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제34권 제2호

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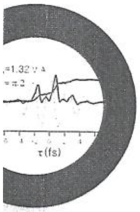

2016 가을 학술논문발표회 및 임시총회

2016.10. 19 (수) - 21(금)

광주 김대중컨벤션센터

KPS 한국물리학회
The Korean Physical Society

SESSION E

2016 October 20(Thu) 14:00–15:48

[E1-st] Biophysics II
2016. 10. 20 Thursday 14:00 – 15:36 Room: # 201
좌장 : 정 영 균 한국과학기술정보연구원
Chair: JUNG Young-Kyun (KISTI)

E1.01(초) [14:00 - 14:24]
Quantifying superdiffusive transport in living cells: a few examples / Jae-Hyung Jeon* (Department of Physics, POSTECH)

E1.02(초) [14:24 - 14:48]
Phase Modulation of Hormonal Oscillations / 박동호[1], 송태근[1], HOANG Danh-Tai[2], XU Jin[1,3], 조정효[*1,3] ([1]Asia Pacific Center for Theoretical Physics, [2]National Institute of Diabetes and Digestive and Kidney Diseases, NIH, USA, [3]Department of Physics, POSTECH)

E1.03* [14:48 - 15:00]
Analysis of diffusion trajectories of anisotropic objects / 노승한[1], 이주연[2], 김용운[*1] ([1]KAIST 나노과학기술대학원, [2]부산대학교 물리학과)

E1.04 [15:00 - 15:12]
Voltage Generation and Relaxation at the ITO-water interface / Yoonnam Jeon[1], Jong Kyun Moon[1], Myung Won Song[1,2], Hyuk Kyu Pak[*1,2] ([1]Center for Soft and Living Matter, Institute for Basic Science (IBS), Ulsan 44919, Korea, [2]Department of Physics, Ulsan National Institute of Science and Technology (UNIST), Ulsan 44919, Kore)

E1.05 [15:12 - 15:24]
Emergence of Sparsely Synchronized Rhythms and Their Responses to External Stimuli in An Inhomogeneous Small-World Complex Neuronal Network / LIM Woochang*, KIM Sang-Yoon (Institute for Computational Neuroscience, Daegu National University of Education)

E1.06 [15:24 - 15:36]
Cross-species essentiality landscape for the evolution of the metabolic networks / KIM Purin[1], LEE Deok-sun[*2], KAHNG Byungnam[*1] ([1]Department of Physics and Astronomy, Seoul National University, [2]Department of Physics, Inha University)

[E2-op] Optical imaging and technology
2016. 10. 20 Thursday 14:00 – 15:36 Room: # 204
좌장 : 최 수 봉 인천대학교
Chair: CHOI Soo-Bong (Incheon National Univ.)

E2.01* [14:00 - 14:12]
Demonstration of Structured Magnetic Illumination Microscopy / LEE Dukhyung[1], KANG Taehee[1], KIHM Hyun Woo[2], KIM Dai-Sik[*1] ([1]Department of Physics and Astronomy and Center for Atom Scale Electromagnetism, Seoul Natl. Univ., [2]Korea Research Institute of Chemical Technology (KRICT), 141 Gajeong-ro, Yuseong-gu, Daejeon)

E2.02* [14:12 - 14:24]
Near-ultraviolet structural color in aluminum nanoantenna array / LEE Chun-Ho[1], KIM Youngrok[2], SONG Jung-Hwan[1], EE Ho-Seok[1], JEONG Kwang-Yong[3], HWANG Min-Soo[3], PARK Hong-Gyu[3], LEE Takhee[2], SEO Min-Kyo[*1] ([1]Department of Physics Korea Advanced Institute of Science and Technology, [2]Department of Physics and Astronomy, and Institute of Applied Physics, Seoul National University, [3]Department of Physics Korea University)

