

ASTR 18900 1 (Winter 2021) Mapping the Heavens: Early Astronomical Surveys

Version: 10 January 2021

Syllabus

ASTR/HIPS 18900 Mapping the Heavens

Winter Quarter 2021

MW 1:50 – 3:10

KPTC 106

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The course aims to immerse students in the world of astronomy of a century ago. We will focus on aspects of how and why early (circa 1890 - 1920) photographic maps of the sky were undertaken, using primary sources such as journal articles and digitized glass-plate photographs of the sky. We will see how information about stars and galaxies can be derived from the photographs using modern tools. Students will attain an understanding of the historical development of key ideas about the organization of stars within the Milky Way and galaxies in the space beyond.

Each Monday a practical project will be demonstrated that students will undertake during the week. Wednesdays will be used for discussion of weekly readings, mostly scientific journal articles from the period, and we will also be studying maps and other material. There will be no textbook: astronomical jargon will be explained and other background will be covered as we go along.

Modules: Each week will have a corresponding module. The module will include sets of slides:

- 1) P project: an activity that uses original materials. This will be demonstrated on Monday with the slides providing a worked-through example.
- 2) R readings: original journal papers or other material. The readings (along with other material) provide a basis for discussion on Wednesday.

- 3) M map: map with link to its origin, some orientation, and a set of questions.
- 4) D discussion slides giving additional background information, illustrations, etc. Mostly for Wednesday.

Weekly schedule:

Each week the module is normally published no later than Saturday. Please look over the slides before class on Monday.

The weekly project and responses about the map are due the following Friday.

Answers to the questions related to the weekly readings are due Tuesday evening to give me time to organize the Wednesday discussion. You may also (in addition to, not instead of) submit revised answers on Friday, based on Wednesday's discussion.

Software: To accomplish the assigned projects you will need to download two bits of free data-exploration software. The first one displays and allows analysis of image files: <https://sites.google.com/cfa.harvard.edu/saoimageds9> (Links to an external site.) and the second one is used for visualization of data in tables: <http://www.star.bris.ac.uk/~mbt/topcat/> (Links to an external site.) We will be making extensive use of both of these tools. Please make sure you have been able to install and test this software before the start of the class.

Adapting to uncertain conditions: Although we have been assigned KPTC 106 for an in-person class, we may need to switch to fully remote at any time. Some students may need to work asynchronously. I will try to design the mechanics of the class to accommodate students in a variety of circumstances, e.g. by recording sessions in case you cannot be present or working synchronously. In addition, we are planning to have Zoom capability at all times, including when we are in the classroom for those who cannot be there in person.

Grading: the assignments (projects, answers to questions about the readings, and answers to questions about the maps) comprise the work upon which grades will be based: 50%, 40%, and 10%, respectively. There will be no exams, and we will wrap everything up by Friday March 12.

Late submission of assignments: let me know ahead of time if you need to submit an assignment late for some reason, otherwise there will be a penalty.

Owning your work: working with a partner or in a group on the assignments is encouraged. However when you submit any assignment, it needs to be your individual work. For example, if a solution was devised within a group discussion, that solution needs to be written down by you and not by others. If you worked collaboratively on an assignment, please identify who contributed.

Office hours: We can have a Zoom room open Tuesday 4:30 - 5:30 and Friday 1:30 - 2:30 for anyone to join. Special appointments welcome.

Schedule

Mondays: demo of the weekly project; Wednesdays: discussion of readings and other related material

Week 1

M Jan 11 types of stars appearing on an early star map

W Jan 13 overview of the end-to-end process of creating a map; visualizing astronomical distances

Week 2

M Jan 18 MLK Day

W Jan 20 Newton's unstable universe; the Cosmological Principle; sidereal and nebular systems; telescopes & photography ca. 1900

Week 3

M Jan 25 classifying nebulae on an early plate

W Jan 27 different kinds of nebulae; limits of human vision and gains from photography

Week 4

M Feb 1 measuring motions: moving stars and rotating nebulae

W Feb 3 tangential velocities for stars; dynamical arguments; time scales

Week 5

M Feb 8 do-it-yourself star catalog

W Feb 10 measuring stellar brightness

Week 6

M Feb 15 validating Edwin Hubble's PhD thesis research (measuring diameters of nebulae)

W Feb 17 discovering and understanding astrophysical structures

Week 7

M Feb 22 stellar distribution depends on stellar type

W Feb 24 spectra of stars – the Henry Draper Memorial Catalogue

Week 8

M Mar 1 investigating the Coma Cluster of nebulae

W Mar 3 distribution of the nebulae across the sky – clustering and the Zone of Avoidance

Week 9

M Mar 8 star counts and Olbers's Paradox

W Mar 10 Kapteyn's Plan of Selected Areas

F Mar 12 all assignments due

Learning Objectives for ASTR/HIPS 18900

Referring to the period from approximately 1890 to 1920, students will be able to:

1. read a map of stars or nebulae and identify structures within it
 2. explain the process of how starlight is captured and focused by a telescope, recorded by photography, and how a glass plate is developed to produce a permanent picture of the sky
 3. explain the process of measuring a photographic plate to produce a catalog of star positions and brightnesses
 4. explain how a catalog of stars is used to deduce the distribution of stars in space
 5. explain Olbers's Paradox and its resolution
 6. explain what is meant by the "sidereal system" (the system of the stars), and the "nebular system," and how the understanding of these systems evolved in the first decades of the 20th century
 7. explain what is meant by an "island universe" and how this concept became the prevailing framework for the nature and distances of galaxies
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All students on campus are required to adhere to the guidelines in the UChicago Health Pact in order to promote a safe environment in the classroom.

- Secure face coverings must be worn appropriately at all times at all times while in University buildings
- Maintain a distance of 6 feet from others
- Do not attend and in-person class if you feel unwell or are experiencing COVID-19 related symptoms

- The complete text of the UChicago Health Pact along with additional information about COVID-19 protocols can be found [here](#).

Any concerns over inappropriate PPE usage, physical distancing, cleaning/disinfection, or other COVID-19 related public health concerns should be directed to UCAIR. If there is an emergency, call 773-702-8181 or dial 123 on any campus phone.

If you were potentially exposed to COVID-19 or your COVID-19 test results come back positive, reach out immediately to C19HealthReport@uchicago.edu.

The Recording and Deletion Policies for the current academic year can be found in the Student Manual under Petitions, Audio & Video Recording on Campus.

- Do not record, share, or disseminate any course sessions, videos, transcripts, audio, or chats.
- Do not share links for the course to those not currently enrolled.
- Any Zoom cloud recordings will be automatically deleted 90 days after the completion of the recording.

Students who have been exposed to or who are experiencing symptoms of COVID-19 should contact UChicago Student Wellness immediately to be tested, and reach out to their area Dean of Students to request accommodations for classes until:

- At least 10 days have passed since symptoms first appeared and;
- At least 3 days (72 hours) have passed since recovery- defined as resolution of fever without the use of fever-reducing medications and improvement in respiratory symptoms (e.g., cough, shortness of breath).

The University of Chicago is committed to ensuring equitable access to our academic programs and services. Students with disabilities who have been approved for the use of academic accommodations by Student Disability Services (SDS) and need a reasonable accommodation(s) to participate fully in this course should follow the procedures established by SDS for using accommodations. Timely notifications are required in order to ensure that your accommodations can be implemented. Please meet with me to discuss your access needs in this class after you have completed the SDS procedures for requesting accommodations.

Phone: (773) 702-6000

Email: disabilities@uchicago.edu