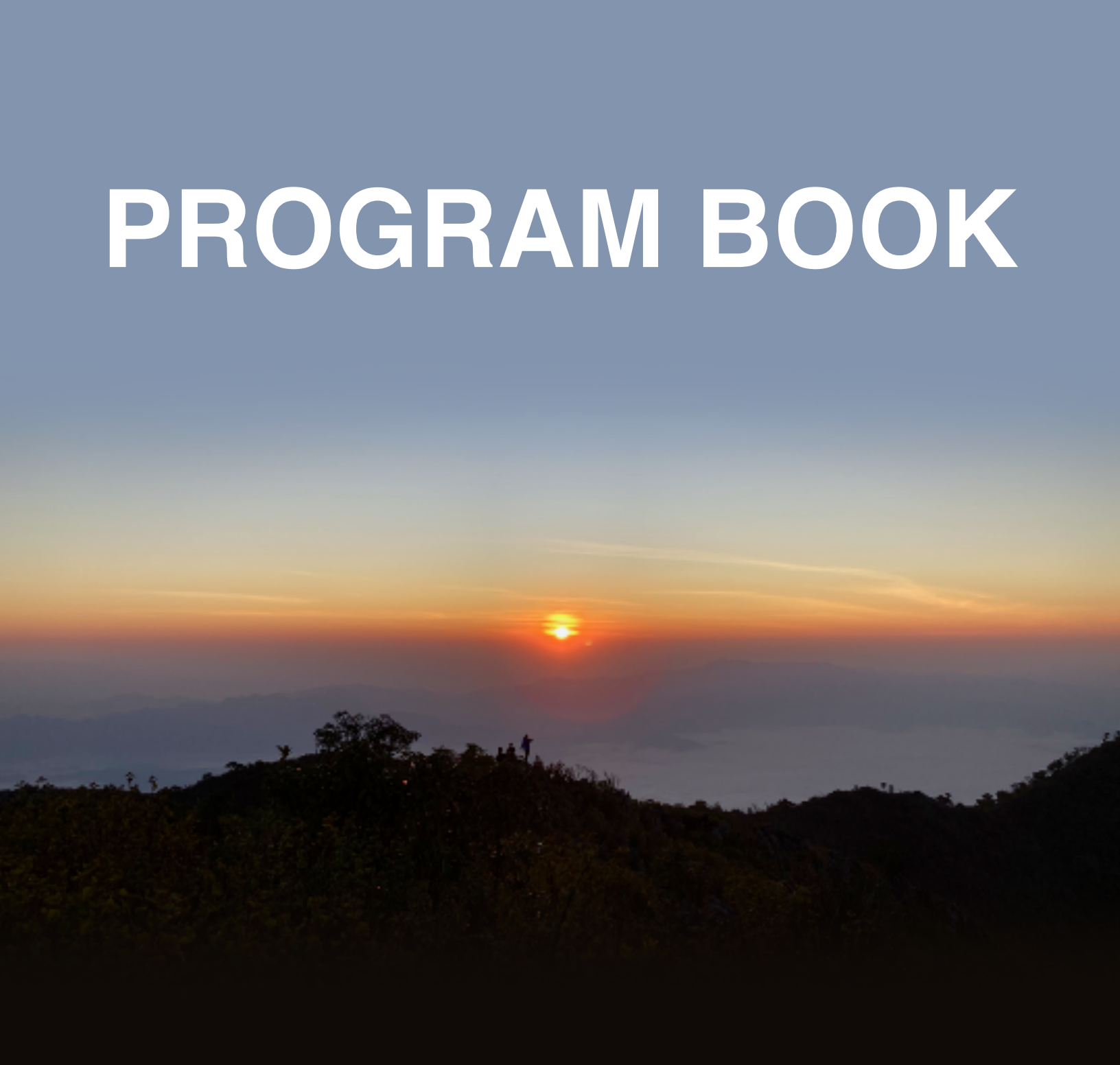
PROGRAM BOOK



The 6th Sino-Thai Symposium on High Energy Physics, Astrophysics, and Materials Science (STSP 2024)

Chiang Mai, Thailand | August 19 – 13, 2024

Content

About

The 6th Sino-Thai Symposium on High Energy Physics, Astrophysics and Material Science (STSP2024) will be held in Chiang Mai, Thailand, during 19 - 23 August, 2024. STSP is a series of symposiums organized since 2011. Previous editions have been organized in the following dates and venues:

	Meeting	Field	Place	Date	Main organizer(s)	Co-organizer(s)
1	STSP2011	High Energy Physics	Wuhan, China	22 – 27 April 2011	CCNU	SUT
2	STSP2012	High Energy Physics and Astrophysics	Nakhon Ratchasima, Thailand	30 July – 4 August 2012	SUT	CCNU, NARIT, RMUTI, SLRI, & ThEP
3	STSP2014	High Energy Physics	Wuhan, China	1 – 6 June 2014	CCNU	SUT
4	STSP2016	High Energy Physics and Astrophysics	Chiang Mai, Thailand	3 – 8 July 2016	SUT & NARIT	CCNU
5	STSP2018	High Energy Physics and Astrophysics	Lijiang, China	18 – 22 July 2018	YNAO	NARIT, CCNU, & SUT

The cooperation between China and Thailand has been a time-honored, fruitful and of healthy development. The purpose of this symposium is to jointly strengthen the Sino-Thai relationship and deepen the scientific cooperation in high energy physics, astrophysics, and relevant fields which conform to the common interests of both the countries.

The STSP has truly served as a venue for researchers in high energy physics and astrophysics from both China and Thailand to exchange their research results and knowledges. It has also been a stage for network developments between Chinese and Thai physicists.

