in the internationally renowned journal *Nanophotonics*.

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