



# ASTR340: *The Origin of the Universe*

**Prof. Massimo Ricotti**

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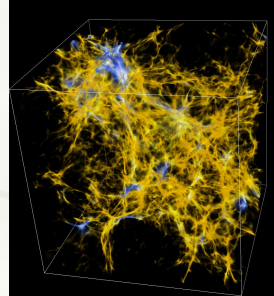
Office hours: 3:30-4:30pm Thurs

TA: KwangHo Park

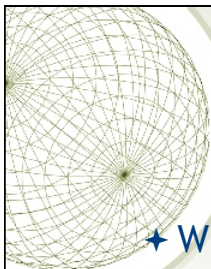
Email: kpark@astro.umd.edu

Room: CSS 0224 Phone: 301-405-1534

Office hours: 10am-11am Wed

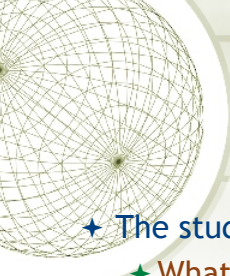


**NO OPEN LAPTOPS DURING LECTURES**



## Welcome!


- ✦ What is this course about?
- ✦ Logistics
  - ✦ Textbook, web pages
  - ✦ Pre-requisites
  - ✦ Assignments, exams, grading
  - ✦ Academic integrity
  - ✦ Semester plan
- ✦ Introductory Discussion



# Cosmology

- ✦ The study of the Universe as a whole
  - ✦ What does the present-day Universe look like?
  - ✦ What was the history of the Universe?
  - ✦ What is the future of the Universe?
  - ✦ What make the whole thing “tick” ?
- ✦ These are clearly **big questions!**
- ✦ **Cosmogony** = an explanation of the origin and evolution of the Universe
- ✦ **Cosmology** =the **scientific** study of the formation, structure, and evolution of the Universe

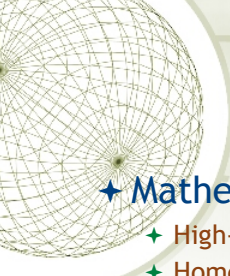
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# Textbook & web pages

- ✦ Required text: *Foundations of Modern Cosmology* (2nd edition) by Hawley & Holcomb
- ✦ Authors' web page:  
<http://www.astro.virginia.edu/~jh8h/Foundations>
- ✦ Course web page:  
[http://www.astro.umd.edu/~ricotti/NEWWEB/teaching/ASTR340\\_11.html](http://www.astro.umd.edu/~ricotti/NEWWEB/teaching/ASTR340_11.html)
  - ✦ Information, syllabus, lecture schedule
  - ✦ Assignments
  - ✦ Past lectures

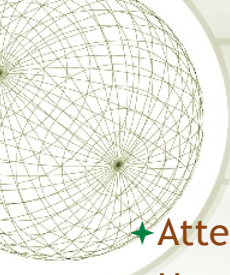
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## Pre-requisites

- ✦ **Mathematics**
  - ✦ High-school algebra and geometry but...
  - ✦ Homework and exams involve problem solving skills: why?
- ✦ **Familiarity with astronomy at ASTR100 level**
  - ✦ Course will be fairly self-contained
  - ✦ I will use basic astronomy terms freely (e.g. star, planet, galaxy), and will cover some topics quickly
  - ✦ Consult chapters 4 and 5 of the textbook for review/ refresher, as needed
  - ✦ Please ask about anything when you are unsure!

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## Assignments & Grading

- ✦ Attendance and participation: 10%
- ✦ Homework: 40%
- ✦ Midterm : 20%
- ✦ Final : 30%
- ✦ TOTAL : 100%

✦ **Note: No “extra-credit projects”**

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## Letter grades

### ★ Grading by:

Letter grade	Percentage
A	85-100
B	70-84
C	55-69
D	40-54
F	0-39

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## Exams

- ★ Mid-term, in class Thursday March 17
- ★ Final exam, 10:30-12:30 May 16 (Monday morning)
- ★ In event of a REAL EMERGENCY which forces you to miss an exam
  - ✦ Contact me prior to the exam
  - ✦ Document the emergency

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## Homework

- ★ Homework assigned approx. once every two weeks
- ★ HW is collected *at the start of class* on the due date (a week later)
  - ✦ Please hand in on time, or document the valid reason why it is late.
  - ✦ No credit after the day on which it is due.

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## Academic integrity

- ★ **Always:**
  - ✦ Present your own thoughts in your own words
  - ✦ Cite any references that you use
- ★ **Never:**
  - ✦ Copy from another student
  - ✦ Directly quote any published article unless you also give full credit to that article.
  - ✦ Allow other students to copy from you.
- ★ Per campus policy, please write the honor pledge on each assignment

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## Topics to cover

- ✦ Early history of cosmology
- ✦ The laws that govern the Universe
  - ✦ Newton's laws of motion and gravitation
  - ✦ Einstein's Theory of Relativity
- ✦ Observations of the Universe
  - ✦ The universe is expanding!
  - ✦ What does the future hold?
- ✦ The Big Bang Theory
  - ✦ What is it...
  - ✦ ... and why do we think its right?
- ✦ Physics of the very early universe

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## Discussion: myth and science in cosmogony