Organizing Committee

Apimook Watcharangkool (NARIT)	
Ayut Limphirat (SUT)	**Co-chair**
Boonrucksar Soonthornthum (NARIT)	**Co-chair**
Chinorat Kobdaj (SUT)	
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Wiphu Rujopakarn (NARIT)	
Yupeng Yan (SUT)	

Program

Opening Ceremony and Conference Report

August 19th, 2024		
Time		**Program**
15.00	17.00	Registration at hotel lobby

August 20th, 2024		
Time		**Program**
Venue: Princess Sirindhron AstroPark		
08.30	09.00	Travel to Princess Sirindhron AstroPark
09.00	09.30	Registration
09.30	10.00	Opening Ceremony: 1. Welcome speech by Dr. Saran Poshyachinda 2. Welcome speech by Prof. Dr. Santi Maensiri 3. Open by Prof. Boonrucksar Soonthornthum
Group photo and coffee break		
10.30	12.00	Visit NARIT's laboratories
Lunch		
13.30	14.30	Travel to the Thai National Radio Astronomy Observatory (TNRO)
14.30	16.00	Visiting TNRO
16.00	17.00	Travel back to the city
18.00	21.00	Reception at Khum Khantoke

Plenary session

Venue:

August 21st, 2024			
Time		**Speaker**	**Title**
Session Chair: Puji Irawati			
09.00	09.40	Shengbang Qian	Mass ejections and physical properties of accreting disk during nova explosions
09:40	10.20	Santi Maensiri	Nanomaterials and composites for energy storage applications

August 22nd, 2024			
Time		**Speaker**	**Title**
Session Chair: Yupeng Yan			
09.00	09.40	Boonrucksar Soonthornthum	Sino-Thai Collaboration: A Global Challenge
09.40	10.20	Chunxu Yu	Status and perspective of the CEPC

Session Meeting of High Energy Physics

Venue:

August 21st, 2024			
Time		**Speaker**	**Title**
Session Chair: Khanchai Khosonthongkee			
10.40	11.10	Zhiyong Wang	Recent advances in hadron production in e^+e^- annihilation at BESIII
11.10	11.40	Cong Li	Study of e^+e^- to $\Omega^-\ \Omega^+$ process
11.40	12.10	Zheng Zhao	Study of S- and P-wave charmonium-like tetraquark mass spectrum
Lunch			
Session Chair: Chunxu Yu			
13.30	14.00	Xiaomei Li	R&D of advanced detectors and international collaboration at CIHENP
14.00	14.30	Kai Xu	Investigation of helicity amplitudes of N(1520) and N(1535) resonances including pentaquark components
14.30	15.00	Ek-ong Atthaphan	Determining the meson cloud contribution of nucleon electromagnetic form factor using dispersion relation
Coffee Break			
Session Chair: Kai Xu			
15.20	15.50	Atirat Pitaktrakul	Simulation study on neutron flux and radiation safety design for the Suranaree University of Technology Research Reactor (SUT-RR) building using Monte Carlo N-Particle (MCNP)
15.50	16.20	Ziya Zhang	Performance study of a new cluster splitting algorithm for the reconstruction of PANDA EMC data
16.20	16.50	Jittinun Saenpoowa	Comparative analysis of neutron shielding properties in natural rubber-boron carbide composites and borated polyethylene using Monte Carlo N-Particle simulations

Session Meeting of High Energy Physics

Venue:

August 22nd, 2024			
Time		**Speaker**	**Title**
Cofee Break			
Session Chair: Chia-Chu Chen			
10.40	11.10	Thanat Sangkhakrit	Radiative decays of χ_{c1} states in effective field theory approach
11.10	11.40	Minghao Li	** Partial wave analysis of $\Psi(3686) \rightarrow p\,K^{-}\overline{\Lambda} + c.c$
11.40	12.10	Danhao Zhang	Study of $e^{+}e^{-} \rightarrow \pi^{+}\pi^{-} - Ds^{+}Ds^{-}$
Lunch			
Session Chair: Yuliang Yan			
13.30	14.00	Xiyuan Shao	Overview of PandaX-4T experiment
14.00	14.30	Dong Shan	The light simulation of PandaX-20T
14.30	15.00	Attaphon Kaewnsod	Investigation of the $\Delta(1232)$ resonance substructure in the $p\gamma^{*} \rightarrow \Delta(1232)$ process through helicity amplitudes
Coffee Break			
Session Chair: Ayut Limphirat			
15.20	15.50	Yue Chang	High precision TPC Detection Technology for CEPC
15.50	16.20	Apiwit Kittiratpattana	Nuclei and hypernuclei production from the pion beam at HADES
16.20	16.50	Discussion on Sino-Thai Collaboration in CEPC	
18.00	21.00	Banquet	

Session Meeting of Astrophysics

Venue:

August 21st, 2024			
Time		**Speaker**	**Title**
Session Chair: Puji Irawati			
10.40	11.10	Liying Zhu	Contact binaries towards merging
11.10	11.40	Jingjing Wang	The activities on two W-subtype solar-like contact binary
11.40	12.10	Nianping Liu	On the structure and the subtype phenomenon of late-type contact binaries
Lunch			
Session Chair: Shengbang Qian			
13.30	14.00	Huiting Zhang	Study on the long-period Algol-type binary stars
14.00	14.30	李 福兴	Analysis and study of massive binaries in the Magellanic Cloud
14.30	15.00	Linfeng Chang	The search and study on faint companions to B-type stars
Coffee break			
Session Chair: Shengbang Qian			
15.20	15.50	Wenping Liao	Intriguing multiple-star systems
15.50	16.20	Zhongtao Han	Study on three eclipsing accreting white dwarfs based on ground-based and TESS observations
16.20	16.50	Qi-Bin Sun	Tilted disk precession in cataclysmic variables

Session Meeting of Astrophysics

Venue:

August 22nd, 2024			
Time		**Speaker**	**Title**
Session Chair: Liying Zhu			
10.40	11.10	Xiang-Dong Shi	Search and study of OB-type pulsating stars
11.10	11.40	Ergang Zhao	Eclipsing binaries with pulsating component based on sky survey
11.40	12.10	Lin-Jia Li	RR Lyrae stars and their binarity
Lunch			
Session Chair: Apimook Watcharangkool			
13.30	14.00	Napat Nabklang	Optimizing machine learning in astrophysics: Enhancing variable star classification and globular cluster detection by ensemble method
14.00	14.30	Farah Najla	Radial velocity study of white dwarf and A, F, G, K main sequence binaries with Thai National Telescope
14.30	15.00	Chitipat Deesamer	Effect of the neutrino oscillation above the neutrino-dominated accretion flows around black holes
Coffee Break			
Session Chair: Apimook Watcharangkool			
15.20	15.50	Kamonwan Khanthasombat	Comparative analysis of the disc-corona parameters in X-ray reverberation models: KYNxilev and KYNrefrev
15.50	16.50	Discussion	
18.00	21.00	Banquet	

