ASTR3010

Astrophysics of Radiation and Stars

Session 1, Special circumstances, North Ryde 2021

Department of Physics and Astronomy

Contents

Notice

As part of Phase 3 of our return to campus plan, most units will now run tutorials, seminars and other small group activities on campus, and most will keep an online version available to those students unable to return or those who choose to continue their studies online.

To check the availability of face-to-face activities for your unit, please go to timetable viewer. To check detailed information on unit assessments visit your unit's iLearn space or consult your unit convenor.

General Information

Unit convenor and teaching staff
Convenor
Richard McDermid
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Orsola De Marco
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Credit points
10

Prerequisites
(ASTR278 or ASTR2020) and (PHYS202 or PHYS2020)

Corequisites

Co-badged status

Unit description
The first part of this unit covers the physical mechanisms responsible for the generation, absorption and scattering of light in environments as diverse as rarefied nebulae, hot compact stellar atmospheres and distant galaxies. During the second part of the unit the theory of stellar structure and evolution is developed. Students become familiar with spectroscopic observations and the python programming language, and carry out a project using computer models of how stars live and die.

Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at https://students.mq.edu.au/important-dates

Learning Outcomes

On successful completion of this unit, you will be able to:

ULO1: discuss principles and difficulties of observational methods that allow us to interpret the physical characteristics of an astronomical object based on the light we receive from it.

ULO2: demonstrate knowledge of the way radiation interacts with matter in different

astrophysical environments through solving radiative transfer problems.

ULO3: describe the internal structure of our Sun and stars other than the Sun, and explain the key observational properties of different types of stars.

ULO4: apply the equations of stellar structure and the simplifications that lead to polytropic stellar models.

ULO5: explain the processes and physics involved in stellar evolution, including the processes that bring about stellar death.

ULO6: apply computational techniques to model physical phenomena in different astrophysical environments using the Unix environment and elements of the python computing language.

ULO7: design, conduct, analyse and report on observational experiments related to measuring the radiation from stars, galaxies and other astronomical objects in order to determine their properties.

General Assessment Information

The 'estimated time on task' for each assessment item is an estimate of the *additional* time needed to complete each assessment outside of all scheduled learning activities. These estimates assume that you actively engage with all scheduled learning activities *and* spend an additional **24 hours of self-led study** during the session.

Hurdle tasks

This unit has hurdle requirements, specifying a minimum standard that must be attained in aspects of the unit.

You must obtain a mark of at least 40% in the **final exam** and **laboratory project** to be eligible to pass the unit. If your mark in these assessments is between 30% and 39% inclusive, you may be a given a second and final chance to attain the required level of performance. Note that the mark awarded for the second assessment towards your final unit mark will be capped at 40%, and you will be allowed to sit the second exam only if this mark would be sufficient to pass the unit overall.

Supplementary examinations

If you receive special consideration for the final exam, a supplementary exam will be scheduled in the interval between the regular exam period and the start of the next session. By making a special consideration application for the final exam you are declaring yourself available for a resit during the supplementary examination period and will not be eligible for a second special consideration approval based on pre-existing commitments. Please ensure you are familiar with the policy prior to submitting an application. You can check the supplementary exam information page on FSE101 in iLearn (bit.ly/FSESupp) for dates, and approved applicants will receive an individual notification one week prior to the exam with the exact date and time of their supplementary examination.

If you are given a second opportunity to sit the final examination as a result of failing to meet the minimum mark required, you will be offered that chance during the same supplementary examination period and will be notified of the exact day and time after the publication of final results for the unit.

Late Assessments Policy

The non-examination assessment components should be submitted via iLearn by the due date and time.

The penalty for late submission is deduction of 5% of the possible mark for that item for each 24 hour period (or part) overdue. Assessments will not be accepted for marking if submitted more than 1 week past the due date. Extensions to the due dates for assignments, practical assessments, and project will only be considered if requested with valid reason prior to the due date.

Students anticipating or experiencing difficulties in meeting a deadline should discuss this with one of the lecturers in the first instance, ideally ahead of the deadline, if at all possible. Students should also be familiar with the University's provisions for Special Considerations.

Assessment Tasks

Name	Weighting	Hurdle	Due
Assignments	20%	No	Various deadlines throughout the semester
Final examination	40%	Yes	University Exam Period
Project	20%	Yes	Week 13
Observational Analysis Task	20%	No	Start of Week 7

Assignments

Assessment Type [1]: Problem set
Indicative Time on Task [2]: 18 hours
Due: **Various deadlines throughout the semester**
Weighting: **20%**

A series of assignments throughout the session

On successful completion you will be able to:

- discuss principles and difficulties of observational methods that allow us to interpret the

physical characteristics of an astronomical object based on the light we receive from it.
- demonstrate knowledge of the way radiation interacts with matter in different astrophysical environments through solving radiative transfer problems.
- describe the internal structure of our Sun and stars other than the Sun, and explain the key observational properties of different types of stars.
- apply the equations of stellar structure and the simplifications that lead to polytropic stellar models.
- explain the processes and physics involved in stellar evolution, including the processes that bring about stellar death.

Final examination

Assessment Type [1]: Examination
Indicative Time on Task [2]: 20 hours
Due: **University Exam Period**
Weighting: **40%**
This is a hurdle assessment task (see assessment policy for more information on hurdle assessment tasks)

Examination during the exam period covering all content from the unit.

