

# Master on Physics of the Universe: Cosmology, Astrophysics, Particles and Astroparticles

# A unique and *specialized Master's degree*

- Organized by Centro de Astropartículas y Física de Altas Energías
- with implication of
  - Laboratorio Subterráneo de Canfranc
  - Centro de Estudios de Física del Cosmos de Aragón
  - other national and international institutes

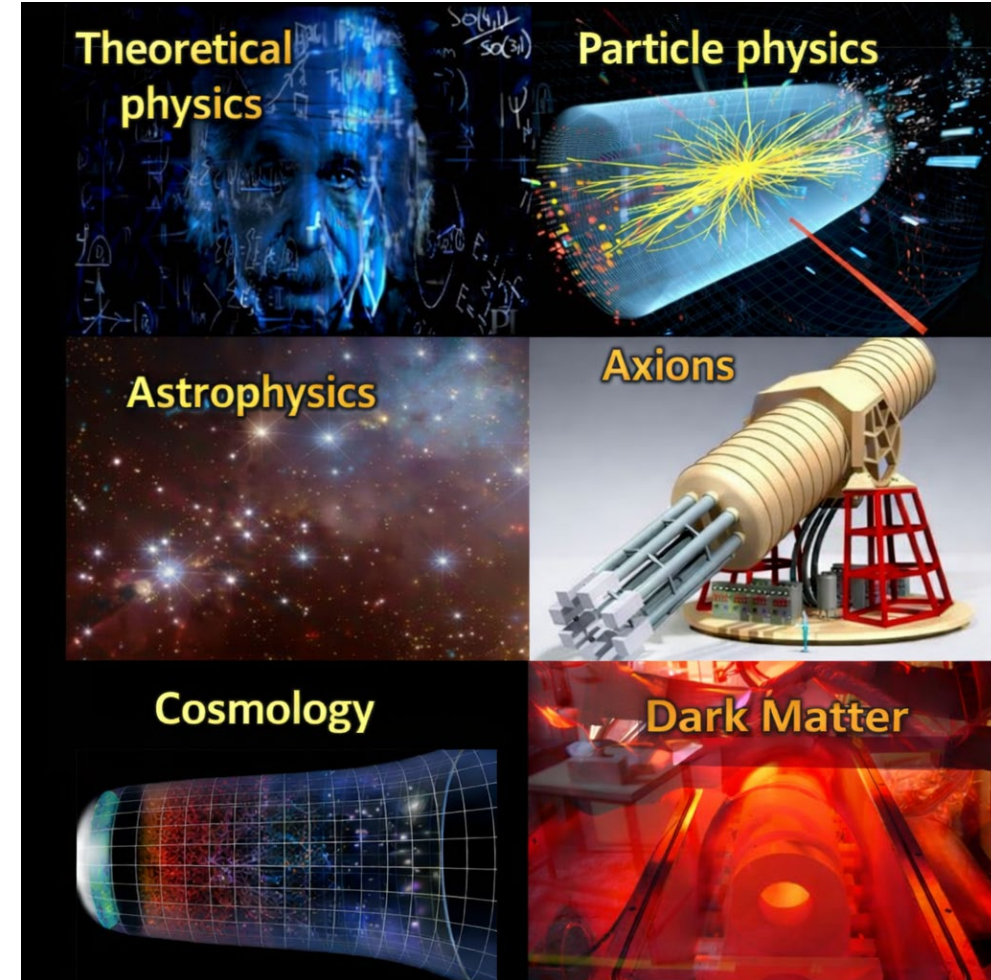


Centro de Astropartículas y  
Física de Altas Energías  
Universidad Zaragoza



# Research lines of teaching staff

- Direct detection of Dark Matter
- Dark matter modeling in galaxies
- Axion physics: theory and detection
- Neutrino physics: double beta decay and neutrino mass
- Radioactivity and low-background techniques
- Development of new particle detectors
- Lattice gauge theories
- Applications of field theory to quantum information and topological materials
- Phenomenology of the Standard Model and new physics beyond the SM
- Theory and phenomenology of quantum gravity
- Cosmology and Galaxy Evolution



# A short description

- Specialization in the study of Cosmology, Astrophysics, Astronomy, Astroparticles and Particle Physics
  - Two complementary orientations:
    - **theoretical-phenomenological**
    - **experimental or technological**
- ✓ Entry requirements: degree in Physics, Mathematics or Engineering
  - ✓ Distribution of learning activities: 60 ECTs in 2 Semesters
  - ✓ Language of instruction: English/Spanish

# What does the master's degree offer?

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- Learning in leading research centers
- Theoretical-phenomenological or/and experimental-technological formation
- International research environment
- International agreements for the Master Thesis
- Participation in training, research and dissemination activities
- Possibility of starting research contracts
- Possibility of becoming a PhD student

# What do you learn?

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- Use advanced computational techniques and tools for modeling, numerical simulation, and scientific data analysis.
- Analyze, process, and interpret experimental data from experiments and observations, applying appropriate statistical and computational methods.
- Pose, formulate, and solve complex theoretical problems, developing physical models and performing advanced calculations.
- Understand and handle the main instruments, detectors, and experimental methodologies used in particle physics, astrophysics, and astroparticles.
- Develop scientific software projects and work collaboratively in multidisciplinary environments.
- Delve into a specific research topic, becoming familiar with the scientific literature, the latest advances, and current research lines in the field.

