Assessment plan for the curriculum of the **Master's** degree programme in Astronomy, 2024-2025

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

Date advice Board of Examiners: June 21, 2024

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 may 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.
- Practicals are 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.
- 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.
- The first examiner may delegate daily supervision, but is ultimately responsible for the smooth flow and outcome of the research project.
- 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	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	is familiar with the quantitative character of astronomy and astrophysics and with the relevant research methods;
A3	who has completed: a) the *Quantum Universe track* 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 *Business, Science and Policy track* 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	is capable of carrying out research, aimed at understanding of astronomical phenomena, both observational and theoretical;
B2	is capable of analysing a (new) complex astrophysical problem, and to use modelling skills to develop a structured and well-planned research approach;
B3	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	is capable of collaborating in a (multi-disciplinary) team and has basic skills to manage a (collaborative) project.
C. Judgement	
C1	is capable of obtaining relevant information using modern information channels, and of interpreting this information critically in the context of an absolute standard;
C2	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	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	is acting and conducting research according to the VSNU Code of Conduct for Academic Practice.

D. Communication skills	
D1	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	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)*
- *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**	**Does (part of the) assessment have a formative function?**	**Test moment(s)** (e.g. mid-term, continuous assessment, exam week, etc)	**First examiner**	**Second examiner**
1	1B	Astroparticle Physics (WMAS027-05)	5	WE	Yes		M. Vecchi	S. Hoekstra
1	1A	General Relativity (WMPH009-05)	5	AST, WE	Yes	continuous assessment, exam week	E.A. Bergshoeff	D. Roest
1	2A	Particle Physics Phenomenology (WMPH026-05)	5	AST, WE	Yes		K.A.M. de Bruyn	D. Boer
1	2B	Student Seminar Quantum Universe (WMPH039-05)	5	P	Yes		L. Willmann	M. Vecchi, E. Dimastrogiovanni

Quantum Universe track (core astronomy courses)

Year	Period	Course	EC	Assessment methods	Does (part of the) assessment have a formative function?	Test moment(s) (e.g. mid-term, continuous assessment, exam week, etc)	First examiner	Second examiner
1	1B	Exoplanets (WMAS026-05)	5	AST, PR, WE	Yes		T. Lichtenberg	I.E.E. Kamp
1	2B	Astronomical Data Science (WMAS007-05)	5	AST, PR, R	Yes		L. Wang	G.A. Verdoes Kleijn
1	1B	High-energy Astrophysics (WMAS006-05)	5	AST, PR	Yes		P. Dayal	R.M. Mendez
1	2B	Cosmic Structure Formation (WMAS004-05)	5	PR, P, WE	Yes		M.A.M. van de Weijgaert	S. Zaroubi
1	2A	Star and Planet Formation (WMAS017-05)	5	AST, WE	Yes		F.F.S. van der Tak	I.E.E. Kamp
1	1A	Formation and Evolution of Galaxies (WMAS005-05)	5	AST, WE	Yes		F. Fraternali	P. Dayal

Quantum Universe track: Theoretical and Observational Astronomy courses

Year	Period	Course	EC	Assessment methods	Does (part of the) assessment have a formative function?	Test moment(s) (e.g. mid-term, continuous assessment, exam week, etc)	First examiner	Second examiner
Mandatory								
2	-	Master Research Project (WMAS901-60)	60	AST, PR, P, R	Yes	continuous assessment	E. Tolstoy, see list of examiners research projects below	
Elective								
1	1A	Active Galaxies & AGN (WMAS022-05)	5	WE, AST, PR, P	Yes		R. Morganti	TBD
1	1A	Basic Detection Techniques (WMAS002-05)	5	AST, WE	Yes		G. de Lange	A.M. Barychev
1	2A	Basics of Teaching (TEM0105)	5	WE	Yes		C.A.M. Griep-Hoebink	**
1	2B	Elementary Particles (WMPH034-05)	5	WE	Yes		E. Pallante	R.G.E. Timmermans
1	2	La Palma Observation Trip (WMAS012-05)	5	AST, P	Yes		R.F. Peletier	S.C. Trager
1	1B	Oriëntatie op Onderwijs in de Bètawetenschappen - voor Masterstudenten (WMEC013-05)	5	OR, R, P	Yes		J.E. van der Laan	G. Roorda
1	2B	Internship in secondary education 1 Teacher Education (TEM0205)	5	AST, OR	Yes		S. Tuenter	**
1	2A	Deep Learning in Physics (WMPH054-05)	5	WE, AST	Yes		J. Aalbers	TBD
1	2A	Gravitational Waves (WMPH022-05)	5	AST, R	Yes		A. Mazumdar	D. Roest
1	1B	Statistical Signal Processing (WMAS011-05)	5	WE, R, AST	Yes		S. C. Trager	R.F. Peletier

