# CURRICULUM
# Academic year 2022-2024

| | |
|---|---|
| Faculty | Faculty of Physics |
| **Cycle of university studies** | Master's |
| **Master's Program:** | Astrophysics, elementary particles and computational physics |
| **Qualification:** | Astrophysics, elementary particles and computational physics |
| **Title awarded:** | Master in Physics |
| **Period of study:** | 2 years |
| **Number of credits (ECTS):** | 120 ECTS |
| **Form of education:** | Full time (IF) |
| **Teaching language:** | english |
| **Location:** | Timișoara, România |
| **Classification the study programme in fields of science** | |
| **Fundamental field:** | Mathematics and Natural Sciences |
| **Branch of science:** | Physics |
| **Field of master's program studies** | Physics |
| **Wide field of study (cf. DL-ISCED F-2013):** | Natural Sci, Mathematics and statistics |
| **Restricted field of study (cf. DR-ISCED F-2013):** | Physical sciences |
| **Detailed field of study (cf. DDS-ISCED F-2013):** | Physics |

# GENERAL PRESENTATION OF THE PROGRAM OF UNIVERSITY STUDIES

## 1. Mission of the study program

The most ambitious mission of the "Astrophysics, elementary particles and computational physics" Master's Program is the bridge it can offer to motivated students in order to approach a possible research and university teaching career in Physics, assuming that they will consistently continue their studies with a doctorate, subsequently.

At the same time, this master's has a spectrum as wide as possible, being accessible (with the recalibration of the individual objectives) to students who have a reduced Physics background, licensed from other fields of Knowledge - or who wish, in professional or personal interest, to complete this fascinating journey of two years. We will try to convey to students the current view (Standard Model) about the fundamental building blocks of Matter, about the elementary forces, about cosmic objects, about the future and the past of the Universe.

As is known, the main research center in fundamental physics, CERN, is the largest civilian consumer of computing power in the world. We will talk about the modern technologies involved in these activities at the frontiers of Science.

## 2. Competencies and expected learning outcomes formed within the study program

Key skills:

- Science, technology, engineering and mathematics skills
- Digital skills

Professional skills:

- In-depth knowledge of the main areas of Physics
- Performs scientific research

Transversal skills:

a) Personal skills:

- The ability to filter information and establish its veracity
- Active learning capacity
- The ability to analyze and synthesize
- Curiosity
- Critical and innovative thinking
- Complex information processing

b) Interpersonal skills:

- Active listening

c) Global citizenship skills:

- Concern for protecting the environment

## 3. Expected Learning Outcomes

a) Knowledge - According to the European Qualifications Framework (EQF), the learning outcomes related to qualification level 7, corresponding to university master's studies, require highly specialized knowledge and their critical awareness, some of them being at the vanguard of the level of knowledge from a field of work or study, as a basis for original thinking and/or research:

- Consolidated (and operational) knowledge of the fundamental areas of Physics.
- Knowledge of developments in modern Physics after 1900: Relativity and Quantum Mechanics
- Knowledge of the Standard Model of the structure of matter.
- Knowledge of elementary forces. Quantum fields and particles.
- Knowing the notions of astronomy.
- Classification of cosmic objects.
- Knowing notions of Cosmology.

b) Skills - According to the European Qualifications Framework (EQF), the learning outcomes related to qualification level 7, corresponding to university master's studies, assume specialized skills for solving research and/or innovation problems, for the development of new knowledge and procedures and for the integration of knowledge from different fields:

- The ability to qualitatively and quantitatively evaluate complex Physics problems.
- The ability to use numerical and symbolic computational methods.
- Scientific discernment.

c) Responsibility and autonomy - According to the European Qualifications Framework (EQF), the learning outcomes related to qualification level 7, corresponding to university master's studies, involve the management and transformation of work or study situations that are complex, unpredictable and require new strategic approaches, by taking responsibility to contribute to professional knowledge and practices and/or to review the strategic performance of teams:

- Using free sources of information for individual, discerning and autonomous study.

## 4. Occupations that can be practiced on the labor market

- 211101 - physicist,
- 211102 – researcher in Physics

## 5. Ensuring flexible learning paths within the study program

The flexibility of the study program is ensured through optional subjects, optional subjects and complementary subjects.