E2.03* [14:24 - 14:36]
Bio-inspired structural coloration realized by thin-film rolling technique / 한창현[1], 김한빛[1], 정현호[1], 전헌수[*1,2] ([1]서울대학교 물리천문학부, [2]서울대학교 생물물리 및 화학생물학과)

E2.04* [14:36 - 14:48]
시간역행 거울을 이용한 미세 광집속 / 박종찬, 박용근* (한국과학기술원 물리학과)

E2.05* [14:48 - 15:00]
초점가변렌즈를 이용한 구조조명 기반의 3차원 표면형상측정 방법 / 김주완[1], 허정무[2], 박호진[2], 엄종현[1], 엄주범[3], 안재성[3], 박안진[3], 이병하[*2] ([1]광주과학기술원 의생명공학과, [2]광주과학기술원 전기전자컴퓨터공학부, [3]한국광기술원 광의료연구센터)

E2.06* [15:00 - 15:12]
Measurement of wafer morphology using interferometer for the overlay correction / 김재순[*1], 윤성민[1], 임승일[1], 최재준[1], 양한모[1], 정우성[2], 이윤기[2], 이재용[3] ([1]명지대학교 물리학과 NEMO Lab., [2]AUROS Technology, [3]한국표준과학연구원)

E2.07* [15:12 - 15:24]
반도체 웨이퍼 상의 결함 검출용 고효율 조명계의 애너모픽적 접근에

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Emergence of Sparsely Synchronized Rhythms and Their Responses to External Stimuli in An Inhomogeneous Small-World Complex Neuronal Network

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Abstract:

By taking into consideration the inhomogeneous population of interneurons in real neural circuits, we consider an inhomogeneous small-world network (SWN) composed of inhibitory short-range (SR) and long-range (LR) interneurons, and investigate the effect of network architecture on emergence of sparsely synchronized rhythms by varying the fraction of LR interneurons p_{long}. The betweenness centralities of the LR and the SR interneurons (characterizing the potentiality in controlling communication between other interneurons) are distinctly different, although they have the same average in- and out-degrees (representing the potentiality in communication activity). Hence, in view of the betweenness, SWNs we consider are inhomogeneous, unlike the "canonical" Watts-Strogatz SWN with nearly same betweenness centralities. For small p_{long}, the average betweenness centrality of LR interneurons is much larger than that of SR interneurons. Hence, the load of communication traffic is much concentrated on a few LR interneurons. However, with further increase in p_{long} the number of LR connections (coming from LR interneurons) increases, and then the average betweenness centrality of LR interneurons decreases. Consequently, the average path length becomes shorter, and the load of communication traffic is less concentrated on LR interneurons, which leads to better efficiency of global communication between interneurons. Sparsely synchronized rhythms are thus found to emerge when passing a small critical value $p^{(c)}_{long}$ ($\simeq$ 0.16). This transition from desynchronization to sparse synchronization is well characterized in terms of a realistic "thermodynamic" order parameter, and the degree of sparse synchronization is well measured in terms of a realistic "statistical-mechanical" spiking measure. These dynamical behaviors in the inhomogeneous SWN are also compared with those in the homogeneous Watts-Strogatz SWN, in connection with their network topologies. Particularly, we note that the main difference between the two types of SWNs lies in the distribution of betweenness centralities. Unlike the case of the Watts-Strogatz SWN, dynamical responses to external stimuli vary depending on the type of stimulated interneurons in the inhomogeneous SWN. We consider two cases of external time-periodic stimuli applied to sub-populations of LR and SR interneurons, respectively. Dynamical responses (such as synchronization suppression and enhancement) to these two cases of stimuli are studied and discussed in relation to the betweenness centralities of stimulated interneurons, representing the effectiveness for transfer of stimulation effect in the whole network.

Keywords:

Short-range and long-range interneurons, Inhomogeneous small-world network, Inhomogeneous betweenness centrality, Sparsely synchronized rhythms, Synchronization suppression and enhancement