Year	Period	Course	EC	Assessment methods	Does (part of the) assessment have a formative function?	Test moment(s) (e.g. mid-term, continuous assessment, exam week, etc)	First examiner	Second examiner
1	2B	Nuclear Astrophysics (WMPH038-05)	5	AST, WE, IT	No	Exam Week	C.E. Rigollet	J. Even
1	1A	Computational Physics (WMPH007-05)	5	R	Yes		P.R. Onck	E. van der Giessen
1	1A	Fundamental Constants (WMPH008-05)	5	AST, R	Yes		L. Willmann	J. Even
1	1A	Lie Groups in Physics (WMPH011-05)	5	WE	Yes		D. Boer	R.G.E. Timmermans
1	1B	Mathematical Methods of Physics (WMPH016-05)	5	AST	Yes		R. Klein	D. Boer
1	2A	Geometry and Differential Equations (WMMA017-05)	5	AST, WE, P	Yes		A.V. Kiselev	J. Top
1	1B	Quantum Field Theory (WMPH018-05)	5	WE	Yes		E. Pallante	R.G.E. Timmermans
1	1B	Quantum Experiments (WMPH017-05)	5	AST, P	Yes	continuous assessment	S.A. Jones	L. Willmann
1	2A	Introduction to Plasma Physics (WMPH035-05)	5	AST, WE, P	No	exam week	C.E. Rigollet	J. Even

Quantum Universe track: Instrumentation and Informatics courses

Year	Period	Course	EC	Assessment methods	Does (part of the) assessment have a formative function?	Test moment(s) (e.g. mid-term, continuous assessment, exam week, etc)	First examiner	Second examiner
Mandatory								
2	-	Master Research Project (WMAS902-40)	40	AST, PR, P, R	Yes	continuous assessment	F. Fraternali, see list of examiners research projects below	
2	-	Industrial Internship (WMPH004-20)	40	AST, PR, P, R	Yes	continuous assessment	R.F. Peletier, see list of examiners research	

Year	Period	Course	EC	Assessment methods	Does (part of the) assessment have a formative function?	Test moment(s) (e.g. mid-term, continuous assessment, exam week, etc)	First examiner	Second examiner
							projects below	
Elective								
1	2A	Advanced Detection Techniques (WMME005-05)	5		Yes		M. Kavatsyuk	A.M. Barychev
1	1A	Basic Detection Techniques (WMAS002-05)	5		Yes		G. de Lange	A.M. Barychev
1	2A	Basics of Teaching (TEM0105)	5	WE	Yes		C.A.M. Griep-Hoebink	**
1	1A	Robotics for IEM (WMIE005-05)	5	WE, R	Yes		M. Cao	B. Jayawardhana
1	2	La Palma Observation Trip (WMAS012-05)	5	AST, P	Yes		J. Noel-Storr	S.C. Trager
1	1B	Oriëntatie op Onderwijs in de Bètawetenschappen - voor Masterstudenten (WMEC013-05)	5	OR, R, P	Yes		J.E. van der Laan	G. Roorda
1	2B	Internship in secondary education 1 Teacher Education (TEM0205)	5	AST, OR	Yes		S. Tuenter	**
1	2A	Gravitational Waves (WMPH022-05)	5	AST, R	Yes		A. Mazumdar	D. Roest
1	2B	Nuclear Astrophysics (WMPH038-05)	5	AST, WE, IT	No	Exam Week	C.E. Rigollet	J. Even
1	1B	Statistical Signal Processing (WMAS011-05)	5	WE, R, AST	Yes		S. C. Trager	R.F. Peletier
1	1A	Scientific Visualization (WMCS018-05)	5	WE, PR	Yes		S.D. Frey	A.C. Telea
1	1B	Mechatronics (WBIE011-05)	5	WE, PR	Yes		S. Ahmed	B. Jayawardhana
1	2A	Applied Optics (WMME010-05)	5	WE, AST, PR	Yes		W. Jellema	B. Jayawardhana
1	2A	Advanced Detection Techniques	5	AST, P	Yes			

