

From: noreply@wsu.edu
To: [curriculum.submit](#)
Subject: 669883 New or Restore Course: ASTRONOM 511
Date: Friday, October 1, 2021 2:08:56 PM
Attachments: [2021.10.01.13.50.42.60.FormData.html](#)
[2021.10.01.13.50.41.44.currentFileUpload_Astronomy511syllabus.pdf](#)
[2021.10.01.13.50.41.44.currentFileUpload1_Astronomy511Justification.pdf](#)

Matthew Duez has submitted a request for a major curricular change. His/her email address is: m.duez@wsu.edu.

Course Subject: ASTRONOM

Course Number: 511

Title: Astronomical Methods

Lecture Hours: 3

Total Credits: 3

Prerequisite: graduate standing

Catalog Description: Detectors and telescopes; radio astronomy; interferometry and Fourier methods; data handling; statistics; data mining.

Grading Type: Letter graded A-F

Requested Effective Date: Fall 2022

Dean: Swindell, Samantha - Assoc Dean - CAS

Chair: Saam, Brian – Chair – Physics and Astronomy

UCORE Committee
Approval Date

All-University Writing
Com / Date

Catalog Subcommittee
Approval Date

AAC, PHSC, or GSC
Approval Date

Faculty Senate
Approval Date

From: [Saam, Brian](#)
To: [curriculum.submit](#)
Cc: [Swindell, Samantha](#); [Stratton, Robin G](#)
Subject: RE: 669883 New or Restore Course: ASTRONOM 511
Date: Friday, October 1, 2021 2:14:25 PM

I approve this proposal in its current form.

Brian T. Saam, Ph.D.
Professor and Chair
Department of Physics and Astronomy
Washington State University
509-335-1182

From: curriculum.submit@wsu.edu <curriculum.submit@wsu.edu>
Sent: Friday, October 1, 2021 1:51 PM
To: Saam, Brian <brian.saam@wsu.edu>
Cc: Swindell, Samantha <sswindell@wsu.edu>
Subject: 669883 New or Restore Course: ASTRONOM 511

Saam, Brian – Chair – Physics and Astronomy,
Swindell, Samantha - Assoc Dean - CAS,
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Both Chair and Dean approval is required to complete the submission process. Please indicate that you have reviewed the proposal by highlighting one of the

From: [Swindell, Samantha](#)
To: [curriculum.submit](#); [Saam, Brian](#)
Subject: RE: 669883 New or Restore Course: ASTRONOM 511
Date: Friday, October 1, 2021 2:24:10 PM

1. I approve this proposal in its current form.

From: curriculum.submit@wsu.edu <curriculum.submit@wsu.edu>
Sent: Friday, October 1, 2021 1:51 PM
To: Saam, Brian <brian.saam@wsu.edu>
Cc: Swindell, Samantha <sswindell@wsu.edu>
Subject: 669883 New or Restore Course: ASTRONOM 511

Saam, Brian – Chair – Physics and Astronomy,
Swindell, Samantha - Assoc Dean - CAS,
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Both Chair and Dean approval is required to complete the submission process. Please indicate that you have reviewed the proposal by highlighting one of the statements below and **reply all** to this email. (curriculum.submit@wsu.edu.) [Details of major change requested can be found in the attached supplemental documentation]

1. I approve this proposal in its current form.

Justification for a graduate astronomy sequence

The Department of Physics and Astronomy has targeted astronomy/astrophysics as one of its primary research areas, with four tenure or tenure-track faculty engaged in research and graduate advising in the subject. Each year, about a third of our graduate applicants express a preference for doing research in astronomy/astrophysics, and of our annual incoming graduate class of around ten, usually a few have astronomy/astrophysics as their main interest. Students must master a significant body of existing knowledge before they can meaningfully engage in astrophysical research. Unfortunately, while the department's required graduate curriculum gives students a strong physics background, it includes no astronomy. In fact, the course catalog currently lists only one graduate-level astronomy class: Astronomy 581: Advanced Topics in Astronomy. The lack of a graduate astronomy sequence no doubt hurts our ability to recruit astronomy graduate students, who can see that we have no structure in place to guarantee that they will be properly trained.

For the past decade, Physics and Astronomy faculty engaged in astrophysical research have tried to overcome this deficiency by offering Astronomy 581 at an average rate of about once per academic year. Often, faculty would teach a subject relevant to their research area. This was an imperfect arrangement, because there was no coordination to make sure all the foundational material was covered. Indeed, some of the core, foundational topics in astrophysics, such as stellar structure and radiation transport, have *never* been taught at a graduate level. Furthermore, students could have no guarantee that any particular astrophysical subject would be taught during their time as graduate students, and many have been driven to fulfill their course requirements with classes irrelevant to their topic of interest.

