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Author(s)	Title	Abstract
Masuo Suzuki (RIKEN)	Liouvillian formulation, TFD and Irreversibility	The Liouvillian formulation (LF) is applied to studying irreversibility by Prigogine, Petrosky, Hatano et al. On the other hand, the thermofield dynamics (TFD) is another useful method to study equilibirum and non-equilibrium systems [1-5]. In the present poster, the author insists that the LF is equivalent to the TDF in treating the complex eigenvalue problems. The TFD gives a clear formulation on this problem and clarifies irreversibility of quantum systems. Refs. [1] M. Suzuki, J. Phys. Soc. Jpn. 54 (1985) 4483 (general representation theorem of TFD). [2] M. Suzuki, in 'Progress in Quantum Field Theory' edited by H. Ezawa and S. Kamefuchi (Elsevier Science Pub. B.V. 1986). [3] M. Suzuki, J. Stat. Phys. 42 (1986) 1047. [4] M. Suzuki, in Thermal Field Theories and their Applications, eds. H. Ezawa et al., (Elsevier Science Pub. B.V. 1991). [5] M. Suzuki, Int. J. Mod. Phys. B, Vol. 5, No. 11 (1991) 1821.
J. Nebreda Manjon, J. R. Pelaez and G. Rios	Quark mass dependence of phase shifts and resonance poles	We review our works on the dependence of the phase shifts and resonance's properties on the quark masses using Chiral Perturbation Theory. We have studied the dependence of the phase shifts within both unitarized and standard SU(2) ChPT up to one and two loops [1], as well as the evolution of the properties of the lightest resonances within unitarized SU(3) ChPT [2]. Refs. [1] J. Nebreda and J.R. Pelaez. Phys.Rev. D81 (2010) 054035. [2] J. Nebreda, J. R. Pelaez and G. Rios, Phys. Rev. D 83, 094011 (2011).
Y.Yamaguchi, S.Ohkoda, S.Yasui, A.Hosaka	Exotic baryons from a heavy meson and a nucleon	We study hadronic molecules formed by a heavy meson and a nucleon respecting heavy quark symmetry. We study bound and resonant states by solving coupled channel Schrodinger equations. The tensor force of pion exchange plays an important role to yield a strong attraction in the system.
Rei Matsuzaki, Satoshi Yabushita	Theoretical calculation of photoionizing continuum orbitals by variationally optimizing complex basis functions.	Contrary to highly developed bound state electronic structure calculations, those for molecular continuum states are still difficult if many-body effects are included. The complex basis function (CBF) method is one of the methods for calculating photoionization cross-sections using L2 basis functions. In this method, photoionization cross-sections are calculated from the imaginary part of analytically-continued frequency-dependent polarizability. Although the CBF method has been successfully applied to total-cross sections, it has difficulty in calculating differential cross-sections and asymmetry parameters, since the method cannot describe continuum orbitals up to asymptotic regions. To overcome this difficulty, we are studying the method to optimize the basis set to be used for the CBF method, and extrapolation methods of the wave functions. As a test calculation, we have optimized at each photon energy the complex orbital exponents in the hydrogen atom problem and calculated the asymmetry parameter. In the poster session, we will describe the optimized orbital exponents and the calculated results of the photoionization cross sections and asymmetry parameters.
Satoshi Yabushita and Masato Morita	Theoretical calculations of photoionization cross sections with the variationally optimized frequency-dependent polarizability	We have been developing calculation methods for photoionization cross-sections using a variational principle for the analytically continued frequency-dependent polarizability (FDP). The analytical continuation is carried out either by (a) using complex basis functions explicitly whose orbital exponents of STOs/GTOs are of complex valued, or (b) constructing implicitly the FDP as an analytic function of a particularly chosen real-orbital exponent, thus avoiding complex arithmetic. At each photon energy, the FDPs thus obtained are further optimized variationally with respect to the orbital exponents. The two procedures (a) and (b) have been applied satisfactorily to the direct ionization of H atom, auto-ionizations of He and Be atoms, and to some simple diatomic molecules. For the computational efficiency, the Dirichlet boundary value problem is applied to fit the FDPs. The physical meaning of the variational principle will be discussed in relation to the variation-perturbation method and the first-order pertubative wave equation with the driven term of transition moments.
