1. **Course:** ASPH 307, Introduction to Observational Astrophysics - Winter 2022

Lecture 01: TR 09:30 - 10:45 in SB 148

<table>
<thead>
<tr>
<th>Instructor</th>
<th>Email</th>
<th>Phone</th>
<th>Office</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr Philip Langill</td>
<td><a href="mailto:pplangil@ucalgary.ca">pplangil@ucalgary.ca</a></td>
<td>403 220-5402</td>
<td>SA 101B</td>
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</tbody>
</table>

Office Hours will be held Wednesdays from 1 to 3 pm via zoom. It may be necessary to change this occasionally due to scheduling conflicts. If any changes are imminent, new office hours will be communicated via D2L and/or during lecture.

To account for any necessary transition to remote learning in the winter 2022 semester, courses with in-person lectures, labs, or tutorials may be shifted to remote delivery for a certain period of time. In addition, adjustments may be made to the modality and format of assessments and deadlines, as well as to other course components and/or requirements, so that all coursework tasks are in line with the necessary and evolving health precautions for all involved (students and staff).

**In Person Delivery Details:**

When permission is given to return to main campus, lectures will take place in SB148.

**Re-Entry Protocol for Labs and Classrooms:**

To limit the spread of COVID-19 on campus, the University of Calgary has implemented safety measures to ensure the campus is a safe and welcoming space for students, faculty and staff. The most current safety information for campus can be found [here](#).

**Online Delivery Details:**

This course does not follow a scheduled meeting pattern.

Office hour interaction will occur via zoom. The zoomroom link will be communicated at the start of the semester via D2L and/or during lecture.

While the default mode for team data gathering is to work together in SB518, there may be instances where this activity will be moved over to the zoom platform. Constant communication about this will happen throughout the semester via D2L and/or during lecture.

**Course Site:**

D2L: Asph307W22 - Intro to Observational Astrophysics

**Note:** Students must use their U of C account for all course correspondence.

**Equity Diversity & Inclusion:**

The University of Calgary is committed to creating an equitable, diverse and inclusive campus, and condemns harm and discrimination of any form. We value all persons regardless of their race, gender, ethnicity, age, LGBTQIA2S+ identity and expression, disability, religion, spirituality, and socioeconomic status. The Faculty of Science strives to extend these values in every aspect of our courses, research, and teachings to better promote academic excellence and foster belonging for all.

The Physics and Astronomy EDI Committee acknowledges there are persistent barriers that prevent such accessibility and hinder our progress towards EDI. Our representatives (faculty, postdocs, graduate and undergraduate students) are committed to addressing any concerns and work towards proactive solutions that enact necessary change within the department. To submit anonymous questions, comments or concerns regarding EDI related issues, please reach out to our Acting Associate Head EDI, Jo-Anne Brown ([jocat@ucalgary.ca](mailto:jocat@ucalgary.ca))
2. **Requisites:**

See section 3.5.C in the Faculty of Science section of the online Calendar.

**Prerequisite(s):**
Astrophysics 213 or 305.

**Antirequisite(s):**
Credit for Astrophysics 307 and 507 will not be allowed.

3. **Grading:**

The University policy on grading and related matters is described in F.1 and F.2 of the online University Calendar.

In determining the overall grade in the course the following weights will be used:

<table>
<thead>
<tr>
<th>Course Component</th>
<th>Weight</th>
<th>Due Date (duration for exams)</th>
<th>Modality for exams</th>
<th>Location for exams</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assignments (4-5)</td>
<td>20%</td>
<td>Ongoing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observing Projects</td>
<td>36%</td>
<td>Ongoing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Team participation Evaluation</td>
<td>2.5%</td>
<td>Ongoing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Midterm Exam</td>
<td>17.5%</td>
<td>Mar 01 2022 at 09:30 am (75 Minutes)</td>
<td>in-person</td>
<td>Regular classroom</td>
</tr>
<tr>
<td>Registrar Scheduled Final Exam</td>
<td>24%</td>
<td>Will be available when the final exam schedule is released by the Registrar</td>
<td>in person</td>
<td>Will be available when the final exam schedule is released by the Registrar</td>
</tr>
</tbody>
</table>

1 Assignments will be spaced throughout the semester. Dates of submission will be posted in D2L two weeks prior to the due date.

