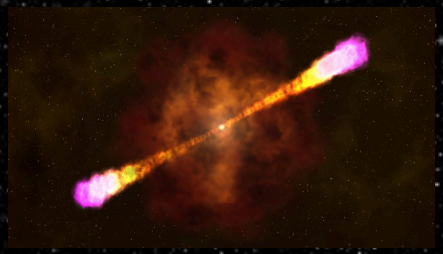

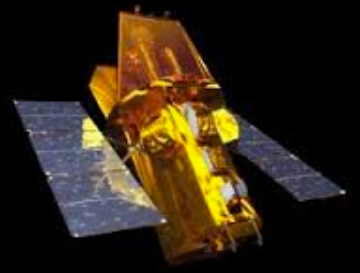

Special Projects in Astronomy: Astronomy Research Techniques

Amy Lien

Goddard Space Flight Center

ASTR 288C, Lecture 1

A little history of me

A little history of me

About the class

- Time: Monday 3:30-5:15 pm
- Instructor: Amy Lien amy.y.lien@nasa.gov
- Location: ATL 0224
- Course webpage:
  http://userpages.umbc.edu/~alien/ASTR_288C/Index.html
  - Class info including lecture note and homework.
  - Updated frequently
- Office Hours: Monday 2:15 – 3:15 pm
  - Option for alternative office hour:
    http://doodle.com/poll/mrfqbp259sraqsyq (Multiple choices)
- Textbook: None
- Exam: None!
  →Written and oral presentation on research project
- Your feedback during the semester is not only encouraged, it's important!

About the class

- The first step into research
  - Research method
  - Research technique
    - Unix, programming, statistics, common astronomy tools…
  - Problem solving
  - Presentation (written and oral)
  - Science communication and collaboration

About the class

- **Lectures:**
  - introduce basic concepts, and present examples, often from our own research experience
- **Labs:**
  - illustrate these with hands-on applications
- **Homework:**
  - address the material in more depth and detail
- **Research project:**
  - put it all together by carrying out a project from the analysis stage all the way through the presentation of results.

Student evaluation

- Grades:
  - Lab/participation – 15%
  - Homework – 45%
  - Research project – 40% (paper 20%, presentation 20%)
- Lab/participation
  - **No more than one unjustified absence is permitted.**
  - Finish worksheet during the lab.
    - If running out of time, inform the instructor during lab and turn in at the beginning of the next class.
    - If absence from class, complete and turn in worksheet at the beginning of the next class.
- Homework
  - Due at 3:30 pm on Monday (beginning of class).
  - Late homework will be accepted within one week after the original due date, but the grade will be decreased by 50%.
  - Lowest homework grade will be dropped.

Research Project

- Proposal
  - Choose from a list of possible topics
  - Find your own topic
  - ~ 2 pages
- Paper
  - Draft →referee report
  - Final paper
  - ~ 5 pages
- Oral presentation
  - Final week
  - ~ 10 min

Week	Lecture	Lab
1	Introduction and overview	Unix environment
3	Stellar explosion	Literature search
4	Gamma-ray bursts	Latex
5	The research process	Proposal discussion
6	Gamma-ray and X-ray astronomy	BAT and XRT database
7	Simulation and programming I	Python I
8	Simulation and programming II	Python II
9	Statistical analysis	Likelihood analysis
10	Temporal analysis	Burst duration and light curve
11	Spectral analysis	Making spectrum
12	Spectral modelling	Spectral fitting
13	Scientific proposal	Student proposal
14	Science communication	Project discussion
15	Dedicated time for research projects	Individual research
16	Dedicated time for research projects	Individual research
17	Oral presentation	

*Schedule may subject to minor revision based on class progress

Week	Lecture	Lab
1	Introduction and overview	Unix environment
3	Stellar explosion	Literature search
4	Gamma-ray bursts	Latex
5	The research process	Proposal discussion (Proposal draft)
6	Gamma-ray and X-ray astronomy	BAT and XRT database
7	Simulation and programming I	Python I
8	Simulation and programming II	Python II
9	Statistical analysis	Likelihood analysis
10	Temporal analysis	Burst duration and light curve
11	Spectral analysis	Making spectrum (Final proposal)
12	Spectral modelling	Spectral fitting
13	Scientific proposal	Student proposal (Project start)
14	Science communication	Project discussion
15	Dedicated time for research projects	Individual research (Paper draft)
16	Dedicated time for research projects	Individual research
17	Oral presentation	(Final paper submission)

*Schedule may subject to minor revision based on class progress

Academic Integrity

- Students must be fully familiar and comply with the University Code of Academic Integrity, as detailed at

  http://www.president.umd.edu/policies/iii100a.html
- There is a **zero tolerance** policy with respect to incidents of academic dishonesty, including cheating, fabrication, facilitation, and plagiarism.

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Definition of academic plagiarism

"Plagiarism is presenting someone else's work or ideas as your own, with or without their consent, by incorporating it into your work without full acknowledgement. All published and unpublished material, whether in manuscript, printed or electronic form, is covered under this definition. Plagiarism may be intentional or reckless, or unintentional. Under the regulations for examinations, intentional or reckless plagiarism is a disciplinary offence."

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(https://www.ox.ac.uk/students/academic/guidance/skills/plagiarism?wssl=1)

Academic Integrity

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Collaboration ✔

Plagiarism ✗

Academic Integrity

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Collaboration ✔

- Discuss with your classmates
- Help each other
- Share ideas

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Collaboration ✔

- Discuss with your classmates
- Help each other
- Share ideas

Plagiarism ✗

- Reports with exact same sentences.
- Publishing other's ideas as your own
- Using other's idea in your report without proper references/citations/ acknowledgment.

