Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Emergence of Life-Like Properties from Dissipative Self-Assembly of Nanoparticles SERIM ILDAY, GHAITH MAKEY, GURSOY B. AKGUC, OZGUN YAVUZ, ONUR TOKEL, IHOR PAVLOV, OGUZ GULSEREN, F. OMER ILDAY, Bilkent University — A profoundly fundamental question at the interface between physics and biology remains open: What are the minimum requirements for emergence of life-like properties from non-living systems? Here, we address this question and report emergent complex behavior of tens to thousands of colloidal nanoparticles in a system designed to be as plain as possible: The system is driven far from equilibrium by ultrafast laser pulses, which create spatiotemporal temperature gradients, inducing Marangoni-type flow that drags the particles towards aggregation; strong Brownian motion, used as source of fluctuations, opposes aggregation. Nonlinear feedback mechanisms naturally arise between the flow, the aggregate, and Brownian motion, allowing fast external control with minimal intervention. Consequently, complex behavior, analogous to those commonly seen in living organisms, emerges, whereby the aggregates can self-sustain, self-regulate, self-replicate, self-heal and can be transferred from one location to another, all within seconds. Aggregates can comprise of only one pattern or bifurcated patterns can co-exist, compete, survive or die.

Serim Ilday
Bilkent University

Date submitted: 11 Nov 2016 Electronic form version 1.4