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## Optical study of new quasi-particles in 2D semiconductors

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Quasi particles such as excitons, trions, and bi-excitons are important both for the understanding of fundamental physics in semiconductors and for photonic applications. Such quasi-particles in 2D monolayer semiconductors have attracted a great deal of attention in recent years due to their many unique properties. In this talk, we will present some of the recent results of our group on the optical study of 2D materials, especially possible new quasi-particles beyond those well-known ones. For the case of three-particle interaction, we will show that the common concept of a trion needs to be re-examined and there are two possible configurations due to the Coulomb interaction. Our focus will be on the recent experimental observation of a series of new spectral peaks that are not attributable to excitons, trions, or bi-excitons. Our combined theory and experiments provide strong evidence for the existence of a new four-particle entity, the quadruplon which corresponds to an irreducible cluster of two electrons and two holes. Details of theory and experimental evidence will be discussed.

**Short Bio:**



Dr. Ning is a Chair Professor and Dean of the College of Integrated Circuits and Optoelectronic Chips at Shenzhen Tech University. Previously, he was a Professor at Tsinghua University, Director of Tsinghua International Center for Nano-Optoelectronics, and a Full Professor at Arizona State University. He is widely recognized as a leading researcher in semiconductor nanolasers. His team demonstrated the world's first electrical-injection plasmonic nanolaser and its room-temperature operation. He was also the inventor of white lasers and demonstrated the first monolithic white laser. His many achievements have been reported worldwide in radio, TV, news media and tech magazines. MIT Technology Magazine recognizes that their "nanolasers were the first to break the wavelength constraints on the size of lasers". The first white laser demonstration by his group has won "The Best of Tech in 2015" and the "Top 10 Engineering Achievements" by Popular Science magazine. For his many technical contributions, he has won several awards including NASA Awards, NASA Space Act Patent Awards, CSC Technical Excellence Award, and IEEE/Photonics Society

Distinguished Lecturer Award, and the Humboldt Research Award. Dr. Ning is a Fellow of the Optical Society (OSA), IEEE, and the Electromagnetic Academy, and a member of US National Academy of Invention.