

NOMATEN HYBRID-SEMINAR

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In-person: Proton 251 seminar room, PNT, NCBJ

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Nanofriction under the lens of MD simulations

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Abstract:

The high complexity of dealing with systems with many degrees of freedom under a strict size confinement arises especially in sliding friction phenomena, where the key mechanisms take place at a buried interface. In the last three decades, developments in nanotechnology have extended the experimental study of friction, permitting the analysis on well-characterized materials and surfaces at the nano and mesoscale. Here, by presenting three case studies related to the frictional properties of deposited metallic clusters [1,2], physisorbed graphene nanoribbons [3,4], and instabilities in disordered materials [5,6], I show how modeling and molecular dynamics simulations can help in advancing our theoretical understanding in the field of nanotribology.

[1] R. Guerra, U. Tartaglino, A. Vanossi, and E. Tosatti, 'Ballistic Nanofriction', *Nature Materials* 9, 634 (2010).

[2] R. Guerra, E. Tosatti, and A. Vanossi, 'Slider Thickness Promotes Lubricity: from 2D Islands to 3D Clusters', *Nanoscale* 8, 11108 (2016).

[3] L. Gigli, N. Manini, A. Benassi, E. Tosatti, A. Vanossi, R. Guerra, 'Graphene nanoribbons on gold: understanding superlubricity and edge effects', *2D Materials* 4, 045003 (2017).

[4] L. Gigli, S. Kawai, R. Guerra, et al., 'Detachment dynamics of graphene nanoribbons on gold', *ACS Nano* 13, 689 (2018).

[5] S. Bonfanti, R. Guerra, C. Mondal, I. Procaccia, S. Zapperi, 'Elementary plastic events in amorphous silica', *Phy. Rev. E* 100, 060602 (2019).

[6] S. Bonfanti, J. Chattoraj, R. Guerra, I. Procaccia, S. Zapperi, 'Oscillatory instabilities in three-dimensional frictional granular matter', *Phys. Rev. E* 101 (5), 052902 (2020).

Bio:

Roberto Guerra is associate professor of theoretical condensed matter at the University of Milano. He has obtained a Bachelor Degree in Physics at the University of Pisa, with the thesis work carried out at the LIGO Observatory (WA) and at the California Institute of Technology (CA). He Master-graduated in Physics at the University of Modena and Reggio Emilia, where he also received a Ph.D. in Physics. After four years as post-doc in Modena, there mainly researching on opto-electronical properties in nanostructured semiconductors, he spent other four post-doc years at SISSA (Trieste) dedicated on the study of friction phenomena at the nanoscale. On 2017 he was hired as researcher at the Physics

Department of the University of Milano, on 2019 he received a tenure-track position, and on March 2022 he was appointed associate professor. So far he authored 3 book chapters and more than 50 articles including 1 Nature Materials, 2 Nature Nanotechnology, 1 Nature Communications, 1 PNAS, 2 Nano Letters, 1 JACS, 1 ACS Nano, 6 Nanoscale, 1 2D Materials, 1 Physical Review X, 1 Physical Review Letters

