

# PTYS 416/516: Asteroids, Comets, Kuiper Belt Objects

Spring 2025, Kuiper 312, TTH 2:00-3:15p.m.

## Instructor and Contact Information

**Instructor: Daniella DellaGiustina (she/her)**, Kuiper 526, (520) 784-3976, [danidg@lpl.arizona.edu](mailto:danidg@lpl.arizona.edu)

Office hours: Stop by anytime or email me for a guaranteed time.

Teaching Assistant: Robert Melikyan, [rmelikyan@arizona.edu](mailto:rmelikyan@arizona.edu)

## Description & Course Objectives

This course is an introduction to the "minor planets" –the asteroids, comets, Kuiper Belt objects, and dwarf planets. These small celestial bodies constitute the debris left over from the processes of planet formation and, as such, hold physical and chemical clues to almost the entire history of the solar system. During this course, we will review the current state of knowledge about their spatial distribution, their physical characteristics and chemical compositions, their origin and evolution, as well as techniques of study. Students will acquire a broad overview of the natural processes that govern our solar system and of the techniques that planetary scientists use to extend our knowledge.

## Course Website

Students will need a UA Net ID to access the class web page at <http://d2l.arizona.edu>

## Course Format and Teaching Methods

Lecture with laboratory and fieldtrip components. Occasionally lectures may be delivered via Zoom.

## Expected Learning Outcomes

- You will be able to identify and summarize the important features of and differences between small solar system bodies: Asteroids, Comets, and Kuiper Belt Objects.
- You will be able to describe the different techniques used to observe and study small solar system bodies.
- You will gain hands on experience collecting and analyzing both real and analog observations collected of small solar system bodies.
- *Graduate Students Only:* You will be able to prepare and present an effective, informative, and accurate synthesis of results of a planetary exploration mission to a small body.

## Absence and Class Participation Policy

Participating in the course and attending lectures and other course events are vital to the learning process. As such, attendance is required at all lectures and discussion section meetings. Absences may affect a student's final course grade. If you anticipate being absent, are unexpectedly absent, or are unable to participate in class online activities, please contact me as soon as possible. To request a disability-related accommodation to this attendance policy, please contact the Disability Resource Center at (520) 621-3268 or [drc-info@email.arizona.edu](mailto:drc-info@email.arizona.edu). If you are experiencing unexpected barriers to your success in your courses, the Dean of Students Office is a central support resource for all students and may be helpful. The Dean of Students Office is located in the Robert L. Nugent Building, room 100, or call 520-621-7057.

The UA's policy concerning Class Attendance, Participation, and Administrative Drops is available at: <http://catalog.arizona.edu/policy/class-attendance-participation-and-administrative-drop>

The UA policy regarding absences for any sincerely held religious belief, observance or practice will be accommodated where reasonable, <http://policy.arizona.edu/human-resources/religious-accommodation-policy>.

Absences pre-approved by the UA Dean of Students (or Dean Designee) will be honored. See: <https://deanofstudents.arizona.edu/absences>

### Required Texts or Readings

There is no required textbook. The following books provide review articles and background on the topics that we will cover, but we will also read journal articles from the current planetary science literature.

- Asteroids III, pub: University of Arizona Press, yr: 2002
- Asteroids IV, pub: University of Arizona Press, yr: 2015
- Comets II, pub: University of Arizona Press, yr: 2004
- The Solar System Beyond Neptune, pub: University of Arizona Press, yr: 2008
- Asteroids, Comets and Dwarf Planets, au: Andrew S. Rivkin, pub: Greenwood, yr: 2009

### Required Extracurricular Activities

There is one planned field activity that will take place outside the classroom. Students will spend an evening at the telescope of one of the largest asteroid search programs in the world, the Catalina Sky Survey, which is conducted at the UofA's facilities at Mount Lemmon; the estimated time commitment is six hours, including travel time.

Other activities will include assignments that require time spent in the departmental laboratory.

### Scheduled Topics/Activities and Assignments Due Dates

See attached (pg. 6). The instructor reserves the right to adjust this schedule per classroom pace and performance.

### Final Examination or Project

The due date of your final term paper is 12/15/2022.

### Grading Scale and Policies

Regular grades are awarded for this course: A B C D E. Grading scale: A > 90% ; B = 80.1 - 90%; C = 70.1 - 80%; D = 60.1 - 70%; E < 60%. The instructor reserves the right to adjust these grade boundaries to her expectation of class performance.

*400 level expectations:* Students will be expected to actively participate in class and will be required to complete a number of homework assignments, and a term paper (in lieu of a final exam).

*400 level Grading:* Class participation: 20%; Homework assignments: 60%; Term paper: 20%.

*500 level expectations:* All of the above for 400-level, plus students will be expected to (i) to research the literature on one of the primary topics and to lecture/lead the class discussion on it, and (ii) include some original work in their term paper.

*500 level Grading:* Class participation: 20%; Homework assignments: 50%; Term paper: 15%. Leading Class Lecture: 15%.

