

Assessment plan for the curriculum of the Master's degree programme in Astronomy, 2025-2026

Programme director: M.A.M. van der Weijgaert

Date advice Board of Examiners: 27 May 2025

Date approval Faculty Board:

1. Vision on assessment

Objectives

The vision behind the Master of Astronomy programme is to train excellent researchers in the fields of astronomy and astrophysics. The programme offers two distinct tracks: Quantum Universe (QU), and Science and Business Policy (SBP). The QU track emphasizes the relations between Astronomy, Theoretical Physics and Particle Physics in the study of nature on the different scales, and includes 3 different specializations: 1) Theoretical and Observational Astronomy, 2) Instrumentation and Informatics and 3) Data Science of Astronomy. The SBP track integrates cutting-edge astronomy knowledge with a comprehensive understanding of both business and policy aspects in science.

The MSc Astronomy programme traditionally targets students aspiring to pursue research careers, with a substantial portion of graduates proceeding to enroll in PhD programs. At the same time, the programme also prepares graduates for a broader career in society. A significant number of students continue on diverse career paths, such as consultancy firms, process management, financial sectors, or pursuing teaching positions. This broad range of opportunities arises because the programme equips students not only with specialized knowledge but also with versatile competences and skills that enhance their adaptability and suitability for various professional roles.

A major part of the MSc program is the 1-year 60 ECTS MSc research project, for the QU Theoretical and Observational specialization, and the Data Science for Astronomy specialization. The QU Instrumentation and Informatics specialization includes a 40 ECTS MSc research project and a 20 ECTS industrial internship. During the MSc program, students also have the option for an observational practical at La Palma Observatory or other professional observatory. The practical involves all ingredients of professional observational astronomical practice, including proposal, proposal assessment, observing the proposed and accepted proposal, reducing and analyzing the data and presenting them to peers. For many astronomy students this is the most outstanding opportunity for having to deal with the practical aspects of observational astronomy.

Assessment vision statement:

- Assessment guides and evaluates student learning in a diverse manner, emphasizing content knowledge and essential skills, including problem-solving, group work, practical application, and relevance to real-world scenarios.
- Assessment motivates students by offering constructive feedback, promoting active learning from mistakes, and encouraging the integration of specific knowledge and skills.
- Assessment serves as a guiding principle for lifelong learning and as an instrument in shaping students' future careers by facilitating skill enhancement, adaptive growth, and decision-making.
- All assessments and feedback, final and day-to-day, are provided in English to prepare students for a career with an international job market.

2. Assessment guidelines

Guidelines for assessment quality:

- The course assessment scheme should be communicated to the students during the introduction to the course at the first lecture, and also included in the course webpage and Ocasys. The assessment scheme might not be changed during the course.
- The courses are assessed through written or oral exams as assigned in the assessment plan. For resits, the examiner can always choose for oral examination.
- If the course includes several parts taught by different instructors, the course coordinator determines how these components are integrated into the final assessment and their respective contributions to the overall grade.

- Written exams must contain the following information on the first page: the course title and code, when and where the exam takes place, the number of questions/pages, exam conditions (What is allowed and not allowed to use) and the grading scheme
- A clear rubric or a comprehensive grading scheme is drawn up by the course coordinator to promote fairness and transparency in the grading process.
- For courses with a written exam, a mock exam (for example, an exam from a previous year) must be made available, at least two weeks prior to the exam.
- Oral exams are graded using the dedicated oral exam grading form. At the beginning of the exam, the student should be informed of the topics to be examined (pre-indicated in the grading form). An independent observer (preferably the preassigned second examiner) must be present during the full exam. The examination material (photos of the blackboard or paper sheets with student's answers) should be collected and added to the examination form.
- For courses with hands-on practicals, the grade of the report might be a (weighted) part of the final grade. The grade might also be binary (pass/no pass); a pass grade is required to be admitted to the exam.
- If the practical work is performed in teams, the team report might be handed in and graded for the whole team unless exceptional circumstances (e.g., a student did not participate in report writing). Individual reports might also be requested by the course coordinator. This should be clearly communicated to the students during the first lecture.
- Practical work is assessed through a written report, and/or presentation, with feedback to the students on development points. This is provided as explicit feedback written for each individual student on the grading form.