List of Abstracts – Plenary Talks

August 21st, 2024

Mass ejections and physical properties of accreting disk during nova explosions

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Classical novae are caused by thermonuclear eruptions on the surfaces of white dwarfs accreting material from their hydrogen-rich companions in cataclysmic variables (CVs), which produces mass ejection and loss as well as inducing disk precessions. However, both the mass-loss rate and physical properties of accreting disk during nova outbursts are poorly understood. The release of a large amount of photometrically survey data provides a valuable opportunity to study the properties of classical novae. We have already carried out in-depth investigations on classical novae based on TESS data. In this talk, I will review some of the progresses. A large suddenly increase in the orbital period is discovered during a nova eruption, which is caused a mass ejection larger than 24 Jupiter masses. This is about two orders of magnitude larger than those determined ever before, which will cause a decline in accretion rate of the CV and thus a hibernation after the nova eruption. The precession and nutation of the accreting disk are found during the nova outburst. Meanwhile, the shortest period novae are also detected. These results will shed light on the hibernation theory of novae, and suggest that classical novae, the most common astrophysical thermonuclear explosions, may be major contributors to Galactic-scale nucleosynthesis

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Nanomaterials and Composites for Energy Storage Applications

S. Maensiri[1,2,3,*], S. Chaisit[1,2,3], U. Wongpratat[1,2,3], S. Sonsupab[1,2,3], J. Khajonrit[1,2,3], T. Sichumsaeng[1,2,3], O. Kalawa[1,2,3], W. Senanon[1,2,3], C. Veann, P. Kidkhunthod[4], and N. Chanlek[4]

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In this talk, we report the development of electrode materials consisting of nanomaterials and composites such as biomass-derived porous carbon materials, nanostructured oxides, and composites. The nanostructured materials and composites are prepared through various synthetic methods including sol-gel, hydrothermal, electrospinning, etc. The physical characteristics of the materials are deliberated and discussed in detail using basic and synchrotron-based characterization techniques. The electrochemical performances of the materials are evaluated in aqueous-based electrolytes via electrochemical techniques consisting of cyclic voltammetry (CV), galvanostatic charge/discharge (GCD), and electrochemical impedance spectroscopy (EIS). Lastly, a simple fabrication of energy storage devices using the developed electrode materials as cathode/anode is demonstrated for energy storage applications.

Keywords**:** Biomass; Metal oxides; Glass; Composite materials; Electrode materials; Electrochemical capacitors; Energy storage

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August 22nd, 2024

Sino-Thai Collaboration: A Global Challenge

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Since 2011, the 1st Sino-Thai Symposium focused on High Energy Physics (STSP) was first initiated in 2011 under the cooperation between Suranaree University of Technology (SUT), Nakorn Ratchasima, Thailand and Central China Normal University (CCNU) in Wuhan, P.R. of China. After the 1st successful symposium, the other 2nd symposium was organized in Nakorn Ratchasima, Thailand hosted by SUT in 2012 and the 3rd Symposium in 2014 in Wuhan hosted by CCNU.

It was agreed in principle that the Sino-Thai symposium would be organized alternatively between Thailand and China to strengthen the close collaboration not only in High Energy Physics but also the other disciplines beyond this field. In 2016, the National Astronomical Research Institute of Thailand (NARIT) was invited to join in organizing this symposium and including Astrophysics which Thailand is actively cooperated with China especially Yunnan Observatories, Chinese Academy of Sciences. At Present, the Sino-Thai cooperation has extend to several disciplines and we have received the continuous patronage from HRH Princess Maha Chakri Sirindhorn for more than few decades for her initiatives on several key cooperative projects between Peoples' Republic of China and Thailand, for example, Astrophysics under collaboration with Yunnan Observatories (YNO) and Shanghai Astronomical Observatory (SHAO) , in High Energy Physics under collaboration with the Institute of High Energy Physics (IHEP) and Space Science and Technology under collaboration with China National Space Agency (CNSA) including more active collaborations on research and education in Physics and Materials with universities and research institutes in China.

I believe the long-lasting Sino-Thai collaboration on High Energy Physics, Astrophysics and beyond would definitely be a global challenge for the cooperative research and education, infrastructure development, human capacity buildings which would benefit for the sustainable development on Science and Technology of the Peoples' Republic of China and Thailand.

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August 22nd, 2024

Status and Perspective of the future CEPC

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A worldwide high energy physics community of the physicists was working to realize an exceptional physics program of the energy-frontier, electron-positron collision, especially for the Circular Electron Positron Collider (CEPC), International Linear Collier (ILC) and Future Circular Collider (FCC-ee). The center of mass energies will be reached in several stages from 250 GeV possibly up to 1 TeV with the possibility of the short calibration runs at Z pole of 91 GeV. One of the main goals is to study the Higgs-boson and determine its properties with high statistics and high precision. The future e^+e^- collider experiments will not only search to understand the predicted mass generation mechanisms and super symmetric particles, but also for the un-predicted.

After the enormous efforts and achievements from CEPC team as well as its IAC, IARC and TDR review committee for more than 10 years, the significant progress has been achieved including of the accelerate technology, the physics technology and so on. This talk will present the updated progress of CEPC study group, which was proposed by Chinese HEP community in 2012, right after the Higgs discovery. Its aim is to start operation in 2030s, as a Higgs/Z/W factory, and the accelerator Technology Design Report (TDR) has been released in the end of 2023. The physics and detector Design Report also prepared and will be released in June next year.

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Recent Advances in Hadron Production in e^+e^- Annihilation at BESIII

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This talk will present recent experimental findings at BESIII, encompassing three distinct studies. Firstly, the search for the production of deuterons and antideuterons in e^+e^- annihilation at center-of-mass energies between 4.13 and 4.70 GeV is discussed. The investigation aims to unravel the production mechanisms and properties of these light nuclei, shedding light on the dynamics of hadronization and quark-gluon interactions. Secondly, the measurement of the Born cross-section of $e^+e^- \rightarrow \Sigma^+$ anti-Σ^- at center-of-mass energies between 3.510 and 4.951 GeV is addressed. This study provides valuable insights into the production of Σ^+ anti-Σ^- pairs in e^+e^- collisions, contributing to our understanding of hadron dynamics in this energy regime. Finally, the observation of significant flavor-SU(3) breaking in the kaon wave function at 12 $GeV^2 < Q^2 < 25$ GeV^2 and the discovery of the charmless decay $\psi(3770) \rightarrow K_{0S} K_{0L}$ are discussed. These results offer new perspectives on the flavor dynamics within the kaon wave function and the rare decay processes involving the $\psi(3770)$ resonance.

