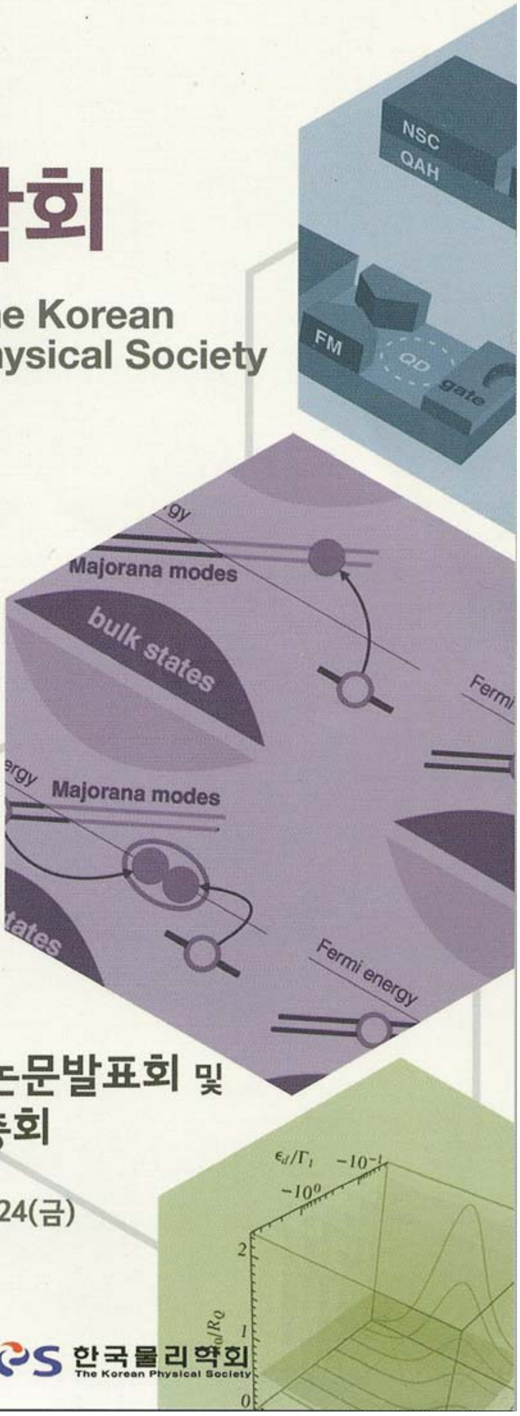
2015. 04
제33권 제1호

한국 물리학회 회보
The Korean Physical Society



2015 봄 학술논문발표회 및 제 91회 정기총회

2015. 4. 22(수) ~ 24(금)
대전컨벤션센터

KPS 한국물리학회
The Korean Physical Society

[B10-st] Biophysics
2015년 4월 23일 목요일 09:00 – 10:45 장소: 202호
좌장: 정 영 균 KISTI

B10.01 [09:00-09:15]
Developing Integral Self-Consistent Mean Field Theory of Polymers / KIM Jaeup(Department of Physics, School of Natural Science, UNIST.)

B10.02 [09:15-09:30]
Tension-induced Binding of Semiflexible Biopolymers / BENETATOS Panayotis, VON DER HEYDT Alice[1], ZIPPELIUS Annette[2](Kyungpook National University, Department of Physics. [1]University of Goettingen, Institute for Theoretical Physics, Germany. [2]University of Goettingen, Institute for Theoretical Physics, and Max-Planck-Institute for Dynamics and Selforganization, Germany.)

B10.03 [09:30-09:45]
Ergodic Properties of Anomalous Diffusion in Fractal Geometries / JEON Jae-Hyung, MARDOUKHI Yousof[1](Korea Institute for Advanced Study. [1]Tampere University of Technology, Finland.)

B10.04 [09:45-10:00]
Prediction of Protein Rigid Domains and Hinge Residues based on Elastic Network Model and Graph Theory / 이주련(숭실대학교 생명정보학과.)

B10.05 [10:00-10:15]
Unraveling the core genetic circuitry of plant circadian system through computational model / FOO Mathias, SOMERS David[1], KIM Pan-Jun(APCTP. [1]Ohio State University.)

B10.06 [10:15-10:30]
Fast Sparsely Synchronized Cortical Rhythms in A Scale-Free Neural Network / LIM Woochang, KIM Sang-Yoon[1](Daegu National Univerisity of Educaiton, Department of Science Education. [1]Daegu National Univerisity of Educaiton, Department of Science Education, Computational Neuroscience Lab.)

B10.07* [10:30-10:45]
인공 유모세포를 통한 유모세포에 청각 변환 능력의 한계에 관한 연구 / 안강헌, 이우석(충남대학교, 물리학과.)