Master research project:

- All MSc astronomy research projects are coordinated by the MSc research project coordinator, who is also responsible for a fair and balanced grading process, and who chairs MSc project presentation and grading session. Each project is supervised by a Kapteyn Institute faculty member, and graded by supervisor, who is 1st examiner, and 2nd examiner (in a session chaired by the coordinator).
- The first examiner may delegate daily supervision, but is ultimately responsible for the smooth flow and outcome of the research project.
- To ensure standardized and fair grading, the master research project is assessed by the first examiner and an independent second examiner, in a session chaired by the MSc astronomy project coordinator who sees to a balanced grading.
- For the research project, midterm assessment with specific feedback on development points and self-reflection of the student must be provided. The feedback is documented on the dedicated form.
- In research projects, regular progress meetings (at least every week) with the daily supervisor should take place, in which the student is given feedback and instructions on the day-to-day research and on their progress.
- Supervisors should provide feedback on at least one full draft version of the master thesis, provided the student meets the agreed deadline for handing in the full draft.
- The master thesis must be checked by the supervisor and MSc project coordinator for plagiarism before grading.
- The students should be instructed on the possible use and misuse of AI and online information tools with the focus on ethics and critical thinking.
- If the research project is awarded a negative grade or there is a substantial delay, a remediation trajectory should be drawn by the supervisor(s), coordinator and the student. The programme management should be informed promptly about this development.

3. Learning outcomes of the degree programme

Learning Outcome:	
A. Knowledge and understanding	
A1	An Astronomy master's graduate masters the fundamental astronomical and astrophysical concepts as well as the necessary tools from physics, mathematics and computer science, including modelling skills, at a level which permits admission to a PhD programme;
A2	An Astronomy master's graduate is familiar with the quantitative character of astronomy and astrophysics and with the relevant research methods;
A3	An Astronomy master's graduate who has completed: a) the <i>Quantum Universe track</i> has operational knowledge in i) an observational or theoretical astronomical or astrophysical subarea, or ii) the area of instrumentation and information technology in astronomy, physics, and/or space research, or iii) the area of data science in astronomy, as well as knowledge of the state-of the art in at least one specific research area; b) the <i>Business, Science and Policy track</i> has operational knowledge of and insight into the functioning of companies and administrations, as well as the relevant legislation and knowledge of the state-of the art in at least one specific research area.
B. Application of knowledge and understanding	
B1	An Astronomy master's graduate is capable of carrying out research, aimed at understanding of astronomical phenomena, both observational and theoretical;
B2	An Astronomy master's graduate is capable of analysing a (new) complex astrophysical problem, and to use modelling skills to develop a structured and well-planned research approach;
B3	An Astronomy master's graduate is capable of applying his/her specific knowledge and mathematical, experimental, and computer skills to solve astronomy problems in his/her own and related subject areas and fields;
B4	An Astronomy master's graduate is capable of collaborating in a (multi-disciplinary) team and has basic skills to manage a (collaborative) project.
C. Judgement	
C1	An Astronomy master's graduate is capable of obtaining relevant information using modern information channels, and of interpreting this information critically in the context of an absolute standard;
C2	An Astronomy master's graduate is capable of managing and judging his/her and others' actions within a highly scientific and professional context, taking societal and ethical aspects into account;
C3	An Astronomy master's graduate is able of drawing conclusions on the basis of limited or incomplete information, and is able to realise and formulate the limitations of such conclusions;

C4	An Astronomy master's graduate is acting and conducting research according to the VSNU Code of Conduct for Academic Practice.
D. Communication skills	
D1	An Astronomy master's graduate is capable of communicating clearly in English, both verbally and in writing, on his/her subject and relevant applications, at a level which is understandable to experts and non-experts, and using modern communication tools.
E. Learning skills	
E1	An Astronomy master's graduate is capable of addressing issues inside as well as outside his/her main subject area, therefore and thereby gaining new knowledge and skills.