Study of $e^+e^- \rightarrow \Omega^-\bar{\Omega}^+$ process

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Using e^+e^- collision data corresponding to a total integrated luminosity of 22.7 fb^{-1}, collected at center-of-mass energies between 3.7 and 4.7 GeV with the BESIII detector operating at the BEPCII storage ring, we present a measurement of energy-dependent Born cross sections and effective form factors (or their upper limits) for the $e^+e^- \rightarrow \Omega^-\bar{\Omega}^+$ process based on a single baryon tag method. From the distribution of measured cross sections, we can search for the charmonium-like vector states in its baryonic decay. The measured effective form factors provide essential information to understand the structure of Ω^- hyperons. In addition, BESIII so far has collected 27.13×10^8 $\psi(2)$ events at the center-of-mass energy of 3.686 GeV. The first orbital (1P) excitations of Ω^- with negative parity were expected around 2 GeV by many theoretical predictions. The center-of-mass energy at 3.686 GeV is sufficiently high to search for lighter excited Ω^- hyperons within the region from 1.75 to 2 GeV through the process of $\psi(2S) \rightarrow \Omega^{*-}\bar{\Omega}^+$. This study will provide interest of theoreticians in understanding the nature of the excited Ω^- state and help to interpret different theoretical models.

Study of S- and P-wave charmonium-like tetraquark mass spectrum

Zhao, Z.[1,*], Xu, K., Tagsinsit, N., Kaewsnod, A., Limphirat, A. Yan, Y.
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The masses of S- and P-wave charmonium-like tetraquark are calculated in a constituent quark model (CQM) where the Cornell-like potential and Breit-Fermi interaction are employed. All model parameters were predetermined by studying the low-lying S- and P- wave light, charmed, and bottom meson mass spectra.

The S-wave tetraquark theoretical results are compared with the observed X and Z stated, and one tentative assignment is suggested. All charged charmonium-like tetraquark states can be accommodated in this tetraquark interpretation except for Z(3900). The P-wave tetraquark theoretical results are compared with the selected exotic states, also known as Y states, and one tentative assignment is suggested. The work suggests that $\psi(4230)$ and $\psi(4360)$ might be P-wave tetraquark states.

R&D of Advanced Detectors and International Collaboration at CIHENP

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This report will mainly introduce R&D of Advanced Detectors and International Collaboration at CIHENP (CIAE Intermediate and High Energy Physics). Integrated Micromegas detector is a new type of micro-pattern gas detector utilizing photoetching technology for its production. Capacitance testing across each channel has confirmed good uniformity, gain and energy resolution under varying Ar and CO_2 ratios. The detector is now capable of mass production with all processes conducted domestically.

In cooperation with Fudan University and Peking University, we completed the R&D, production, and testing tasks for the electromagnetic calorimeter of the sPHENIX experiment. This marks the first use of innovative technologies such as tungsten powder, scintillating fibers with SiPM readouts technology for calorimeter signals in high-energy collision experiment. By establishing Beijing and Shanghai Development Center, Chinese team developed 1228 scintillating fiber detectors for the sPHENIX experiment, achieving a yield rate of 97%.

CIHENP also involves ALICE Focal upgrade, and is developing detectors and electronics. Currently, these detectors have been applied to several X-ray, muon and neutron experiments.

Investigation of helicity amplitudes of N(1520) and N(1535) resonances including pentaquark components

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We study the helicity amplitudes of the N(1520) and N(1535) resonances via photo production process $\gamma^* p \to N^*$, where N^* includes both L=1 three-quark core and ground state $q^4\bar{q}$ pentaquark components. The helicity transition amplitudes $A_{\frac{1}{2}}, A_{\frac{3}{2}}$ (for spin 3/2 states) and $S_{\frac{1}{2}}$ of the three-quark core and the pentaquark states are calculated in the constituent quark model using the impulse approximation, where one gluon is exchanged for the pentaquark states. The theoretical results on the helicity amplitudes of L=1 three-quark contribution and the ones from the coupling of the three-quark core and pentaquark contributions are compared to the experimental results. The fact that a better fit to the helicity amplitudes in the mixing three-quark and pentaquark picture indicates us that the lowest negative-parity nucleon resonances may include a considerable ground state pentaquark components.

Determining the Meson Cloud Contribution of Nucleon Electromagnetic Form Factor Using Dispersion Relation

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In this study, we present an approach to determine the meson clouds contribution of nucleon electromagnetic form factor by utilizing dispersion relation. This work mainly focuses on the vector form factor for nucleon. The experimental results of transition amplitudes for pion-nucleon scattering are taken directly to derive the contribution of meson cloud to the nucleon form factor, under the assumption that the nucleon pole term serves as the main contribution. With the characteristic of the nucleon pole term, meson cloud in this work contains only vector pion. This meson cloud distribution from dispersion relation approach might be combines with quark core contribution from quark model to reveal the electromagnetic structure of the nucleon resonances. This paper shows that for the proton case, this approach can give a well-fitted form factor.

Simulation Study of Neutron Flux and Radiation Safety Design for the Suranaree University of Technology Research Reactor (SUT-RR) building using Monte Carlo N-Particle (MCNP)

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Nuclear safety is one of the primary concerns for all nuclear facilities. Before construction, a detailed simulation radiation map of neutron flux distribution inside the facility should be calculated. This study aims to assess radiation levels inside the Suranaree University of Technology Research Reactor (SUT-RR) building during normal operation. We utilize TopMC software to convert the building's CAD models and beam ports into the Monte Carlo N-Particle (MCNP) framework to simulate neutron flux distribution. There are four irradiation rooms, which we emphasize in this present work. Preliminary results indicated that the maximum neutron flux at the horizontal ports was $(7.6 \pm 0.4) \times 10^7\ n\ cm^{-2}s^{-1}$, $(8 \pm 3) \times 10^5\ n\ cm^{-2}\ s^{-1}$, $(5.1 \pm 0.6) \times 10^5\ n\ cm^{-2}s^{-1}$, and $(2.7 \pm 0.6) \times 10^6\ n\ cm^{-2}s^{-1}$, respectively. These values were used to calculate neutron dosage in those irradiation rooms. The results will be compared with radiation safety standard set by the International Atomic Energy Agency (IAEA). This analysis will enhance the design and construction quality of SUT-RR facilities, ensuring they meet stringent safety standards and provide effective protection against radiation risks.

