

Astronomy 311

- Instructor: **Greg Arkos**
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- Office Hours: **T, R 11:30-1:00pm**
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Course Info

- **read course outline**, *especially dates, etc.*

Notes, Quizzes

- **notes** posted *online* ahead of time; *incomplete*
- any *deferment* requests **require** documentation

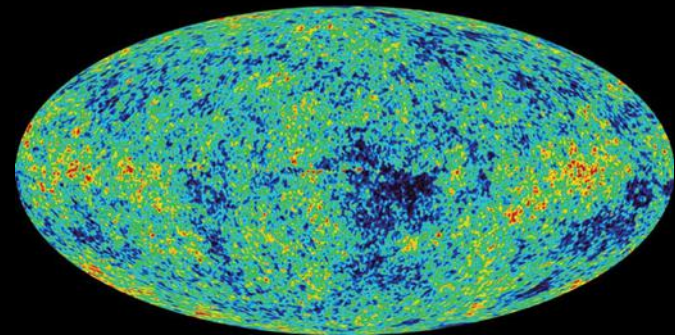
Group Presentation

- **group (3) presentations** *in class* starting **Apr 2**
- **proposals** due on **Thurs, Jan 31**
- **rubric** & **guidelines** are on the *website*

Doing well

- **come to class** & **participate** (*active learning*)
- put in a solid effort on the **presentation (25%)**
- **study** & **keep up** with material; see me with *Q's*

ASTR 311: *Exploring the Universe*



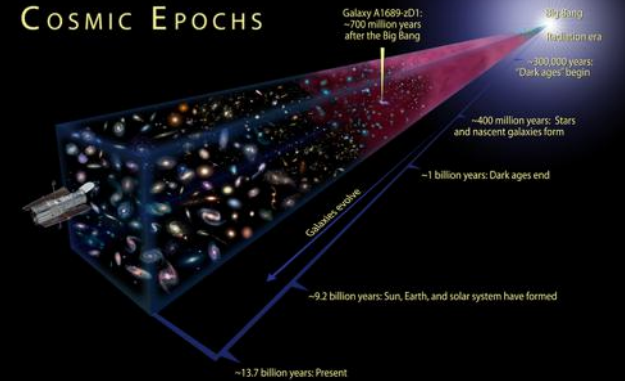
Course Overview



- Introduction
- Big Bang & Cosmology
- Our Strange Universe
- Extraterrestrial Life

Big Bang & Cosmology

Cosmic Epochs

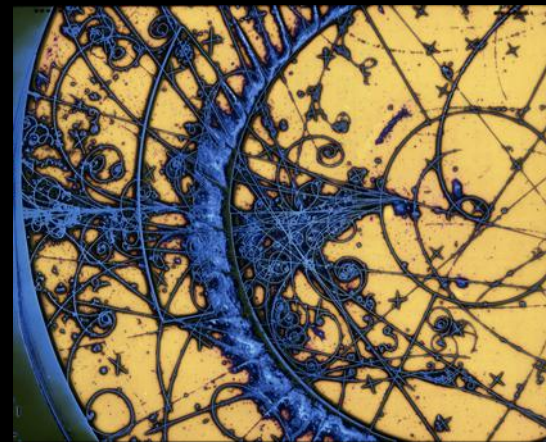


- *how did everything come to be as it is?*

Our Strange Universe



- *time & space are NOT absolute...*



- ... and the subatomic realm operates by very different rules than our everyday world

Extraterrestrial Life



- *are we alone?*

“Tatooine”: Kepler-16b



Musings...

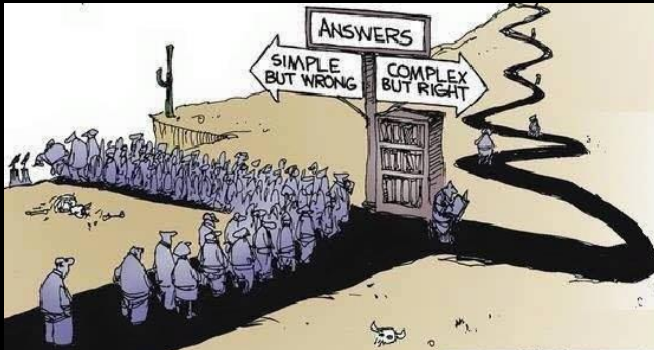
- 1) Where did “everything” come from?
- 2) What is the most likely *fate* of our universe?
- 3) Are we *alone* in the galaxy (universe)?

