**Tipo di tesi:** Laurea magistrale

**Corso di Laurea:** Fisica

**Tipologia:** teorica

**Titolo della tesi:** Non-adiabatic processes during interactions between magnetized particles and low-frequency electromagnetic waves: classical and quantum aspects

**Proponente:** F. Sattin

**Relatore Accademico:** L. Salasnich

**Capogruppo:** S. Cappello

**Argomento della tesi**: Adiabatic processes in classical mechanics involve a non-autonomous Hamiltonian H = H(t), featuring an extremely (rigorously, infinitely) slow variation, when compared to all time scales involved.
Canonical action variables stay unaltered, to within terms of higher order in dH/dt, and are accordingly called "adiabatic invariants". The existence of these invariants is fundamental in Bohr's development of quantum mechanics, and is extremely important in classical mechanics as well, since constraints the dynamics over manifolds of lower dimension.
A textbook example is provided by the magnetic moment of a charged particle in a slowly varying magnetic field.

A slow deformation of H is a necessary but not sufficient condition in order to ensure adiabaticity. There exist instances of systems where a finite but arbitrarily small rate of variation does actually breaks adiabatic invariants up. The reason lies in the existence, in phase space, of topologically distinct regions, separated by one or several separatrices evolving in time. Any transition from one to another of these regions is accompanied by a finite irreversible change of the adiabatic invariants.

The student is asked to study a paradigmatic case of this phenomenology: a charged particle in magnetic field, interacting with one or several electromagnetic waves with frequency lower than the particle cyclotron one, in order to avoid resonance conditions.
This toy model may be taken as representative of an important class of true physical systems: e.g., it may be used to model the ion heating by Alfvèn waves in the solar corona.
Student's tasks will be: to write down the hamiltonian function of such a system; study its topology in the phase space while varying the free parameters; identify the transition from an adiabatic to a diabatic process through the numerical integration of the equations of motion.
Once the study of the classical version of the problem is over, the student shall tackle the quantum side, by writing the time-dependent Schrödinger equation down, numerically solving it, and checking the validity (or failure) of the adiabatic theorem.

**Competenze richieste (se necessarie):** Si tratta di una tesi a carattere teorico/numerico. E' richiesta familiarità con--o disponibilità ad apprendere l'uso di--software per l'analisi numerica (preferibilmente Mathematica).

**Data della proposta:** 14/01/19

**Stato:** non assegnata

**Laureando/a:** (quando sarà assegnata)