

## SEMINAR OF MATHEMATICS

**Tuesday February 28<sup>th</sup>, 2017 at 14h15, CIB lecture hall [BI AO 448](#)**

**Dr. Maria Colombo (ETHZ - ITS)**

will present a seminar entitled:

**"The structure of transport equations and the Vlasov-Poisson system"**

Abstract:

The transport equation describes the evolution of a distribution of particles moving along the flow of a prescribed smooth vector field. An accurate description of its solutions, even when the smoothness assumption is dropped, is motivated by several applications, among which the study of kinetic equations such as the Vlasov-Poisson system.

Given a vector field in  $\mathbb{R}^d$ , the classical Cauchy-Lipschitz theorem shows existence and uniqueness of its flow provided the vector field is sufficiently smooth; this, in turn, translates in existence and uniqueness results for the transport equation. In 1989, Di Perna and Lions proved that Sobolev regularity for vector fields, with bounded divergence and a growth assumption, is sufficient to establish existence, uniqueness and stability of a generalized notion of flow, consisting of a suitable selection among the trajectories of the associated ODE. Their theory relies on a growth assumption which prevents the trajectories from blowing up in finite time. In this seminar we give an overview of the topic and we introduce a new notion of maximal flow for non-smooth vector fields which allows for finite-time blow up of the trajectories. We show structure results for the transport equation under only local assumptions on the vector field and we apply them to the Vlasov-Poisson system, where we describe the solutions as transported by a suitable flow.

Lausanne, February 23, 2017 / mg