There is thus a great need for a sequence of courses which 1) is designed so that a student who takes all of them will have the core knowledge that any working astronomer or astrophysicist should have, and 2) is offered regularly, so that astronomy/astrophysics students can plan their course schedules with the knowledge that they will be able to take these classes within their first two or three years.

The astronomy faculty at WSU have jointly devised a 4-course sequence of 500-level classes for astronomy-focused graduate students. The plan is to offer one class per semester, so that each is taught once every other year. In the Physics and Astronomy department, it is customary for students to spend their first two years taking classes, and subsequent years focused on research. The planned schedule would allow students to take the astronomy sequence during this time. Which two Astronomy classes a student takes in his or her first year and which in the second year would, of course, alternate. We have designed the classes to be independent. None is a prerequisite of any other, so they can be taken in any order.

The proposed schedule also guarantees a minimal increase in faculty load, since the new classes will *replace* the current disorganized Astronomy 581 offerings. It will require teaching a graduate astronomy class each semester rather than each year. Fortunately, the number of qualified faculty will soon be double what it was a few years ago. Last year, a new astronomer, Vivienne Baldassare, joined us at the Assistant Professor level. Also, next semester, Associate Professor Sukanta Bose will return to Pullman after several years in India.

None of the proposed courses overlaps with any existing course in another department. The undergraduate astronomy sequence (ASTRONOM 435 and 436) would be totally inadequate for training graduate astronomy students.

For the graduate astronomy program to grow and thrive, the need for a core astronomy graduate sequence is obvious and urgent.

Justification for Astronomy 511: Astronomical Methods

The astronomical methods course provides core principles in statistical inference, the operation of telescopes and detectors, and basic data mining concepts that underlie the day-to-day practice of the modern astrophysicist. A young astrophysicist should have a working vocabulary of the common and high-universal tools of the trade before they launch into research at the frontiers of knowledge.

The present training method for astrophysics graduate students resembles the medieval master-apprentice relationship where the student picks up jargon from their advisor along the way. This is inefficient, especially of the professor's time. Enrollment in the astro-related Ph.D. path continues to increase, and we seek a way to increase the effectiveness of our growing but still limited resources.

Astronomy 511 is envisioned as a crash course in the truly essential. One third is dedicated to statistics and statistical inference. Because astronomy is an observational science, controlled experiments are not possible. Instead, we rely on time-series observations, observations of many objects, and observations at the limits of instrumental sensitivity. Proper statistical treatment for (usually) multidimensional and (often) non-Gaussian error models is the bread and butter of astronomy, but isn't taught at WSU.

Another third of the course is a dive into the properties of light and the manifold ways light can be detected using earthbound and space-based telescopes and detectors. Topics such as interference, interferometry, Fourier analysis, image reconstruction, and radio aperture synthesis are covered, as well as detectors for gamma rays, X-rays, UV, visible, infrared, microwave, and radio waves.

The final third covers the rapidly evolving new field of data mining and related topics such as time series analysis, messengers other than light (neutrinos and gravity waves), and a survey of ongoing surveys. These areas are all "base layers" that lay down concepts and jargon common to broad swaths of astronomy.

Astronomy 511 Syllabus

COURSE INFORMATION

Astronomy 511: Astronomical Methods

Spring 2023

3 credits. Detectors and telescopes, radio astronomy, interferometry and Fourier methods, data handling, statistics, data mining.

Course type: Face to face.

MEETING SCHEDULE

11:10 – 12:00 MWF, Webster 11

Persistent zoom link for attendance while sick: **TBD**

INSTRUCTOR INFORMATION

Guy Worthey or any other departmental faculty member

948C Webster

gworthey@wsu.edu, 509.335.4994

Office hours 12:00-12:30 MWF or by appointment, either face to face or zoom.

TEXTBOOKS AND COURSE MATERIALS

Optional textbooks:

Astrophysical Techniques, 5th ed. By C. R. Kitchin, 2009, CRC Press, 978-1-4200-8243-2

Practical Optical Interferometry: Imaging at Visible and Infrared Wavelengths (Cambridge Observing Handbooks for Research Astronomers Book 11), 1st ed., by David F. Buscher and Malcolm Longair, Cambridge University Press, 978-1107042179

Statistics, Data Mining, and Machine Learning in Astronomy: A Practical Guide for the Analysis of Survey Data, Updated Edition (Princeton Series in Modern Observational Astronomy, 13) by Z. Ivezić et al., 2019, Princeton University Press, 978-0691198309

INSTRUCTIONAL METHODS

The class will have a traditional lecture format, supplemented with in-class group exercises. Students are allowed and encouraged to discuss homework with each other, but each student's homework submissions are expected to be completely his or her own.