4. Overview of assessment methods, test moments for course units, and examiners

The abbreviations for the relevant teaching methods are explained in the legend of the table. Examples of assessment methods include:

- Written Exam (WE)
- Midterm (MT)
- Multiple Choice (MC)
- Oral Exam (OR)
- Report (R)
- Presentation (P)
- Practical Work (PR)
- Assignment (AST)

Quantum Universe track (core programme)

Year	Period	Course	EC	Assessment methods	Incl. Formative Assessment?	Test moment(s) (e.g. mid-term, continuous assessment, exam week, etc)	First examiner	Second examiner
1	1A	General Relativity (WMPH009-05)	5	AST, WE	Yes	continuous assessment, exam week	E.A. Bergshoeff	D. Roest
1	1B	Astroparticle Physics (WMAS027-05)	5	MT, WE	Yes	continuous assessment, exam week	M. Vecchi	S. Hoekstra
1	2A	Particle Physics Phenomenology (WMPH026-05)	5	AST, WE	Yes	continuous assessment, exam week	K.A.M. de Bruyn	D. Boer
1	2B	Student Seminar Quantum Universe (WMPH039-05)	5	P	Yes	continuous assessment, exam week	L. Willmann	M. Vecchi, E. Dimastrogiovanni

Quantum Universe track (core astronomy courses)

Year	Period	Course	EC	Assessment methods	Incl. Formative Assessment?	Test moment(s) (e.g. mid-term, continuous assessment, exam week, etc)	First examiner	Second examiner
1	1A	Formation and Evolution of Galaxies (WMASo05-05)	5	AST, WE	Yes	continuous assessment, exam week	F. Fraternali	K.I Caputi
1	1B	Stars, Nucleosynthesis, and Chemical Evolution (WMASo10-05)	5	AST, PR	Yes	continuous assessment, exam week	E. Tolstoy	E. Starkenburg
1	2A	Exoplanets (WMASo26-05)	5	AST, PR, R, P	Yes	continuous assessment, exam week	T. Lichtenberg	I.E.E. Kamp
1	2A	Astrochemistry (WMASo18-05)	5	AST, WE	Yes	continuous assessment, exam week	F.F.S. van der Tak	I.E.E. Kamp
1	2A	Dynamics of Galaxies (WMASo14-05)	5	AST, WE	Yes	continuous assessment, exam week	A. Helmi	L.V.E. Koopmans
1	2B	Astronomical Data Science (WMASo07-05)	5	AST, PR, R	Yes	continuous assessment, exam week	L. Wang	G.A. Verdoes Kleijn

Capita Selecta Courses

Year	Period	Course	EC	Assessment methods	Incl. Formative Assessment?	Test moment(s) (e.g. mid-term, continuous assessment, exam week, etc)	First examiner	Second examiner
1	1A	Dark Matter Detection (WMASo23-03)	3	PR	Yes	continuous assessment, exam week	M. Vecchi	F. Fraternali
1	2A	Interferometry (WMASo15-03)	3	AST, WE	Yes	continuous assessment, exam week	T.A. Oosterloo	M.W. Verheyen
1	2B	Stellar Populations in Galaxies (WMASo29-03)	3	AST, WE	Yes	continuous assessment, exam week	R.F. Peletier	S. Trager

Quantum Universe track: Theoretical and Observational Astronomy courses

Year	Period	Course	EC	Assessment methods	Incl. Formative Assessment?	Test moment(s) (e.g. mid-term, continuous assessment, exam week, etc)	First examiner	Second examiner
1	1	La Palma Observation Trip (WMASo12-05)	5	AST, P	Yes	continuous assessment	R.F. Peletier	S.C. Trager
1	1A	Basic Detection Techniques (WMASo02-05)	5	AST, WE	Yes	continuous assessment, exam week	G. de Lange	T. Oosterloo
1	1A	Computational Physics (WMPHo07-05)	5	R	Yes	continuous assessment	P.R. Onck	E. van der Giessen
1	1A	Fundamental Constants (WMPHo08-05)	5	AST, R	Yes	continuous assessment, exam week	L. Willmann	J. Even
1	1A	Lie Groups in Physics (WMPHo11-05)	5	WE	Yes	continuous assessment, exam week	D. Roest	D. Boer
1	1B	Geometry and Topology (WMMAo18-05)	5	AST, WE	Yes	continuous assessment, exam week	A.V. Kiselev	J. Top
1	1B	Mathematical Methods of Physics (WMPHo16-05)	5	AST	Yes	continuous assessment, exam week	R. Klein	D. Boer
1	1B	Oriëntatie op Onderwijs in de Bètawetenschappen - voor Masterstudenten (WMECo13-05)	5	OR, R, P	Yes	continuous assessment, exam week	J.E. van der Laan	G. Roorda
1	1B	Quantum Experiments (WMPHo17-05)	5	AST, P	Yes	continuous assessment	S.A. Jones	L. Willmann
1	1B	Quantum Field Theory (WMPHo18-05)	5	WE	Yes	exam week	E. Pallante	R.G.E. Timmermans
1	1B	Statistical Signal Processing (WMASo11-05)	5	WE, R, AST	Yes	continuous assessment, exam week	S. C. Trager	R.F. Peletier
1	2	La Palma Observation Trip (WMASo12-05)	5	AST, P	Yes	continuous assessment, exam week	R.F. Peletier	S.C. Trager
1	2	Neem regie (WMECo13-05)	10	OR, R, P	Yes	continuous assessment, exam week	J.E. van der Laan	G. Roorda
1	2A	Deep Learning in Physics (WMPHo54-05)	5	AST	Yes	continuous assessment	J. Aalbers	D. Meerburg

