

Stars and the Galaxy

AST 6215

Class Periods: MWF-7, 1:55pm-2:45pm

Location: Remote on Zoom

Academic Term: Spring 2021

Instructor:

Dr. Rana Ezzeddine

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Bryant Space Science Center – Office 324

Office Hours: After class or email me to setup time

Course Description

This course is intended to give you a solid foundation in the subject of stellar structure and properties, and how it relates to our understanding of the Milky Way. The course will cover the observable properties, structure, composition, and evolution and death of stars — in light of the resounding successes of modern physics. It brings together elements from almost every sub-field of physics (from atomic and nuclear physics, through to classical mechanics and relativity), allowing us to understand in surprising detail what goes on deep inside an object that, to us, is a mere pinprick of light in the sky.

Course Pre-Requisites / Co-Requisites

In addition to a general familiarity with astronomy at the introductory level, this course requires knowledge of calculus, differential equations, as well as basic knowledge of thermodynamics, atomic and nuclear physics.

Course Objectives

This course is one of several core courses required in the graduate astronomy curriculum but is also open to interested students in other departments. We will discuss both the theoretical and observational aspects of the topic. In all facets of the course, relevant journal articles from the active research in the literature will be used to augment and extend the topics discussed in lecture. During the course we will aim to:

- understand the global properties of stars: energies and timescales
- study the micro-physics relevant for stars: the equation of state, nuclear reactions, energy transport and opacity
- derive the equations necessary to model the internal structure of stars
- examine (quantitatively) the properties of simplified stellar models
- survey (mostly qualitatively) how stars of different masses evolve, and the endpoints of stellar evolution (white dwarfs, neutron stars, etc..)
- discuss a few ongoing research areas in stellar evolution
- place stars in the context of the Milky Way Galaxy

Suggested Textbooks, Online notes and Software

Non-exhaustive, but sufficiently information will be presented by slides during the talks. The slides will be made available every week, along with any additional materials or papers discussed in class. Below are some additional recommendations for reading materials:

1- “Stellar Interiors” by C.J. Hansen, Kawaler, & Trimble, 2nd edition, Springer publication.

2- “Stars and Stellar Processes” by M. Guidry, 1st edition, Cambridge University Press publication.

3- “An Introduction to Modern Stellar Astrophysics” by Carroll & Ostlie, 2nd edition, Cambridge University Press publication.

4- “Stellar Structure and Evolution” by R. Kippenhahn & A. Weigert, 1990, Springer-Verlag publication.

5- “Stellar Structure and Evolution” by Onno Pols https://www.astro.ru.nl/~onnop/education/stev_utrecht_notes/

Evaluation of Grades

Assignment	Percentage of Final Grade
Projects	30.00%
Review Lectures	20.00%
Midterm Exam	20.00%
Assignments	30.00%

Course Schedule:

As the semester progresses and depending upon class interest, we may deviate slightly from this plan.

Week 1 (01/11-01/15): Basic concepts, Observable quantities, Fundamental equations

Week 2 (01/18 Holiday, 01/20-01/22): Stellar Structure equations I, Stellar Structure equations II

Week 3 (01/15-01/29): Energy transport in stars, Radiative transfer

Week 4 (02/01-02/05): Stellar atmospheres, Nuclear burning processes and element formation in stars

Week 5 (02/08-02/12): Stellar models, Evolution of stars: Massive stars

Week 6 (02/15-02/19): Evolution of stars: Low and Intermediate mass stars

Week 7: (02/22-02/26): End lives of stars

Week 8 (03/01-03/05, **Midterm 03/01**): Star formation, Stellar clusters and moving groups

Week 9 (03/08-03/12): Dwarf galaxies, Stellar streams

Week 10 (03/15-03/19): Milky Way Galactic stellar populations

Week 11(03/22-03/26, 03/24 Recharge day): Galaxy formation and Galactic structure I

Weeks 12 (03/29-04/02): Galaxy formation and Galactic structure II

Week 13 (04/05-04/09): Galaxy structure and Galactic timescales

Week 14 (04/12-04/16): Recap and conclusions

Attendance Policy and Class Expectations

Class attendance is expected, and special accommodation will not be made for students with unexcused absences. Excused absences must be consistent with university policies in the Graduate Catalog (<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#attendance>) and require appropriate documentation. Additional information can be found here:

<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>

Project assignments (estimated at 2 in number) will be handed out during class and are due in class two weeks later. Point assignments will be associated with each problem. Project assignments must be completed on time to receive full credit. Partial credit will be assigned where work has been carried out the full correct answer is not provided. Projects handed in after the graded, corrected projects have been distributed out to the rest of the class will not be accepted.

Oral and written communication skills are very important for a scientist. You will thus be required to present an in-class lecture, as well as a summary paper (5-10 pages) on a topic related to stellar physics. The Annual Reviews of Astronomy & Astrophysics is a good place to look for topics. Your chosen topic must be approved before midterm. Students should submit a rank-ordered list of preferred articles to present, two weeks before the midterm. Paper assignments and presentation dates will be assigned immediately following. Presentations will take place every Friday, right after midterms. Each presentation is expected to last roughly 15 minutes if carried out interruption free. A grading rubric will be assigned.

Grading Policy

The following is given as an example only.

Percent	Grade	Grade Points
90.0 - 100.0	A	4.00
87.0 - 89.9	A-	3.67
84.0 - 86.9	B+	3.33
81.0 - 83.9	B	3.00
78.0 - 80.9	B-	2.67
75.0 - 79.9	C+	2.33
72.0 - 74.9	C	2.00
69.0 - 71.9	C-	1.67
66.0 - 68.9	D+	1.33
63.0 - 65.9	D	1.00
60.0 - 62.9	D-	0.67
0 - 59.9	E	0.00

More information on UF grading policy may be found at: <http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades>

<https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

Students Requiring Accommodations

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/>. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Course Evaluation

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.

University Honesty Policy

UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this

assignment.” The Honor Code (<https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor in this class.

Software Use

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <http://registrar.ufl.edu/catalog0910/policies/regulationferpa.html>

Campus Resources:

Health and Wellness

U Matter, We Care:

If you or a friend is in distress, please contact umatter@ufl.edu or 352 392-1575 so that a team member can reach out to the student.

Counseling and Wellness Center: <http://www.counseling.ufl.edu/cwc>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Assault Recovery Services (SARS)

Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

Academic Resources

E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu. <https://lss.at.ufl.edu/help.shtml>.

Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling. <https://www.crc.ufl.edu/>.

Library Support, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. <https://teachingcenter.ufl.edu/>.

Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers. <https://writing.ufl.edu/writing-studio/>.

Student Complaints Campus: https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf.

On-Line Students Complaints: <http://www.distance.ufl.edu/student-complaint-process>.