UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

# SYLLABUS DEL CORSO

## Laboratorio di Fisica Computazionale

**2425-1-F1701Q119**

### Aims

Study and implementation of techniques for computing path integrals.

### Contents

Elementary numerical integration, Monte Carlo methods, numerical simulation of simple quantum and statistical systems.

### Detailed program

ELEMENTARY NUMERICAL INTEGRATION:

Formulae of Newton-Cotes, Gaussian quadratures, composite integration.

MONTE CARLO METHODS:

Central limit theorem, Monte Carlo, importance sampling, Markov chains, Metropolis algorithm.

NUMERICAL SIMULATIONS:

Implementation of the Metropolis algorithm for the computation of ratios of path integrals for elementary quantum systems.

Definition of the Quantum Chromodynamics (QCD) on the lattice. Numerical computation of the leading contribution

to the eta' mass due to the chiral anomaly.

## Prerequisites

Mechanics, Quantum mechanics.

## Teaching form

Teaching with standard lectures and laboratory activities:
-32 hours of standard lectures delivered in presence;
-88 hours of laboratory sessions carried out in interactive mode in presence;

All activities will take place in the Computational Physics Laboratory "Marco Comi".

## Textbook and teaching resource

Numerical Recipes, W. H. Press, S. A. Teukolsky, W. T. Vetterling, B. P. Flannery.

W. Feller, An introduction to probability theory and its application.

M. Creutz, Quarks, gluons and lattices.

M. Creutz, B. Freedman, A statistical approach to quantum mechanics, Annals of Physics 132 (1981) 427.

I. Montvay, and G. Münster, Quantum Fields on a Lattice, Cambridge University Press (1997).

C.B. Lang, and C. Gattringer, Quantum Chromodynamics on the Lattice. An Introductory Presentation (Lecture Notes in Physics 788), Springer-Verlag Berlin Heidelberg (2010).

## Semester

First and second semester.

## Assessment method

The students must prepare a written report which summarizes the theoretical material of the course and contains a presentation of the results of the numerical simulations. The report will be discussed in an oral exam, during which the general knowledge of the course programme will be verified.
Sara' possibile svolgere le prove di esame in inglese per studenti stranieri.

## Office hours

Students may come to my office any time, preferably Friday 14:00-16:00 . If needed, send an e-mail to fix an appointment.

## Sustainable Development Goals

QUALITY EDUCATION | INDUSTRY, INNOVATION AND INFRASTRUCTURE