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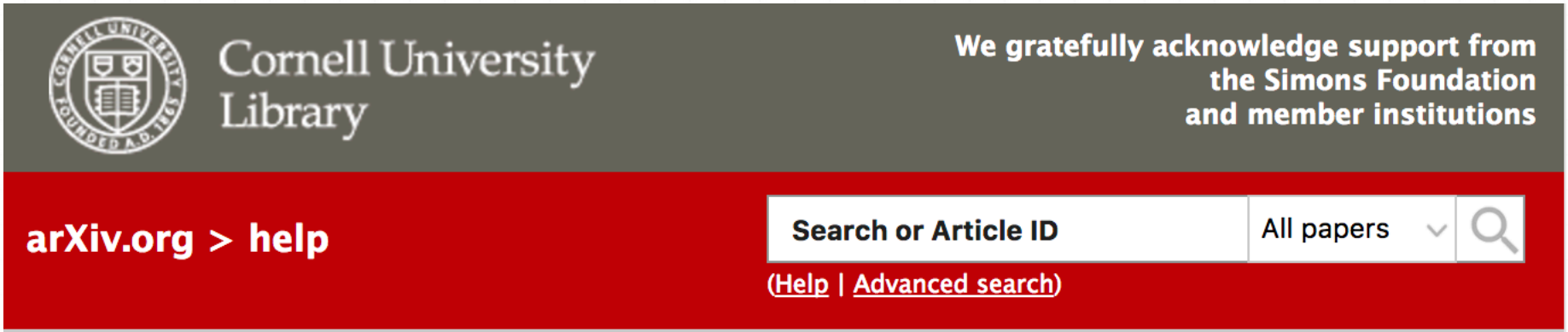
Academic Integrity



Ref: https://arxiv.org/help/overlap

About you

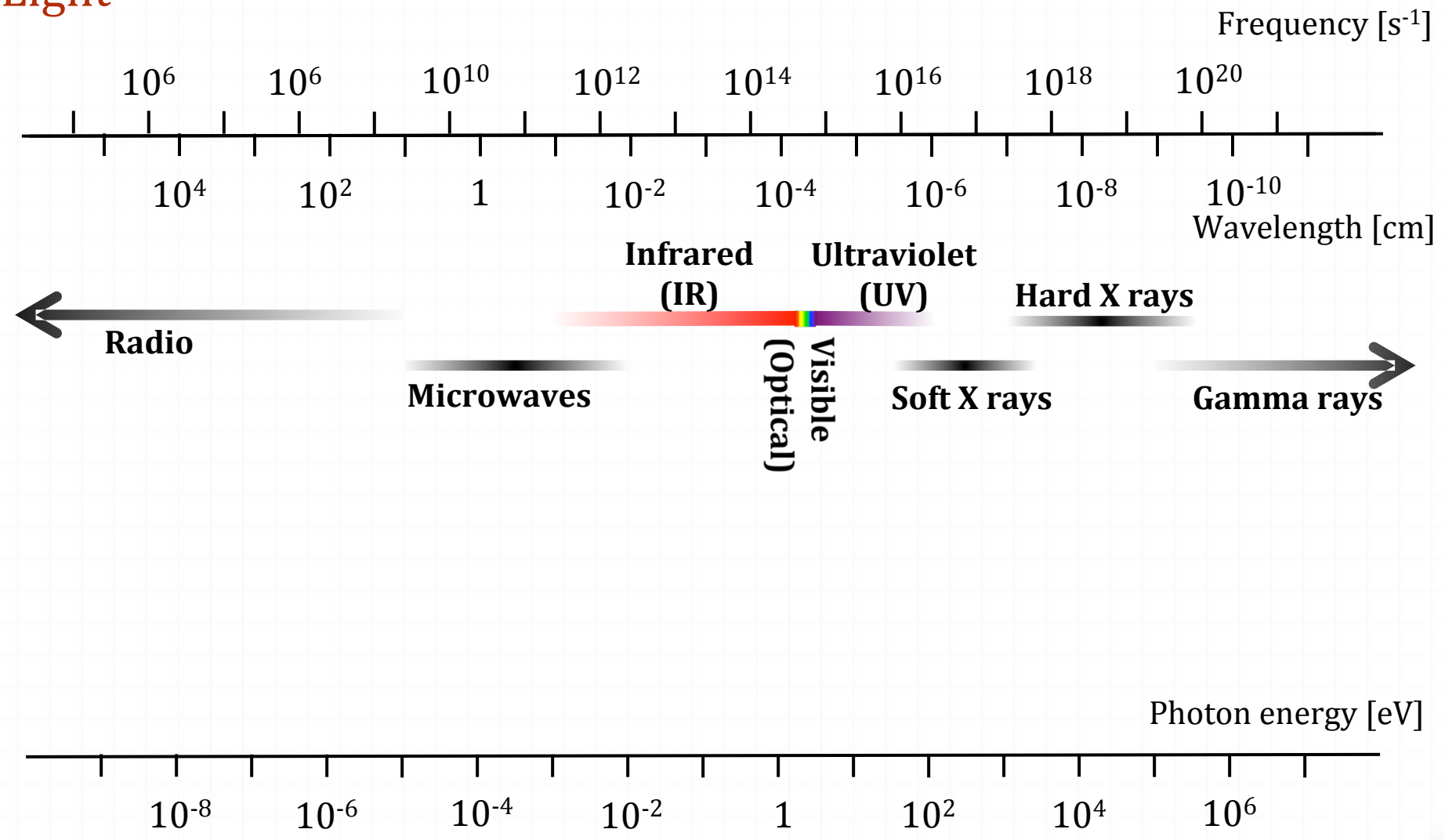
- What is your major?
- Are you a freshman, sophomore, junior, or senior?
- Why are you interested in this class?
- What astronomy classes have you taken?
- What is your programming experience?

What is astrophysics?

- Exploring mysteries in the universe
  - How the universe works?
  - How the universe begins and evolves?
  - Is there life elsewhere in the universe?

