



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

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



Centro de
Estudios de
Física del Cosmos
de Aragón



Laboratorio Subterráneo de Canfranc



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
- Distribution of learning activities: 90 ECTS in 3 Semesters
- Erasmus agreements & double Master title with Cergy Paris University
- Language of instruction: English/Spanish

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

Syllabus

	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)	

Educational methodology

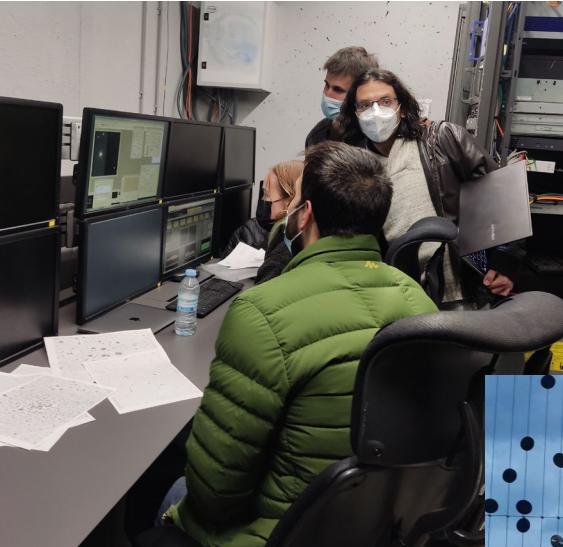
Active methodologies, with the students being responsible for their own learning, following the dictates of the European Space of Higher Education for the training of professionals

- 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 ?

- 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, CEFCA & 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?



Contact for information: mfu@unizar.es

Instagram [master fisica universo](#)

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capa.unizar.es

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