Throughout history, all cultures have sought to make the Cosmos intelligible, imposing order and addressing timeless questions:

- ✦ Have the heavens and Earth existed forever?
- ✦ Is the Universe unendingly large?
- ✦ If not, how did it all begin?
- ✦ Will the Universe come to an end?
- ✦ How did humans come about, and what is their role in the Universe?
- ✦ *What are your "big" questions? What would you like to cover/discuss in this class?*

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COSMOLOGY MARCHES ON



## Creation myths

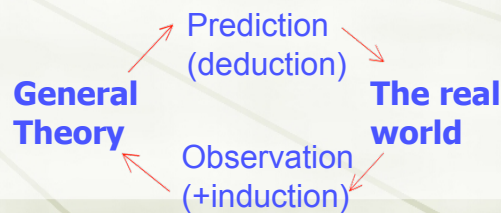
- ★ Myths may be meant literally or figuratively
- ★ Mythology reflects what is important to a culture, e.g.
  - ✦ revolve around seasons, planting & harvesting for agricultural societies
  - ✦ involve animals with human characteristics for hunter-gathering peoples
- ★ Creation myths share common themes
  - ✦ Use similar imagery to describe origins/formation of the Universe: e.g creation from seed/egg; supreme craftsman; order from chaos
  - ✦ Use past events to explain aspects of the human condition
  - ✦ Involve catastrophes and supernatural occurrences
  - ✦ Establish relationships among animals, humans, gods
  - ✦ Assert the centrality of humans to the Cosmos

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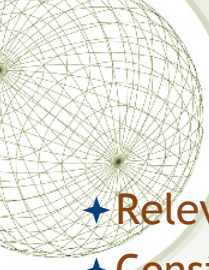
## Scientific cosmology

- ★ Non-anthropocentric narrative
- ★ Is based on concept of causality, but not purpose
- ★ Derives from **data** = objective (reproducible), quantitative observations of the physical world
- ★ Models/theories are continually re-evaluated based on the *scientific method*
- ★ To be scientific, *a theory must be falsifiable* : whole or part may be rejected based on new data
- ★ New data can **support** an existing theory, but **cannot prove it**



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## The scientific method

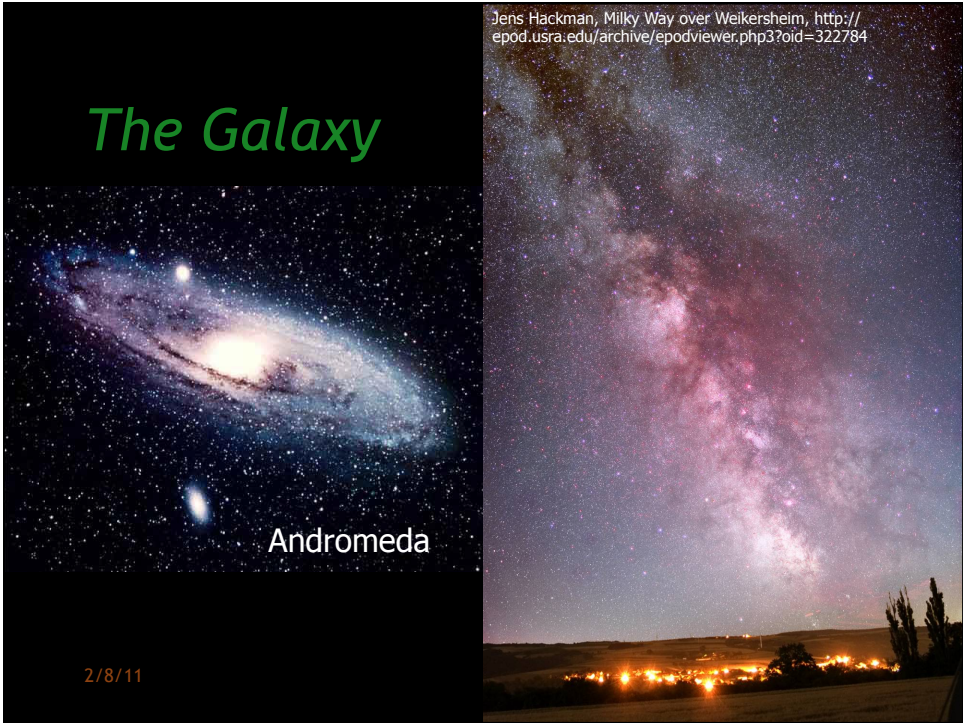
- ★ Relevant (explanatory power)
- ★ Consistent
- ★ Predictive (qualitative and quantitative)
- ★ Testable (falsifiable)
- ★ Simple (Occam's razor)

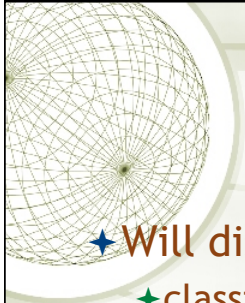
A hypothesis that survives significant tests of many of its predictions can become a *theory*, and perhaps even a *law*.

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## Next Time...

- ★ Will discuss
  - ✦ classical (geocentric) model of the Universe
  - ✦ observations and ideas of the Renaissance
- ★ *Please read Chapter 1 of the book*
- ★ *Read Chapter 2 next week*
- ★ First HW assigned Thursday next week

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