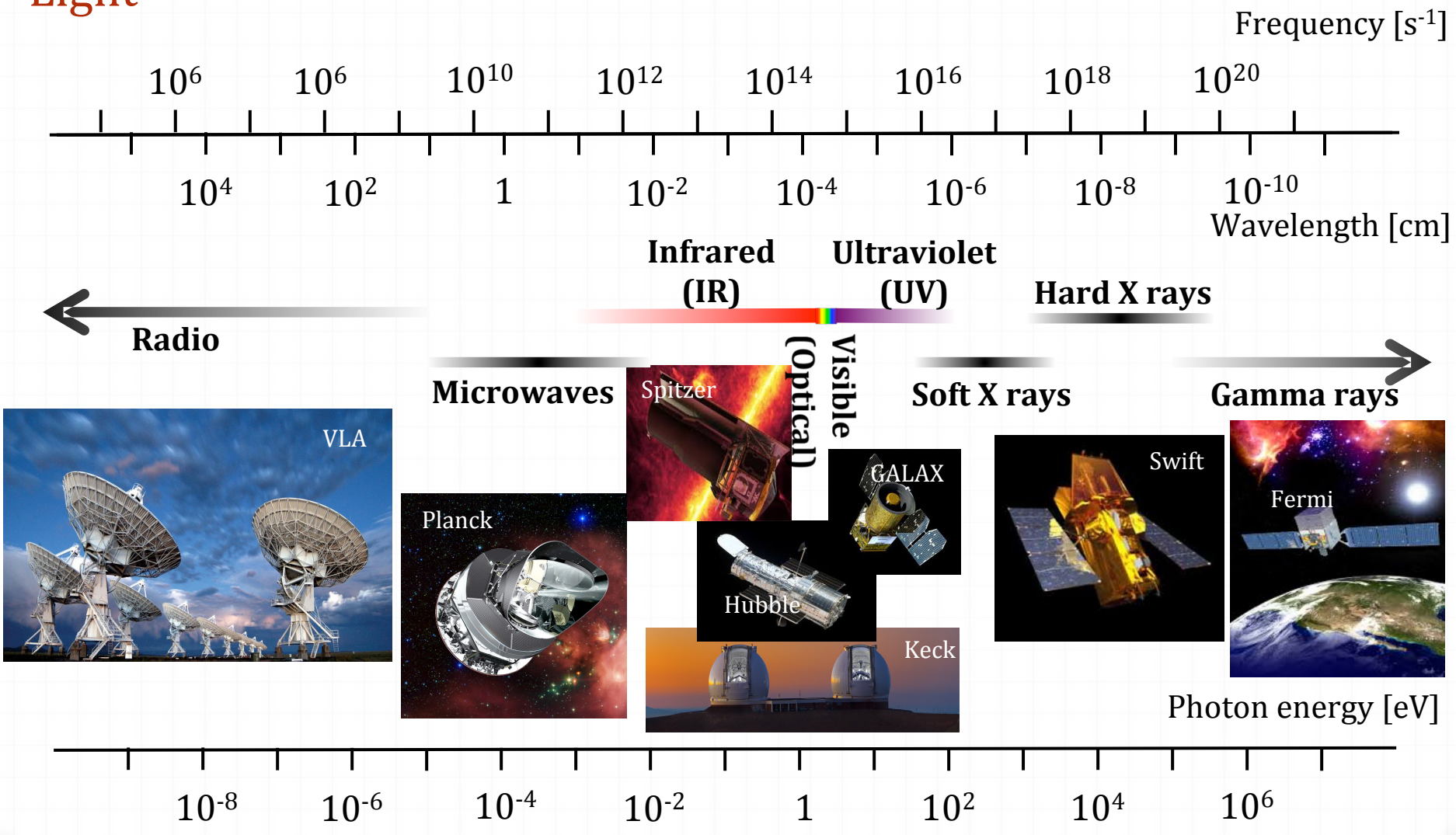
Tools to study the Universe

Light



Tools to study the Universe

Light



Tools to study the Universe

Light

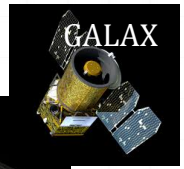
Frequency [s^{-1}]

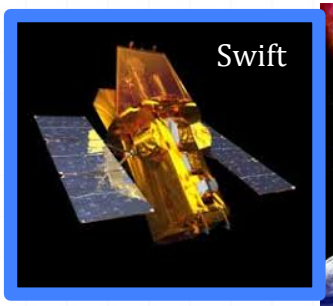
10^{6} 10^{6} 10^{10} 10^{12} 10^{14} 10^{16} 10^{18} 10^{20}

10^{4} 10^{2} 1 10^{-2} 10^{-4} 10^{-6} 10^{-8} 10^{-10}

Wavelength [cm]

Radio | **Microwaves** | **Infrared (IR)** | **Visible (Optical)** | **Ultraviolet (UV)** | **Soft X rays** | **Hard X rays** | **Gamma rays**





Photon energy [eV]

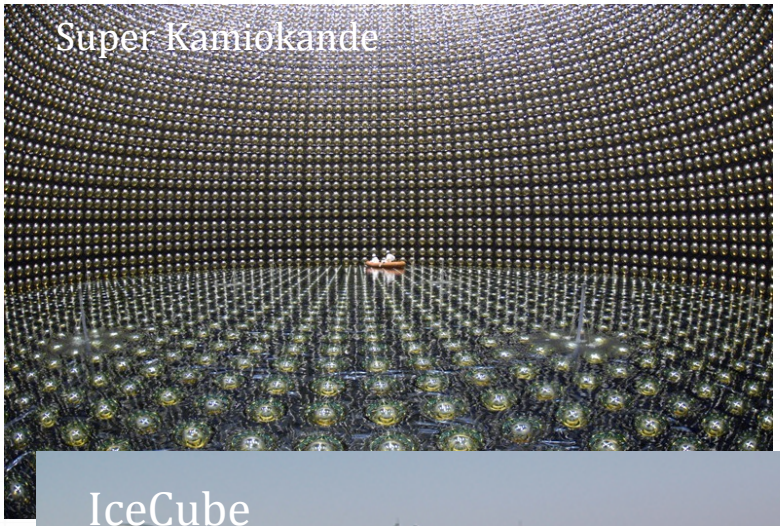
10^{-8} 10^{-6} 10^{-4} 10^{-2} 1 10^{2} 10^{4} 10^{6}

