6th OMEG Workshop 연구 성과 발표회

Date: DEC 20th, (wed) 2023 11:00-18:30

Place: Soongsil University Dasomhall (전산관)

Program

	Time	Speaker	Title
	10:40-11:00	Registration, discussions, chats	
Chair: Doris Y Kim			
1	11:00-11:10	Myung-Ki Cheoun	Opening
2	11:10-11:35	Ju-bin Park	AI-Enhanced R-Matrix Approaches in Scattering Analysis
3	11:35-12:00	Chae-min Yun	Constraints on the cosmological bulk viscosity in the interested epochs
4	12:00-12:25	Jeong-Yeon Lee	Consistent analyses of nuclear structures and reactions using the Gamow Shell Model
5	12:25-12:50	Dukjae Jang	Annual Progress Report 2023
	12:50-13:30		Taking a photo & Lunch Break
Chair: Kim HeeSang			
6	13:30-13:55	kiwan Park	자기장과 플라즈마 방정식의 특성 및 응용
7	13:55-14:20	SangHo Kim	Exclusive electroproduction of vector mesons
8	14:20-14:45	Tsuyoshi Miyatsu	Nuclear equation of state in relativistic mean-field models with isoscalar- and isovector-meson mixing
9	14:45-15:10	Jae Hwan Lee	Introduction of absorbing phase transition
	15:10-15:20		Coffee Break
Chair: Lee TaeHoon			
10	15:20-15:45	Yusuke Tanimura	Effect of center-of-mass correction on nuclear charge radius
11	15:45-16:10	Jiwon Park	Constraining the anisotropy of the universe during the radiation-dominated epoch
12	16:10-16:35	Gilberto Ramalho	Electric and Magnetic form factors of Hyperons at large timelike q2
13	16:35-17:00	Sehoon Oh	First-principles study of one-dimensional materials
	17:00-17:10		Taking a photo & Coffee Break
Chair: Kim JinMin			
14	17:10-17:35	EunJung Ko	Effects of structures and elements on shift currents in quasi-one-dimensional bulk ferroelectrics MOX_4 (M = Mo, W, and X = Cl, Br)
15	17:35-18:00	P. Karuna Kumari	First-principles investigation of electronic, ferroelectric, and piezoelectric properties, and spin-defect states in quasi-one-dimensional materials
16	18:00-18:25	Se Young Park	Electronic control of magnetism in Fe3-xGeTe2/In2Se3 van der Waals ferromagnetic/ferroelectric heterostructures

11:10-11:35
Title: AI-Enhanced R-Matrix Approaches in Scattering Analysis
Speaker: Jubin Park
Abstract: In this presentation, we explore the dual approaches of R-matrix theory—computable and phenomenological methods—in nuclear physics.
The computable method, grounded in the Schrödinger equation, enables detailed analysis of scattering characteristics, while the phenomenological approach
effectively parameterizes cross-sections in nuclear physics. Both methodologies have significantly contributed to our understanding of various scattering processes,
including elastic, inelastic, and radiation capture reactions. We aim to review these R-matrix methodologies and discuss the potential of emerging artificial intelligence
techniques in enhancing their application. This integration of AI with traditional physics methods holds promise for innovative advances in theoretical physics,
offering novel insights into complex physical phenomena.

11:35-12:00
Title: Constraints on the cosmological bulk viscosity in the interested epochs
Speaker: Chae-min Yun
Abstract: We consider how to determine the upper bounds on the cosmological bulk viscosity from a relativistic imperfect fluid for a toy model during an interested epoch, e.g. during the radiation- and matter-dominated eras with the conditions of decelerating and accelerating expansion of the universe, respectively.

12:00-12:25
Title: Consistent analyses of nuclear structures and reactions using the Gamow Shell Model
Speaker: Jeong-Yeon Lee
Abstract: The Gamow shell model (GSM) is an extension of the conventional shell model and uses Gamow-style many-body wavefunctions. GSM is based on Rigged Hilbert space and introduces complex-energy eigenstates. GSM is a quasi–stationary open quantum system extension of the standard configuration interaction approach for well-bound system. GSM explains bound, resonant, and non-resonant states, simultaneously, in unified bases. GSM allows for a unified treatment of nuclear structures and reactions. The main aspects of the GSM will be shown in this presentation

12:25-12:50
Title: Annual Progress Report 2023
Speaker: Dukjae Jang
Abstract: This presentation covers a comprehensive overview of my research throughout the year 2023. Specifically, I will provide a brief introduction to the papers published this year, present updates on recent research projects, and outline the research plan for the upcoming year, 2024.

