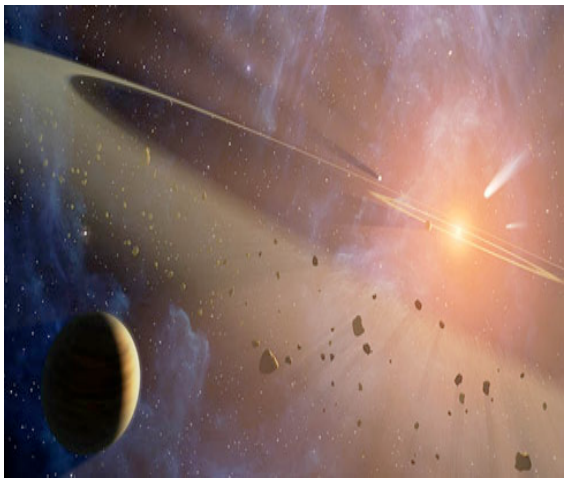
200E: Planetary Origins
Winter 2012 syllabus



ESS 200E is a one-quarter course based on our experience teaching a two-quarter sequence offered jointly by the Departments of Physics and Astronomy and of Earth and Space Sciences in 2010. The course is intended for graduate students who are interested in the origins of planetary systems and the history of our Solar System. Advanced undergraduates and postdocs are welcome to participate as well.

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Course Goals:
1) To provide the background needed to understand and/or participate in research related to the formation and evolution of the solar system and of other planetary systems.
2) To describe the star/planet formation process and subsequent evolution of planetary systems by integrating observations and theory.
3) To foster interdisciplinary knowledge and communication among P&A, ESS students and faculty.

Format: The course will consist of lectures by the instructor and/or guests, as well as discussions of current literature. Additionally, each student will present a review and lead a discussion of a topic of their choice. Some problem sets may be assigned.

Schedule: Mon 3:00 – 4:20 pm, Thu 2:30 – 3:50 pm GEOLOGY 5644.

LECTURE SCHEDULE

Week	Date	Topic	Who
1	01/09	Organizational meeting, debate logistics, project logistics.	JLM
	01/12	The Big Picture. Astronomical context. (Molecular clouds, dense cores, cloud collapse, star formation, disk formation, Young stellar objects, observations of disks).	JLM
2	01/16	Fundamentals of Celestial Mechanics. (Two-body problem, orbital elements, hyperbolic flyby, restricted three-body problem, Hill radius).	JLM
	01/19	Protoplanetary disk structure (Model nebula, vertical and radial force balance, radial temperature profile of passive disks, radial dependence of model parameters).	JLM
3	01/23	Planetesimal formation (Aerodynamic drag on solid particles, dust settling and grain growth, radial drift of solid particles, gravitational instability).	JLM
	01/26	Terrestrial planet formation (pairwise accretion, gravitational focusing, dynamical friction, orderly growth, runaway growth, oligarchic growth).	JLM
4	01/30	Giant planet formation.	JLM
	02/02	**Core accretion vs. gravitational instability debate.**	
5	02/06	Nucleosynthesis, solar system abundances (elemental and isotopic).	KM
	02/09	Isotope systematics, fractionation, anomalies. Oxygen isotopes.	KM
6	02/13	Meteorite props and classification; Condensation, CAIs, chondrules.	JW
	02/16	Chronology, age of the solar system, short-lived radioactivity (abundances and sources)	KM
7	02/20	Timescales of CAI, chondrule formation, accretion and core formation.	KM
	02/23	Exoplanet search techniques, census and statistical properties.	JLM
8	02/27	Dynamical evolution of planetary systems (Pert. theory, secular evolution).	JLM
	03/01	Dynamical evolution of planetary systems (Resonances).	JLM
9	03/05	Dynamical evolution of planetary systems (Migration, stability, chaos).	JLM
	03/08	**Nice model debate.**	
10	03/12	Student presentations	
	03/15	Student presentations	

Useful references:

Astrophysics of Planet Formation, Philip Armitage, Cambridge Univ. Press, 2010
Accretion Processes in Star Formation, Lee Hartman, Cambridge Univ. Press, 2008
Physics and Chemistry of the Solar System, 2nd Edition, J. S. Lewis, 2004
Treatise on Geochemistry, Vol. 1 – Meteorites, Comets, and Planets, ed. A. Davis, 2004
Meteorites, a petrologic-chemical synthesis, Robert T. Dodd. 1981
Meteorites, a petrologic, chemical and isotopic synthesis, Robert Hutchinson 2004
Meteorites: Their Record of Early Solar-system History, John Wasson, 1985
Chondrites and the protoplanetary disk, Astronomical Society of the Pacific, 2005
Chondrules and the protoplanetary disk, Cambridge Univ. Press, 1996
Protostars and Planets V, U. of Arizona Press, 2007
Protostars and Planets IV, U. of Arizona Press, 2000
Protostars and Planets III, U. of Arizona Press, 1993
Meteorites and the Early Solar System, U. of Arizona Press, 1988
Meteorites and the Early Solar System II, U. of Arizona Press, 2006