### Incomplete (I) or Withdrawal (W):

Requests for incomplete (I) or withdrawal (W) must be made in accordance with University policies, which are available at <http://catalog.arizona.edu/policy/grades-and-grading-system#incomplete> and <http://catalog.arizona.edu/policy/grades-and-grading-system#Withdrawal> respectively.

## Dispute of Grade Policy

One week is the acceptable time period for disputing a grade on a paper, project, or exam.

## Classroom Behavior Policy

To foster a positive learning environment, students and instructors have a shared responsibility. We want a safe, welcoming, and inclusive environment where all of us feel comfortable with each other and where we can challenge ourselves to succeed. To that end, our focus is on the tasks at hand and not on extraneous activities (e.g., texting, chatting, reading a newspaper, making phone calls, web surfing, etc.).

Students are asked to refrain from disruptive conversations with people sitting around them during lecture. Students observed engaging in disruptive activity will be asked to cease this behavior. Those who continue to disrupt the class will be asked to leave lecture or discussion and may be reported to the Dean of Students.

## Threatening Behavior Policy

The UA Threatening Behavior by Students Policy prohibits threats of physical harm to any member of the University community, including to oneself. See <http://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students>.

## Accessibility and Accommodations

At the University of Arizona, we strive to make learning experiences as accessible as possible. If you anticipate or experience barriers based on disability or pregnancy, please contact the Disability Resource Center (520-621-3268, <https://drc.arizona.edu/>) to establish reasonable accommodations.

## Code of Academic Integrity

Students are encouraged to share intellectual views and discuss freely the principles and applications of course materials. However, graded work/exercises must be the product of independent effort unless otherwise instructed. Students are expected to adhere to the UA Code of Academic Integrity as described in the UA General Catalog. See: <http://deanofstudents.arizona.edu/academic-integrity/students/academic-integrity>.

The University Libraries have some excellent tips for avoiding plagiarism, available at <http://new.library.arizona.edu/research/citing/plagiarism>.

Selling class notes and/or other course materials to other students or to a third party for resale is not permitted without the instructor's express written consent. Violations to this and other course rules are subject to the Code of Academic Integrity and may result in course sanctions. Additionally, students who use D2L or UA e-mail to sell or buy these copyrighted materials are subject to Code of Conduct Violations for misuse of student e-mail addresses. This conduct may also constitute copyright infringement.

## Nondiscrimination and Anti-harassment Policy

The University of Arizona is committed to creating and maintaining an environment free of discrimination. In support of this commitment, the University prohibits discrimination, including harassment and retaliation, based on a protected classification, including race, color, religion, sex, national origin, age, disability, veteran status, sexual orientation, gender identity, or genetic information. For more information, including how to report a concern, please see <http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy>

Our classroom is a place where everyone is encouraged to express well-formed opinions and their reasons for those opinions. We also want to create a tolerant and open environment where such opinions can be expressed without resorting to bullying or discrimination of others.

### Additional Resources for Students

UA Academic policies and procedures are available at <http://catalog.arizona.edu/policies>

#### **Campus Health**

<http://www.health.arizona.edu/>

Campus Health provides quality medical and mental health care services through virtual and in-person care.

Phone: 520-621-9202

#### **Counseling and Psych Services (CAPS)**

<https://health.arizona.edu/counseling-psych-services>

CAPS provides mental health care, including short-term counseling services.

Phone: 520-621-3334

#### **The Dean of Students Office's Student Assistance Program**

<http://deanofstudents.arizona.edu/student-assistance/students/student-assistance>

Student Assistance helps students manage crises, life traumas, and other barriers that impede success. The staff addresses the needs of students who experience issues related to social adjustment, academic challenges, psychological health, physical health, victimization, and relationship issues, through a variety of interventions, referrals, and follow up services.

Email: [DOS-deanofstudents@email.arizona.edu](mailto:DOS-deanofstudents@email.arizona.edu)

Phone: 520-621-7057

#### **Survivor Advocacy Program**

<https://survivoradvocacy.arizona.edu/>

The Survivor Advocacy Program provides confidential support and advocacy services to student survivors of sexual and gender-based violence. The Program can also advise students about relevant non-UA resources available within the local community for support.

Email: [survivoradvocacy@email.arizona.edu](mailto:survivoradvocacy@email.arizona.edu)

Phone: 520-621-5767

### Campus Pantry

Any student who has difficulty affording groceries or accessing sufficient food to eat every day, or who lacks a safe and stable place to live and believes this may affect their performance in the course, is urged to contact the Dean of Students for support. In addition, the University of Arizona Campus Pantry is open for students to receive supplemental groceries at no cost. Please see their website at: [campuspantry.arizona.edu](http://campuspantry.arizona.edu) for open times.

Furthermore, please notify me if you are comfortable in doing so. This will enable me to provide any resources that I may possess.