[B10-st] Complex Systems II
2015년 4월 23일 목요일 11:00 – 12:45 장소: 202호
좌장: 김 철 민 UNIST

B

B10.08* [11:00-11:15]
Population growth and the evolution of cooperation / 박혜진, 김범준, 정형채[1](성균관대학교, 물리학과. [1]세종대학교, 물리학과.)

B10.09 [11:15-11:30]
First-Passage Dynamics of Evolutionary Games in Structured Populations / YANG Hyunmo, GHIM Cheol-Min[1](Department of Phyiscs, UNIST. [1]Department of Biomedical Engineering and Department of Physics, UNIST.)

B10.10* [11:30-11:45]
Spreading dynamics with layer-crossing costs in multiplex networks / 민병준, 곽상환[1], 고광일[1](Department of Physics and Levich Institute, City College of New York. [1]Department of Physics, Korea University.)

B10.11 [11:45-12:00]
Finding Lagrangian Coherent Structures Using Community Detection / LEE Sang Hoon, FARAZMAND Mohammad[1], HALLER George[2], PORTER Mason[3](Department of Energy Science, Sungkyunkwan University. [1]School of Physics, Georgia Institute of Technology. [2]Institute of Mechanical Systems, ETH Zurich. [3]Mathematical Institute, University of Oxford.)

B10.12 [12:00-12:15]
Correlated Bursts Model with Long-Range Memory / JO Hang-Hyun, PEROTTI Juan[1], KASKI Kimmo[2], KERTESZ Janos[3](POSTECH, Department of Physics. [1]IMT Lucca. [2]Aalto University. [3]Central European University.)

B10.13 [12:15-12:30]
The SIS immortality transition in small networks / HOLME Petter (Department of Energy Science, Sungkyunkwan University.)

B10.14* [12:30-12:45]
Phase Lead/Lag of Coupled Oscillator Model due to Degree Inhomogeneity in Complex Networks / KO Tae-Wook, KIM Junhyeok[1], MOON Joon-Young[2], LEE Uncheol[3], MASHOUR George[3], KIM Seunghwan[1](National Institute for Mathematical Sciences. [1]POSTECH, Department of Physics. [2]University of Michigan Medical School, Department of Anesthesiology. [3]University of Michigan Medical School, Department of Anesthesiology & Center for Consciousness Science.)

Fast Sparsely Synchronized Brain Rhythms in A Scale-Free Neural Network

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Daegu National University of Education, Daegu 705-115, Korea

Abstract

We consider a directed version of the Barabási-Albert scale-free network (SFN) model with symmetric preferential attachment with the same in- and out-degrees, and study emergence of sparsely synchronized rhythms for a fixed attachment degree in an inhibitory population of fast spiking Izhikevich interneurons. Fast sparsely synchronized rhythms with stochastic and intermittent neuronal discharges are found to appear for large values of J (synaptic inhibition strength) and D (noise intensity). For an intensive study we fix J at a sufficiently large value, and investigate the population states by increasing D. For small D, full synchronization with the same population-rhythm frequency f_p and mean firing rate (MFR) f_i of individual neurons occurs, while for large D partial synchronization with $f_p > \langle f_i \rangle$ ($\langle f_i \rangle$: ensemble-averaged MFR) appears due to intermittent discharge of individual neurons; particularly, the case of $f_p > 4\langle f_i \rangle$ is referred to as sparse synchronization. For the case of partial and sparse synchronization, MFRs of individual neurons vary depending on their degrees. As D passes a critical value D^* (which is determined by employing an order parameter), a transition to unsynchronization occurs due to destructive role of noise to spoil the pacing between sparse spikes. For $D < D^*$, population synchronization emerges in the whole population because the spatial correlation length between the neuronal pairs covers the whole system. Furthermore, the degree of population synchronization is also measured in terms of two types of realistic statistical-mechanical measures. Only for the partial and sparse synchronization, contributions of individual neuronal dynamics to population synchronization change depending on their degrees, unlike the case of full synchronization. Consequently, dynamics of individual neurons reveal the inhomogeneous network structure for the case of partial and sparse synchronization, which is in contrast to the case of statistically homogeneous random graphs and small-world networks. Finally, we investigate the effect of network architecture on sparse synchronization for fixed values of J and D in the following three cases: (1) variation in the degree of symmetric attachment (2) asymmetric preferential attachment of new nodes with different in- and out-degrees (3) preferential attachment between pre-existing nodes (without addition of new nodes). In these three cases, both relation between network topology (e.g., average path length and betweenness centralization) and sparse synchronization and contributions of individual dynamics to the sparse synchronization are discussed.