Laurea magistrale in

Fisica dei Sistemi Complessi

(Physics of Complex Systems)
A master’s degree designed by a network of researchers, mainly theoretical physicists, working on

**Complex Systems**: interacting, correlated systems with many degrees of freedom.
Physics of Complex Systems

We apply methods of modern theoretical physics to problems from various domains.
A few examples:

- modelling and simulation of biomolecules (proteins, DNA, RNA) and their interactions
- developing efficient algorithms for hard combinatorial optimization problems
- inferring connectivity in neural networks
- modelling financial markets
- ...
Physics of Complex Systems

A Master’s Degree:

- research oriented
- interdisciplinary contents
- with strong methodological and computational components
This Master (Laurea Magistrale) programme:

- is offered to students with a Bachelor in
  - physics
  - mathematics
  - engineering (information area)
  - and related disciplines

- è nella classe LM–44 (Modellistica matematico–fisica per l’ingegneria)
Physics of Complex Systems

This Master (Laurea Magistrale) programme:

- is offered to students with a Bachelor in
  - physics
  - mathematics
  - engineering (information area)
  - and related disciplines

- è nella classe LM–44 (Modellistica matematico–fisica per l’ingegneria)
Physics of Complex Systems

2 tracks (percorsi)

- **International** track:
  - fully taught in **English**
  - leading to a **double** diploma
  - enrolls $\leq 20$ students per year

- **National** (PoliTO) track:
  - mainly taught in English
  - leading to a Laurea Magistrale
  - number of students is not limited
Apply 2018 @ PoliTO (bando chiuso)

- **Requisito generale:** 100 crediti entro il 30 marzo
- **Requisiti curriculari:**
  - 40 crediti nei settori (di base) CHIM/07, FIS/01, FIS/03, MAT/02, MAT/03, MAT/05
  - 60 crediti nei settori (caratterizzanti/affini) CHIM/07, FIS/01, FIS/02, FIS/03, FIS/04, ING-IND/31, ING-INF/01, ING-INF/02, ING-INF/05, ING-INF/07, MAT/06, MAT/07, MAT/08
  - i crediti dei settori CHIM/07, FIS/01, FIS/03 vengono conteggiati prioritariamente per le attività di base, quelli residui vengono considerati come caratterizzanti e affini
  - se il totale dei crediti sopra richiesti è inferiore di 10 crediti o meno saranno verificate le eventuali affinità dei settori
- **Inglese:** certificazione di livello B2 (IELTS 5.5)
Physics of Complex Systems: international track

Apply 2018 @ PoliTO (bando chiuso)

▶ Valutazione:

▶ 60 punti per esami triennale (media pesata, non depurata, normalizzazione al max)

▶ 40 punti per colloquio (superato con min 24)
Places and partners:

**Trieste**
- SISSA (International School for Advanced Studies)
- ICTP (International Center for Theoretical Physics)

**Torino**
- Politecnico di Torino

**Paris**
- Université Sorbonne
- Université Paris Diderot
- Université Paris–Sud (no lectures here)
Places and partners:

**Trieste**
- SISSA (International School for Advanced Studies)
- ICTP (International Center for Theoretical Physics)

**Torino**
- Politecnico di Torino

**Paris**
- Université Sorbonne
- Université Paris Diderot
- Université Paris–Sud (no lectures here)
Physics of Complex Systems: international track

Places and partners:

**Trieste**
- SISSA (International School for Advanced Studies)
- ICTP (International Center for Theoretical Physics)

**Torino**
- Politecnico di Torino

**Paris**
- Université Sorbonne
- Université Paris Diderot
- Université Paris–Sud (no lectures here)
Physics of Complex Systems: international track

I semester (Trieste)

▶ Introduction to Quantum Mechanics, Quantum Statistics and Field Theory (8 ECTS)
▶ Probability and Information Theory (8 ECTS)
▶ Elective courses (8 ECTS)

II semester (Torino)

