MCC
Master in Crystallography and Crystallization
Ph.D. Programme
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Master in Crystallography and Crystallization Ph.D. Programme

Official University Degree
Postgraduate Programme

Location
Casa de la Ciencia (CSIC)  
Pabellón de Perú  
Avda. de María Luisa s/n  
41013 Sevilla, Spain

Universidad Internacional  
Menéndez Pelayo  
Palacio de la Magdalena  
39005 Santander, Spain

October - July
M-II y III Supervised  
Research and Specialised  
Subjects  
Offered at chosen laboratories

The Master and Ph.D. programme in Crystallography and Crystallization is offered in a joint effort between the University International Menéndez Pelayo (UIMP) and the Agencia Estatal Consejo Superior de Investigaciones Científicas (CSIC). The Master’s features collaboration by both Spanish and international institutions.

The Master provides a unified, in-depth examination of the crystalline state, its properties and applications to the various scientific/technical disciplines deemed as ‘users’ of crystallography, such as structural chemistry, materials science, molecular biology, crystal growth, industrial crystallization, nanotechnology, pharmacology, mineralogy and solid-state physics.
Objectives

At the end of the course the student will have acquired:

> Advanced, in-depth knowledge about the fundamental aspects of crystallography and crystallization. Thecnological and industrial applications of this knowledge.

> Skills to develop new research topics in these fields.

> In depth knowledge of the fundamental of crystallization and the use of various crystallization techniques.

> The necessary training for the student to be able to design his own protocol to grow both small molecule and macromolecule crystals.

> Fundamental and practical knowledge on the design, implementation and realization of diffraction experiment for the collection of structural data and the characterization of crystals.

> Training in the use of cutting-edge techniques for structural resolution by X-ray diffraction, including inorganic, organic and biological macromolecules.

> Methods for the exploitation of structural information in different disciplines.

> Practical experience in the use of large facilities related to crystallography: synchrotron and neutron radiation.

> Adequate preparation to enter the third cycle of university studies (doctorate), embarking upon a research line in order to develop the doctoral thesis.

Structure

The Master’s runs for a whole academic year from October until July and comprises 60 ECTS credits organized in three modules (600 hours of lecture time plus 900 hours of personal work).

Teaching Programme

MODULE I: **Fundamentals of Crystallography and Crystallization** (28 ECTS/compulsory, Sevilla)

<table>
<thead>
<tr>
<th>Code</th>
<th>Course</th>
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</thead>
<tbody>
<tr>
<td>101158</td>
<td>Fundamentals of crystallization (6 ECTS)</td>
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<tr>
<td>101159</td>
<td>Fundamentals of crystallography (4 ECTS)</td>
</tr>
<tr>
<td>101160</td>
<td>Diffraction methods (7 ECTS)</td>
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<tr>
<td>101161</td>
<td>Structure solving and refining (9 ECTS)</td>
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<tr>
<td>101162</td>
<td>Crystallography and society (2 ECTS)</td>
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MODULE II: **Supervised Research** (70 ECTS offered/14 ECTS to choose)

<table>
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<tr>
<th>Code</th>
<th>Course</th>
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<tbody>
<tr>
<td>101163</td>
<td>Laboratory practice in crystallization I (7 ECTS)</td>
</tr>
<tr>
<td>101164</td>
<td>Laboratory practice in crystallization II (7 ECTS)</td>
</tr>
</tbody>
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Location (alternatives):
- Laboratorio de Estudios Cristalograficos, LEC, Universidad de Granada (IACT, CSIC) (Spain).
- Grupo de polimorfismo y miscibilidad en estado sólido, Universidad de Barcelona (Spain).
- Dipartimento di Chimica Giacomo Ciamician, Università di Bologna (Italy).
- Departamento de Cristalográfia y Mineralogía, Universidad Complutense de Madrid (Spain).
101165 Laboratory practice in chemical crystallography and materials I (7 ECTS)
101166 Laboratory practice in chemical crystallography and materials II (7 ECTS)
Location (alternatives):
- Departamento de Química Inorgánica, Universidad de Alcalá de Henares (Spain).
- Laboratorio de Cristalografía, Instituto de Ciencia de Materiales de Madrid (ICMM - CSIC) (Spain).
- Laboratorio de Rayos X y Materiales Moleculares, Universidad de La Laguna (Spain).
- Grupo de Análisis Estructural, Instituto de Ciencia de Materiales de Aragón (ICMA - CSIC) (Spain).
- Laboratorio de Cristalografía, Universidad de Oviedo (Spain).
- Instituto de Investigaciones Químicas de Cataluña (ICIQ) (Spain).
- Departamento de Química Química y Ambiental, Università dell’Insubria (Italy).
- Departamento de Química Inorgánica (Farmacia), Universidad de Granada (Spain).
- Departamento de Química Inorgánica Cristalografía y Mineralogía, Universidad de Málaga (Spain).
- Departamento de Química Inorgánica, Universidad de Sevilla (Spain).
- Instituto de Ciencia de Materiales de Sevilla (ICMSE - CSIC) (Spain).