13:30-13:55
Title: 자기장과 플라즈마 방정식의 특성 및 응용
speaker: 박기완
Abstract: 플라즈마 유체 이론과 자기장의 몇 가지 응용에 대한 소개를 한다. 첫 번째는 자기장이 플라즈마 시스템의 유전율을 변형시켜 핵반응에 나타나는 전위장벽을 낮추어 핵반응률을 높이는 연구를 소개한다. 두번째는 물질의 다양한 점성도와 자기저항에 따른 기전력의 선형화 계수의 변화를 소개한다. 세 번째는 플라즈마 유체 방정식에서 운동량 방정식이 의학 물리에 쓰이는 분야를 소개한다. 알츠하이머나 파킨슨 병은 뇌 내부의 노폐물이 뇌척수액에 의해 청소되지 않고 축적됨으로써 나타나는데, 유체 방정식을 사용해 척수액의 유동과 노폐 물질의 농도 변화를 일부 설명할 수 있다. 세가지 주제 모두 같은 편미분 방정식으로 묘사되는 특성이 있다.

13:55-14:20
Title: Exclusive electroproduction of vector mesons
speaker: SangHo Kim
Abstract: Exclusive electroproduction of vector mesons is a suitable place to test model predictions in a kinematic region where the transition between the hadronic and partonic domains is involved according to the ranges of the photon virtuality Q^2 and the photon energy W .
We investigate vector-meson electroproduction off the proton target by employing an effective Lagrangian approach. In addition to the universally accepted Pomeron exchange, we consider various meson exchanges in the t channel. We also introduce some Pomeron models for the description of hard diffraction which can be used in the future HERA and EIC experiments.

14:20-14:45

Title: Nuclear equation of state in relativistic mean-field models with isoscalar- and isovector-meson mixing

speaker: Tsuyoshi Miyatsu

Abstract: We construct nuclear equation of state (EoS) of dense matter using the relativistic mean-field (RMF) model with nonlinear couplings. Taking into account the results of neutron skin thickness of 208 Pb and 48 Ca by the PREX-2 and CREX experiments as well as the particle flow data in heavy-ion collisions, the observed mass of PSR J0740+6620, and the tidal deformability of a neutron star from GW170817, we build new effective interactions in the RMF model with the isovector, Lorentz-scalar meson. In addition, we study the effect of isoscalar- and isovector-meson mixing on the properties of finite nuclei, nuclear matter, and neutron stars.

14:45-15:10

Title: Introduction of absorbing phase transition

speaker: Jae Hwan Lee (이재환)

Abstract: Systems with absorbing (trapped) states may exhibit a nonequilibrium phase transition from a noise-free inactive phase into an everlasting active phase.

We briefly review the absorbing critical phenomena and universality classes, and discuss over the controversial issues on the pair contact process with diffusion.

To obtain accurate values of the critical exponents related to the correlation lengths, we employ a recently developed method to directly measure the spatial correlation length.

15:20-15:45

Title: Effect of center-of-mass correction on nuclear charge radius

speaker: Yusuke Tanimura

Abstract: Nuclear charge radius is one of the most fundamental observables of the atomic nucleus, and is measured with high precision. Although it represents simply the size of the nuclear many-body system, it exhibits signs of various nuclear structure effects. In this talk, I will present a systematic study of the charge radius with a particular focus on the "center-of-mass correction", which is associated with the inevitable spontaneous violation of the translational symmetry of the theory.

15:45-16:10

Title: Constraining the anisotropy of the universe during the radiation-dominated epoch

Presenter: Jiwon Park

Abstracts: Although our current universe is believed to be nearly isotropic, general relativity does not deny the possibility that the early universe was much more anisotropic than the present one. Understanding this anisotropy is an important task, as it could affect Big Bang nucleosynthesis and the formation of cosmic large-scale structures in the early radiation-dominated and matter-dominated universe. In this talk, we discuss how anisotropy in the early universe can be inferred from observations in the present universe. To this end, I will introduce how to convey the parameter estimation with nested sampling, a method of Bayesian statistical inference, and discuss whether it can be used to constrain the anisotropy of the early radiation-dominated universe. More generally, we will also discuss some physical implications of a relativistic fluid with anisotropy.

16:10-16:35

Title: Electric and Magnetic form factors of Hyperons at large timelike q2

Presenter: Gilberto Ramalho

In the last two decades it became possible to study the electromagnetic structure of the hyperons in the timelike region using electron-positron and proton-antiproton collisions, in facilities such as BaBar, BES, CLEO and PANDA.