Elective courses (optional) (see tables with lists of courses) are proposed for semesters 1-2 and are grouped into optional packages, which complete the student's specialization path. The choice of the route is made by the student, before the start of each academic year.

The optional subjects are proposed for semesters 1-4 by the Department/Faculty of Physics that manages the study program, but they can also be chosen from the packages offered by other UVT faculties.

In accordance with the provisions of the Regulation on the development of education plans for the study programs at the Western University of Timișoara, so that students can benefit from credits for volunteering activities based on the provisions of the National Education Law no. 1/2011, with subsequent amendments and additions (article 203, paragraph

(9)), the Volunteering discipline is available every semester in the curricula of all bachelor's and master's degree programs, with optional subject status, with a number of 2 ECTS credits.

## 6. Professional activity and student assessment

The rights, obligations and conditions of the professional activity of students at the Western University of Timișoara are regulated by the Student Rights and Obligations Code and the Regulation on the professional activity of students from UVT undergraduate and master's university study cycles, approved by the UVT Senate.
The form and assessment/examination methods for each subject in the curriculum are established by the subject sheets.

## 7. The final exam

In accordance with the Regulation on the organization and conduct of final exams for undergraduate and master's university studies at the Western University of Timișoara, approved by the UVT Senate, the final exam for master's university studies in any master's degree program organized at UVT it consists of a sample of elaboration and support of the dissertation work, for which 10 credits are awarded. The topic and the bibliography corresponding to the final exam tests are published on each faculty's own website and/or on the UVT website before the beginning of each academic year. Enrollment in the graduation exam is conditional on the student choosing the theme of the graduation thesis within 60 days at most from the beginning of the academic year of the final year of study. The submission of the final version of the thesis on the e-learning platform is done at least 5 working days before the date scheduled for the start of the exam. Each thesis will be accompanied, at the time of submission, by the Similarity Report resulting from the verification of the originality of the thesis through a specialized software, on the UVT e-learning platform. According to the structure of the academic year, at UVT the exams for completing university studies can be organized in 3 sessions, usually in the months of July, September and February.

## 8. Preparation for the teaching profession (if applicable)

Students who wish to opt for a teaching career in pre-university education must complete (in addition to this study program) and complete the Psychopedagogical Training Program in order to certify the skills for the teaching profession and obtain the Certificate of Completion of this program. In the Western University of Timișoara, this program is organized through the Department for the Training of Teaching Staff (DPPD) and can be followed in parallel with university studies or as a postgraduate. For more information, visit the link: https://dppd.uvt.ro.

# LIST OF DISCIPLINES, GROUPED BY YEARS AND SEMESTERS OF STUDIES

## ACADEMIC YEAR I
## 2022-2023

| Nr. crt. | Course | C1 | C2 | Cod | 1-st Semester (14 weeks) | | | | | 2-nd Semester (14 weeks) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | C | S | L/P | ex | Cr | C | S | L/P | ex | Cr |
| 1. | Complements of Theoretical Physics | DF | DO | AP 1101 | 2 | 2 | | E | 7 | | | | | |
| 2. | Complements of Solid State Physics | DF | DO | AP 1102 | 2 | 2 | | E | 7 | | | | | |
| 3. | Complements of Atom and Molecule Physics | DF | DO | AP 1103 | 2 | 2 | | E | 7 | | | | | |
| 4. | Ethics of the research. Methodology of scientific work | DC | DO | AP 1104 | 1 | 1 | | E | 2 | | | | | |
| 5. | Optional course 1 **(choose 1 of 3):** | | | AP 1105 | 2 | 2 | | E | 7 | | | | | |
| | 1. Magnetic active materials | DS | DOP | | | | | | | | | | | |
| | **2. Symmetries in physics** | DS | DOP | | | | | | | | | | | |
| | 3. Complements of biophysics with applications in medicine | DS | DOP | | | | | | | | | | | |
| 6. | Standard Model | DF | DO | AP 1201 | | | | | | 2 | 2 | | E | 8 |
| 7. | Gravitation and cosmology | DF | DO | AP 1202 | | | | | | 2 | 1 | | E | 6 |
| 8. | Optional course 2 **(choose 1 of 2)** | | | AP 1203 | | | | | | 1 | | 2 | E | 6 |
| | 1. Particle physics at accelerators | DS | DOP | | | | | | | | | | | |
| | **2. Introduction in astronomy** | DS | DOP | | | | | | | | | | | |
| 9. | Quantum fields | DF | DO | AP 1204 | | | | | | 2 | 1 | | E | 6 |
| 10. | Computational Physics | DS | DO | AP 1205 | | | | | | 1 | | 2 | E | 4 |
| 11. | Volunteering I | DC | DFac | n.a. | | (1) | | | (2) | | | | | |
| 12. | Volunteering II | DC | DFac | n.a. | | | | | | | (1) | | | (2) |
| | | **Total hours/week** | | | **9** | **9** | | **5E** | **30** | **8** | **4** | **4** | **5E** | **30** |
| | | | | | **18** | | | | | **16** | | | | |

