



$$\begin{aligned}\mathcal{L} = & -\frac{1}{4}F_{\mu\nu}F^{\mu\nu} \\ & + i\bar{\Psi}\not{D}\psi \\ & + D_{\mu}\Phi^{\dagger}D^{\mu}\Phi - V(\Phi) \\ & + \bar{\Psi}_L\hat{Y}\Phi\Psi_R + h.c.\end{aligned}$$

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



**Centro de Astropartículas y
Física de Altas Energías**
Universidad Zaragoza

A unique and *specialized Master's degree*

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

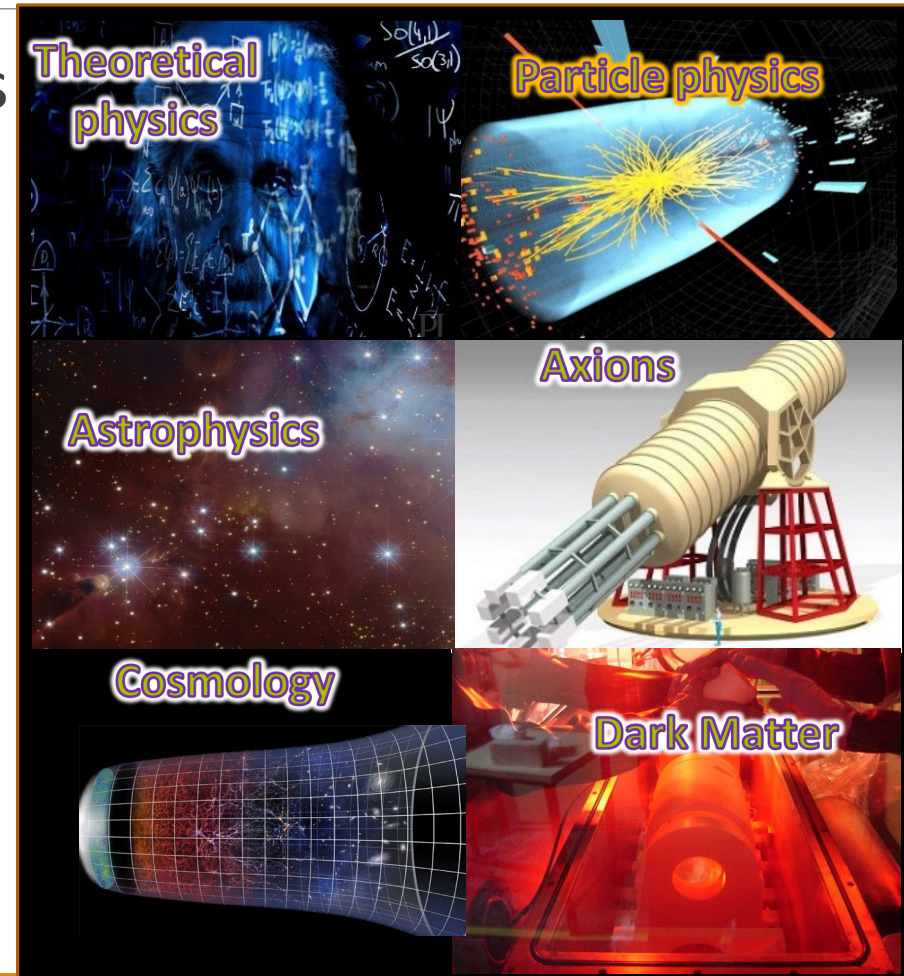


Centro de Astropartículas y
Física de Altas Energías
Universidad Zaragoza



Research lines of teaching staff

- Dark matter, axion physics and neutrino physics
- Low background techniques and detector development
- Lattice gauge theory and field theory applications
- Standard Model extensions and quantum gravity
- Observational astrophysics and cosmology



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
 - Erasmus agreements & double Master title with Cergy Paris University
 - Language of instruction: Spanish/English

What does the master's degree offer?

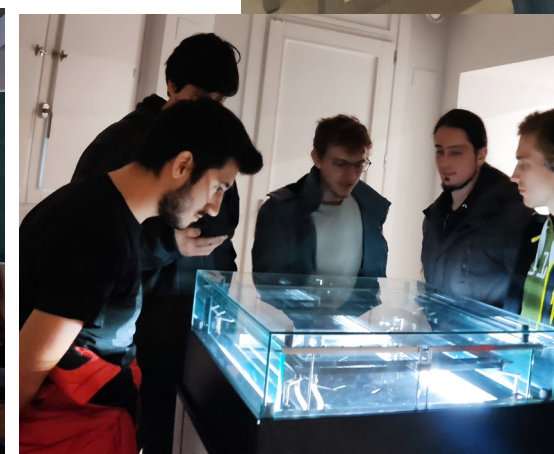
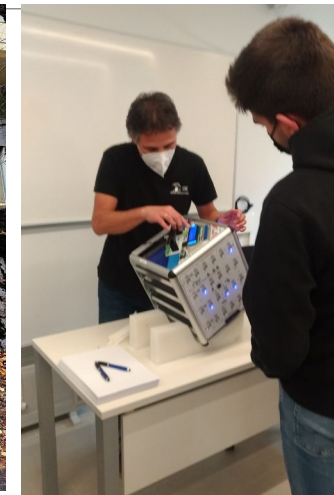
- Learning in leading research centers
- Theoretical-phenomenological or/and experimental-technological formation
- International research environment
- International agreements for the Master Thesis
- Participation in training, research and dissemination activities
- Possibility of starting research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