101167 Laboratory practice in macromolecular crystallography I (7 ECTS)
101168 Laboratory practice in macromolecular crystallography II (7 ECTS)
Location (alternatives):
- Departamento de Cristalografía y Biología Estructural, Instituto de Química Física Rocasolano (IQFR –CSIC) (Spain).
- Laboratorio de Proteólisis, Instituto de Biología Molecular de Barcelona (IBMB - CSIC) (Spain).
- Grupo de Estudios Estructurales en Complejos Macromoleculares, Centro Nacional de Biotecnología (CNB - CSIC) (Spain).
- Departamento de Biología Estructural de Proteínas, Centro de Investigaciones Biológicas (CIB – CSIC) (Spain).
- School of Biochemistry and Immunology, Trinity Collage (Ireland).

101169 Laboratory practice in fundamental and computational crystallography I (7 ECTS)
101170 Laboratory practice in fundamental and computational crystallography II (7 ECTS)
Location (alternatives):
- Laboratorio de Cristalografía, Universidad de Oviedo (Spain).
- Instituto di Cristallografia - CNR Sede di Bari (Italy).
- Departamento de Física de la Materia Condensada, Universidad del País Vasco (Spain).

101171 Laboratory practice in large facilities I (7 ECTS)
101172 Laboratory practice in large facilities II (7 ECTS)
Location (alternatives):
- Spline CRG, European Synchrotron Radiation Facility (France).
- Macromolecular Crystallography beamline, Sincrotrón ALBA (Spain)
- Materials Science and Powder Diffraction Beamline, Sincrotrón ALBA (Spain).
- Difracción Group, Institute Laue-Langevin (ILL) (France).

MODULE III: Specialised Courses (30 ECTS offered, 6 ECTS to choose)

Code
101173 Crystallography in large facilities (3 ECTS)
101174 Weak interactions in crystals (3 ECTS)
101175 Crystallization in the pharmaceutical, agrochemical and food industries* (3 ECTS)
100176 Diffraction under extreme conditions (3 ECTS)
101177 Electronic Densities* (3 ECTS)
101178 Polymorphism (3 ECTS)
101179 Crystallography of macromolecules and biomineralisation* (3 ECTS)
101180 Crystallography of biological macromolecules * (3 ECTS)
101181 X-Ray powder diffraction and the Rietveld method* (3 ECTS)
101182 Computational crystallography: development of crystallographic software* (3 ECTS)

101183 MASTER’S THESIS (12 ECTS)

* Open course. Students not registered in the Master can attend this course.
Management Board

The organization and teaching of MCC is run by professors of European Universities and Research Centres leaders in the fields of Crystallography and Crystallization, which bestows the Master a strong international and interdisciplinary nature. Courses are taught in English.

Director of the Master
Fermín Otálora Muñoz
Research Scientist
Consejo Superior de Investigaciones Científicas (CSIC)

Assistant Director of the Master
Santiago García Granda
Research Professor
University of Oviedo

Lecturers

More than 50 lecturers from Research Centres and Universities in Spain, Europe, America and Asia participate in this Master. The lecturers are selected for their recognised scientific and teaching excellence in the fields of crystallography and crystallization.

Research Centres of the Lecturers:
> Centre National de la Recherche Scientifique
> Consejo Superior de Investigaciones Científicas (Higher Scientific Research Council)
> European Synchrotron Radiation Facility, Grenoble
> Institut di Cristallografía di Bari
> Institute Laue Langevin, Grenoble
> Institute National de la Recherche Agronomique
> Martin Luther Universität Halle, Wittenberg
> Technical University of Delft
> University of Alabama at Huntsville
> University of Alcalá
> University of Barcelona
> Autonomous University of Barcelona
> University of Bolonia
> University of Geneva
> University of Innsbruck
> University Jaime I, Castellón
> University of La Laguna
> University of Leeds
> University of Málaga
> University of Manchester
> University of Oviedo
> University of Torino
> University of Utrecht
> University of Zurich
> University of York
> Leibniz Institute for Crystal Growth (IKZ), Berlin
> University of Toulouse
> University of Cambridge
Admissions Requirements

For admission to the Master, students must have an official university degree from an institution of higher education in a country included in the “European Higher Education Area” (EHEA). This degree must be valid to access Master education in the issuing country. Engineering and Sciences degrees will be accepted with priority.

