● 2024.04 제42권 제1호
● Bulletin of the Korean Physical Society
● 한국물리학회 회보

2024 KPS Spring Meeting

# 2024년 봄 학술논문발표회 및 제100회 정기총회

일시: 4월 23일(화)~26일(금)

장소: 대전컨벤션센터 제1 전시장

후원 대전광역시 DAEJEON METROPOLITAN CITY DAEJEON 대전관광공사

KPS 한국물리학회 The Korean Physical Society

**J5.06*** [14:00 - 14:12]

**Direct observation of room temperature magnetic skyrmion motion driven by ultra-low current density in a van der Waals ferromagnet** / JI Yubin[1], YANG Seungmo[2], AHN Hyo-Bin[3], MOON Kyoung-Woong[2], JU Tae-Seong[2], IM Mi-Young[5], HAN Hee-Sung[5,6], LEE Jisung[7], PARK Seung-Young[7], LEE Changgu[4], KIM Kab-Jin[*1], HWANG Chanyong[2] ([1]Department of Physics, KAIST, [2]Quantum Spin Team, Korea Research Institute of Standards and Science, [3]SKKU Advanced Institute of Nanotechnology, Sungkyunkwan University, [4]School of Mechanical Engineering, Sungkyunkwan University, [5]Center for X-ray Optics, Lawrence Berkeley National Laboratory, [6]Department of Materials Science and Engineering, Korea National University of Transportation, [7]Center for Scientific Instrumentation, Korea Basic Science Institute)

**J5.07*** [14:12 - 14:24]

**Mass-loaded graphene nano-electromechanical drums; simulation study and observation of resonance mode** / JE YUGYEONG[1], SHIN DONG HOON[2], JEONG HYUNJEONG[1], LEE Sang-Wook[*1] ([1]Department of Physics, Ewha Womans University, [2]Kavli Institute of Nanoscience, Delft University of Technology)

**J5.08*** [14:24 - 14:36]

**New polytypism in $GeSe_{2-x}Te_x$ nanowires via twinning and interlayer twist** / KANG Hani[1], KIM Dong-gyu[1], LEE Kihyun[1], LEE Yangjin[1], JANG Myeongjin[1], JUNG Joong-Eon[1], KIM Kwanpyo[*1] ([1]Physics, Yonsei University)

**J5.09** [14:36 - 14:48]

**Exploring 1D Nanostructures via Nanotube Encapsulation: Tetrahedral $GeX_2$ and Magnetic $MX_3$ Single-Chains** / LEE Yangjin[1,2,3,4], CHOI Young Woo[2,3], LEE Kihyun[1,4], SONG Chengyu[5], ERCIUS Peter[5], COHEN Marvin L.[2], ZETTL Alex[2,3], KIM Kwanpyo[*1,4] ([1]Physics, Yonsei University, [2]Department of Physics, UC Berkeley, [3]Materials Sciences Division, Lawrence Berkeley National Lab, [4]Center for Nanomedicine, Institute for Basic Science, [5]National Center for Electron Microscopy, Lawrence Berkeley National Lab)

**[J6-st] Soft Matter & Biophysics**

2024. 04. 26 Friday 13:00~14:48

Room: 106

좌장: 이남경 세종대학교

Chair: LEE Nam Kyung (Sejong University)

**J6.01** [13:00 - 13:12]

**Complex Self-Consistent Field Theory: A Hidden Symmetry of Polymer Field Theory** / KIM Jaeup[*1] ([1]Department of Physics, UNIST)

**J6.02** [13:12 - 13:24]

**The geometry of the confinement can expedite rapid target search** / KIM Won Kyu*[1] ([1]School of Computational Sciences, Korea Institute for Advanced Study (KIAS))

**J6.03*** [13:24 - 13:36]

**Bending elasticity of the reversible freely jointed chain** / YI Minsu[1], LEE Dongju[1], BENETATOS Panayotis*[1] ([1]Department of Physics, Kyungpook National University)

**J6.04*** [13:36 - 13:48]

**Stretching multi-state flexible chains and loops** / NOH Geunho[1], BENETATOS Panayotis*[1] ([1]Department of Physics, Kyungpook National University)

**J6.05** [13:48 - 14:00]

**Hydrodynamic pursuit and cooperative behaviors of self-steering microswimmers** / GOH Segun*[1], WINKLER Roland G.[1], GOMPPER Gerhard[1] ([1]Theoretical Physics of Living Matter (IBI-5/IAS-2), Forschungszentrum Jülich)

**J6.06*** [14:00 - 14:12]

**Phase separation of active particles with chemokinesis and fuel depletion** / OH Yongjae[1], KWON Euijoon[1], BAEK Yongjoo*[1] ([1]Department of Physics and Astronomy, Seoul National University)

**J6.07** [14:12 - 14:24]

**Derivation of an efficient and thermodynamically consistent lattice Monte Carlo method for active particles** / KIM Kiwon[1], KWON Euijoon[1], BAEK Yongjoo*[1] ([1]Department of Physics and Astronomy, Seoul National University)

**J6.08** [14:24 - 14:36]

**Learning the underlying dynamics of underdamped Langevin systems via Bayesian neural networks** / BAE Youngkyoung[1,2], HA Seung Woong[3], JEONG Hawoong*[1] ([1]Physics Department, KAIST, [2]Physics & Astronomy Department, Seoul National University, [3]Applied Complexity, Santa Fe Institute)

**J6.09** [14:36 - 14:48]

**Quantitative Analysis of Competitive Harmony between Direct and Indirect Pathways in A Spiking Neural Network of The Basal Ganglia** / KIM Sang-Yoon[1], LIM Woochang*[1] ([1]Department of Science Education, Daegu National University Of Education)

# Quantitative Analysis of Competitive Harmony between Direct and Indirect Pathways in A Spiking Neural Network of The Basal Ganglia

KIM Sang-Yoon [1], LIM Woochang [*1]

[1]Department of Science Education, Daegu National University Of Education

wclim@icn.re.kr

**Abstract:**

The basal ganglia (BG) show a variety of functions for motor and cognition. There are two competitive pathways in the BG; direct pathway (DP) which facilitates movement and indirect pathway (IP) which suppresses movement. It is well known that diverse functions of the BG may be made through "balance" between DP and IP. But, to the best of our knowledge, so far no quantitative analysis for such balance was done. We develop a spiking neural network of the BG. Then, as a first time, we make quantitative analysis for competitive harmony (i.e., competition and cooperative interplay) between DP and IP by introducing their competition degree $\mathcal{C}_d$. We first consider the case of normal dopamine (DA) level of $\phi^* = 0.3$. In the case of phasic cortical input (10 Hz), a healthy state with $\mathcal{C}_d^* = 2.82$ (i.e., DP is 2.82 times stronger than IP) appears. In this case, normal movement occurs via harmony between DP and IP. Next, we consider the case of decreased DA level, $\phi = \phi^*(= 0.3)\ x_{DA}$ ($1 > x_{DA} \geq 0$). With decreasing $x_{DA}$ from 1, the competition degree $\mathcal{C}_d$ between DP and IP decreases monotonically from $\mathcal{C}_d^*$, which results in appearance of a pathological state (e.g., Parkinson's disease) with decreased competition degree. In this pathological state, strength of IP is much increased than that in the case of normal healthy state, leading to disharmony between DP and IP. Due to such break-up of harmony between DP and IP, impaired movement occurs. Finally, we also study treatment of the pathological state via recovery of harmony between DP and IP.

**Keywords:**

Basal ganglia, Competitive harmony between "Go" direct pathway and "No-Go" indirect pathway, Competition degree