In those experiments, is measured an effective form factor (G) of the hyperons, composed by a combination of the absolute values of the electric (GE) and magnetic (GM) form factors. More recently, it became also possible to measure the absolute value of the two electromagnetic form factors separately, as well as the ratio |GE|/|GM|. We present predictions for the effective form factor G and for |GE/GM|, for large values of q2. The calculations are based on a covariant quark model developed for the spacelike region (probed by electron beams), and extended to the timelike region. The results are compared with the available data.

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16:35-17:00

Title: First-principles study of one-dimensional materials

speaker: 오세훈 (Sehoon Oh)

Abstract: The atomic, electronic, and topological properties of quasi-one-dimensional linear chain compounds are explored using first-principles calculations. Interesting physical phenomena were discovered such as an unusual helical torsional wave in single-chain NbSe3, a size-driven metal-insulator transition in few-chain HfTe3. The discovery of heretofore unkwown van der Waals-bonded one-dimensional materials, NbTe3, VTe3, TiTe3, and Hf2Te9, were reported. Crystal-symmetry-protected topological invariants of the one-dimensional materials are also investigated, which could open up new opportunities in low-dimensional, gate-tunable, magnetic, and topological crystalline systems.

17:10-17:35

Title: Effects of structures and elements on shift currents in quasi-one-dimensional bulk ferroelectrics MOX_4 (M = Mo, W, and X = Cl, Br)

speaker: EunJung Ko

Abstract: Recently shift currents of bulk ferroelectrics has been studied intensively to discover efficient photovoltaic materials which enable the direct conversion of light to electricity. Based on the first-principles density functional theory, we investigate shift currents of quasi-one-dimensional bulk ferroelectric transition-metal oxytetrahalides MOX_4 (M = Mo, W, and X = Cl, Br) using wannier functions. Our systematic computation results show effects of structures and constituent elements of MOX_4 on electronic structures and eventually on shift currents. Especially, our band-dependent shift-current results exhibit unexpected shift currents originating from band mixing. As a result, shift currents of uniaxially strained MOX_4 turn out to be modulated by strain effects. Our findings provide the fundamental knowledge of shift currents associated with structures furthermore facilitate developments of advanced photovoltaic devices.

17:35-18:00

Title: First-principles investigation of electronic, ferroelectric, and piezoelectric properties, and spin-defect states in quasi-one-dimensional materials

speaker: P. Karuna Kumari

Abstract: Recent advancements in quasi-one-dimensional (1D) materials have opened new frontiers in the development of high-density memory devices. Quasi-1D materials consists of 1D chains weakly coupled by van der Waals interactions. In these materials, anisotropy coupling between local polarization can lead to small domain wall thickness in the weak coupling directions, facilitating their application in planar geometry devices with high spatial resolution. Additionally, the spatial confinement in these structures aids in isolating specific sites for spin-defect creation. We performed first-principles density functional theory (DFT) calculations to investigate the electronic properties of quasi-1D MOX 4 (M = Cr, Mo, W; X = F, Cl, Br) materials focusing on the compositional dependence on the ferroelectric and piezoelectric properties. These MOX 4 materials exhibit sizeable polarization, robust ferroelectricity, and high piezoelectric coefficients comparable to conventional ferroelectrics. Our findings reveal that the energy cost for the formation of 180 ◦ domain walls is negligibly small, resulting in atomically thin domain wall with almost zero reduction in the local polarization.

18:00-18:25

Title: Electronic control of magnetism in Fe3-xGeTe2/In2Se3 van der Waals ferromagnetic/ferroelectric heterostructures

speaker: Se Young Park

Abstract: We investigate the electronic and magnetic properties of ferromagnetic/ferroelectric in Fe3-xGeTe2/In2Se3 heterostructures. It is observed that gate voltages applied to the Fe3xGeTe2/In2Se3 heterostructure device modulate the magnetic properties of Fe3-xGeTe2 with a significant decrease in the coercive field for both positive and negative voltages. Raman spectroscopy on the heterostructure device shows a voltage-dependent increase in the in-plane In2Se3 and Fe3-xGeTe2 lattice constants for both voltage polarities. Thus, the voltage-dependent decrease in the Fe3-xGeTe2 coercive field, regardless of the gate voltage polarity, can be attributed to the in-plane tensile strain. This is supported by density functional theory calculations showing tensile-strain-induced reduction of the magnetocrystalline anisotropy, which in turn decreases the coercive field. Our results demonstrate an effective method to realize low-power voltage-controlled vdW spintronic devices utilizing the magnetoelectric effect in van der Waals ferromagnetic/ferroelectric heterostructures.