Year	Period	Course	EC	Assessment methods	Incl. Formative Assessment?	Test moment(s) (e.g. mid-term, continuous assessment, exam week, etc)	First examiner	Second examiner
1	2A	Introduction to Plasma Physics (WMPH035-05)	5	AST, WE, MT	No	exam week	C.E. Rigollet	J. Even
1	2A	Particle Cosmology (WMPH025-05)	5	AST, R	Yes	continuous assessment, exam week	D. Meerburg	D. Roest
1	2B	Elementary Particles (WMPH034-05)	5	WE	Yes	exam week	E. Pallante	R.G.E. Timmermans
1	2B	Nuclear Astrophysics (WMPH038-05)	5	AST, WE, MT	No	exam Week	C.E. Rigollet	J. Even
2	-	Master Research Project (WMAS901-60)	60	AST, PR, P, R	Yes	continuous assessment	F. Fraternali, see list of examiners research projects below	

Quantum Universe track: Instrumentation and Informatics courses

Year	Period	Course	EC	Assessment methods	Incl. Formative Assessment?	Test moment(s) (e.g. mid-term, continuous assessment, exam week, etc)	First examiner	Second examiner
1	1	La Palma Observation Trip (WMASo12-05)	5	AST, P	Yes	continuous assessment	R.F. Peletier	S.C. Trager
1	1A	Basic Detection Techniques (WMASo02-05)	5	AST, WE	Yes	continuous assessment, exam week	G. de Lange	A.M. Barychev
1	1A	Robotics for IEM (WMIEo05-05)	5	WE, R	Yes	continuous assessment, exam week	M. Cao	B. Jayawardhana
1	1B	Device Physics (WBPHo37-05)	5	WE, P, R	Yes	continuous assessment, exam week	B.J. van Wees	M.A. Loi
1	1B	Mechatronics (WBIEo11-05)	5	WE, PR	Yes	continuous assessment, exam week	S. Ahmed	B. Jayawardhana
1	1B	Oriëntatie op Onderwijs in de Bètawetenschappen - voor Masterstudenten (WMECo13-05)	5	OR, R, P	Yes	continuous assessment, exam week	J.E. van der Laan	G. Roorda
1	1B	Scientific Visualization (WMCSo18-05)	5	WE, PR	Yes	continuous assessment, exam week	S.D. Frey	A.C. Telea
1	1B	Statistical Signal Processing (WMASo11-05)	5	WE, R, AST	Yes	continuous assessment, exam week	S. C. Trager	R.F. Peletier
1	2	La Palma Observation Trip (WMASo12-05)	5	AST, P	Yes	continuous assessment, exam week	J. Noel-Storr	S.C. Trager
1	2	Neem regie (WMECo13-05)	10	OR, R, P	Yes	continuous assessment, exam week	J.E. van der Laan	G. Roorda
1	2A	Applied Optics (WMMEo10-05)	5	WE, AST, PR	Yes	continuous assessment, exam week	W. Jellema	B. Jayawardhana
1	2A	Particle Cosmology (WMPHo25-05)	5	AST, R	Yes	continuous assessment, exam week	D. Meerburg	D. Roest