Performance Study of a New Cluster Splitting Algorithm for the Reconstruction of PANDA EMC Data

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For the high momentum π^0 mesons, the angle between the two final-state photons decreases with the increase of the momentum of the π^0, which enhances the probability of overlapping electromagnetic showers. The performance of the cluster splitting algorithm in the EMC reconstruction is crucial for the mass resolution measurements of the π^0 at high momenta. If there are several local maxima in a cluster, it is considered as a superposition of a multiple showers. It is necessary to split the cluster according to the number of maxima. The classical cluster splitting algorithm is based on the theoretical lateral distribution of electromagnetic showers which can be described as a (multi-)exponential function. In a realistic electromagnetic calorimeter, considering the granularity of the detector, the measured energy in a cell is actually the integral of the theoretical energy deposition, which deviates from the exponential function. Based on the simulation of the barrel EMC of the PANDA experiment, the cluster splitting algorithm is updated using a new lateral energy measurement function which depends on the dedicated granularity of the detector. The mass resolution of π^0 has been improved in the high momentum range compared with the previously used method.

Comparative Analysis of Neutron Shielding Properties in Natural Rubber-Boron Carbide Composites and Borated Polyethylene using Monte Carlo N-Particle Simulations

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Nuclear reactors and other high-energy physics application necessitate neutron shielding materials to protect individuals from harmful neutron radiation. This study investigates the neutron shielding made from the natural rubber with the coron carbide composite and borated polyethylene (BPE) composite materials. Natural rubber and polyethylene are chosen for their flexibility and high hydrogen content, which is necessary to decrease neutron energy, while boron carbide is selected for its high neutron cross section. The Monte Carlo N-Particle (MNCP) simulation program was used to find neutron shielding properties of composite materials. Our simulation focuses on the macroscopic cross-section values obtained from the neutron flux for materials containing different concentration of boron carbide 50 percent by weight at thickness of 0.5, 1, 2, 3, and 5 cm. A 14 MeV point source of neutron radiation with 5000000 neutron particles was employed for the simulation. The results indicate that BPE composites and natural rubber with boron carbide composites exhibit macroscopic cross—section values of 0.1227 cm^{-1} and 0.1017 cm^{-1} respectively. The comparison revealed that a 5.2981 cm thick natural rubber boron carbide composite and a 5 cm thick BPE composite yield a residual neutron flux of $0.000512\ neutrons\ cm^{-2}s^{-1}$.

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Radiative Decays of χ_{c1} States in Effective Field Theory Approach

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The $\chi_{c1}(3872)$ state, discovered by the Belle, BABAR, CDF, D0, and LHCb collaborations, with its quantum numbers identifies as $J^{PC} = 1^{++}$, has been extensively investigated due to its intriguing properties. Various theoretical interpretations, including the $\chi_{c1}(2P)$, the molecular $\bar{D}^*D/\bar{D}D^*$, and the compact tetraquark states have been proposed to explain its unique characteristics. However, the issues related to its mass coincidence with the threshold and isospin violation pose challenges within the frameworks of both pure $c\bar{c}$ and compact tetraquark models.

An upgrade of the electron energy to 22 GeV at CEBAF presents a valuable opportunity to address these puzzles. This upgrade will facilitate the measurement of the energy dependence of the production rate, allowing us to explore the production mechanism of the $\chi_{c1}(1P)$ and $\chi_{c1}(3872)$ state in γ^*p reactions.

In this study, we investigate the radiative decays of the $\chi_{c1}(1P)$ and $\chi_{c1}(3872)$ states within the framework of effective field theory, incorporating triangle loops of D and D^* mesons. The model parameters are determined based on the observed branching fractions of the radiative dacay modes $\chi_{c1} \to J/\psi\gamma, \rho\gamma, \omega\gamma$. Additionally, we apply this model to calculate the production rates of the reactions $\gamma^*p \to J/\psi\gamma, \rho\gamma, \omega\gamma$. This inclusion of triangle loops in theoretical models has the potential to deepen our understanding of production mechanisms and elucidate the observed features of these exotic states.

Partial Wave Analysis of $\psi(3686) \to pK^-\overline{\Lambda} + c.c.$

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A study on baryon spectroscopy is conducted to investigate intermediate excited states using a partial wave analysis of $\psi(3686) \to pK^-\overline{\Lambda} + c.c.$ and its charged conjugate. The study utilizes 2.7 billion $\psi(3686)$ events collected in 2009, 2012 and 2021. The intermediate resonant states in the decay process are investigated using the partial wave analysis of Feynmann diagram calculation (FDC-PWA). In the fitting, 16 resonance states are used as the base solution, with each resonance state required to be significantly greater than 5σ. The study determined the branching graction to be $\mathcal{B}(\psi(3686) \to pK^-\overline{\Lambda}) = (131.48 \pm 0.45 \pm 6.18) \times 10^{-6}$.

Study of $e^+e^- \to \pi^+\pi - Ds^+Ds^-$

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We present a measurement of the Born cross-section of $e^+e^- \to \pi^+\pi^- Ds^+Ds^-$ using the e^+e^- collision data collected with the BESIII detector operating at the BEPCIII storage ring at 15 energy points from $\sqrt{s}$ = 4.42 GeV to 4.946 GeV. By merging datasets from 15 energy points, the process of $e^+e^- \to \pi^+\pi^- Ds^+Ds^-$ is observed for the first time with a statistical significance of 5.1σ. Additionally, the upper limits for the Born cross-section are measured at various energy points.

Overview of PandaX-4T Experiment

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Like ordinary matter, the mysterious dark matter in the Universe may be composed of fundamental particles. The hunt for these particles has been intensively carried out globally using many different particle detectors. Dark matter direct detection experiments, typically located deep underground, are particularly sensitive to dark matter within a mass range approximately from GeV/c^2 to $100\,TeV/c^2$, via the nuclear recoil (NR) of the target nucleus. In recent years, large-scale liquid xenon time projection chambers (TPCs) have spearheaded the detection sensitivity.

The PandaX experiment, located in the China Jinping Underground Laboratory (CJPL), is dedicated to search for dark matter particles and to study fundamental properties of neutrinos. CJPL is one of the most ideal sites for low background experiments, with an overburden of roughly 2400 m, it has an extremely low cosmic-ray muon flux and muon-induced background rate. This report will report several systems of PandaX-4T, and show report of the first dark matter search result using commissioning data.