▶ Condensed Matter Theory (10 ECTS)
▶ Statistical Physics and Biophysics (12 ECTS)
▶ Algorithms for Optimization, Inference and Learning (8 ECTS)
▶ Advanced Experimental Physics (6 ECTS)
Physics of Complex Systems: international track

I semester (Trieste)

- Introduction to Quantum Mechanics, Quantum Statistics and Field Theory (8 ECTS)
- Probability and Information Theory (8 ECTS)
- Elective courses (8 ECTS)

II semester (Torino)

- Condensed Matter Theory (10 ECTS)
- Statistical Physics and Biophysics (12 ECTS)
- Algorithms for Optimization, Inference and Learning (8 ECTS)
- Advanced Experimental Physics (6 ECTS)
Physics of Complex Systems: international track

III semester (Paris)

- Statistical Field Theory (6 ECTS)
- Stochastic Processes (6 ECTS)
- Non Linear Physics and Dynamical Systems (3 ECTS)
- Computational Science (3 ECTS)
- Elective courses (12 ECTS)

IV semester

- Spring College (12 ECTS)
- Research internship (18 ECTS)
Physics of Complex Systems: international track

III semester (Paris)

- Statistical Field Theory (6 ECTS)
- Stochastic Processes (6 ECTS)
- Non Linear Physics and Dynamical Systems (3 ECTS)
- Computational Science (3 ECTS)
- Elective courses (12 ECTS)

IV semester

- Spring College (12 ECTS)
- Research internship (18 ECTS)
Physics of Complex Systems: international track

SPRING COLLEGE 2018

- Reinforcement learning
- Nonequilibrium Behavior of Quantum Statistical Systems
- Hierarchical Inference
- Polymer Physics of Chromosome Folding
- Statistics of Extremes in Correlated Systems
Physics of Complex Systems: international track

Financial support:

- Erasmus+ for Paris and an equivalent amount for Trieste
- Université Franco–Italienne / Università Italo–Francese
- additional grants, on a competitive basis, from various institutions in the Paris area
- support can be available (possibly on a competitive basis) for the internship

Housing offices
Physics of Complex Systems: international track

Financial support:

- Erasmus+ for Paris and an equivalent amount for Trieste
- Université Franco–Italienne / Università Italo–Francese
- additional grants, on a competitive basis, from various institutions in the Paris area
- support can be available (possibly on a competitive basis) for the internship

Housing offices
Physics of Complex Systems: international track

Financial support:
- Erasmus+ for Paris and an equivalent amount for Trieste
- Université Franco–Italienne / Università Italo–Francese
- additional grants, on a competitive basis, from various institutions in the Paris area
  - support can be available (possibly on a competitive basis) for the internship

Housing offices
Physics of Complex Systems: international track

Financial support:
- Erasmus+ for Paris and an equivalent amount for Trieste
- Université Franco–Italienne / Università Italo–Francese
- additional grants, on a competitive basis, from various institutions in the Paris area
- support can be available (possibly on a competitive basis) for the internship

Housing offices
Physics of Complex Systems: international track

Graduates in Physics of Complex Systems (see Alumni web page):

- continue with a **PhD program** at international institutions in
  - **Italy**: PoliTO, SISSA/ISAS, SNS, UniBO
  - **France**: ENS, ESPCI, Sorbonne, Paris Diderot, Paris-Sud, Institut Curie, CNRS
  - **Europe**: EPFL, ETHZ, Imperial College London, King’s College London, University of Leeds
  - **USA**: NYU, Stanford, Rice

- get a second (Nanotech) master’s degree
- collaborate with private research institutions
- are hired by private companies in the ICT area
Graduates in Physics of Complex Systems (see Alumni web page):

- continue with a **PhD program** at international institutions in:
  - **Italy**: PoliTO, SISSA/ISAS, SNS, UniBO
  - **France**: ENS, ESPCI, Sorbonne, Paris Diderot, Paris-Sud, Institut Curie, CNRS
  - **Europe**: EPFL, ETHZ, Imperial College London, King’s College London, University of Leeds
  - **USA**: NYU, Stanford, Rice
- get a second (Nanotech) master’s degree
- collaborate with private research institutions
- are hired by private companies in the ICT area
Graduates in Physics of Complex Systems (see Alumni web page):