Educational methodology

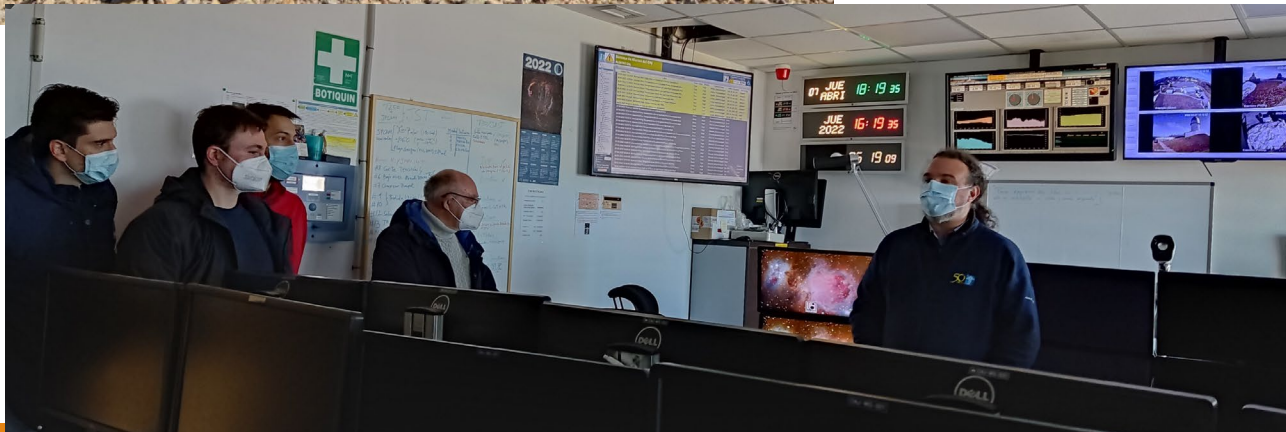
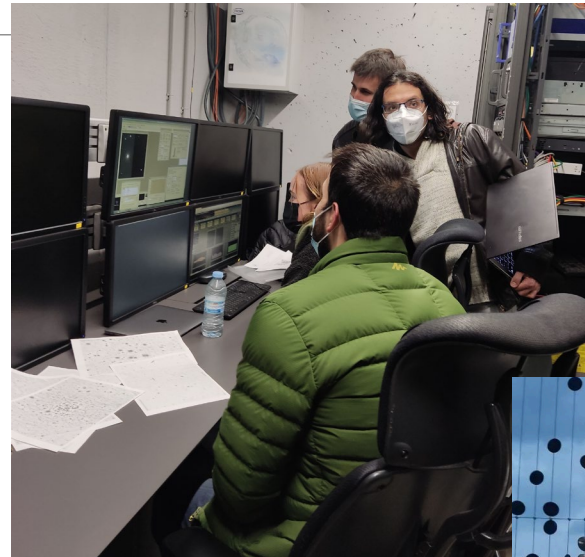
Active methodologies, with the students being responsible for their own learning, following the dictates of the European Space of Higher Education for the training of professionals

- 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.

Syllabus (2024-2025)

	S1	S2
12 Compulsory ECTs	-Frontier topics in cosmology, astrophysics and particle physics -Mathematical and computational methods in cosmology, astrophysics and particle physics	
48 Optional ECTs (4 courses / semester)	1. Cosmology I: the early Universe 2. Quantum Field Theory 3. Electrodynamics: radiation and matter interaction 4. General relativity and gravitational waves. 5. Astroparticle physics I: gamma rays, neutrinos and cosmic rays. 6. Stellar astrophysics 7. Low radioactivity techniques 8. Physics and engineering of particle detectors	1. Cosmology II: structure formation in the Universe 2. Theory and phenomenology of the Standard Model of particle physics. 3. Particle physics beyond the Standard Model 4. Astroparticle physics II: the dark Universe 5. Observational astrophysics 6. Extragalactic astrophysics 7. Advanced instrumentation for astronomy and particle physics experiments
	S3	
30 Compulsory ECTs	-Master Thesis (18 ECTs) -External internship and other activities (12 ECTs)	

Syllabus (2025-2026)? 30 ECTs Master

	S1	S2
30 Compulsory ECTs	-Frontier topics in cosmology, astrophysics and particle physics (6 ECTs) -Methods and techniques in cosmology, astrophysics and particle physics (9 ECTs) -Master Thesis (15 ECTs)	
30 Optional ECTs (5 courses)	<ol style="list-style-type: none"> 1. Field theory and particles 2. General relativity and gravitational waves. 3. Astroparticle physics I: gamma rays, neutrinos and cosmic rays. 4. Stellar and extragalactic astrophysics 5. Particle Detectors: physical fundamentals, design, and operation 	<ol style="list-style-type: none"> 1. Particle physics phenomenology 2. Cosmology 3. Astroparticle physics II: the dark Universe 4. Observational astrophysics 5. Applications of particle detectors in science and technology

So, What to do next ?

- Starting a doctoral thesis (already after the 60ECTs of the first year)
- 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

Astrophysics and high energy physics is a priority line for Aragón (“Planes complementarios”). This involves CAPA, CEFA & ITA

These 2 academic years

- Starting research contracts
- Ph contracts
- Erasmus+ internship in CEA
- “investigo contracts”
- Erasmus and double Title in Cergy-Paris

Cosmology, astrophysics, particle and astroparticles frontier physics

Do you want to join us in this learning adventure?



Centro de Astropartículas y Física de Altas Energías
Universidad Zaragoza



Facultad de Ciencias
Universidad Zaragoza



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