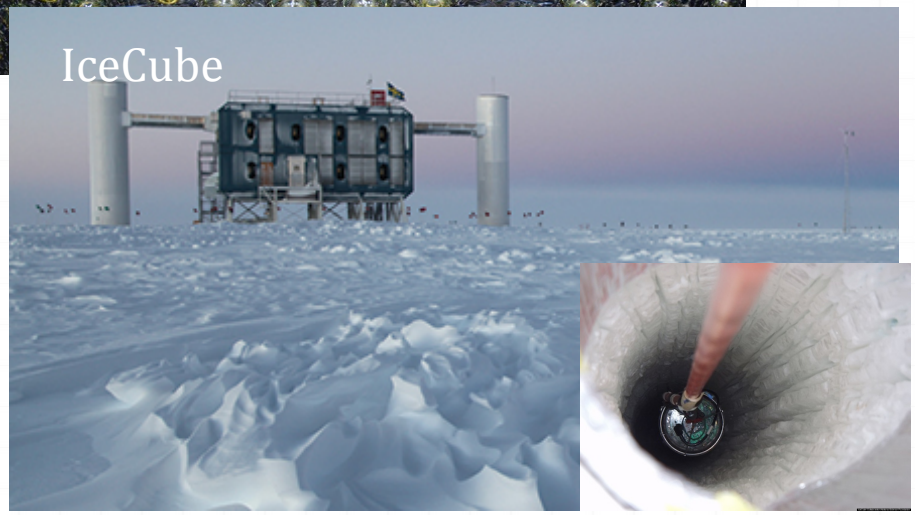
0.3 keV to 350 keV

Tools to study the Universe

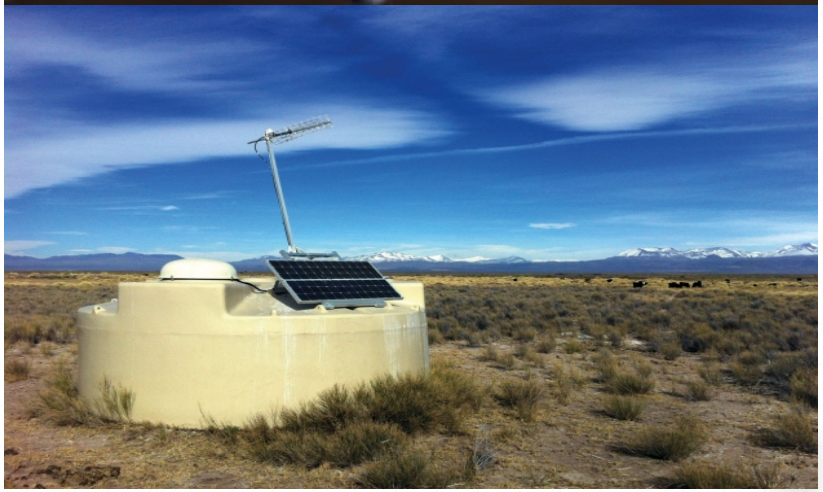
Particles

Neutrinos





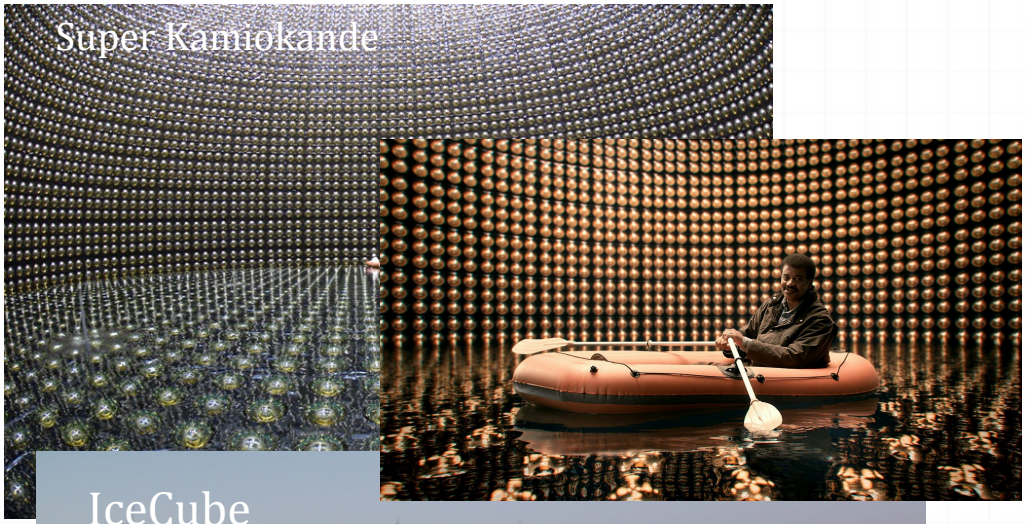
Cosmic Rays

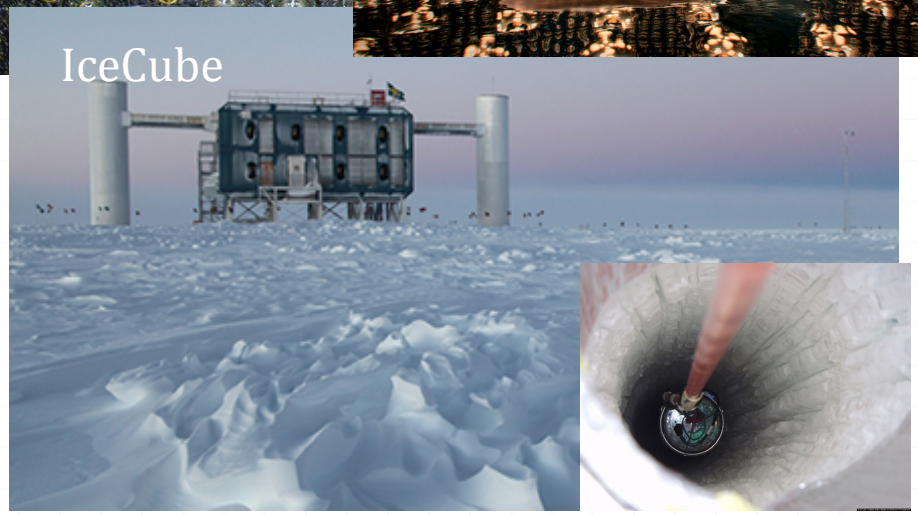


Tools to study the Universe

Particles

