SEMINAIRE

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Controlling out-of-equilibrium nano-systems

Feedback control provides a versatile tool for manipulating nanoscale systems dominated by thermal or quantum fluctuations. We present two experimental applications of feedback to explore non-equilibrium physics.

First, we demonstrate how a feedback loop can create a virtual double potential for an underdamped micromechanical oscillator, enabling a 1-bit memory platform to perform fast logical operations and investigate the energetic cost of information processing [1-5].

Second, we introduce FLIP (Feedback Stabilization on an Inverted Potential), a novel feedback scheme combining Kalman filtering with optical trapping to achieve quantum control **[6]** and ground-state cooling of levitated nanospheres. This approach allows stable levitation in a double-well configuration while mitigating absorption, opening new routes for optical manipulation at the quantum limit [7].

[1] S. Dago, J. Pereda, S. Ciliberto, and L. Bellon,. *JSTAT, 2022(5):053209, (2022).*
[2] S. Dago, J. Pereda, N. Barros, S. Ciliberto, and L. Bellon, *Phys. Rev. Lett., 126:170601 (2021).*
[3] S. Dago, and L. Bellon, *Phys. Rev. Lett., 128, 070604 (2022)*
[4] S. Dago, L. Bellon, *Phys. Rev. E 108, L022101 (2023)*
[5] S. Dago, S. Ciliberto and L. Bellon, *PNAS Vol.120, No 39*
[6] L. Magrini, P. Rosenzweig, C. Bach, A. Deutschmann-Olek, S. G. Hofer, S. Hong, N. Kiesel, A. Kugi *Nature 595, 373 (2021).*
[7] S. Dago, J. Rieser, M. Ciampini, V. Mlynar, M. Aspelmeyer, A. Deutschmann-Olek et N. Kiesel *Optics Express 32, 45133-45141 (2024)*

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