**ACADEMIC YEAR II**
**2023-2024**

| Nr. crt. | Courses | C1 | C2 | Cod | 3 rd Semester (14 weeks) | | | | | 4 th Semester (14 weeks) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | C | S | L/P | ex | Cr | C | S | L/P | ex | Cr |
| 1. | Fields in interaction | DF | DO | AP 2301 | 2 | 2 | | E | 7 | | | | | |
| 2. | Stellar astrophysics | DS | DO | AP 2302 | 2 | 2 | | E | 6 | | | | | |
| 3. | Astrophysics and elementary particles | DS | DO | AP 2303 | 2 | 2 | | E | 7 | | | | | |
| 4. | Statistical methods for data analyzing in astrophysics | DS | DO | AP 2304 | 2 | 2 | | E | 5 | | | | | |
| 5. | Solar resources in space | DS | DO | AP2305 | 2 | 1 | | E | 5 | | | | | |
| 6. | Specialization practice (projects, etc) | DC | DO | AP 2401 | | | | | | | | 8 | E | 14 |
| 7. | Scientific research internship | DC | DO | AP 2402 | | | | | | | | 4 | E | 8 |
| 8. | Practice for elaboration of dissertation | DC | DO | AP 2403 | | | | | | | | 4 | E | 8 |
| 9. | Volunteerning III | DC | DFac | n.a. | | (1) | | | (2) | | | | | |
| 10 | Volunteering IV | DC | DFac | n.a. | | | | | | | (1) | | | (2) |
| | | Total hours/ week | | | **10** | **9** | | **5E** | **30** | | | **16** | **3E** | **30** |
| | | | | | 19 | | | | | 16 | | | | |

**Abbreviations**

C1 content criterion
C2 the obligation criterion
DF fundamental disciplines
DD field disciplines (where applicable)
DS specialized disciplines
DC complementary disciplines
DA advanced subjects
Dsi synthesis disciplines
DO compulsory disciplines (imposed)
DOP optional subjects (of your choice)
DFAC optional subjects
CP professional competence
CT transversal competence
C course-type didactic activity
S seminar-type didactic activity
L didactic activity of practical laboratory type
P didactic activity of the internship type

# GENERAL BALANCE SHEET I
# (according to the content criterion)

| Nr. crt. | Discipline type | Total no. of hours | | | | Total | | ARACIS specific standard provision |
|---|---|---|---|---|---|---|---|---|
| | | Yr. I | | Yr II | | Hours | % of total | |
| | | Curs | S/L | Curs | S/L | | | |
| 1. | Fundamental | 12 | 10 | 2 | 2 | 26 | 38 | |
| 2. | Of domain | | | | | | | |
| 3. | Specialized | 4 | 6 | 8 | 7 | 25 | 36 | |
| 4. | Complementary | 1 | 1 | | 16 | 18 | 26 | |
| **TOTAL** | | **17** | **17** | **10** | **25** | **69** | **100** | |

# GENERAL BALANCE SHEET II
# (according to the obligativity criterion)

| Nr. crt. | Discipline type | Total no. of hours | | | | Total | | ARACIS specific standard provision |
|---|---|---|---|---|---|---|---|---|
| | | Yr. I | | Yr. II | | Hours | % of total | |
| | | Curs | S/L | Curs | S/L | | | |
| 1. | Mandatory | 13 | 14 | 10 | 25 | 62 | 90 | |
| 2. | Optional | 3 | 4 | | | 7 | 10 | |
| 3. | Facultative | | 2 | | 2 | | | *does not count towards totals* |
| **TOTAL** | | **17** | **17** | **10** | **25** | **69** | **100** | |

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