Each piece of work (reports, assignments, quizzes, midterm exam(s) or final examination) submitted by the student will be assigned a grade. The student’s grade for each component listed above will be combined with the indicated weights to produce an overall percentage for the course, which will be used to determine the course letter grade.

The conversion between a percentage grade and letter grade is as follows.

<table>
<thead>
<tr>
<th></th>
<th>A+</th>
<th>A</th>
<th>A-</th>
<th>B+</th>
<th>B</th>
<th>B-</th>
<th>C+</th>
<th>C</th>
<th>C-</th>
<th>D+</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum % Required</td>
<td>95%</td>
<td>90%</td>
<td>85%</td>
<td>80%</td>
<td>75%</td>
<td>70%</td>
<td>65%</td>
<td>60%</td>
<td>55%</td>
<td>50%</td>
<td>45%</td>
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</table>

This course will have a Registrar Scheduled Final exam that will be delivered in-person and on campus. The Final Examination Schedule will be published by the Registrar’s Office approximately one month after the start of the term. The final exam for this course will be designed to be completed within 2.5 hours.

**NOTE:** Students who attain a combined weighted average grade, on the midterm and final exams, of less than 40% should not expect to receive a course letter grade above a D+.

The University of Calgary offers a [flexible grade option](https://science.ucalgary.ca/current-students/undergraduate/program-advising/flexible-grading-option-cg-grade) to support student’s breadth of learning and student wellness. Faculty units may have additional requirements or restrictions for the use of the CG grade at the faculty, degree or program level. To see the full list of Faculty of Science courses where CG is not eligible, please visit the following website: [https://science.ucalgary.ca/current-students/undergraduate/program-advising/flexible-grading-option-cg-grade](https://science.ucalgary.ca/current-students/undergraduate/program-advising/flexible-grading-option-cg-grade)

4. **Missed Components Of Term Work:**

The university has suspended the requirement for students to provide evidence for absences. Please do not attend medical clinics for medical notes or Commissioners for Oaths for statutory declarations.

In the event that a student legitimately fails to submit any online assessment on time (e.g. due to illness etc...), please contact the course coordinator, or the course instructor if this course does not have a coordinator to arrange for a re-adjustment of a submission date. Absences not reported within 48 hours will not be accommodated. If an excused absence is approved, one possible arrangement is that the percentage weight of the legitimately missed assignment could also be pro-rated among the components of the course. This option is at the discretion of the coordinator and may not be a viable option based on the design of this course.

Missed components of term work receive a zero grade without exception. This includes late assignments. If a documented valid reason for missed work is provided a solution will be offered that may include transfer of
weight or an opportunity to finish the work at a later date at the discretion of the instructor. Such accommodation will only be considered if the request is made at the earliest possible opportunity.

5. Scheduled Out-of-Class Activities:

There are no scheduled out of class activities for this course.

Data gathering observing sessions will be carried out at the Rothney Astrophysical Observatory and/or on the main UC campus in SB518, in the evening hours after sunset, when weather conditions allow.

6. Course Materials:

Required Textbook(s):

Frederick R. Chromey, *To Measure the Sky: An Introduction to Observational Astronomy* 2nd Ed.: Cambridge.

In order to successfully engage in their learning experiences at the University of Calgary, students taking online, remote and blended courses are required to have reliable access to the following technology:

- A computer with a supported operating system, as well as the latest security, and malware updates;
- A current and updated web browser;
- Webcam/Camera (built-in or external);
- Microphone and speaker (built-in or external), or headset with microphone;
- Current antivirus and/or firewall software enabled;
- Stable internet connection.

For more information please refer to the UofC ELearning online website.

7. Examination Policy:

Non-communicating calculators will be allowed during the midterm and final exam. Other resources may be allowed, as discussed in lecture.

Students should also read the Calendar, Section G, on Examinations.

8. Approved Mandatory And Optional Course Supplemental Fees:

There are no mandatory or optional course supplemental fees for this course.

9. Writing Across The Curriculum Statement:

For all components of the course, in any written work, the quality of the student's writing (language, spelling, grammar, presentation etc.) can be a factor in the evaluation of the work. See also Section E.2 of the University Calendar.

10. Human Studies Statement:

Students will not participate as subjects or researchers in human studies.

See also Section E.5 of the University Calendar.

