UNIVERSITÀ DI TRENTO
Dipartimento di Matematica

DOTTORATO

CYCLE 36th
ORAL DEFENCE OF THE PHD THESIS

Thursday 7th March 2024 – 10.00 am

Department of Mathematics
Seminar Room – Department of Physics
The event will take place in presence and online through the ZOOM platform.
To get the access codes please contact the secretary office.

Federica Ferrarese

PhD Student in Mathematics

Particles methods for kinetic equations in plasma physics, collective behaviors and optimization.

Abstract:
In recent years, the development of efficient numerical methods for the simulation of kinetic dynamics plays an important role. Besides deterministic methods, such as Lagrangian schemes, Galerkin schemes and finite volume schemes, an important attention is given to particles schemes. These methods are able to produce a good approximation of the density function, and, by introducing stochasticity, they are able to capture the natural property of the system such as randomness and uncertainties. They can also be suitable to solve the issue of high dimensionality related to deterministic schemes and to substantially reduce the related computational costs. In this thesis we will focus on the application of particles schemes to different problems, developing novel methods to improve the efficiency of the existent ones. In Chapter 2 we will focus on a particular problem related to magnetic confinement in Plasma Physics. We will introduce an optimal control problem and discretize it by means of a particular particle scheme. In Chapter 3 we will formulate a follower-leader kinetic model to simulate the collective motion of birds. We will show how it is possible to improve the efficiency of classical stochastic algorithms in presence of non-locality. In Chapter 4 we will consider a similar setting in the context of optimization and we will develop a novel stochastic algorithm useful to minimize non-convex high dimensional functions. Finally, in Chapter 5 we will focus on a predator-prey model, developing an efficient version of classical approximated stochastic algorithms which is able to preserve the accuracy.

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