# General presentation of the curriculum

The program consists of 60 ECTS credits distributed as follows:

- **15 compulsory ECTS** (one 6-ECTS course and one 9-ECTS course)
  - **30 optional ECTS** (chosen from a total offering of 6 courses, including the interdisciplinary one)
  - **15 ECTS for the Master's Thesis**
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- **Compulsory courses (annual):**
    - Current Topics in Cosmology, Astrophysics, and Particle Physics (6 ECTS)
    - Methods and Techniques in Cosmology, Astrophysics, and Particle Physics (9 ECTS)
  - **Optional subjects, consisting of two semester-long courses of 6 ECTS each:**
    - Cosmology and Gravitation
    - Particle Physics
    - Astroparticle Physics
    - Astrophysics
    - Technology and Instrumentation

# Syllabus

- **15 compulsory ECTS**
- **30 optional ECTS**  
(5 courses)
- **15 ECTS Master's Thesis**

TYPE	PER.	COURSE	ECTS
CO	A	Methods and Techniques in Cosmology, Astrophysics, and Particle Physics	9
CO	A	Current Topics in Cosmology, Astrophysics, and Particle Physics	6
OP	S1	Stellar and Extragalactic Astrophysics	6
OP	S2	Observational Astrophysics	6
OP	S1	General Relativity and Gravitational Waves	6
OP	S2	Cosmology	6
OP	S1	Astroparticle Physics: Gamma Rays, Neutrinos, and Cosmic Rays	6
OP	S2	Astroparticle Physics: the Dark Universe	6
OP	S1	Field and Particle Theory	6
OP	S2	Particle Physics Phenomenology	6
OP	S1	Particle Detectors: Physical Principles, Design, and Operation	6
OP	S2	Applications of Particle Detectors in Science and Technology	6
OP		Interdisciplinary	6
TFM	A	Master's Thesis	15

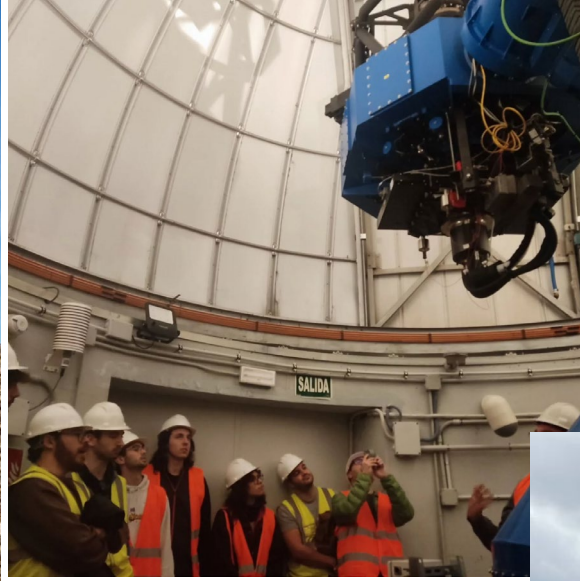
# Educational methodology

- **Active methodologies, with the students being responsible for their own learning, following the dictates of the European Space of Higher Education for the training of professionals**
- Specific resources and didactic methods: face-to-face classes, research laboratories, computing, virtual learning, seminars, outreach ...
- Activities will be offered in English and Spanish languages
- Visits and activities in the Laboratorio Subterráneo de Canfranc and the Observatorio Astrofísico de Javalambre (OAJ)

# LSC activities



# CEFCA activities



# Career opportunities. Profiles:

- **Researcher profile:** to start a PhD in the field of Physics and Astronomy, or engage in scientific research activities carried out in the public sector or in R&D divisions of the private sector.
- **Technical profile of expert in software and data analysis** to work on: information technology (IT), data and analytics companies, healthcare, financial companies, marketing and advertising, energy and environment, artificial intelligence and machine learning, public agencies, etc.
- **Technical profile of expert in instrumentation and technology** to work on: particle physics, astrophysics and astronomy, nuclear medicine, medical imaging, nuclear technologies, research in materials science, security and defence, environment, geophysical exploration, medical physics, etc.
- **Teacher and disseminator profile** that allows professional opportunities in: teaching, content creation, museums and science centres, media, dissemination, etc.

# So, What to do next ?

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- Starting a doctoral thesis
- Applying for technical positions in research centres (particle physics, astroparticles, astrophysics, big data, software, medical physics, ...)
- Continuing technical training at universities and research centres.
- Preparing for the FIR exam
- ... more opportunities in the near future

# Cosmology, astrophysics, particle and astroparticles frontier physics

Do you want to join us in this learning adventure?

**CAPA**

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Universidad Zaragoza

 Facultad de Ciencias  
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 LSC  
Laboratorio Subterráneo de Canfranc

