非線型科学 コロキウム
Nonlinear Science Colloquium

講演者： 太田 隆夫　Takao Ohta

東京大学大学院理学系研究科　客員共同研究員
お茶の水女子大学ソフトマター教育研究センター　客員研究員

講演題目：Collective Dynamics of Deformable Self-Propelled Particles

Interacting self-propelled objects have been studied for these almost two decades from the view point of nonlinear dynamics [1]. Various dynamical orders have been found theoretically in which most of the studies are based on either point particles or rigid particles allowing their overlapping. Studies of self-propelled motions with repulsive interactions between particles to take account of the excluded volume effect have been started rather recently [2], [3], [4]. Furthermore, many of the self-propelled objects, in particular, biological micro-organisms are soft and deformable. Therefore, the coupling between migration and deformation is also a relevant nonlinearity in self-propulsion.

Recently, we have introduced a model system of deformable self-propelled particles with pair-wise repulsive interaction [5], [6]. Numerical simulations are carried out in two dimensions by changing the noise intensity and the particle density to obtain the dynamical phase diagram of the ordered and the disordered states. One of the new findings is that the ordered state is broken via a discontinuous transition by *increasing* the particle density (volume fraction). Another finding is a spontaneous formation of a traveling band of the ordered state surrounded by the disordered state, which appears at the high-density transition region. This is similar to the band structure obtained by Chate et al in point particles [7]. Quite recently we have found that traveling band structures emerge rather easily if the propelling velocity depends on the local density around the particle [8]. A band structure indicates coexistence of dynamically ordered and disordered states, which never occurs in phase transitions in thermal equilibrium and is a characteristic feature in the transition out of equilibrium.

[1] T. Vicsek and A. Zafeiris, Phys. Rept. 517, 71 (2012).
[2] F. Peruani, A. Deutsch, M. Baer, Phys. Rev. E 74, 030904(R) (2006).
[3] S. Henkes, Y. Fily, and M. C. Marchetti, Phys. Rev. E 84, 040301(R) (2011)
[4] J. Bialke, T. Speck and H. Loewen, Phys. Rev. Lett. 108, 168301 (2012).
[5] Y. Itino, T. Ohkuma and T. Ohta, J. Phys. Soc. Jpn. 80, 033001 (2011).
[6] Y. Itino, and T. Ohta, J. Phys. Soc. Jpn. 81, 10407 (2012)
[7] H. Chate, F. Ginelli, G. Gregoire, F. Raynaud, Phys. Rev. E 77, 046113 (2008).
[8] S. Yamanaka and T. Ohta, unpublished.

日時：**2013年6月3日（月）18:00~19:00**

場所：早稲田大学西早稲田キャンパス
55号館S棟2階 第3会議室【55S-2-04 】

非線型科学コロキウム
早稲田大学理工学術院先進理工学部応用物理学科
組織委員：相澤 洋二　大谷 光春
山崎 義弘　小澤 徹

連絡先：小澤 徹 研究室
早稲田大学理工学術院西早稲田キャンパス55号館N-3-10
03-5286-8487 / 内線 73-3564
txozawa@waseda.jp / 秘書：a.kanayama@kurenai.waseda.jp