

(1)

Name: Motoichi Ohtsu

Affiliation: Research Origin for Dressed Photon

Title: Dressed photon phenomena that demand off-shell scientific theories

Abstract:

This presentation reviews experimental results on dressed photon (DP) phenomena that demand the quantum field measurement theory and quantum walk theory. In relation to the quantum field measurement theory, it is shown that disturbance of the DP momentum was observed. It is also shown that the linear relation between the cause and effect of the DP energy measurement is lost. An electric-dipole forbidden transition becomes an allowed transition, and the energy disturbance is enhanced by decreasing the probe-specimen distance. In relation to the quantum walk theory, it is shown that energy transfer of the DP and the Brownian motion of nanometer-sized particles were autonomously controlled.

(2)

Name: Naoya Tate

Affiliation: ISEE, Kyushu University

Title: Correlation analysis of the size-resonanced near-field optical signals for advanced physical security

Abstract:

With the increasing popularity of the Internet of Things (IoT), there are considerable demands to improve the performance of physical security systems owing to the increase in edge devices. In recent years, fabrication and measurement techniques used by attackers are continuously improving, and it is difficult to ensure the security of edge devices by conventional approaches. To go against variable attacks in this background, we propose the *Nano-opt metric system*, which is based on a functional collaboration of existing physical security and near-field optical techniques. In this presentation, we report the results of quantitative evaluations of obtained optical signals due to near-field optical interactions between *target* and *reader* from the viewpoint of physical security. Additionally, interpretation of the signals based on size-resonance effect of the interactions will be discussed.

(3)

Name: Izumi Ojima

Affiliation: Research Origin for Dressed Photon

Title: Dynamics of Micro-Macro Duality

Abstract

The Micro-Macro Duality consists of two kinds of dualities, the duality between the system algebra (Alg) and its state space (States) and the duality from the spectrum (Spec) to the system dynamics (Dyn), In view of the difference between these two kinds of dualities, the repetition of the cycle,  $\text{Dyn} \rightarrow \text{Alg} \rightarrow \text{States} \rightarrow \text{Spec} \rightarrow \text{Dyn} \rightarrow \dots$  can become delicate at the stage of  $\text{Spec} \rightarrow \text{Dyn}$ , which is the important target in the dynamics of Micro-Macro Duality.

(4)

Name: Fumio Hiroshima

Affiliation: Graduate school of mathematics, Kyushu University

Title: Localization in quantum field theory

Abstract

We consider the Hamiltonian of the form

$$H = H_p \otimes 1 + 1 \otimes H_{\text{field}} + \phi(x),$$

$H$  is defined on  $L^2(\mathbb{R}^d) \otimes \mathcal{F}$ . Here

$$H_p = -\frac{1}{2}\Delta + V$$

denotes the Schrödinger operator,  $H_{\text{field}} = \int \omega(k) a^*(k) a(k) dk$  the free field Hamiltonian and

$$\phi(x) = \frac{1}{\sqrt{2}} \int a^*(k) \frac{e^{-ikx} \varphi(k)}{\sqrt{\omega(k)}} + a(k) \frac{e^{ikx} \varphi(k)}{\sqrt{\omega(k)}} dk$$

is a scalar field with ultraviolet cutoff  $\varphi$ . Here  $\omega(k) = \sqrt{|k|^2 + m^2}$  denotes the energy of a boson with mass  $m$  and momentum  $k \in \mathbb{R}^d$ .

$N = \int a^*(k) a(k) dk$  denotes the number operator and

$$\phi(f) = \frac{1}{\sqrt{2}} \int a^*(k) \hat{f}(k) + a(k) \overline{\hat{f}(k)} dk$$

is the field operator smeared by  $f$ . Let  $\Psi$  be the ground state of  $H$ . We show the localizations:

$$\|e^{|x|} \Psi\|_{\mathcal{H}} < \infty, \quad \|e^{\beta \phi(f)^2} \Psi\|_{\mathcal{H}} < \infty, \quad \|e^{\beta N} \Psi\|_{\mathcal{H}} < \infty$$

under some conditions.

(5)

Name: Hiroshi Ando

Affiliation: Department of Mathematics and Informatics, Chiba University

Title: Dressed photons and Electromagnetic fields from operator algebraic viewpoint

Abstract:

Dressed photons are considered to be associated with quantum fields with off-shell dispersion relations. Especially it is of interest to consider how to specify a state which describes an interaction of electromagnetic fields with electrons trapped in nano materials. We discuss how to model such fields, focusing on an operator algebra (or representation theoretic) viewpoint.

(6)

Name: Tetsuo Yabuki

Affiliation: Hokusei Gakuen University

Title: A theoretical analysis of the localization of a spontaneously emitted photon

Abstract:

Following the previous our report of the Dressed Photon Workshop held in Hokusei Univ, we reported on the theoretical analysis of the localization phenomenon of a spontaneously emitted massless scalar photon from an excited electron. This time, we analyzed the localization by the position wave function using massless vector photon as the original massless particle of spin 1, instead of the previous analysis with massless scalar photons. We make our original analysis report, based on the results of original numerical analysis by collaborator Nobuki Maeda, and based on the considerations of the presenter (T.Yabuki) regarding the following three points mentioned in various documents about photons which are the spin-1 massless particles.