Year	Period	Course	EC	Assessment methods	Does (part of the) assessment have a formative function?	Test moment(s) (e.g. mid-term, continuous assessment, exam week, etc)	First examiner	Second examiner
		(WMME005-05)						
1	2A	Device Physics (WMPH050-05)	5	WE, P, R	Yes			
1	2B	Systems Engineering (WMIE021-05)	5	AST, P, R	Yes		N.B. Szirbik	TBD

Quantum Universe track: Data Science courses

Year	Period	Course	EC	Assessment methods	Does (part of the) assessment have a formative function?	Test moment(s) (e.g. mid-term, continuous assessment, exam week, etc)	First examiner	Second examiner
Mandatory								
1	1A	Introduction to Data Science	5	AST, WE	Yes		K. Bunte	E. Wilhelm
2	-	Master Research Project (WMAS901-60)	60	AST, PR, P, R	Yes	continuous assessment	F. Fraternali, see list of examiners research projects below	
Elective								
1	2A	Advanced Detection Techniques (WMME005-05)	5		Yes		M. Kavatsyuk	A.M. Barychev
1	1A	Basic Detection Techniques (WMAS002-05)	5		Yes		G. de Lange	A.M. Barychev
1	2A	Basics of Teaching (TEM0105)	5	WE	Yes		C.A.M. Griep-Hoebink	**
1	2	La Palma Observation Trip (WMAS012-05)	5	AST, P	Yes		J. Noel-Storr	S.C. Trager
1	1B	Oriëntatie op Onderwijs in de	5	OR, R, P	Yes		J.E. van der Laan	G. Roorda

Year	Period	Course	EC	Assessment methods	Does (part of the) assessment have a formative function?	Test moment(s) (e.g. mid-term, continuous assessment, exam week, etc)	First examiner	Second examiner
		Bètawetenschappen - voor Masterstudenten (WMEC013-05)						
1	2B	Internship in secondary education 1 Teacher Education (TEM0205)	5	AST, OR	Yes		S. Tuenter	**
1	2A	Gravitational Waves (WMPH022-05)	5	AST, R	Yes		A. Mazumdar	D. Roest
1	2B	Nuclear Astrophysics (WMPH038-05)	5	AST, WE, IT	No	Exam Week	C.E. Rigollet	J. Even
1	2A	Deep Learning in Physics (WMPH054-05)	5	WE, AST	Yes		J. Aalbers	TBD
1	1A	Modelling and Simulation (WMCS003-05)	5	WE, R	Yes		M.H.F. Wilkinson	M. Biehl
1	1A	Scientific Visualization (WMCS018-05)	5	WE, PR	Yes		S.D. Frey	A.C. Telea
1	1B	Statistical Signal Processing (WMAS011-05)	5	WE, R, AST	Yes		S. C. Trager	R.F. Peletier
1	1B	Neural Networks and Computational Intelligence (WMCS010-05)	5	WE, R	Yes		J. Guo	TBD
1	1B	Information Systems (WMCS009-05)	5	WE, PR	Yes		G. Azzopardi	TBD
1	2A	Scalable Computing (WMCS017-05)	5	WE, R, P	Yes		A. Lazovik	A. Tsyganov