Year	Period	Course	EC	Assessment methods	Incl. Formative Assessment?	Test moment(s) (e.g. mid-term, continuous assessment, exam week, etc)	First examiner	Second examiner
1	2A	Systems Engineering (WMIE021-05)	5	AST, P, R	Yes	continuous assessment, exam week	N.B. Szirbik	A. Hübl
1	2B	Nuclear Astrophysics (WMPH038-05)	5	AST, WE, MT	No	Exam Week	C.E. Rigollet	J. Even
2	-	Industrial Internship (WMPH004-20)	40	AST, PR, P, R	Yes	continuous assessment	R.F. Peletier, see list of examiners research projects below	
2	-	Master Research Project (WMAS902-40)	40	AST, PR, P, R	Yes	continuous assessment	E. Tolstoy, see list of examiners research projects below	

Quantum Universe track: Data Science courses

Year	Period	Course	EC	Assessment methods	Incl. Formative Assessment?	Test moment(s) (e.g. mid-term, continuous assessment, exam week, etc)	First examiner	Second examiner
1	1	La Palma Observation Trip (WMAS012-05)	5	AST, P	Yes	continuous assessment	R.F. Peletier	S.C. Trager
1	1A	Basic Detection Techniques (WMAS002-05)	5	AST, WE	Yes	continuous assessment, exam week	G. de Lange	A.M. Barychev
1	1A	Introduction to Data Science	5	AST, WE	Yes	continuous assessment, exam week	K. Bunte	E. Wilhelm
1	1A	Modelling and Simulation (WMCS003-05)	5	WE, R	Yes	continuous assessment, exam week	M.H.F. Wilkinson	M. Biehl
1	1A	Scientific Visualization (WMCS018-05)	5	WE, PR	Yes	continuous assessment, exam week	S.D. Frey	A.C. Telea
1	1B	Information Systems (WMCS009-05)	5	WE, PR	Yes	continuous assessment, exam week	G. Azzopardi	D. Karastoyanova

Year	Period	Course	EC	Assessment methods	Incl. Formative Assessment?	Test moment(s) (e.g. mid-term, continuous assessment, exam week, etc)	First examiner	Second examiner
1	1B	Neural Networks and Computational Intelligence (WMCS010-05)	5	WE, R	Yes	continuous assessment, exam week	M. Biehl	J. Guo
1	1B	Oriëntatie op Onderwijs in de Bètawetenschappen - voor Masterstudenten (WMEC013-05)	5	OR, R, P	Yes	continuous assessment, exam week	J.E. van der Laan	G. Roorda
1	1B	Pattern Recognition (for CS) (WMCS011-05)	5	WE, AST	Yes	continuous assessment, exam week	J. Guo	M. Biehl
1	1B	Software Maintenance and Evolution (WMCS013-05)	5	AST	Yes	continuous assessment, exam week	A. Capiluppi	A. Rastogi
1	1B	Statistical Signal Processing (WMAS011-05)	5	WE, R, AST	Yes	continuous assessment, exam week	S. C. Trager	R.F. Peletier
1	2	La Palma Observation Trip (WMAS012-05)	5	AST, P	Yes	continuous assessment, exam week	J. Noel-Storr	S.C. Trager
1	2	Neem regie (WMEC013-05)	10	OR, R, P	Yes	continuous assessment, exam week	J.E. van der Laan	G. Roorda
1	2A	Deep Learning in Physics (WMPH054-05)	5	AST	Yes	continuous assessment	J. Aalbers	P. D. Meerburg
1	2A	Particle Cosmology (WMPH025-05)	5	AST, R	Yes	continuous assessment, exam week	D. Meerburg	D. Roest
1	2A	Scalable Computing (WMCS017-05)	5	WE, R, P	Yes	continuous assessment, exam week	A. Lazovik	A. Tsyganov
1	2B	Nuclear Astrophysics (WMPH038-05)	5	AST, WE, Midterm	No	exam Week	C.E. Rigollet	J. Even
2	-	Master Research Project (WMAS901-60)	60	AST, PR, P, R	Yes	continuous assessment	E. Tolstoy, see list of examiners research projects below	

