**Title:** The Chaotic Life of Mayonnaise

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Stabilized multi-component emulsions, commonly found in many foods and cosmetic products, display a fascinating and rich phenomenology. How do such complex fluids flow? Despite considerable attention in the literature, many fundamental questions still remain to be answered. For experiments it is difficult, when not impossible, to provide full 3d microscopic details for a moving emulsion. Therefore, in order to understand the interplay between small-scale physics and large-scale rheology we employ 3d state-of-the-art numerical simulations. Thanks to two PRACE projects granted in the 17th and 19th PRACE project call, respectively, we have been able to model a multi-component fluid both under influence of a turbulent stirring (figure left) as well as in his stationary (jammed) phase (figure right).

In this talk we describe our experience in investigating the dynamics of stabilized emulsions via mesoscale 3d numerical simulations (at various resolutions, up to $1024^3$) by employing highly optimized numerical codes based on a multicomponent Lattice Boltzmann model (LBM).

In the first part I will describe the effort of code optimization of the LBM, in order to achieve high-performance on the available HPC platforms, including an analysis of the performance and scalability. Target processors of the analysis are the Intel KNL and Intel SKL processors, equipping the hosting platform for the two PRACE projects: the Marconi-KNL partition at CINECA and the MareNostrum at BSC, respectively. Results of the porting of the code on distribute multi-GPUs hybrid nodes of CINECA’s Marconi-100 will be presented, also in view of future PRACE project applications.

In the second part, I will present the steps required to explore the physics of complex fluid emulsions: from their production, via turbulent stirring, to their (statistical) behavior under flowing and under resting (jammed) conditions. I will discuss the emulsion morphology (e.g. droplet size distribution) at varying the stirring intensity, the resolution, as well as the relative volume fraction of the two fluid components. A particular focus will be given on how to achieve large volume fraction of the dispersed droplet phase (i.e. larger than 50%). Indeed, strong forcing, too rapid increase or too large values of the dispersed phase volume fraction will invariably lead to the so-called catastrophic phase inversion (a sudden non-equilibrium process through which the emulsion rapidly destabilize and phases invert).