☆EVENT　インタラクティブ物質科学・カデットプログラムセミナー☆

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基礎工学棟A棟 A403

講師をお招きしてセミナーを開催しました。

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講演タイトル： Controlling the flow of light with parity-time symmetric microcavities

Abstract: Parity (space-)-time- (PT-) symmetry- an abstract notion and a mathematical tool in quantum field theory has emerged as a new and powerful tool to design and fabricate artificial materials (meta-materials) with unique properties that cannot be found or attained in natural materials having only gain or loss. PT-symmetric Hamiltonian systems have attracted great interest following the work of Bender and Boettcher [1] who showed that the eigenvalue spectra of non-Hermitian Hamiltonians $\hat{H}\dagger\neq\hat{H}$ can still be entirely real if they respect PT-symmetry, $PT\hat{H}=\hat{H}PT$. The interest was further fueled by the first demonstration of PT-symmetry in optics [2]. Systems respecting the PT-symmetry are interpreted as non-isolated physical systems with carefully balanced loss and gain. When the PT symmetry is broken, such systems

undergo phase transitions which are reflected as the emergence of complex eigenvalues. In the broken-symmetry phase, such systems are expected to exhibit several striking properties [3] such as field localization, unidirectional invisibility, enhanced or reduced reflections, nonreciprocal light transmission, loss induced transparency and co-existing coherent-perfect-absorber and laser. Some of these features have been experimentally demonstrated in optical domain using coupled waveguides with gain and loss. Up to date, all optical experiments have been performed using waveguide structures with dimensions ranging from a few centimeters to hundreds of meters. In this talk, after giving a brief introduction to PT-symmetric systems in optics, I will report the first demonstration of PT-symmetry in on-chip microscale optical resonators [4]. The microresonators belong to a class of optical resonators referred to as whispering gallery mode microcavities. Using these PT-symmetric microcavities, I will also show the first observation of nonreciprocal light transmission in the broken PT-symmetry phase due to enhanced nonlinearity. We envisage PT-symmetric microcavities to play significant role for building unconventional optical devices to manipulate light and control energy flow.

＜主催した先生から＞

オズデミル講師はシリコン基板上にマイクロスケールの微小光共振器を作成し、その高い Q 値を利用した光によるナノ粒子検出や低閾値のレーザー発振の実現を報告された。特に最近の話題として PT-symmetry に関する報告をされ、微小光共振器を利用した PT-symmetry の破れに関する最新の美しい実験結果を披露された。非常にわかりやすく解説していただき、議論も活発に行われた。

（井元信之教授）