Students with an equivalent degree issued by institutions outside the EHEA can be accepted without an explicit, official recognition of qualification after proving the equivalence of the education level and that the given degree gives access to Master education in the country of the issuing institution. The admission of these students does not mean that their degree is recognized in any context other than the admission to the Master.

The official language for tuition during the Master is English, but single-student or small-group activities such as supervised work or tutorship can be done in any other language agreed to by the teacher and the student. Students must be fluent in speaking, reading and writing in English to be accepted. The Master’s Thesis must be prepared and presented in English.

The standards for student acceptance include:

1. Degree
2. Student record
3. Participation in additional education programmes
4. Previous knowledge in informatics tools
5. Motivation

Assessment and rules of attendance

A continuous assessment of student progress will be carried out through examinations after each course. The final grade assigned to each student will include these partial grades and the assessment of the presentation and discussion of their Master’s Thesis.

Students have a maximum of two examination sittings per year to pass each course and must complete all the credits in the programme within two years.

Issuing of Degrees

At the end of the course successful students will be awarded the official Master Degree in Crystallography and Crystallization issued by the Chancellor of the UIMP.

Timetable

The Master’s runs from October until July.

Module I will be taught in the morning (from 9 am to 13:30 pm) and in the afternoon (from 15:30 pm to 17:30 pm) sessions, between October and December, plus an extra week in July.

Module II will be offered in periods of 30 days for two months between January and April.
Module III will also have morning and afternoon sessions in the form of seminars lasting 5 days each, between the months of April and July.

**Location**

Module I will be taught at ‘Casa de la Ciencia del CSIC’ in Seville from October to December. The last subject of Module I (‘Crystallography and Society’) and the presentation of the final research project will take place in Santander (International University Menéndez Pelayo), in July. Laboratory training in Module II and specialised subjects of Module III will be offered at the chosen laboratories in Granada, Alcalá de Henares, Barcelona, Madrid, La Laguna, Zaragoza, Oviedo, Grenoble, Bolonia, Castellón, Valencia, Tarragona, Dublin, Bari, Como or Seville.

**Application for admission and Registration**

Maximum number of students: 25  
**Pre-registration dates:** April – July.  
**Payment for place holding:** July.  
**Registration date:** September.  

If there are open slots left, a special preregistration and matriculation period will be opened up in September.

Applications for admission are made through the site *preinscripción on – line* accessed from the web of UIMP (http://www.uimp.es/preins/index.php). The documents should be attached in JPG or PDF format.

**Required documentation:**

1. **Photocopy of DNI** (National Identity Document) for Spaniards; **passport or Foreign Identification Number** (NIE) for non-Spaniards.
2. **Certified photocopy of Degree** giving access to the University Master’s.
3. **Personal academic transcripts** (original or certified photocopy).
4. **Curriculum Vitae**.
5. **One passport-size photo**.

Students with a non-homologated foreign degree, or one which is in the process of being homologated, are also requested to provide:

1. **A document from the university** where they have studied attesting to the fact that the courses completed qualify the student for access to post-graduate study in the university’s home country.
2. **Personal academic transcripts** indicating the official duration of one’s studies in academic years, the course of studies followed, classes taken, and the grades and credits earned in each class.

**IMPORTANT:** Academic documents presented are to be legalized and translated into Spanish, where necessary. The requirement for legalization shall not be enforced for documents issued in member states of the European Union, or from states having signed the European Economic Space Agreement.

Admission of the candidates will be decided by a designated Academic Commission. The University will duly notify students regarding acceptance to the Master’s individually, after which they will have to formally register.
The original documentation required must be provided to the Secretary of Students ONLY if the Academic Committee of the Study supports the request.

**Registration**

At the time of registration, the following fees apply:

- Registration fee: price per ECTS. Price does not include the cost of academic visits
- Administrative fee, in the first registration
- Office expenses, per year
- School insurance (under 28 years old), per year

Other charges:

- Personal academic certification
- Issuance of Master’s Degree

**NOTE:** Registration and administrative fees, and deadlines for each academic year, are published on the website of the UIMP, upon approval by the Ministry of Education, Culture and Sport.

**Grants**

**‘La Factoría’ support**

The ‘Factoría Española de Cristalización’ will support up to 10 students attending the Master.

The requirements and procedure to apply for this support are available at the following webpage: http://lafactoria.lec.csic.es/mcc/support

The grant application must include the name, address and e-mail from a university professor or researcher at the CSIC or Public Research Institutions or companies responsible that can provide references of the applicant.