- continue with a **PhD program** at international institutions in
  - **Italy**: PoliTO, SISSA/ISAS, SNS, UniBO
  - **France**: ENS, ESPCI, Sorbonne, Paris Diderot, Paris-Sud, Institut Curie, CNRS
  - **Europe**: EPFL, ETHZ, Imperial College London, King’s College London, University of Leeds
  - **USA**: NYU, Stanford, Rice

- get a second (Nanotech) master’s degree
- collaborate with private research institutions
- are hired by private companies in the ICT area
Physics of Complex Systems: national track

- Attivazione dall’anno accademico 2018–19
- Obiettivi e contenuti simili al percorso internazionale
- Erasmus+ (work in progress): KU Leuven, Paris (Paris-Sud, Sorbonne), Zaragoza
- No numero programmato
- **NON** è la versione “semplificata” del percorso internazionale
- Website: http://www.pcs.polito.it
Physics of Complex Systems: national track

REGOLE DI ACCESSO (apply.polito.it)

▶ Requisiti curriculari: gli stessi del percorso internazionale

▶ Adeguatezza della personale preparazione:
  ▶ Candidati PoliTO: tempo di laurea e media (pesata, depurata 28 crediti peggiori)
    ▶ ≤ 4 anni: indipendentemente dalla media
    ▶ 4 ÷ 5 anni: media ≥ 21/30
    ▶ > 5 anni: media ≥ 24/30
  ▶ Candidati altri atenei: Media (pesata, non depurata) ≥ 24/30

▶ Inglese: certificazione IELTS 5.0 o equivalente
Physics of Complex Systems: national track

I semestre

- Advanced quantum mechanics and quantum statistics (8 ECTS)
- Stochastic simulation methods in physics (8 ECTS)
- Fluidodinamica (8 ECTS)

I/II semestre

- Insegnamento a scelta in Experimental Physics (6 ECTS)

II semestre

- Condensed Matter Theory (10 ECTS)
- Statistical Physics and Biophysics (12 ECTS)
- Algorithms for Optimization, Inference and Learning (8 ECTS)
Physics of Complex Systems: national track

I semestre

- Advanced quantum mechanics and quantum statistics (8 ECTS)
- Stochastic simulation methods in physics (8 ECTS)
- Fluidodinamica (8 ECTS)

I/II semestre

- Insegnamento a scelta in Experimental Physics (6 ECTS)

II semestre

- Condensed Matter Theory (10 ECTS)
- Statistical Physics and Biophysics (12 ECTS)
- Algorithms for Optimization, Inference and Learning (8 ECTS)
Physics of Complex Systems: national track

I semestre

▶ Advanced quantum mechanics and quantum statistics (8 ECTS)
▶ Stochastic simulation methods in physics (8 ECTS)
▶ Fluidodinamica (8 ECTS)

I/II semestre

▶ Insegnamento a scelta in Experimental Physics (6 ECTS)

II semestre

▶ Condensed Matter Theory (10 ECTS)
▶ Statistical Physics and Biophysics (12 ECTS)
▶ Algorithms for Optimization, Inference and Learning (8 ECTS)
Physics of Complex Systems: national track

III semestre

- Field theory and critical phenomena (6 ECTS)
- Out of equilibrium physics (6 ECTS)
- Modelli e sistemi a eventi discreti (6 ECTS)
- Insegnamento a scelta (6 ECTS)

IV semestre

- Bioinformatics (6 ECTS)
- Tesi (30 ECTS)
Physics of Complex Systems: national track

III semestre
- Field theory and critical phenomena (6 ECTS)
- Out of equilibrium physics (6 ECTS)
- Modelli e sistemi a eventi discreti (6 ECTS)
- Insegnamento a scelta (6 ECTS)

IV semestre
- Bioinformatics (6 ECTS)
- Tesi (30 ECTS)
Contacts @ PoliTO

- http://www.pcs.polito.it

- Alessandro Pelizzola, alessandro.pelizzola@polito.it