MASTER
ASTROPHYSICS

• **content**
  – evolution of stars and stellar populations
  – high-energy astrophysics and space research
  – solar physics

• **requirements**
  – 1st year: 8 Advanced Astrophysics Courses
  – 2nd year: MSc thesis research, seminars
  – options: other courses, Astrovaria, international

• **Utrecht**
  – astrophysics in depth
  – excellent physics
  – strong links to space research
MSc Astrophysics
Requirements

- **first year = courses**
  - 8 courses @ 7.5 ects
  - 1-2 replacements by Astrovaria permitted
  - 1-2 replacements by NOVA or other courses permitted
  - 1-2 replacements by bachelor courses permitted if needed

- **second year = research**
  - research @ 60 ects
  - SIUSS literature-study presentation at start
  - lunch talk presentation at completion
  - poster presentation at Nederlandse Astronomenconferentie

- **both years = seminar participation**
  - SIU Student Seminars
  - SIU lunch talks
  - Utrecht Astrophysics Colloquia
MSc Astrophysics Courses

- **Advanced Astrophysics Courses @ 7.5 ects**
  - Observational astrophysics
  - Radiative transfer in stellar atmospheres
  - Magnetohydrodynamics of astrophysical plasmas
  - Solar physics
  - Stellar evolution
  - Stellar nucleosynthesis
  - Stellar winds and mass loss
  - High-energy astrophysics
  - Galaxies
  - Active galactic nuclei
  - General relativity and astronomy

- **Alternatives**
  - Astrovaria = 7.5 ects astronomical activity (observing, popularization)
  - Interacademiaal College = national astronomy course (6 ects)
  - NOVA courses elsewhere, physics courses (Utrecht or elsewhere)
MSc Astrophysics
Thesis Research

- **one full year (60 ects)**
  - find willing supervisor
  - define subject with supervisor
  - conclude formal contract

- **SIU**
  - evolution of stars and stellar populations
  - high-energy astrophysics and space research
  - solar physics

- **elsewhere**
  - SRON Utrecht: X-ray astronomy
  - FOM Rijnhuizen: plasma physics and magnetohydrodynamics
  - other NOVA institutes: Amsterdam, Leiden, Groningen, Nijmegen
MSc Astrophysics Seminars

- **SIU Student Seminars**
  - half-hour presentations by Masters and PhD students
  - training opportunity
  - friendly moderator

- **SIU lunch talks**
  - half-hour presentations by students, staff, visitors
  - recent research
  - preceded by round-the-table news exchange

- **Utrecht Astrophysics Colloquia**
  - one-hour presentations by visiting scientists
  - alternating between SIU and SRON
  - followed by drinks and dinner with speaker
MSc Astrophysics Options

- **other courses**
  - bachelor astronomy courses if needed
  - NOVA astronomy courses at Amsterdam, Leiden, Nijmegen, Groningen
  - physics courses at Utrecht or elsewhere

- **Astrovaria**
  - observation (DOT La Palma)
  - popularization (Zenit article)
  - education (contribution to practica, lecture notes)

- **international**
  - observation (DOT La Palma)
  - part of thesis research elsewhere (Erasmus)
  - Astrovaria elsewhere (Erasmus)
Evolution of Stars and Stellar Populations

- **stellar evolution and stellar environments**
  - structure and evolution of single and binary stars
  - nucleosynthesis
  - structure and formation of stellar winds and nebulae

- **stellar end stages**
  - formation of white dwarfs, neutron stars, black holes
  - supernovae
  - gamma-ray bursts

- **stellar evolution versus galaxy evolution**
  - starburst galaxies
  - formation of stars in interacting galaxies
  - cluster evaporation in different galaxies
High-Energy Astrophysics and Space Research

- **neutron stars**
  - neutron star properties
  - pulsar magnetospheres
  - pulsar radiation mechanisms

- **X-ray binaries**
  - properties and formation
  - close encounters
  - binary cluster evolution

- **relativistic shocks**
  - dynamics
  - particle properties
  - active galactic nuclei
Solar Physics

- **instrumentation:** *Dutch Open Telescope*
  - our own solar telescope on La Palma
  - superb high-resolution tomographic imager
  - technical physics projects

- **observation:** *DOT exploiting*
  - structure and dynamics of solar magnetism
  - frequent international campaigns
  - frequent student participation

- **interpretation:** *solar atmosphere physics*
  - magnetic fields photosphere–chromosphere–corona
  - structure and dynamics of magnetic elements
  - structure and dynamics of active regions