11. Reappraisal Of Grades:

A student wishing a reappraisal, should first attempt to review the graded work with the Course coordinator/instructor or department offering the course. Students with sufficient academic grounds may request a reappraisal. Non-academic grounds are not relevant for grade reappraisals. Students should be aware that the grade being reappraised may be raised, lowered or remain the same. See Section I.3 of the University Calendar.

a. Term Work: The student should present their rationale as effectively and as fully as possible to the Course coordinator/instructor within ten business days of either being notified about the mark, or of the item's return to the class. If the student is not satisfied with the outcome, the student shall submit the Reappraisal of Graded Term work form to the department in which the course is offered within 2 business days of receiving the decision from the instructor. The Department will arrange for a reappraisal of the work within the next ten business days. The reappraisal will only be considered if the student provides a detailed rationale that outlines where and for what reason an error is suspected. See sections I.1 and I.2 of the University Calendar.
b. **Final Exam:** The student shall submit the request to Enrolment Services. See Section I.3 of the University Calendar.

12. **Other Important Information For Students:**

   a. **Mental Health** The University of Calgary recognizes the pivotal role that student mental health plays in physical health, social connectedness and academic success, and aspires to create a caring and supportive campus community where individuals can freely talk about mental health and receive supports when needed. We encourage you to explore the mental health resources available throughout the university community, such as counselling, self-help resources, peer support or skills-building available through the SU Wellness Centre (Room 370, MacEwan Student Centre, Mental Health Services Website) and the Campus Mental Health strategy website (Mental Health).

   b. **SU Wellness Services:** For more information, see www.ucalgary.ca/wellnesscentre or call 403-210-9355.

   c. **Sexual Violence:** The Sexual Violence Support Advocate, Carla Bertsch, can provide confidential support and information regarding sexual violence to all members of the university community. Carla can be reached by email (svsa@ucalgary.ca) or phone at 403-220-2208. The complete University of Calgary policy on sexual violence can be viewed at (https://www.ucalgary.ca/legal-services/sites/default/files/teams/1/Policies-Sexual- and-Gender-Based-Violence-Policy.pdf)

   d. **Misconduct:** Academic integrity is the foundation of the development and acquisition of knowledge and is based on values of honesty, trust, responsibility, and respect. We expect members of our community to act with integrity. Research integrity, ethics, and principles of conduct are key to academic integrity. Members of our campus community are required to abide by our institutional Code of Conduct and promote academic integrity in upholding the University of Calgary’s reputation of excellence. Some examples of academic misconduct include but are not limited to: posting course material to online platforms or file sharing without the course instructor’s consent; submitting or presenting work as if it were the student’s own work; submitting or presenting work in one course which has also been submitted in another course without the instructor’s permission; borrowing experimental values from others without the instructor’s approval; falsification/fabrication of experimental values in a report. Please read the following to inform yourself more on academic integrity:

   - Student Handbook on Academic Integrity
   - Student Academic Misconduct Policy and Procedure
   - Research Integrity Policy

   Additional information is available on the Student Success Centre Academic Integrity page

   e. **Academic Accommodation Policy:**

       It is the student’s responsibility to request academic accommodations according to the University policies and procedures listed below. The student accommodation policy can be found at: https://www.ucalgary.ca/legal-services/sites/default/files/teams/1/Policies-Student-Accommodation-Policy.pdf

       Students needing an accommodation because of a disability or medical condition should communicate this need to Student Accessibility Services in accordance with the Procedure for Accommodations for Students with Disabilities: https://www.ucalgary.ca/legal-services/sites/default/files/teams/1/Policies-Accommodation-for-Students-with-Disabilities-Procedure.pdf.

       Students needing an accommodation in relation to their coursework or to fulfil requirements for a graduate degree, based on a Protected Ground other than Disability, should communicate this need, by filling out the Request for Academic Accommodation Form and sending it to Dr. David Feder by email phas.ahugrd@ucalgary.ca preferably 10 business days before the due date of an assessment or scheduled absence.

   f. **Freedom of Information and Privacy:** This course is conducted in accordance with the Freedom of Information and Protection of Privacy Act (FOIPP). Students should identify themselves on all written work by placing their name on the front page and their ID number on each subsequent page. For more information, see Legal Services website.

   g. **Student Union Information:** VP Academic, Phone: 403-220-3911 Email: suvpace@ucalgary.ca. SU Faculty Rep., Phone: 403-220-3913 Email: sciencerep@su.ucalgary.ca. Student Ombudsman, Email: ombuds@ucalgary.ca.