On successful completion you will be able to:
- discuss principles and difficulties of observational methods that allow us to interpret the physical characteristics of an astronomical object based on the light we receive from it.
- demonstrate knowledge of the way radiation interacts with matter in different astrophysical environments through solving radiative transfer problems.
- describe the internal structure of our Sun and stars other than the Sun, and explain the key observational properties of different types of stars.
- apply the equations of stellar structure and the simplifications that lead to polytropic stellar models.
- explain the processes and physics involved in stellar evolution, including the processes that bring about stellar death.

Project

Assessment Type [1]: Project
Indicative Time on Task [2]: 10 hours
Due: **Week 13**

Weighting: **20%**
This is a hurdle assessment task (see assessment policy for more information on hurdle assessment tasks)

Project involving computer programming, astrophysical interpretation, report and presentation

On successful completion you will be able to:

- apply computational techniques to model physical phenomena in different astrophysical environments using the Unix environment and elements of the python computing language.

Observational Analysis Task

Assessment Type [1]: Lab report
Indicative Time on Task [2]: 0 hours
Due: **Start of Week 7**
Weighting: **20%**

A report on the outcomes of collection and analysis of observational data.

On successful completion you will be able to:

- apply computational techniques to model physical phenomena in different astrophysical environments using the Unix environment and elements of the python computing language.
- design, conduct, analyse and report on observational experiments related to measuring the radiation from stars, galaxies and other astronomical objects in order to determine their properties.

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[1] If you need help with your assignment, please contact:

- the academic teaching staff in your unit for guidance in understanding or completing this type of assessment
- the Learning Skills Unit for academic skills support.

[2] Indicative time-on-task is an estimate of the time required for completion of the assessment task and is subject to individual variation

Delivery and Resources

Your lecturers are Associate Professor Richard McDermid and Professor Orsola De Marco.

Lectures will be provided as online videos, posted weekly at the scheduled lecture time.

Weekly tutorials will be on campus, and will be used to go through problem sets, worked examples, and Q&A from lectures.

Lab sessions will be conducted **on campus** in the Physics and Astronomy computer lab, and will make use of Python Notebooks, running on the Google CoLab environment. **Note that labs start in Week 1.**

Labs during the first half of the unit will involve using the **campus observatory** to obtain high-resolution spectra of stars with the Macquarie University Learning and Teaching Spectrograph. **This will involve supervised night time observing on campus during weeks 3 and 4.** Each student will attend one observing night during this period - **please make sure you can attend campus from 8pm-11pm on your allocated night.** More details will be provided during the week 1 lab session, and posted on iLearn.

Links to lecture videos, lecture notes, and lab resources, as well as any relevant announcements, will be provided via iLearn. There is no required text, but the course will be closely based on material drawn from one of our favourite books: "An Introduction to Modern Astrophysics" by Carroll and Ostlie.

Unit Schedule

Week 1: Introduction to stars and astrophysical radiation

Week 2: Properties of radiation fields

Week 3: Saha and Boltzmann Equations

Week 4: Atomic processes

Week 5: Radiative transfer

Week 6: Opacity in stellar interiors

Week 7: Stellar structure equations

Week 8: Thermodynamics and convection

Week 9: Stellar energy generation and nucleosynthesis

Week 10: Stellar evolution

Week 11: The evolution of massive stars

Week 12: Stellar remnants

Week 13: Interacting stars

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central (https://policies.mq.edu.au). Students should be aware of the following policies in particular with regard to Learning and Teaching:

- Academic Appeals Policy
- Academic Integrity Policy
- Academic Progression Policy
- Assessment Policy
- Fitness to Practice Procedure
- Grade Appeal Policy
- Complaint Management Procedure for Students and Members of the Public
- Special Consideration Policy

Students seeking more policy resources can visit Student Policies (https://students.mq.edu.au/support/study/policies). It is your one-stop-shop for the key policies you need to know about throughout your undergraduate student journey.

To find other policies relating to Teaching and Learning, visit Policy Central (https://policies.mq.edu.au) and use the search tool.

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/admin/other-resources/student-conduct

Results

Results published on platform other than eStudent, (eg. iLearn, Coursera etc.) or released directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be made available in eStudent. For more information visit ask.mq.edu.au or if you are a Global MBA student contact globalmba.support@mq.edu.au

Student Support

Macquarie University provides a range of support services for students. For details, visit http://students.mq.edu.au/support/

Learning Skills

Learning Skills (mq.edu.au/learningskills) provides academic writing resources and study strategies to help you improve your marks and take control of your study.

- Getting help with your assignment
- Workshops
- StudyWise

- Academic Integrity Module

The Library provides online and face to face support to help you find and use relevant information resources.

- Subject and Research Guides
- Ask a Librarian

Student Enquiry Service

For all student enquiries, visit Student Connect at ask.mq.edu.au

If you are a Global MBA student contact globalmba.support@mq.edu.au

Equity Support

Students with a disability are encouraged to contact the Disability Service who can provide appropriate help with any issues that arise during their studies.

IT Help

For help with University computer systems and technology, visit http://www.mq.edu.au/about_us/offices_and_units/information_technology/help/.

When using the University's IT, you must adhere to the Acceptable Use of IT Resources Policy. The policy applies to all who connect to the MQ network including students.

Changes from Previous Offering

2021 is the first year that we will be using the campus observatory and L&T Spectrograph in this unit.