Neutrinos





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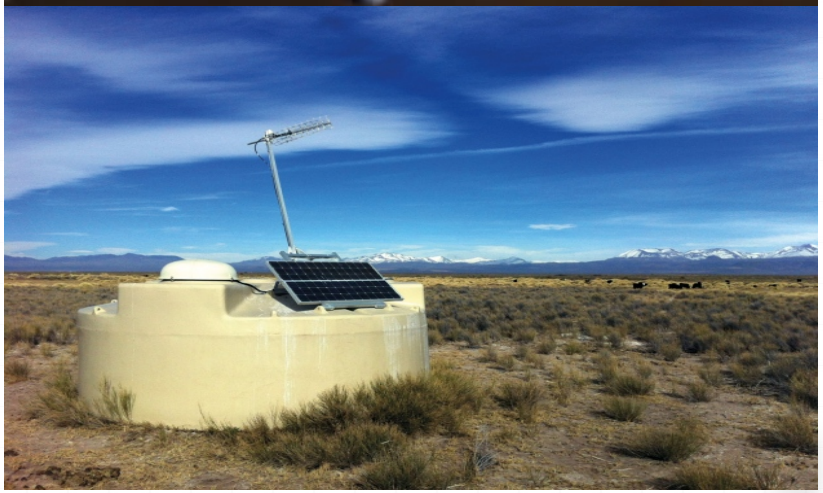

Tools to study the Universe

Particles

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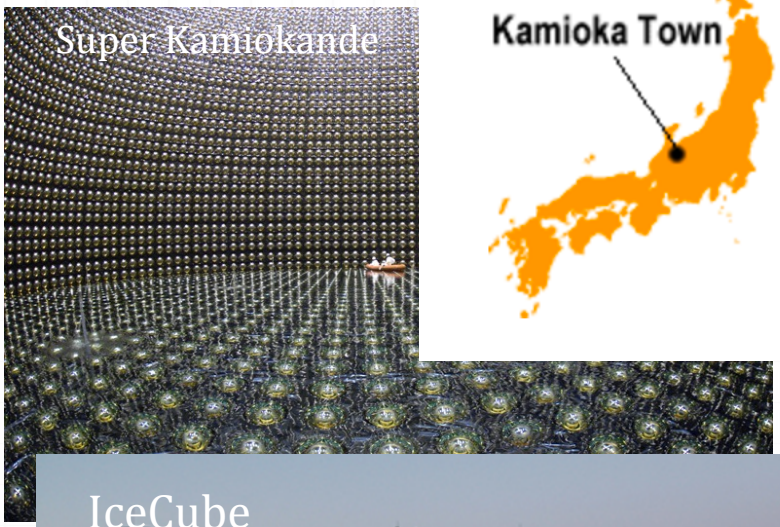
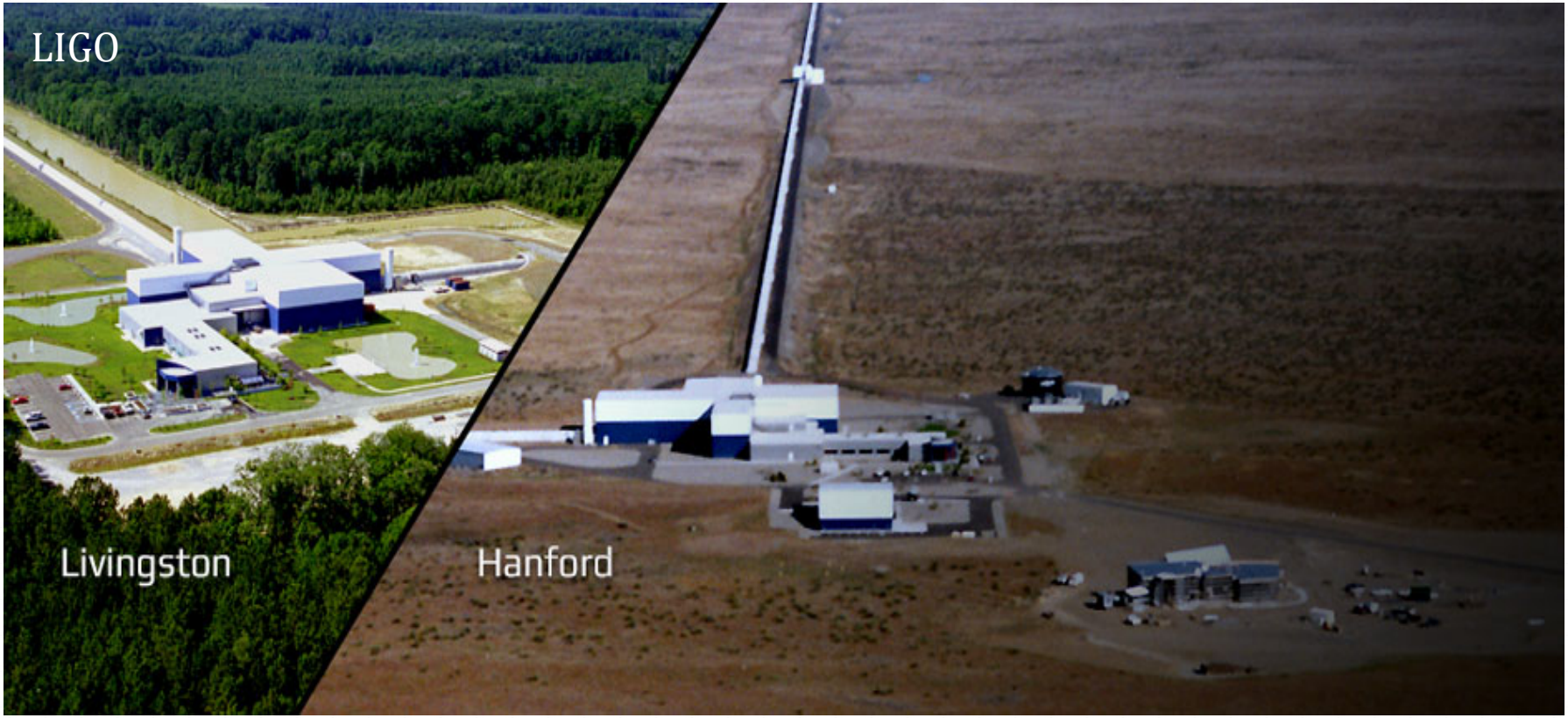


