# 复旦大学物理系 物质科学报告

Time:2:00pm, Tuesday, 2019.10.15

Location: Room C108, Jiangwan Physics Building

**Title:** Re-thinking the possibilities of quantum atom-light interfaces

Speaker: **Darrick Chang**

Institute of Photonic Sciences (ICFO) in Barcelona, Spain

Abstract:Ensembles of atoms or other quantum emitters are envisioned to be an important foundation of quantum applications, ranging from quantum memories for light to photon-photon gates to metrology. Yet, despite the ubiquitous nature of these systems, the standard theoretical models to describe quantum interactions between ensembles and light are only semi-phenomenological in nature, and ignore wave interference and multiple scattering of light. It is thus interesting to ask whether utilizing interference can allow one to carry out applications in ways that can be proven to be more powerful than current strategies, and whether interesting new phenomena or understandings can emerge that are fundamentally not predictable by standard theories.

Here, we discuss a novel theoretical approach that enables one to exactly account for interference and multiple scattering. We show that by exploiting interference, particularly in ordered arrays of atoms, it is possible to attain an exponentially better error bound for quantum memories as a function of physical resources, compared to current known bounds. We also discuss the more general question of why the refractive index of everyday optical materials seems to always be of order unity, and whether this can be understood from the limit of dilute atomic ensembles. These results suggest that we have barely scratched the surface in terms of our understanding of atoms and light and their possibilities.

Darrick Chang received his B.S. degree in Physics from Stanford University in 2001, and his Ph.D in Physics from Harvard University in 2008, under the supervision of Prof. Mikhail Lukin. He subsequently was awarded a prize postdoctoral fellowship at Caltech (2008-2011). There, he collaborated predominantly with the experimental groups of Prof. Jeff Kimble and Prof. Oskar Painter. He has been a professor at ICFO since 2011, where he leads the research group in Theoretical Quantum Nanophotonics. His research interests include quantum optics, atomic physics and nanophotonics and their interface, plasmonics, the optical properties of 2D materials, and quantum optomechanics. Among his recognitions, he is the recipient of a European Research Council Starting Grant, and has been a Visiting Fellow at Laboratoire de Physique des Lasers (2015) and JILA (2016).