Science, Business and Policy track

Year	Period	Course	EC	Assessment methods	Does (part of the) assessment have a formative function?	Test moment(s) (e.g. mid-term, continuous assessment, exam week, etc)	First examiner	Second examiner
1	1B	Astroparticle Physics (WMAS027-05)	5	WE	Yes		M. Vecchi	TBD
1	1A	General Relativity (WMPH009-05)	5	AST, WE	Yes	continuous assessment, exam week	E.A. Bergshoeff	D. Roest
1	1A	Basic Detection Techniques (WMAS002-05)	5		Yes		G. de Lange	A.M. Barychev
1	1B	High-energy Astrophysics (WMAS006-05)	5	AST, PR	Yes		S. C. Trager	R.M. Mendez
1	1A	Active Galaxies & AGN (WMAS022-05)	5	WE, AST, PR, P	Yes		R. Morganti	TBD
1	1B	Statistical Signal Processing (WMAS011-05)	5	WE, R, AST	Yes		S. C. Trager	R.F. Peletier
1	1B	Exoplanets (WMAS026-05)	5	AST, PR, WE	Yes	continuous assessment	T. Lichtenberg	I.E.E. Kamp
1	1A	Formation and Evolution of Galaxies (WMAS005-05)	5	AST, WE	Yes		F. Fraternali	P. Dayal
2	1	Introduction Science and Business (WMSE001-10)	10	AST, WE	Yes		S. Grooters	M.R. Berger, C. Carroll, G.J.W. Euverink, S. Grooters, H.J. van der Windt, J. Zevenberg
2	1	Introduction Science and Policy (WMSE002-10)	10	AST, R, WE	Yes		S. Grooters	M.R. Berger, B. Brink, J. de Ridder, G.J.W. Euverink, H.J. van der Windt, H.B. Winter, J. Zevenberg
2	-	Work Placement Business and Policy (WMSE902-40)	40	AST, PR, P, R	Yes		S. Grooters	M.R. Berger, M.K. de Boer, G.J.W. Euverink, C.M. Ree, M. van Rijssel, 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. Each of the listed examiners in the table below can be first and second examiner of an MSc project, including the select group of staff members from other institutes. In case the latter are first examiner, the 2nd examiner needs to be a member of the Kapteyn Institute.

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.]
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. 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.]
Drs. Martin Vogelaar [M.G.R.]
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)
Dr. Ema Dimastrogiovanni [E.] (VSI)
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	Electromagnetics and Radiative Processes	Particle Physics Phenomenology	Student Seminar Quantum Universe	Astrochemistry	Astronomical Data Science	Astroparticle Physics	Cosmic structure formation	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	X	X
A2					X	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	X
B1					X	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
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	X

Quantum Universe track:
specialization Instrumentation and Informatics

Learning outcomes	mandatory courses QU core (20 ECTS)				mandatory courses Astronomy core (20 ECTS)								electives			
	General Relativity	Electromagnetics and Radiative Processes	Particle Physics Phenomenology	Student Seminar Quantum Universe	Astrochemistry	Astronomical Data Science	Astroparticle Physics	Cosmic structure formation	Dynamics of Galaxies	Exoplanets	Formation and Evolution of Galaxies	Stars, Nucleosynthesis, and Chemical Evolution	Optional courses in QU: TOA	Capita Selecta	Industrial Research internship	Master research project
A1	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
A2					X	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	X	X
B1					X	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	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	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		
	General Relativity	Electromagnetics and Radiative Processes	Particle Physics Phenomenology	Student Seminar Quantum Universe		Astrochemistry	Astronomical Data Science	Astroparticle Physics	Cosmic structure formation	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	X	X	
A2					X	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	X	X
B1					X	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	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	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