**IUCr support**

The International Union of Crystallography will support students from developing countries to attend the Master. Check http://lafactoria.lec.csic.es/mcc/support for details.

**UIMP Grants**

UIMP offers grants for students admitted to university Master’s programs according to academic merit.

The requirements and applications forms are available on www.uimp.es
Ph.D. Programme

Contents

The Ph.D. programme is organised in two stages:

> Training stage: Master in Crystallography and Crystallization (UIMP-CSIC) composed of 60 ECTS credits (from October to July).
> Research stage: To conduct original research that results in a Ph.D. Thesis.

Research lines

The Ph.D. Thesis will involve the completion of an original work of research in any of the following subjects:

Crystallography

> Crystallography of surfaces and interphases.
> Crystallography of solid-liquid interfaces.
> Instrumentation in Synchrotron radiation facilities.
> Data treatment and structural resolution of unstable organometallic crystals.
> Structural resolution of molecular dendrimeric crystals.
> Synthesis and resolution of metalorganic nets.
> Development of crystallographic software.
> Development of crystallographic instrumentation and improvement of diffraction devices.
> Study of the molecular, structural and electronic properties resulting from the crystallographic analysis of monocrystals. Development of novel materials.
> Polymorphism, isomorphism, solvates and co-crystals.
> Development and use of calorimetric methods, DSC, TG, DSC-MASS, for the characterisation of the properties of new materials.
> Structural resolution of proteins, viruses and large macromolecular complexes.

Crystallization

> Crystal nucleation. Kinetics of nucleation and precipitation.
> Design and construction of industrial crystallisers.
> Morphology control and crystal habit.
> Crystallization of membrane proteins and large macromolecular complexes.
> Crystallization of biological macromolecules.
> Molecular mechanisms of crystal growth.
> Crystallization in microgravity and at high pressures.
> Macromolecule/mineral interaction in biomineralisation.
> Nanocrystalline and self-assembled materials.
> Polymorph crystallization with special attention to cosmetics and pharmaceuticals.
> Textural patterns and decoding information contained in geobiological minerals.

Ph.D. Programme admissions requirements

In order to be admitted to the Ph.D. programme, the student must have successfully passed the Master in Crystallography and Crystallization (UIMP-CSIC) or any other equivalent Master (minimum of 60 ECTS credits).
Other students outside the European Higher Education Area can also access the Ph.D. programme provided that they can demonstrate similar qualifications from their country of origin.

**Award of the Ph.D. Degree**

Awarding of the Ph.D. degree will follow after the successful public presentation of a Ph.D. Thesis before a Committee of experts.

**Registration for the Ph.D.**

The first step to be admitted to the Ph.D. programme is to apply to the director of the Master, who will then assign a Thesis supervisor. Once the thesis supervisor and the Director have given their approval, the student can apply to the Ph.D. Commission of the UIMP, which will decide on the application.

Registration for the Ph.D. is open throughout the whole academic year (October-June). The Ph.D. commission meets twice a year (October-February).

**Application for admission to the Doctorate through the UIMP Commission**

The student has to process his application for admission, giving the Department of Postgraduate Students, together with the Thesis Project, a favorable report from his or her director, and original or certified documentation requested within the application form.

When the Ph.D. candidate receives his admission letter from the Doctoral Commission he is to proceed to formalise the payment of tuition fees at the Postgraduate Student Office.

The registration must be renewed and the fee paid each academic year until the end of the doctoral thesis. The thesis must be completed within four years after joining the Master.

At the time of registration, the following fees apply:

- Registration fee, per year
- Administrative fee, in the first registration
- Office expenses, per year
- School insurance (under 28 years old), per year

Other charges:

- Thesis defense
- Issuance of Ph.D. Degree

**NOTE:** Registration and administrative fees, and deadlines for each academic year, are published on the website of the UIMP, upon approval by the Ministry of Education, Culture and Sport.

**Calendar of expiry of doctoral programs regulated by RD 1393/2007**

- Last academic year to allow admission of new Ph.D. students: Academic year 2013-14
- Expiry date for doctoral programs regulated by RD 1393/2007: September 30, 2017
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And Crystallization
Ph.D. Programme

Information
UIMP Postgraduate Secretary Office
C/ Isaac Peral, 23
28040 MADRID
91 592 06 00/20
alumnos.posgrado@uimp.es
www.uimp.es

Web MCC Programme
http://lafactoria.lec.csic.es/mcc

Code Master: P02A
Code PhD: P00V

Entidad colaboradora

www.uimp.es