### Preferred Gender Pronoun

This course affirms people of all gender expressions and gender identities. If you prefer to be called a different name than what is on the class roster, please let me know. Feel free to correct instructors on

your preferred gender pronoun. If you have any questions or concerns, please do not hesitate to contact me directly in class or via email (instructor email). If you wish to change your preferred name or pronoun in the UAccess system, please use the following guidelines:

**Preferred name:** University of Arizona students may choose to identify themselves within the University community using a preferred first name that differs from their official/legal name. A student's preferred name will appear instead of the person's official/legal first name in select University-related systems and documents, provided that the name is not being used for the purpose of misrepresentation. Students are able to update their preferred names in UAccess.

**Pronouns:** Students may designate pronouns they use to identify themselves. Instructors and staff are encouraged to use pronouns for people that they use for themselves as a sign of respect and inclusion. Students are able to update and edit their pronouns in UAccess.

More information on updating your preferred name and pronouns is available on the Office of the Registrar site at <https://www.registrar.arizona.edu/>.

## Use of Generative AI

Generative AI use is allowed for certain purposes/assignments, but not for others

In this course, generative artificial intelligence/large-language-models tools, such as ChatGPT, Dall-e, Bard, Bing, may be used for some with appropriate acknowledgment and citation, but not for the Final Project. If you are in doubt as to whether you are using generative AI tools appropriately in this course, I encourage you to discuss your situation with me. Be aware that many AI companies collect information; do not enter confidential information as part of a prompt. LLMs may make up or hallucinate information. These tools may reflect misconceptions and biases of the data on which they were trained and the human-written prompts used to steer them. You are responsible for checking facts, finding reliable sources for, and making a careful, critical examination of any work that you submit.

Please use [these guidelines](#) for acknowledging/citing generative AI. Your written work may be shared with one or more AI-detection tools designed to predict if the text was created by a generative AI/large-language model like ChatGPT. [TurnItIn Services Privacy Policy](#) is available online.

## Subject to Change Statement

Information contained in the course syllabus, other than the grade and absence policy, may be subject to change with advance notice, as deemed appropriate by the instructor.

<b>Week 1 (1/15)</b>
Class Introduction, Syllabus, Ungraded Assessment Quiz
<b>Week 2 (1/21, 1/23)</b>
Review of Solar System
Historical Observations, Nomenclature
<i>Assignment #1, Decadal Survey</i>
<b>Week 3 (1/28, 1/30)</b>
Telescopic Observation and Surveys (Guest Lecture – Dr. Melissa Bruker)
Intro to Meteorites (Guest Lecture – Dr. Dante Lauretta)
<b>Week 4 (2/4, 2/6)</b>
Intro to Meteorites cont (In Class Lab Exercise)
Intro to Asteroids
<i>Assignment #2, Meteorite Lab</i>
<b>Week 5 (2/11, 2/13)</b>
Interpreting Evidence from Asteroids + Meteorites + Comets (planet formation)
Interpreting Evidence from Asteroids + Meteorites + Comets (planet migration) (Guest Lecture – Kevin Walsh)
<b>Week 7 (2/18, 2/20)</b>
First close-up observations of an asteroids: Galileo flybys + NEAR at Eros
Hayabusa Sample Return Mission to Itokawa
<i>Assignment # 3, Crater Scaling</i>
<b>Week 8 (2/25, 2/27)</b>
The DART Mission (Guest Lecture – Dr. Mike Nolan)
Dawn at Ceres (Remote Lecture)
<b>Week 9 (3/4, 3/6)</b>
Dawn at Vesta
OSIRIS-REx Sample Return Mission at Bennu & Hayabusa 2 Sample Return Mission at Ryugu
<i>Assignment # 4, Spectroscopy</i>
<b>SPRING BREAK 3/8-3/16</b>
<b>Week 10 (3/18, 3/20)</b>
Intro to Comets
Intro to Comets cont...

<i>Assignment #5: Catalina Sky Survey Field Trip, Groups A (3/21) and B (3/22)</i>
<b>Week 11 (3/25, 3/27)</b>
Giotto and the "Halley Armada"
The Deep Impact and Stardust Missions
<i>Assignment #5: Catalina Sky Survey Field Trip, Groups C (3/28) and D (3/29)</i>
<b>Week 12 (4/1, 4/3)</b>
The Rosetta Mission to comet 67P/Churyumov–Gerasimenko.
Intro to KBOs
<b>Week 13 (4/8, 4/10)</b>
Is there a Planet X? (Guest Lecture – Kat Volk)
New Horizons at Pluto (Guest Lecture – TBD)
<i>Assignment # 5, Term paper topics</i>
<b>Week 13 (4/15, 4/17)</b>
New Horizons at Arrokoth (Guest Lecture – TBD)
Small Bodies and the Origin of Life (Guest Lecture – Dante Lauretta)
<b>Week 14 (4/22, 4/25)</b>
Future Missions
Grad Student Presentations
<b>Week 15 (5/6) [Last day of class 5/7]</b>
Grad Student Presentations
<i>Term paper due</i>