The Light Simulation of PandaX-20T

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PandaX (Particle AND Astrophysical Xenon detector) experiment, led by Shanghai Jiao Tong University, is a series of experiments using xenon nuclei as target atoms. PandaX series experiments mainly detect WIMP particles in dark matter candidate particles. Since its inception in 2009, three experiments, PandaX-I, PandaX-II, and PandaX-4T have been conducted. The PandaX-II and PandaX-4T experiments gave world-leading limits on the parameter space of dark nucleon interactions in 2017 and 2021, respectively, and for PandaX-4T, the first two rounds of run0 and run1 fetch and data analysis have been completed. The third round of fetch run2 for PandaX-4T began recently.

At present, the PandaX series detectors are planned to be upgraded to the 20T magnitude-PandaX-20T, compared with the PandaX-4T, the effective mass of liquid xenon, refrigeration system, photomultiplier tube and so on have been upgraded. Recently, we built ad 1T-scale model of our PandaX-20T detector at the Tsung-Dao Lee Institute. I performed the light simulation of PandaX-20T.

Investigation of the $\Delta(1232)$ Resonances Substructure in the $p\gamma^* \rightarrow \Delta(1232)$ process through helicity amplitudes

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This work investigates the substructure of the $\Delta(1232)$ resonance in the $\Delta(1232)$ process through helicity amplitudes within the quark model framework. We consider the involved baryons composed of three quarks, and both the quark core and meson cloud contribute to the transition amplitudes. The comparison of theoretical results with experimental data reveals that, rather than the L = 0 component of the $\Delta(1232)$ resonance, it is the L = 2 resonance that significantly affect its $S_{\frac{1}{2}}$ amplitude. These findings indicate that the $\Delta(1232)$ resonance likely contains a substantial L = 2 component, challenging the conventional view of the $\Delta(1232)$ resonance as a L = 0 baryon.

High Precision TPC Detection Technology for the Future Circular e^+e^- Collider

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The Circular Electron Positron Collider (CEPC) was proposed as a Higgs and high-luminosity Z factory in Chinese High Energy Physics community, and the accelerator Technology Design Report (TDR) was released at the end of 2023. The baseline detector design features a high-precision (approximately 100 μm) spatial resolution Time Projection Chamber (TPC) as the main tracking device surrounding a 3.0 solenoid field, even when operated at Tera-Z. The TPC technology requires a longitudinal time resolution of 100 ns, and the physics requirement of PID resolution should be less than 3%. In this talk, the feasibility and status of high precision TPC as the main track detector for e^+e^- collider will be presented. Compared with the pad readout using the simulation, the high granularity readout TPC option will achieve better spatial resolution for single electrons, and the very high detection efficiency in excellent tracking and good PID performance (less than 3σ). The results of track reconstruction performance and dE/dx are presented. We will review the results of track reconstruction performance and summarize the next step towards TPC construction for CEPC physics and the detector TDR.

Nuclei and Hypernuclei Production from the Pion Beam at HADES

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Recent measurements on proton and Λ production at HADES imply a substantial amount of stopping power at target nuclei. This motivates further investigation into the anticipated nuclei and hypernuclei formation at these collision systems. The Ultra-relativistic Quantum Molecular Dynamics (UrQMD) transport model is employed to simulate corresponding collision system at HADES, $\pi^- + C$ and $\pi^- + W$, at $p_{lab} = 1.7\ GeV$. The results and the experimental data are in agreement. However, residual free protons outside the p_T spectra have to be adjusted. The nuclei and hypernuclei are produced using the coalescence model and the Statistical Multifragmentation Model (SMM). The results on d, t, He^3, He^4, and He^3_Λ are comparable between the two models. The finding suggests that nuclei and hypernuclei abundances, even for larger masses, from the pion beams at HADES are large enough to study in details, and even double-strange hypernuclei are possible with higher beam moments.

List of Abstracts – Astrophysics

August 21st, 2024

Contact Binaries towards Merging

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Contact binaries are special binary system consisting of two strongly interacting component stars where they are filling their critical Roche lobes and sharing a common envelope. Most of them are believed to be formed mainly from the detached systems through near contact binaries. When they evolve to their late stage, they may finally merge into the fast-rotating single stars (e.g. FK Come-type stars and blue stragglers) and produce luminous red novae. Contact Binaries towards Merging are an excellent laboratory for studying stellar coalescence and merging processes. We began to search for them in 2004 and found a group of such systems. In this talk, I will review our latest research progress including the founding of the lowest mass-ratio system (q~0.04), the highest filling-out systems (f>90%), et cetera. Some of them show rapid period decrease and may merge in the future. Furthermore, we detected a very high proportion of the presence of third bodies orbiting around DLMCBs. Some of them have large and unseen companions, which may be the candidates of neutron star or black holes. It is possible that the evolution of DLMCBs may be driven by the third body, which is similar to the merging of two black holes (and producing a gravitational wave) by a third body.

The Activities on Two W-subtype Solar-like Contact Binary

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Compared with the Sun, there is stronger magnetic activity on the surface of the component star in solar-like contact binaries, and periodic oscillations in the long-term variation of the orbital period of some systems. The O' Connell effect and its variation in the light curves of close binary, have been suggested as direct evidence of magnetic activity, such as dark spot. Considering the discontinuity of ground-based telescope observations, it leaks to our insufficient understanding of the O' Connell effect and the variations of the magnetic activities within a short period of time. The data from KEPLER, TESS survey, which are high-precision and short-time continuous observations, provide better opportunity for us to do some studies. V2284 Cyg is a neglected W UMa-type binary star for photometric investigations. Monitored by the Kepler Space Telescope from 2009 to 2013, its light curves are continuously stable, suggesting that both components are inactive during this time interval. But, from the previous studies, the LCs by other ground-based telescope are variable from 1973 to 2020, particularly the magnitude difference between the two maxima. These phenomena indicate that the component has been active in the past 47 years. In addition, during monitoring by the space telescope Transiting Exoplanet Survey Satellite from January to March 2020, we fortunately found continuous variations from the O' Connell effect in every cycle for the first time. The magnetic activity, variations of orbital period, third body and evolution will be discussed.

On the structure and the subtype phenomenon of late-type contact binaries

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The A- and W-subtype classification is a widely accepted concept in defining and describing late-type contact binaries (CBs) due to their distinct distribution in mass ratio and effective temperature. It is important in the study of W Uma binaries, especially in tracing their evolutionary routes and status. I will introduce the commonly existed misunderstanding in the definition of the two subtypes. I will review the statistical result in A- and W- subtypes and its association with their physical structure. The unique W-subtype phenomenon of K-type CBs is presented.

