Astrophysics of Exoplanets
ASTR 25800 / ASTR 35800 / GEO 32080
Spring 2021 at UChicago
Daniel Fabrycky and Jacob Bean
T/Th 9:40-11:00am, location: Zoom (log in through Canvas)
Website on Canvas

Extrasolar planets, a.k.a. exoplanets, are planets orbiting other stars. First definitively detected in the mid 1990s, the planet count has rapidly expanded and their physical characterization has sharpened with improved observational techniques. Theoretical studies of planetary formation and evolution are now attempting to understand this statistical sample. The field also aspires to address questions about life in the universe. Topics are the radial velocity, transit, and other discovery and characterization techniques; statistical distributions of known planets; comparisons among planet structure and planetary system types; formation in a protoplanetary disk and subsequent dynamical evolution; the goal of finding life on an exoplanet; colonization of exoplanets and the Fermi paradox.


Required Readings posted to Canvas -- Arxiv numbers xxxx.yyyy listed below format as https://arxiv.org/abs/xxxx.yyyy

Office hours: Mondays, 4-5pm on the class zoom or by appointment: fabrycky@uchicago.edu, jacobbean@uchicago.edu

Schedule:
Mar 30 History and Context - Bean
Apr  1 Planetary orbits - Fabrycky
     Reading – Murray & Correia arxiv:1009.1738
Apr  6 Solar System overview to compare observable properties of exoplanets - Bean
Apr  8 techniques: radial velocity / Doppler - Bean Assignment 1 due.
     Fischer et al. arxiv:1602.07939, section 3
Apr 13 techniques: transits - Bean
     Winn arxiv:1001.2010
Apr 15 techniques: microlensing, astrometry, timing - Fabrycky
     3 readings, see “Assignments” on Canvas
Apr 20 techniques: direct imaging and gas-giant atmospheres - Bean
     Johnson Chapter 5, Biller & Bonnefoy arxiv:1807.05136
Apr 22 Statistical distributions of exoplanets - Bean Assignment 2 due.
     Reading: Winn & Fabrycky 2015 ARA&A
Apr 27  System Architectures - Fabrycky
   Reading: Winn & Fabrycky 2015 ARA&A
Apr 29  Non-Keplerian Dynamics chapter + Kepler-TTV - Fabrycky
May 4  Internal structure, composition of terrestrial & giants - Fabrycky
   Spiegel, Fortney, & Sotin, arxiv:1312.3323
May 6  Midterm (and short project proposals due, for graduate students)
May 11 protoplanetary disks - Fabrycky
   Armitage arxiv.org/abs/astro-ph/0701485 , skim Section II, reading A; B0,1; C0,4
May 13  formation of terrestrial and giant planets - Fabrycky
   Armitage, section III, intro and parts A:1,4,7; B:1,5,6; C
May 18  interactions with the natal disk – migration - Fabrycky
   Armitage, section IV parts
May 20  interactions among planets - Fabrycky Assignment 3 due.
May 25  life and biosignatures - Bean
   Seager 2003, Science review
May 27  colonization of exoplanets and the Fermi paradox - Bean Assignment 4 due.
   Kite & Howard Physics Today article
May 29 – June 1  Reading-period. Review. Discussions with prof and TA.
June 3  Final (undergraduates)
June ~4  Project due and Presentations (for grad students)

Grades – ASTR 25800 (undergrads): Each assignment is 15%, midterm is 15%, final is 25%.
   Grads: Each assignment is 15%, Proposal=10%, Project=30%.

Assignments - 4 total assignments due at the beginning of class on the listed due date. Please
submit your work through Canvas.

Policy on Late Work – The assignments can be turned in late with a 10% deduction per day late.
The number of days late is rounded up from the time the assignment is due. For example, an
assignment that is turned in on Saturday at 6pm (electronically) and that was due on the
preceding Friday (at class time, 9:30am) would be counted as 2 days late, so 20% off. Incorrect
answers take their full effect, from there.

Policy on Group Work – Collaborative work on the assignments is encouraged, but each
person must submit a complete report in their own words, any coding/plotting should be done
separately by each person, and the report must say who else collaborated on the work.

Attendance – The course is being offered synchronously with the lectures recorded and posted
afterwards. If you can attend the class at the regularly scheduled time then please do so as it
will be more engaging for everyone. Bonus points for having your camera on! But mute your
audio unless you want to ask a question. Both professors will be at all of the lectures and will
monitor the chat window for questions. Otherwise (re-)watch the lecture videos in a timely manner so you stay up to date with the class.

**COVID-19 protocols** can be found at [https://goforward.uchicago.edu/health-requirements/](https://goforward.uchicago.edu/health-requirements/)

Students who have been exposed to or who are experiencing symptoms of COVID-19 should contact [UChicago Student Wellness](https://goforward.uchicago.edu/health-requirements/) 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).

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

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)](https://goforward.uchicago.edu/health-requirements/) 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

If personal issues arise for you this term, that you feel you can’t or shouldn’t bring to me, please contact your area’s Dean of Students:

Graduate Students: [https://physicalsciences.uchicago.edu/academics/dean-of-students/](https://physicalsciences.uchicago.edu/academics/dean-of-students/)

Undergraduate Students: [https://college.uchicago.edu/student-services/college-dean-students](https://college.uchicago.edu/student-services/college-dean-students)

The Recording and Deletion Policies for the current academic year can be found in the Student Manual under [Petitions, Audio & Video Recording on Campus](https://goforward.uchicago.edu/health-requirements/).

- 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.