Chikako Uchiyama, Kota Watanabe, and Hisao Hayakawa	Non-Markovian Analysis of Qunatum Pump by Quantum Master Equation Approach	Recently, the analysis on the adiabatic quantum pumping on the basis of the quantum Markovian master equation (QMME) has revealed that the pump effect is directly connected with geometrical phase in the parameter space. However, the applicable range of QMME is not clear, and thus, the pump current under QMME may not be maximized. To clarify these points, we investigate the non-Markovian effect on quantum pump with non-adiabatic modulation of the parameters, using time-covolutionless QME for a spin-boson system and demonstrate that we can get larger pump current as a result of non-Markovian effect.
S. Ohtsubo^1), Y. Fukushima^1), M. Kamimura^2) and E. Hiyama^2) (1) Department of applied Physics, Fukuoka University, Fukuoka 2) Nishina Center, RIKEN, Wako)	Precise complex-scaling calculation of nuclear three-body resonances using complex-range Gaussian basis functions	We propose to make complex-scaling calculation of nuclear three-body resonances using complex-range Gaussian basis functions, $exp[-(1 ¥pm i¥omega)¥nu_n r^2]$ with the size $¥nu_n$ in a geometric progression. The function space of the basis set is wider than that of the real-range Gaussian set which is often used in calculating three-body resonaces (especially, better in describing oscillating functions seen in complex-scaling calculations). Good example will be presented for the three-body resonaces in 12C and 6He nuclei.

Yuma Kikuchi, Takayuki Myo, Kiyoshi Kato, Kiyomi Ikeda	Coulomb breakup reactions of two-neutron halo nuclei using the complex-scaled solutions of the Lippmann-Schwinger equation	The two-neutron halo nuclei, 6He and 11Li, have the exotic structure in which the valence neutrons are spread widely far from the core nucleus. To investigate their structure and binding mechanism, theoretical studies based on the core+n+n three-body model have been performed. Experimentally, on the other hand, the Coulomb breakup reactions have been carried out to investigate the excitation mode of halo nuclei. The observed cross sections commonly show the low-lying enhancements above the breakup thresholds, and these enhancements have been considered to be related to the weakly-bound halo structure. However, the breakup mechanism of two-neutron halo nuclei is much complicated. Due to the Borromean nature, the two-neutron halo nuclei are broken up to the core+n+n three-body continuum states, which contain various kinds of correlations such as of binary resonances. To extract the physical information from the cross sections, it is necessary to describe the three-body breakups of the core+n+n system. In this contribution, we investigate the Coulomb breakup reactions of 6He and 11Li by using the complex-scaled solutions of the Lippmann-Schwinger equation (CSLS). CSLS is method to describe the many-body scattering states by combining the Lippmann-Sshwinger formalism with the complex scaling method. We calculate the Coulomb breakup cross sections and invariant mass spectra for binary subsystems with CSLS, and discuss the mechanism of the Coulomb breakup reactions of 6He and 11Li.
Yoshihiko Kobayashi, Masayuki Matsuo, Kazuto Nakajima	Quasiparticle Resonances in Neutron Scattering on Superfluid Nuclei	We discuss a scattering of a particle on a superfluid liquid-drop. Namely, we consider one neutron and a superfluid neutron-rich nucleus. We use the Hartree-Fock-Bogoliubov (Bogoliubov-de Gennes) theory in order to describe the scattering. We investigate effects of the pair correlation on the elastic scatering and resonances. In my poster presentation, I will explain the calculation of elastic scattering using the Hartree-Fock-Bogoliubov theory, the cross section, the phase shift, the wave function at resonances, and the width of resonances.
Hiroshi MASUI, Kiyoshi KATO, Kiyomi IKEDA	Comparison between the cluster-obrital shell model and the Gamow shell model	We study contributions of poles and continua of the single-particle states to the wave function obtained by thecluster-orbital shell model (COSM). The COSM wave function is described in terms of a linear combination ofnonorthogonal Gaussian basis sets. In the investigation of the contribution of the single-particle states, we expand the COSM wave function by using an extended completeness relation, which is constructed by the solution of the single-particle Hamiltonian. We use the complex scaling method to obtain the bound, resonant, and continuum states of the Hamiltonian and construct the extended completeness relation. The results are compared with those obtained by the Gamow shell model calculation.