(1) Absence of position operator

(2) Construction of wave functions of “position indication” such as position wave functions, energy wave function.

(3) Localization analysis based on wave functions of “position indication”

(7)

Name: Hayato Saigo

Affiliation: Nagahama Institute of Bio-Science and Technology

Title: Dressed Photon and Quantum Walk

Abstract:

Dressed photon is a useful physical concept for understanding the behavior of the light as quantum field interacting with nanomaterials. Recently, it has been proposed to use the notion of quantum walk, a mathematical concept that originated from the idea of "quantum version of the random walk", as the mathematical tool to analyze dressed photons. In this talk, I will explain why it seems meaningful to model dressed photons in terms of quantum walks, showing some elementary properties of Grover walks on certain kind of graphs and its physical implications. This talk is based on the joint work with M. Hamano, S. Sangu, E. Segawa and M. Ohtsu.

(8)

Name: Suguru Sangu

Affiliation: Ricoh Institute of Technology, Ricoh Company, Limited

Title: Dynamics of dressed-photon population from the perspective of convergence to steady state

Abstract:

A mechanism of localization and dissipation in steady state of dressed photon is becoming clear with the help of mathematical approaches, such as a quantum-walk picture. In this study, generating process of population for specific bases, that are given by diagonalization of steady-state solution of quantum master equation in a nonequilibrium open system, is visualized numerically, and energy transfer among the bases will be discussed. Purpose of this approach is to clear up a major part of object nodes for giving and receiving dressed photons locally as well as the role of a minor one. Knowledge gained from this study will be useful for reducing calculation volume in dressed-photon simulation, and optimizing geometrical structures of nanometric systems.

(9)

Name: Kazuya Okamura

Affiliation: Research Origin for Dressed Photon

Title : Measurement of Dressed Photon

Abstract:

We present a categorical framework for measurement theory of dressed photon. The concept of local net is effectively used.

(10)

Name: Yasuhide Fukumoto (presenter)(1) and Thi Thai LE(2)

Affiliations: (1) IMI, Kyushu University

(2) Hanoi University of Natural Resources and Environment, Vietnam

Title: Stability of an interface of tangential-velocity discontinuity in a shallow-water flow of different depth

Abstract:

For an incompressible fluid, an interface of tangential-velocity discontinuity is necessarily unstable, with growth rate proportional to the velocity difference. This is well known as the Kelvin-Helmholtz instability (KHI). However, the compressibility drastically alters the situation. When the compressibility is called into play, the KHI is suppressed if the Mach number based on the velocity difference exceeds 2.82. By an analogy, with the sound wave taken over by the gravity wave, the KHI of a shallow water flow is suppressed if the Froude number, the ratio of the velocity difference to the phase velocity of gravity wave, exceeds 2.82. In this investigation, we examine the effect of depth difference on the linear stability of an interface of tangential-velocity discontinuity in a shallow water; the depth of the fluid layer is set to be different across the unperturbed interface of the velocity discontinuity. We find that the critical value of the Froude number for suppressing the KHI is increased when the depth is different and that it takes the minimum value 2.82 for the same depth. We make an attempt to understand this result from the view point of the energetics.

(11)

Name: Hirofumi Sakuma (Research Origin for Dressed Photon)

Review on Clebsch dual field and on the parallel between dynamical behavior of dressed photon and gravitational pseudo-energy field.

Abstract

In our effort of developing a new model of dressed photon (DP), we have introduced a notion of Clebsch dual electromagnetic wave field to cover the spacelike counterpart of Maxwell's equation. Brief review of this notion is given focusing on the generating mechanism of dressed photon. As an extension of the study on DP-genesis, we discuss the dynamical behaviors of generated dressed photons in reference to the elusive behavior of gravitational pseudo energy-momentum.

(12)

Name: Itsuki Banno

Affiliation: Interdisciplinary and engineering researches, Yamanashi University

Title: Non-relativistic Nature in Material Systems and the Dressed Photons

Abstract:

Dressed photon (DP) is the off-shell electromagnetic field existing inherently in the material systems, and stands out under the non-resonant condition. Such the non-resonant effects originate from the non-relativistic nature of the material systems, and this presentation will discuss on the relationship between the non-linear non-resonant response and the symmetry breaking from the relativistic system.

(13)

Name: Hiroyuki Ochiai

Affiliation: IMI, Kyushu University

Title: On symmetry of Dressed Photon

Abstract:

We discuss the symmetry of dressed photon, especially on the Grassmannian and flag varieties and on the symmetry arising implicitly in the computation of Weyl tensors reported by Sakuma & Ochiai in the *Off-shell archive*.