

# Theory of nano-optomechanics under fluctuations

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We are developing guiding principles to control the dynamics and functions of nanocomposites by optically modulating the balance between the inter-object interaction and the thermal fluctuations. The degree-of-freedom of nanodynamics can be greatly enhanced since the "light-induced force (LIF)" depends on various properties of excitation light such as wavelength, angular momentum, polarization and intensity distributions. In this talk, I will show our recent achievements obtained with our new theoretical method "Light-induced force nano dynamics method (LNDM)". We have revealed that the spatial configuration and the collective phenomena (*plasmonic superradiance*) of metallic nanoparticles can be simultaneously controlled by LIF [1]. Furthermore, it has been clarified that nanoparticles with desired properties can be selected by designed light field in conjunction with thermal fluctuations from surrounding fluid medium at room temperature [2], i.e., the principle of *fluctuation-mediated optical screening (FMOS)*. Also, we have found that the efficiency of laser cooling to suppress fluctuations in optical microcavity depends on the collision time of ambient molecules [3]. These results can be used for the creation of efficient light-energy conversion materials in green applications, for the separation of nanoparticles and highly sensitive molecular detection in biological applications. Our achievements will pioneer a new research field "Biomimetic Optical Manipulation" based on nano-optomechanics and fluctuations (Fig.1).

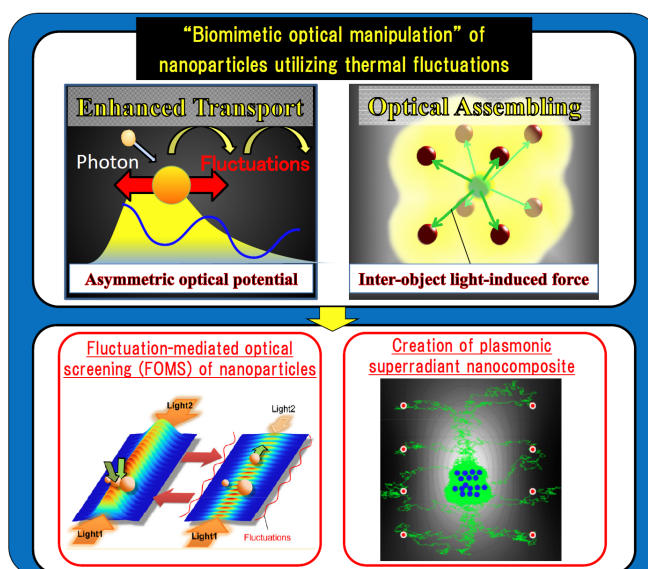


Figure 1: Our concepts and main results.

## References:

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[2] M. Tamura, T. Iida\*, *Nano Lett.*; **12(10)**, 5337 (2012).

[3] N. D. Vy, T. Iida\*, *Appl. Phys. Lett.* **102**, 091101 (2013).



**Takuya Iida** received Bachelor of Engineering (2001), Master of Engineering (2002), and PhD in Science at Osaka University (2004) (twice grade-skipping). After serving as a JSPS research fellow from 2003 to 2005, research fellow of CREST from 2005 to 2007, and an assistant professor in the graduate school of Engineering at Osaka Prefecture University from 2007 to 2009. In 2009, he joined Nanoscience and Nanotechnology Research Center (N2RC), Osaka Prefecture University. From 2009, he serves an Associate Professor (Tenure Track Faculty Member). From 2007 to 2011, he was concurrently serving as a researcher of the PRESTO funded by JST. He received the 12th Incentive Award for Excellent Presentation of the Japan Society of Applied Physics (2002), the 1st EXCON prize for best paper in 6th International Conference on Excitonic Processes in Condensed Matter (EXCON'04) (2004), the 24th Inoue Research Award for Young Scientists (2008), the 3rd Young Scientist Award of the Physical Society of Japan (2009), the Commendation for Science and Technology by the Minister of Education, Culture, Sports, Science and Technology: The Young Scientists' Prize (2010). Other than these, collaborative works with experimental groups were awarded 3 prizes.

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