Science, Business and Policy track

Year	Period	Course	EC	Assessment methods	Incl. Formative Assessment?	Test moment(s) (e.g. mid-term, continuous assessment, exam week, etc)	First examiner	Second examiner
1	1B	Astroparticle Physics (WMASo27-05)	5	WE	Yes	continuous assessment, exam week	M. Vecchi	S. Hoekstra
1	1A	Basic Detection Techniques (WMASo02-05)	5	AST, WE	Yes	continuous assessment, exam week	G. de Lange	A.M. Barychev
1	1A	Formation and Evolution of Galaxies (WMASo05-05)	5	AST, WE	Yes	continuous assessment, exam week	F. Fraternali	P. Dayal
1	1A	General Relativity (WMPHo09-05)	5	AST, WE	Yes	continuous assessment, exam week	E.A. Bergshoeff	D. Roest
1	1B	Geometry and Topology (WMMA018-05)	5	AST, WE	Yes	continuous assessment, exam week	A.V. Kiselev	J. Top
1	1	La Palma Observation Trip (WMASo12-05)	5	AST, P	Yes	continuous assessment, exam week	R.F. Peletier	S.C. Trager
1	1B	Stars, Nucleosynthesis, and Chemical Evolution (WMASo10-05)	5	AST, PR	Yes	continuous assessment, exam week	E. Tolstoy	R.M. Mendez
1	1B	Statistical Signal Processing (WMASo11-05)	5	WE, R, AST	Yes	continuous assessment, exam week	S. C. Trager	R.F. Peletier
1	2	Master Research Project (WMAS902-30)	60	AST, PR, P, R	Yes	continuous assessment	E. Tolstoy, see list of examiners research projects below	
2	-	Work Placement Business and Policy (WMSE902-40)	40	AST, PR, P, R	Yes	continuous assessment	S. Grooters	J. Zevenberg
2	1	Introduction Science and Business (WMSE001-10)	10	AST, WE	Yes	continuous assessment, exam week	S. Grooters	J. Zevenberg
2	1	Introduction Science and Policy (WMSE002-10)	10	AST, R, WE	Yes	continuous assessment, exam week	S. Grooters	J. Zevenberg

Astronomy examiners for Masters Research projects

For the Master Research project of Astronomy, the scientific staff members of the Kapteyn Astronomical Institute can act as first or second examiner. Selected staff members from other institutes may act as second examiner.

Kapteyn Astronomical Institute

Dr. Betsey Adams [B.]
Prof.dr. Andrey Baryshev [A.]
Dr. Erwin de Blok [W.J.G.]
Prof.dr. Karina Caputi [K.I.]
Dr. Quentin Changeat [Q.]
Prof.dr. Pratika Dayal [P.]
Prof.dr. Filippo Fraternali [F.]
Prof.dr. Amina Helmi [A.]
Dr.ir. Willem Jellema [W.]
Prof.dr. Inga Kamp [I.E.E.]
Prof.dr. Léon Koopmans [L.V.E.]
Dr. Gert de Lange [G.]
Dr. Tim Lichtenberg [T.]
Prof.dr. John McKean [J.P.]
Prof.dr. Mariano Méndez [R.M.]
Prof.dr. Raffaella Morganti [R.]
Dr. André Offringa [A.R.]
Prof.dr. Tom Oosterloo [T.A.]
Prof.dr. Reynier Peletier [R.F.]
Dr. Francesca Rizzo [F.]
Dr. Peter Roelfsema [P.R.]
Prof.dr. Olaf Scholten [O.]

Dr. Russell F. Shipman [R.F.]
Dr. Else Starkenburg [E.]
Prof.dr. Floris van der Tak [F.F.S.]
Prof.dr. Eline Tolstoy [E.]
Prof.dr. Scott Trager [S.C.]
Dr. Manuela Vecchi [M.]
Dr. Gijs Verdoes Kleijn [G.A.]
Dr. Harish Vedantham [H.K.]
Prof.dr. Marc Verheijen [M.A.W.]
Dr. Lingyu Wang [L.]
Prof.dr. Rien van de Weijgaert [M.A.M.]
Prof.dr. Saleem Zaroubi [S.]