Cosmic Rays

Tools to study the Universe

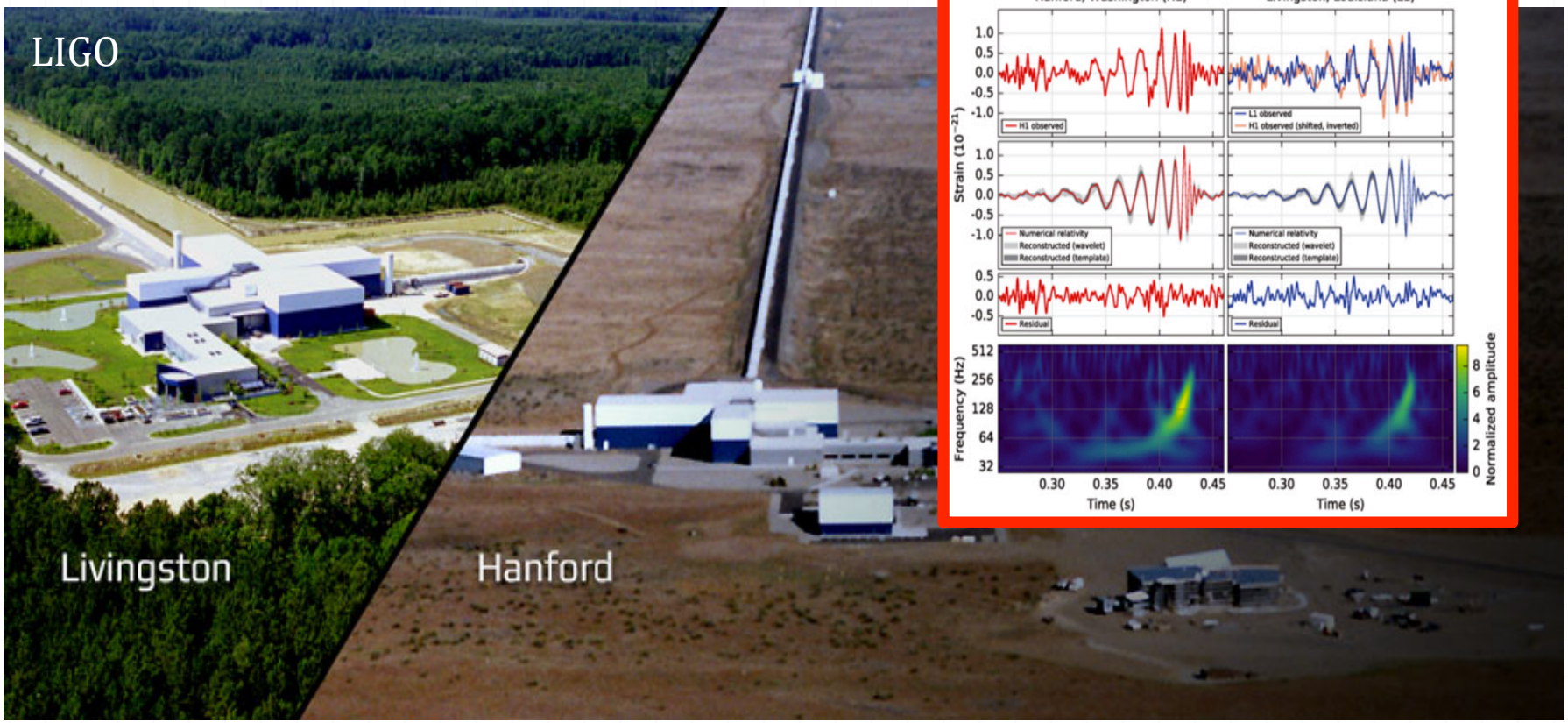
Gravitational Waves



Tools to study the Universe

Gravitational Waves

Abott et al. (2016)