STUDENT LEARNING OUTCOMES

By the end of the course, the student will have a conversant knowledge in each of the course subtopics. This includes conceptual understanding and the ability to express those concepts mathematically as well as verbally.

Homework assignments assess conceptual understanding, mathematical fluency, and written expression. Exams assess conceptual understanding and mathematical fluency.

EXPECTATIONS FOR STUDENT EFFORT

For each hour of lecture equivalent, students should expect to have a minimum of two hours of work outside class.

COURSE TIMELINE

Week	Topic
01	Optical and infrared detectors
02	Gamma, X-ray, UV, and radio detectors
03	Particle (cosmic ray, neutrino) detectors, gravity wave detectors
04	Imaging: deconvolution, interferometry, aperture synthesis
05	Imaging: Speckle interferometry, occultations
06	Image analysis and reduction
07	Photometry, Spectroscopy
08	Coordinate systems and astrometry
09	Polarimetry, solar oscillations, magnetometry
10	Statistical Inference: Maximum Likelihood, modeling, confidence estimates
11	Statistical Inference: Bayesian analysis
12	Data mining: efficient searching, reducing dimensions
13	Regression and model fitting
14	Time series analysis
15	Overflow and time series analysis practicum

DESCRIPTION OF REQUIRED ASSIGNMENTS

Approximately eight homework assignments will be assigned. The format is “free form” where the student composes an explanatory mix of equations and text to answer the questions posed.

Approximately three python-based homework assignments will be assigned. The annotated codes and their output constitute what is turned in and graded.

Two exams will occur.

COURSE GRADING

Grading policy

Homework, including python-based homework, will weigh 70% as regards determining a grade, with the exams weighing the remaining 30%. The weighted average will be assigned a letter grade according to a fixed scale:

W.S.U. Letter Grade	W.S.U. Grade Point	Percentage range
A	4.0	92+
A-	3.7	89 - 91.99
B+	3.3	86 - 88.99
B	3.0	83 - 85.99
B-	2.7	80 - 82.99
C+	2.3	77 - 79.99
C	2.0	74 - 76.99
C-	1.7	71 - 73.99
D+	1.3	68 - 70.99
D	1.0	65 - 67.99
F	0.0	0 - 64.99

Written expression, including correct grammar, punctuation, and spelling, is assessed as part of the homework assignments and exams. Exactitude and correctness also matter, for numerical answers as well as conceptual clarity.

Attendance Policy

Full attendance is expected. If you are fall sick you should stay home and (1) email the instructor, and (2) connect via zoom if possible. Chronic absenteeism will result in a reduced grade by one letter grade per week missed. This policy may be modified at the instructor's discretion.

Late Assignments

Late assignments will be penalized 5% per day late.

Exam make up policy

Makeup exams must be arranged in advance with the professor with suitable documentation such as a note from the coach or doctor and will suffer a 10% penalty in score regardless of the nature of the excuse.

Incomplete (I) grade policy.

If the student is unable to complete their work on time due to extraordinary circumstances beyond their control, such as accidents requiring hospitalization, they should discuss the issue with their instructor.

An 'I' grade may be assigned if all remaining work can be completed within a month after the end of the semester. A contract for finishing the work, including a firm deadline and a list of the work to be complete, will be drawn up and signed before the 'I' grade is submitted (which is generally the Tuesday after the end of finals week).

COVID-19 STATEMENT

Students are expected to abide by all current COVID-19 related university policies and public health directives, which could include wearing a cloth face covering, physically distancing, self-attestations, and sanitizing common use spaces. All current COVID-19 related university policies and public health directives are located at <https://wsu.edu/covid-19/>. Students who do not comply with these directives may be required to leave the classroom; in egregious or repetitive cases, students may be referred to the Center for Community Standards for university disciplinary action.

ACADEMIC INTEGRITY STATEMENT

Academic integrity is the cornerstone of higher education. As such, all members of the university community share responsibility for maintaining and promoting the principles of integrity in all activities, including academic integrity and honest scholarship. Academic integrity will be strongly enforced in this course. Students who violate WSU's Academic Integrity Policy (identified in Washington Administrative Code (WAC) 504-26-010(4)) will receive a zero on the affected assignment(s) and will not have the option to withdraw from the course pending an appeal, and will be reported to the Center for Community Standards.

Cheating includes, but is not limited to, plagiarism and unauthorized collaboration as defined in the Standards of Conduct for Students, WAC 504-26-010(3). You need to read and understand all of [the definitions of cheating](#). If you have any questions about what is and is not allowed in this course, you should ask course instructors before proceeding.

If you wish to appeal a faculty member's decision relating to academic integrity, please use the form available at communitystandards.wsu.edu. Make sure you submit your appeal within 21 calendar days of the faculty member's decision.