Other UG institutes

Prof.dr. Michael Biehl [M.] (BI)
Prof.dr. Anupam Mazumdar [A.] (VSI)
Dr. Daan Meerburg [P.D.] (VSI)
Prof.dr. Diederik Roest [D.] (VSI)
Prof.dr. Rob Timmermans [R.G.E.] (VSI)
Prof.dr. Holger Waalkens [H.] (BI)
Dr. Michael Wilkinson [M.H.F.] (BI)

5. Relationship between course units and details of the learning outcomes

Quantum Universe track: specialization Theoretical and Observational Astronomy													
Learning outcomes	mandatory courses QU core (20 ECTS)				mandatory courses Astronomy core (20 ECTS)						electives		
	General Relativity	Astroparticle Physics	Particle Physics Phenomenology	Student Seminar Quantum Universe	Astrochemistry	Astronomical Data Science	Dynamics of Galaxies	Exoplanets	Formation and Evolution of Galaxies	Stars, Nucleosynthesis, and Chemical Evolution	Optional courses in QU: TOA	Capita Selecta	Master research project
A1	X	X	X	X	X	X	X	X	X	X	X	X	X
A2		X			X	X	X	X	X	X	X	X	X
A3	X	X	X	X	X	X	X	X	X	X	X	X	X
B1		X			X	X	X	X	X	X	X	X	X
B2											X	X	X
B3		X			X	X	X	X	X	X	X	X	X
B4											X	X	X
C1				X							X	X	X
C2				X							X	X	X
C3				X		X					X	X	X
C4				X									X
D1				X		X					X	X	X
E1	X	X	X	X	X	X					X	X	X

Quantum Universe track: specialization Instrumentation and Informatics														
Learning outcomes	mandatory courses QU core (20 ECTS)				mandatory courses Astronomy core (20 ECTS)						electives		Industrial Research internship	Master research project
	General Relativity	Astroparticle Physics	Particle Physics Phenomenology	Student Seminar Quantum Universe	Astrochemistry	Astronomical Data Science	Dynamics of Galaxies	Exoplanets	Formation and Evolution of Galaxies	Stars, Nucleosynthesis, and Chemical Evolution	Optional courses in QU: TOA	Capita Selecta		
A1	X	X	X	X	X	X	X	X	X	X	X	X		X
A2		X			X	X	X	X	X	X	X	X		X
A3	X	X	X	X	X	X	X	X	X	X	X	X	X	X
B1		X			X	X	X	X	X	X	X	X		X
B2											X	X		X
B3		X			X	X	X	X	X	X	X	X	X	X
B4											X	X	X	X
C1				X							X	X	X	X
C2				X							X	X	X	X
C3				X		X					X	X	X	X
C4				X										X
D1				X		X					X	X	X	X
E1	X	X	X	X	X	X					X	X	X	X

Quantum Universe track: specialization Instrumentation and Informatics														
Learning outcomes	mandatory courses QU core (20 ECTS)				Introduction to Data Science	mandatory courses Astronomy core (20 ECTS)						electives		Master research project
	General Relativity	Astroparticle Physics	Particle Physics Phenomenology	Student Seminar Quantum Universe		Astrochemistry	Astronomical Data Science	Dynamics of Galaxies	Exoplanets	Formation and Evolution of Galaxies	Stars, Nucleosynthesis, and Chemical Evolution	Optional courses in QU: TOA	Capita Selecta	
A1	X	X	X	X	X	X	X	X	X	X	X	X	X	
A2		X			X	X	X	X	X	X	X	X	X	
A3	X	X	X	X	X	X	X	X	X	X	X	X	X	X
B1		X			X	X	X	X	X	X	X	X	X	
B2												X	X	
B3		X			X	X	X	X	X	X	X	X	X	X
B4												X	X	X
C1				X								X	X	X
C2				X								X	X	X
C3				X			X					X	X	X
C4				X										
D1				X			X					X	X	X
E1	X	X	X	X	X	X	X					X	X	X

Science, Business and Policy track					
Learning outcomes	Astrophysics electives (30 ECTS)	SBP core courses			Master research project
		Course Science, Business and Policy	Internship in Business and Policy	Work Placement Business and Policy	
A1	X				X
A2	X				X
A3	X	X	X	X	
B1	X				X
B2					X
B3	X	X	X	X	X
B4	X	X	X	X	X
C1	X	X	X	X	X
C2		X	X	X	X
C3	X	X	X	X	X
C4					X
D1	X	X	X		X
E1	X	X	X		X