Tools to study the Universe

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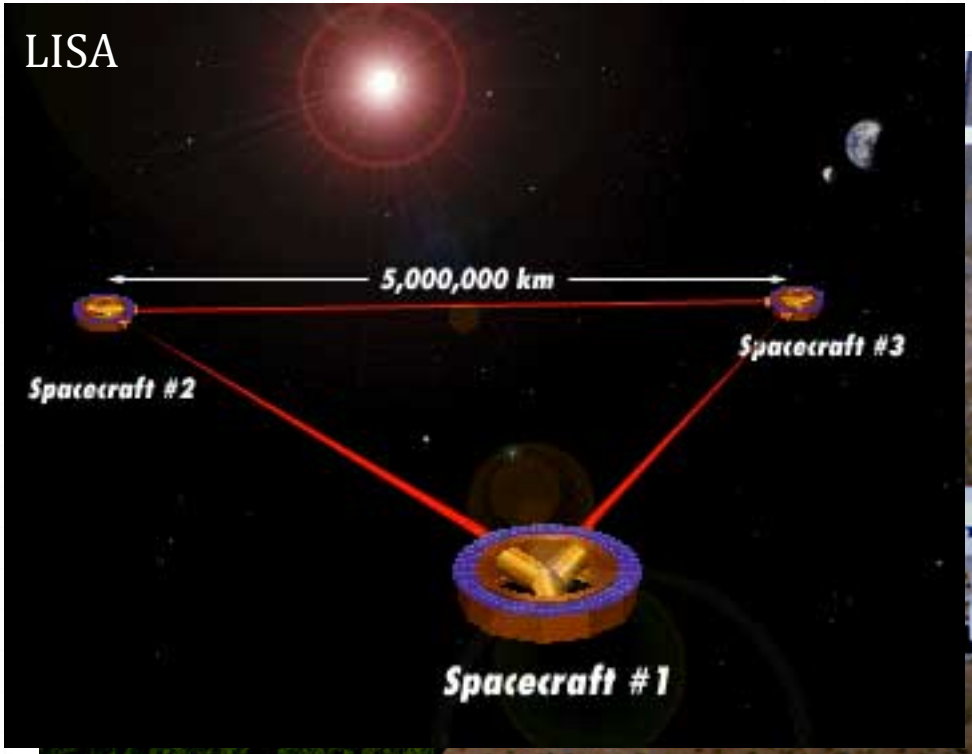

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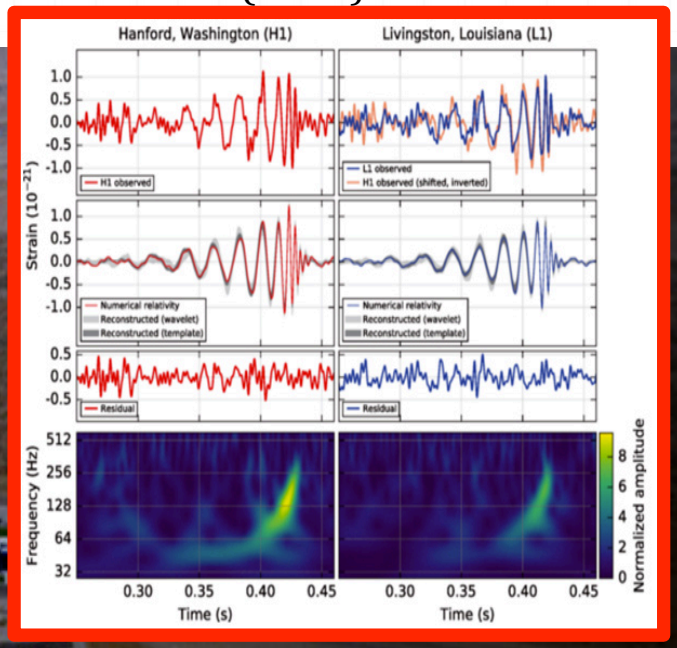
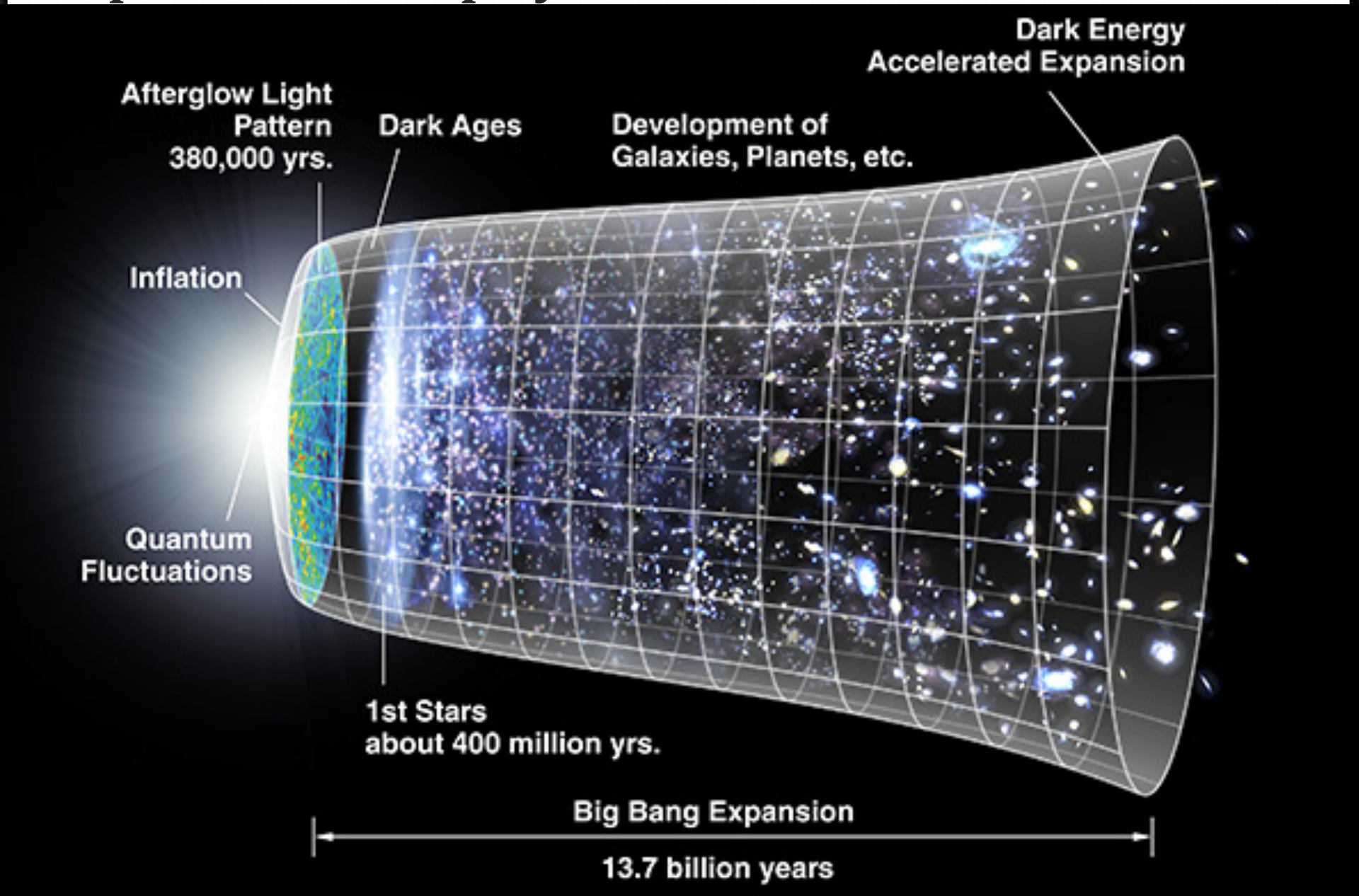