Study on the Long-period Algol-type Binary Stars

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The Algol type binaries: The Algol type is a sime-detected binary where the secondary fills the Roche lobe and there is mass transfer from the secondary to the primary. The primary is a hot B or A type main sequence star 10000 – 15000 K; the secondary is a cool giant or subgiant star (F-KIII/IV) (star is dying) 4000 – 6000 K. Algol-type binaries are some of the best astrophysical laboratories for studying mass transfer and gas accretion. The existence of accretion disks in Algol-type binary has been known since Wyse (1934) discovered emission lines during an eclipse of the short-period Algol-type binary RW Tau.

The Long-period Algol and the physics of the accretion disk: The structures formed during the accretion depend on the separation of the components, the radius of the primary, and the mass ratio. If the gainer is smaller than a certain size, the infalling material has too much angular momentum for the stream to directly impact the gainer. The mass flow misses the object and may collide with itself, changing its direction and feeling into a stable disk. This behavior usually occurs in long-period system (period longer than 6 days), which are called the Long-period Algols (LPAs).

Why study Long-period Algol?

1. The disk precession may cause flux variations as the disk area changes. This may provide an explanation for the long-period variation observed in some double-period variables.
2. The oscillating Eclipsing Algol (oEA) systems may be indicative of the truth behind the Tidally Tilted Pulsators (TTPs) observed in semi-detached binaries.

Analysis and study of massive binaries in the Magellanic Cloud

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The massive binary contains at least an early-type star whose spectral type is O, B-type. The strong interaction and merging between the two massive companions often cause special astrophysical phenomena in the Universe. Among these binaries with the same spectrum, the contact binaries have the lowest orbital angular momentum and the shortest period. It is natural to think that the loss of angular momentum in the formation and evolution of massive contact binaries is caused by the stellar wind. However, in the Large Magellanic Cloud (LMC), the lower metallicity will weaken the stellar wind and reduce the angular momentum loss. So how did these contact binaries form? It is proposed to use the light-time effect to search for the third bodies from the short-period massive contact binaries in the LMC, and then the fundamental parameters of the massive contact binaries and the third bodies could be determined by some methods. Based on the relation between contact binaries and third bodies about all parameters, and compare them with the massive contact binaries in the Milky Way. These results strongly suggest the significant influence of the third body in the formation and evolution of massive contact binaries and may hold the key to unraveling the origins of massive binaries.

The search and study on faint companions to B-type stars

The search and study on faint companions to B-type stars

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B-type stars are massive stars. The prevailing theory on the formation of binary stars suggests that such massive stars frequently occur in binary or multiple systems, with a tendency for their mass ratios to approach unity. However, the discovery of B-type binary systems with notably low mass ratios has posed challenges to this established theory. Furthermore, these low mass ratio systems have been less investigated primarily due to the substantial contrast in the flux between the two components, which complicates their detection. Fortunately, the development of space telescopes brings excellent opportunities to search and study B-type binary stars with faint companions, and investigate the formation pathways of binary systems.

Intriguing Multiple-star Systems

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Close binaries exist in multiple-star systems is a fairly common phenomenon. By using ground-space telescope data from TESS, Gaia and LAMOST, we have found and determined the physical and orbital properties of some intriguing multiple-star systems. For example, a triplet system that contains three equal-mass components (CN Lyn); a single-lined spectroscopic binary companion to an active contact binary in a quintuple stellar system (V410 Aur); et cetera. These results may further indicate that the tertiary companions rotating around close binaries can provide valuable information on the formation and evolution of contact binaries.

Study on three eclipsing accreting white dwarfs based on ground-based and TESS observations

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Accreting white dwarfs are astrophysical binary systems in which a star transfers matter to a white dwarf companion via Roche lobe overflow. As a type of accreting white dwarf binaries, the dwarf novae often show multiple optical outbursts spanning magnitudes of 2 to 8, with recurrence times ranging from days to decades. Eclipsing dwarf nova allows to measure accurate parameters of the binary components and their orbital period changes, which are crucial for improving our understanding on CV evolution. Moreover, the eclipse is a useful tool in the study of accretion disks. The report will introduce our research progress in this area in recent years.

Tilted Disk Precession in Cataclysmic Variables

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Cataclysmic variable stars (CVs) are semi-detached close binaries, with the primary star being a white dwarf and the secondary star being a late low-mass stellar, which fills the Roche lobe and transfers material to the primary star through the Lagrangian point (L1). Depending on the white dwarf's magnetic field strength, either the accretion disk or accretion curtains/columns form.

CVs have two superhump modulations: negative superhumps (NSH) and positive superhumps (PSH), with periods smaller and larger than a few percent of the orbital period. PSH is linked to the precession of the line of apsides, resulting from the 3:1 tidal resonance between the accretion disk and secondary star. The NSH arises from the action between the reverse precession of the nodal line of the tilted disk and the orbital motion of the binary star. In NSH systems, there is generally a super-orbital signal (SOR) of about several days. The SOR is generally considered to be responsible for the reverse precession of the lines of nodes of the tilted accretion disk.

The SOR and NSH in CVs are usually though to originate from the reverse precession of the tilted disk, however, there is a lack of conclusive evidence. In SDSS J0812, a subtype of the CVs, we discovered that the eclipse minima, depth, and amplitude of the NSH vary periodically with the accretion disk's precession. This finding strongly supports the theory of tilted disk precession. The periodic variation of NSH amplitude with the SOR further establishes a direct link between the origin of NSH and tilted disk precession.

Dwarf nova outbursts are usually thought to be caused by the thermal instability of the accretion disk. However, the combination of thermally unstable disk and tilted disk has been poorly studied. Based on the TESS data, we found that the NSH amplitude varies with outburst. Therefore, we suggest that the relationship between NSH amplitude and outbursts can serve as an important window to study accretion disk instability and the origin of NSH.

Search and Study of OB-type Pulsating Stars

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The O- and B- type (OB-type) pulsating stars including Slowly Pulsating B-stars (SPB stars) and β Cephei pulsating variable stars (BCEP stars), are important objects to study the structure and evolution of intermediate-mass and massive stars through astroseismology. A large amount of data from various sky surveys (TESS, LAMOST, Gaia, et cetera) provides an unprecedented opportunity to search for and study these variable stars. We have identified about 1000 new SPB and BCEP stars, which increases the total number of these variable stars by over 100%. We also derive the preliminary results of the period-luminosity relation for SPB and BCEP stars, respectively. It indicates that in addition to the H-R diagram, the period-temperature and period-luminosity diagrams are also very useful for the classification of SPB and BCEP stars. Further detailed analysis of these objects can dramatically increase our understanding of the theories of evolution and structure for OB-type stars.