Q: How do you approach questions like these?!?!?

Science

- astronomy is a *science*
- *science* relies on the *scientific method*:
 - *predict* (hypothesis or model)
 - *observe* (or experiment)
 - *accept, modify* or *reject*
- *iff* ideas pass enough testing → *Law* or *Theory*

Q: Can we ever prove that an idea is 100% correct?



Astronomical Distances

- **astronomical unit** (AU) $\sim 1.5 \times 10^8$ km
- *average* distance between *centers* of Earth & Sun
- **light year** (ly) $\sim 10^{13}$ km (*ten trillion km*)
- *distance* light travels in *one year* (in a vacuum)
- **parsec** (pc) ~ 3 ly

Q: Why do we use *these* units and not *km*?

How far is it to...?

- **Moon:** $\sim 400,000$ km (~ 1 *light-s*)
- **Sun:** 1 AU (150,000,000 km; ~ 8 *light-min*)
- **Pluto:** 40 AU ($\sim 6,000,000,000$ km; ~ 5 *light-h*)
- **α Centaurii:** $\sim 250,000$ AU (40×10^{12} km; ~ 4 *ly*)
- *our galaxy* is $\sim 150,000$ ly in *diameter*

Our Cosmic Neighbourhood



- *our Sun* is an *average* star

- one of 100+ billion stars in the *Milky Way galaxy*



- to count all stars in Milky Way ~ *3000 years*

Q: Where are we within our galaxy?

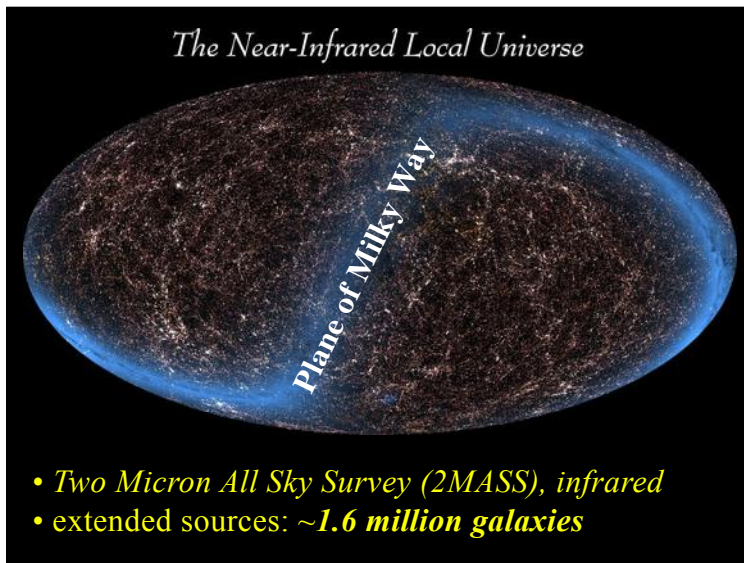


- nearest (large) galaxy: *Andromeda Galaxy (M31)*
- ~2.5 million ly away



- *galaxies* exist in groups called “*clusters*”
- *clusters* are grouped into “*superclusters*”





A Sense of Time...

*If the Universe is **14 billion years old**, and we represent the **Big Bang** to the **present** on a **12 month calendar**...*

- **Big Bang** took place **Jan 1st**
- **Milky Way** formed in **February**
- **Earth** formed **mid-August**
- **simple life** began in **September**

CLICKER: When did humans appear?

(a) **mid September**
(b) **early November**
(c) **late December**

1	2	3	4	5	6	7
8	9	10	11	12	13	14
15 Cambrian Explosion (burst of new life forms)	16	17 Emergence of first vertebrates	18 Early land plants	19	20 First four-limbed animals	21 Variety of insects begin to flourish
22	23	24 First dinosaurs appear	25 First mammalian ancestors appear	26	27 First known birds	28
29 Dinosaurs wiped out by asteroid or comet	30	31 10:15am Apes appear 9:24pm First human ancestors to walk upright 10:48pm Homo erectus appears 11:54pm Anatomically modern humans appear 11:59:45pm Invention of writing 11:59:50pm Pyramids built in Egypt 1 second before midnight: Voyage of Christopher Columbus				

- ***you** were born **a fraction of a second ago!***