

# Chimica Computazionale

## Introduction

Emanuele Coccia



UNIVERSITÀ  
DEGLI STUDI  
DI TRIESTE



**DSCF**

Dipartimento di  
**Scienze Chimiche  
e Farmaceutiche**

PhotoInduced Quantum Dynamics (PIQD) Group



- ecoccia@units.it
- C11 building, fourth floor, room 453/454
- Just send an email to get an appointment
- Register on Moodle

- **Introduction to computational chemistry**

- Definition of computational chemistry
- Math overview

## ● Introduction to computational chemistry

- Definition of computational chemistry
- Math overview

## ● Fundamentals of quantum chemistry

- Fundamentals of quantum mechanics (QM)
- Born-Oppeneimer approximation
- Hartree-Fock method
- Configuration Interaction
- Density functional theory
- Basis sets

## ● Introduction to computational chemistry

- Definition of computational chemistry
- Math overview

## ● Fundamentals of quantum chemistry

- Fundamentals of quantum mechanics (QM)
- Born-Oppeneimer approximation
- Hartree-Fock method
- Configuration Interaction
- Density functional theory
- Basis sets

## ● Molecular mechanics and dynamics

- Molecular mechanics (MM)
- Molecular dynamics
- Monte Carlo method
- Statistical thermodynamics

## ● Introduction to computational chemistry

- Definition of computational chemistry
- Math overview

## ● Fundamentals of quantum chemistry

- Fundamentals of quantum mechanics (QM)
- Born-Oppeneimer approximation
- Hartree-Fock method
- Configuration Interaction
- Density functional theory
- Basis sets

## ● Molecular mechanics and dynamics

- Molecular mechanics (MM)
- Molecular dynamics
- Monte Carlo method
- Statistical thermodynamics

## ● Hybrid multiscale schemes

- QM/MM methods
- Polarizable continuum models

## ● Introduction to computational chemistry

- Definition of computational chemistry
- Math overview

## ● Fundamentals of quantum chemistry

- Fundamentals of quantum mechanics (QM)
- Born-Oppheimer approximation
- Hartree-Fock method
- Configuration Interaction
- Density functional theory
- Basis sets

## ● Molecular mechanics and dynamics

- Molecular mechanics (MM)
- Molecular dynamics
- Monte Carlo method
- Statistical thermodynamics

## ● Hybrid multiscale schemes

- QM/MM methods
- Polarizable continuum models

## ● Geometry optimization and reaction profile

- Characterizing a potential energy surface
- Minimum search
- Transition-state search

## ● Introduction to computational chemistry

- Definition of computational chemistry
- Math overview

## ● Fundamentals of quantum chemistry

- Fundamentals of quantum mechanics (QM)
- Born-Oppheimer approximation
- Hartree-Fock method
- Configuration Interaction
- Density functional theory
- Basis sets

## ● Molecular mechanics and dynamics

- Molecular mechanics (MM)
- Molecular dynamics
- Monte Carlo method
- Statistical thermodynamics

## ● Hybrid multiscale schemes

- QM/MM methods
- Polarizable continuum models

## ● Geometry optimization and reaction profile

- Characterizing a potential energy surface
- Minimum search
- Transition-state search

## ● Computational exercises



# Where studying

- Slides
- F. Jensen, *Introduction to Computational Chemistry*. UK: John Wiley & Sons
- C. J. Cramer, *Essentials of Computational Chemistry*. UK: John Wiley & Sons
- J. Harvey, *Computational Chemistry*. Oxford University Press
- Further reading: D. Frenkel and B. Smit, *Understanding Molecular Simulation: from algorithms to applications*. Academic Press

- Oral exam: (at least) three questions
- Exam done in a lecture room:
  - Two rounds in winter session
  - Two rounds in summer session
  - Two rounds in September