   h. **Surveys:** At the University of Calgary, feedback through the Universal Student Ratings of Instruction (USRI) survey and the Faculty of Science Teaching Feedback form provides valuable information to help with
evaluating instruction, enhancing learning and teaching, and selecting courses. Your responses make a difference - please participate in these surveys.

i. Copyright of Course Materials: All course materials (including those posted on the course D2L site, a course website, or used in any teaching activity such as (but not limited to) examinations, quizzes, assignments, laboratory manuals, lecture slides or lecture materials and other course notes) are protected by law. These materials are for the sole use of students registered in this course and must not be redistributed. Sharing these materials with anyone else would be a breach of the terms and conditions governing student access to D2L, as well as a violation of the copyright in these materials, and may be pursued as a case of student academic or non-academic misconduct, in addition to any other remedies available at law.

Course Goals:
Most people think that all astronomers do is use telescopes to make cool images of things in space. But this course teaches students that a fancy picture is not the goal. All we know about the universe; how big stars are and how far away they are and what they are made of and how old they are and how they are born and how they die, and the physical properties of planets and galaxies and the universe – we know because we collect and study the light that arrives at our telescopes and detectors.

The UC's Rothney Astrophysics Observatory is a laboratory filled with the modern tools astronomers use to collect and study light from space, across the electromagnetic spectrum. In this course, students collect data to make measurements. To estimate uncertainty in those measurements students require a solid understanding of the instruments employed, the data analysis process, statistical arguments, and error propagation. After much work a measurement is in hand including its estimated uncertainty, and from that, conclusions are drawn about the phenomena being studied.

Teamwork:
Students taking this course will learn many of the details involved in this entire process of astronomical investigation and discovery. As students will need to work in groups to accomplish the long list of tasks they are challenged with in this course, this is an opportunity to hone communication and collaborative skills. Accountability to your teammates is part of the evaluation process. Details of this evaluation process will be discussed in lecture and carries a weight of 2.5% toward the final grade.

Course Learning Incomes:
Students entering this course have taken a math-based introductory astrophysics course, or equivalent. Thus, basic concepts such as the magnitude system, astronomical and geological coordinate systems, telescope optics and mounting systems, observable properties of stars, and the constituents of the solar system and Milky Way galaxy are familiar. Mathematical skills are important at all levels of one's undergraduate pursuits in physics, and this course is no exception. Familiarity in geometry, algebra, and calculus are advantageous skills for students coming into this course.

Syllabus:
A wide range of topics will be discussed in this course. These include, but are not restricted to;
- Brief review of astronomical basics
- Aspects of light and matter
- Measurements, statistics, and uncertainty
- Optics, telescopes, and filters
- CCD and CMOS cameras, spectrographs, and other detectors
- Digital image processing

Students will; (i) develop an understanding of telescopes, instruments, and detectors; (ii) become familiar with interpreting astronomical data using reduction and analysis methods, simulations and model fitting, data and error analysis.

Assignments:
The majority of assignment questions come from the required textbook, but some questions also utilize data
collected from RAO equipment. Each student is required to hand in their own individual assignment work.

Projects:
A major component of Asph307 incorporates Team observational Projects. The details of these Projects will be outlined in lecture. Projects involve collecting real data using telescopes and equipment at the RAO, and analyzing that data with specialized astrophysical software. All students are required to be a part of a Team to participate in their Project work. The combined weight of the Projects is 36%.

Final Exam:
Details will be provided in lectures. It carries a weight of 24% toward the final grade.

Course Outcomes:
- Examine how complex optical systems, from telescopes to spectrographs, function
- Examine how specialized astronomical filters (griz, Johnson, Ha, 1420 MHz) and precision photometric arrays (CCDs), work and are applied to different data acquisition methodology
- Learn and apply fundamental data analysis software tools and techniques to remove instrumental defects and reduce noise.
- Learn and attempt to apply advanced data analysis methods such as image stacking, deconvolution, Fourier transform filtering, etc.
- Gain insight into error analysis and error propagation, quantifying signal to noise ratio, and planning ahead to produce the highest quality data possible in the gathering process
- Become proficient in three keys areas of observational astrophysics; Photometry, Astrometry, and Spectroscopy