REASONABLE ACCOMMODATION STATEMENT

Students with Disabilities: Reasonable accommodations are available for students with documented disabilities or chronic medical or psychological conditions. If you have a disability and need accommodations to fully participate in this class, please visit your campus' Access Center/Services website to follow published procedures to request accommodations. Students may also contact their campus offices to schedule an appointment with a Disability Specialist. All disability related accommodations are to be approved through the Access Center/Services on your campus. It is a university expectation that students visit with instructors (via email, Zoom, or in person) to discuss logistics within two weeks after they have officially requested their accommodations.

For more information contact a Disability Specialist on your home campus:

- Pullman, WSU Global Campus, Everett, Bremerton, and Puyallup: 509-335-3417 [Access Center](#) (<https://www.accesscenter.wsu.edu>) or email at access.center@wsu.edu
- Spokane: 509-358-7816 [Access Services](#) (<https://spokane.wsu.edu/studentaffairs/access-resources/>) or email j.schneider@wsu.edu
- Tri-Cities: [Access Services](#) (<http://www.tricity.wsu.edu/disability/>) or email g.hormel@wsu.edu

- Vancouver: 360-546-9238 [Access Center](https://studentaffairs.vancouver.wsu.edu/student-wellness-center/access-center) (<https://studentaffairs.vancouver.wsu.edu/student-wellness-center/access-center>) or email van.access.center@wsu.edu

ACCOMMODATION OF RELIGIOUS OBSERVANCES

Washington State University reasonably accommodates absences allowing for students to take holidays for reasons of faith or conscience or organized activities conducted under the auspices of a religious denomination, church, or religious organization. Reasonable accommodation requires the student to coordinate with the instructor on scheduling examinations or other activities necessary for course completion. Students requesting accommodation must provide written notification within the first two weeks of the beginning of the course and include specific dates for absences. Approved accommodations for absences will not adversely impact student grades. Absence from classes or examinations for religious reasons does not relieve students from responsibility for any part of the course work required during the period of absence. Students who feel they have been treated unfairly in terms of this accommodation may refer to [Academic Regulation 104 - Academic Complaint Procedures](#).

SEVERE WEATHER POLICY

For severe weather alerts, see: <http://alert.wsu.edu/> and <https://oem.wsu.edu/emergency-procedures/severe-weather/>. In the event of severe weather affecting university operations, guidance will be issued through the alert system.

SAFETY AND EMERGENCY NOTIFICATION

Classroom and campus safety are of paramount importance at Washington State University and are the shared responsibility of the entire campus population. WSU urges students to follow the "Alert, Assess, Act," protocol for all types of emergencies and the "[Run, Hide, Fight](#)" response for an active shooter incident. Remain ALERT (through direct observation or emergency notification), ASSESS your specific situation, and ACT in the most appropriate way to assure your own safety (and the safety of others if you are able).

Please sign up for emergency alerts on your account at MyWSU. For more information on this subject, campus safety, and related topics, please view the FBI's [Run, Hide, Fight video](#) and visit the [WSU safety portal](#).

Full details can be found at <https://provost.wsu.edu/classroom-safety/>

DISCRIMINATION AND HARRASSMENT POLICY STATEMENT

Discrimination, including discriminatory harassment, sexual harassment, and sexual misconduct (including stalking, intimate partner violence, and sexual violence) is prohibited at WSU (See WSU Policy Prohibiting Discrimination and Harassment ([Executive Policy 15](#)) and [Standards of Conduct for Students](#) (WAC Code 504-26)). If you feel you have experienced or have witnessed discriminatory conduct, you can contact the WSU Office of Civil Rights Compliance & Investigation (CRCI) and/or the WSU Title IX Coordinator (see cricwsu.edu/title-ix/) at 509-335-8288 to discuss resources, including confidential resources, and reporting options. (Visit cric.wsu.edu for more information).

Most WSU employees, including faculty, who have information regarding sexual harassment or sexual misconduct are required to report the information to CRCI or a designated Title IX Coordinator or Liaison. (Visit cric.wsu.edu/reporting-requirements for more info).

STUDENTS IN CRISIS – PULLMAN RESOURCES

If you or someone you know is in immediate danger, DIAL 911 FIRST!

Student Care Network: <https://studentcare.wsu.edu/>

Cougar Transit: 978 267-7233

WSU Counseling and Psychological Services (CAPS): 509 335-2159

Suicide Prevention Hotline: 800 273-8255

Crisis Text Line: Text HOME to 741741

WSU Police: 509 335-8548

Pullman Police (Non-Emergency): 509 332-2521

WSU Office of Civil Rights Compliance & Investigation: 509 335-8288

Alternatives to Violence on the Palouse: 877 334-2887

Pullman 24-Hour Crisis Line: 509 334-1133