Eclipsing Binaries with Pulsating Component Based on Sky Survey

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Eclipsing binaries with pulsating components are very interesting objects. Binary systems are the most reliable objects to determine absolute stellar parameters based on photometric and spectroscopic observations, which is very fatal in establishing stellar evolutionary models. And stellar internal structure could be interpreted for pulsating stars. These two features make them become very useful to understand stellar structure and evolution in recent decades. Until now, hundreds of them have been detected, especially in the past ten years and thanks to the space missions. But most of them require a detailed analysis to show absolute parameters and internal structure. We will choose some of them which are in the plate of TESS database, combining with spectroscopic observation by LAMOST survey, to understand their structure and evolutionary status, to knowledge influence of tidal forces and mass transfer on stellar pulsations.

RR Lyrae Stars and Their Binarity

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RR Lyrae stars are short-period pulsating variables in the evolutionary stage of the horizontal branch. They are old, metal-poor stellar populations. Due to their characteristics, such as the period-luminosity relation, RR Lyrae stars are commonly utilized as probes to investigate the dynamics and chemical evolution of old-age low-mass stars in the Milky Way. However, in the field of RR Lyrae stars, there are also urgent issues that need to be studied. Exploring the binary properties of RR Lyrae stars and their role in the formation and evolution of these stars is one of the important research endeavors. In this presentation, we will introduce the relevant research background and recent progress in observation and theory. We have also made a series of efforts in this regard, which will be highlighted in the presentation. Finally, we will integrate our own research to offer insights into the future development of this research direction.

Optimizing Machine Learning in Astrophysics: Enhancing Variable Star Classification and Globular Cluster Detection by Ensemble Method

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In astrophysics, identifying and classifying variable stars and globular clusters is a critical task that can benefit significantly from advanced machine learning techniques. This study explores the application of ensemble learning and multi-view learning in these domains. We first demonstrate the effectiveness of ensemble learning by combining predictions from P4J and Lomb-Scargle processes to enhance classification accuracy for variable stars. The ensemble model achieved superior performance with an F1 score ranging from 95-100%, compared to individual processes. In the second task, we applied Weighted Boxes Fusion (WBF) to improve globular cluster detection using multi-view learning with two bands: F814w and F475w. Our approach focused on maximizing recall to identify potential new globular clusters, resulting in high true positive rates and manageable false positives. The WBF model demonstrated enhanced detection capabilities, making it a valuable tool for astrophysical research.

Keywords: Ensemble Learning, Weighted Boxes Fusion, Machine Learning, Astrophysics

Radial Velocity Study of White Dwarf and A, F, G, K Main Sequence Binaries with Thai National Telescope

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The single-degenerate channel is one of the two main pain pathways to form Type Ia Supernovae (SN Ia), where a white dwarf accretes from a main-sequence star at a high rate to sustain stable hydrogen burning. One way to study the progenitor of Type Ia of this channel is through the spectrum of binary system of white dwarf and class A, F, G and K main sequence stars (WD+AFGK binaries). In this paper, we report the radial velocity variations of the several WD+AFGK binary systems observed with the Thai National Telescope with MRES spectrograph in the visual wavelength region (4000 - 10000 Angstrom). We measure the radial velocities and their standard deviation from repeated Gaussian profile fitting of the Fe I, Na I doublet, Ca II triplet and Mg I triplet lines. We find that some of these binaries have radial velocity variations ranging from 29.9km/s to 58.9km/s. Furthermore, we aim to determine the period of these systems using Fast Fourier Transform. We will present our preliminary results of the orbital period determination of a few of these WD+AFGK binaries. Effects of the neutrino oscillation above the neutrino-dominated accretion flows around black holes

Comparative analysis of the disc-corona parameters in X-ray reverberation models: KYNxilrev and KYNrefrev

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We utilize the public simulation models KYNxilrev and KYNrefrev to investigate the effects of fisc-corona parameters of active galactic nuclei (AGN) on the X-ray reverberation time-lags. These models calculate the X-ray reflection profile from the accretion disc based on the xilver and reflionx codes, respectively. Main parameters, including the central black hole mass (M_{BH}), coronal height (h), inclination (i), photon index of the continuum emission (Γ), and X-ray source luminosity (L) are varied, and the corresponding lag-frequency profiles are generated. By considering the known scaling relation, we obtain AGN samples with scaled lag amplitude (τ) and M_{BH}. In these samples, we find a correlation between τ and h, suggesting the potential to establish a new scaling law. Additionally, h (in gravitational units, r_g), is found to have a positive correlation with high M_{BH}. The results of both models are in agreement that the coronal height should be in the range between ~5 – 15 r_g, with an average of 10 r_g, although KYNxilrev tends to suggest lower M_{BH} and h compared to KYNrefrev, especially in lower-spin AGN. Furthermore, a significant correlation between h and L is observed only with KYNrefrev. In conclusion, our findings highlight that correlations between AGN parameters could be influenced by the model used, underlining the critical need to account for potential model bias during data analysis and model-based prediction.

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40	Jittinun Saenpoowa	Suranaree University of Technology
41	Kai Xu	Suranaree University of Technology
42	Kamonwan Khanthasombat	Suranaree University of Technology
43	Khanchai Khosonthongkee	Suranaree University of Technology
44	Santi Maensiri	Suranaree University of Technology
45	Thanat Sangkhakrit	Suranaree University of Technology
46	Yupeng Yan	Suranaree University of Technology
47	Zheng Zhao	Suranaree University of Technology
48	Huiting Zhang	YNAO-China
49	Nianping Liu	Yunnan Observatories
50	Ergang Zhao	Yunnan Observatories, Chinese Academy of Sciences
51	Lin-Jia Li	Yunnan Observatories, Chinese Academy of Sciences
52	Liying Zhu	Yunnan observatories, Chinese Academy of Sciences
53	Wenping Liao	Yunnan Observatories, Chinese Academy of Sciences
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57	Shengbang Qian	Yunnan University
60	Qi-Bin Sun	Yunnan University
58	Zhongtao Han	Yuxi Normal University