Topics in astrophysics



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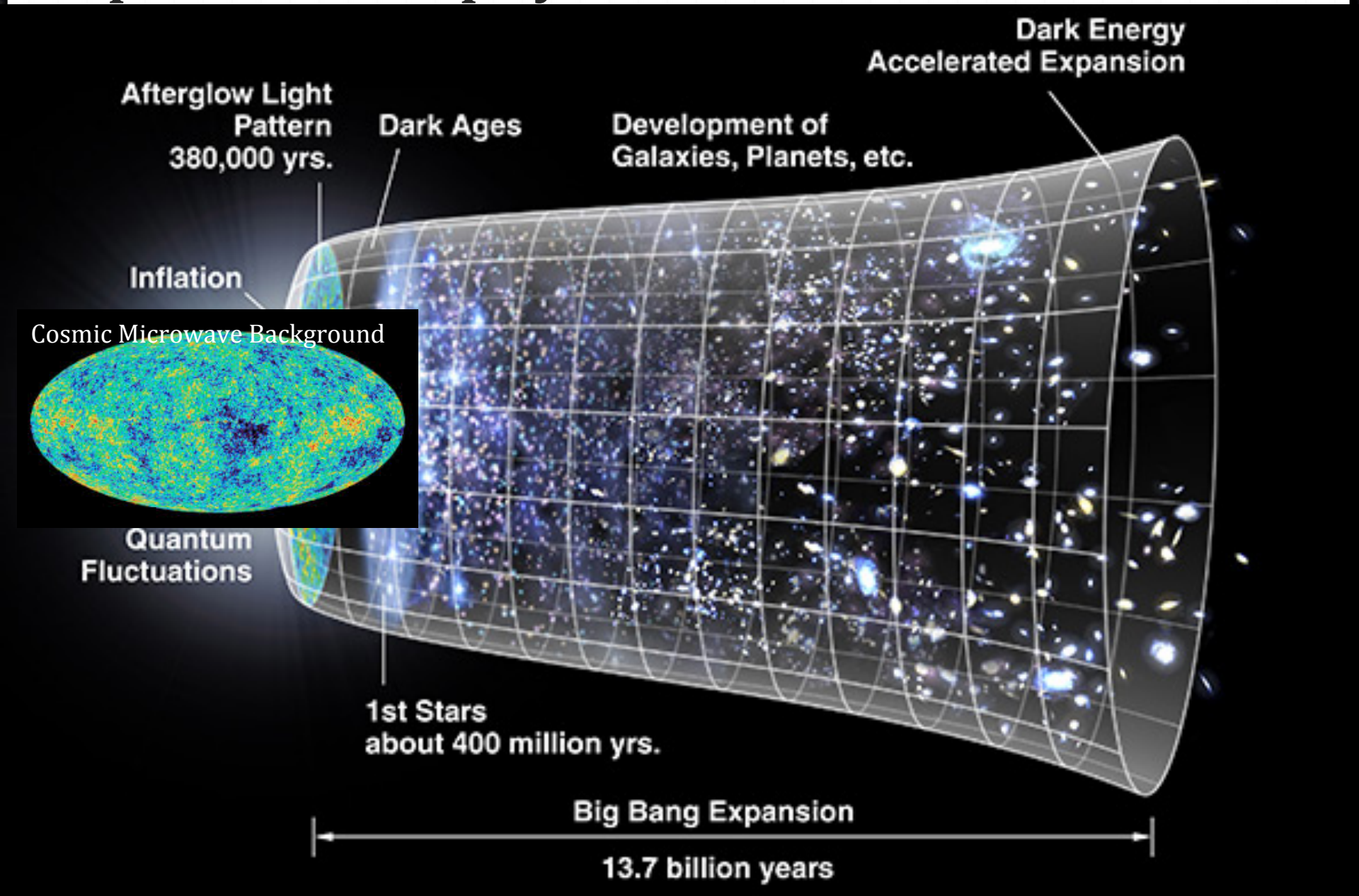

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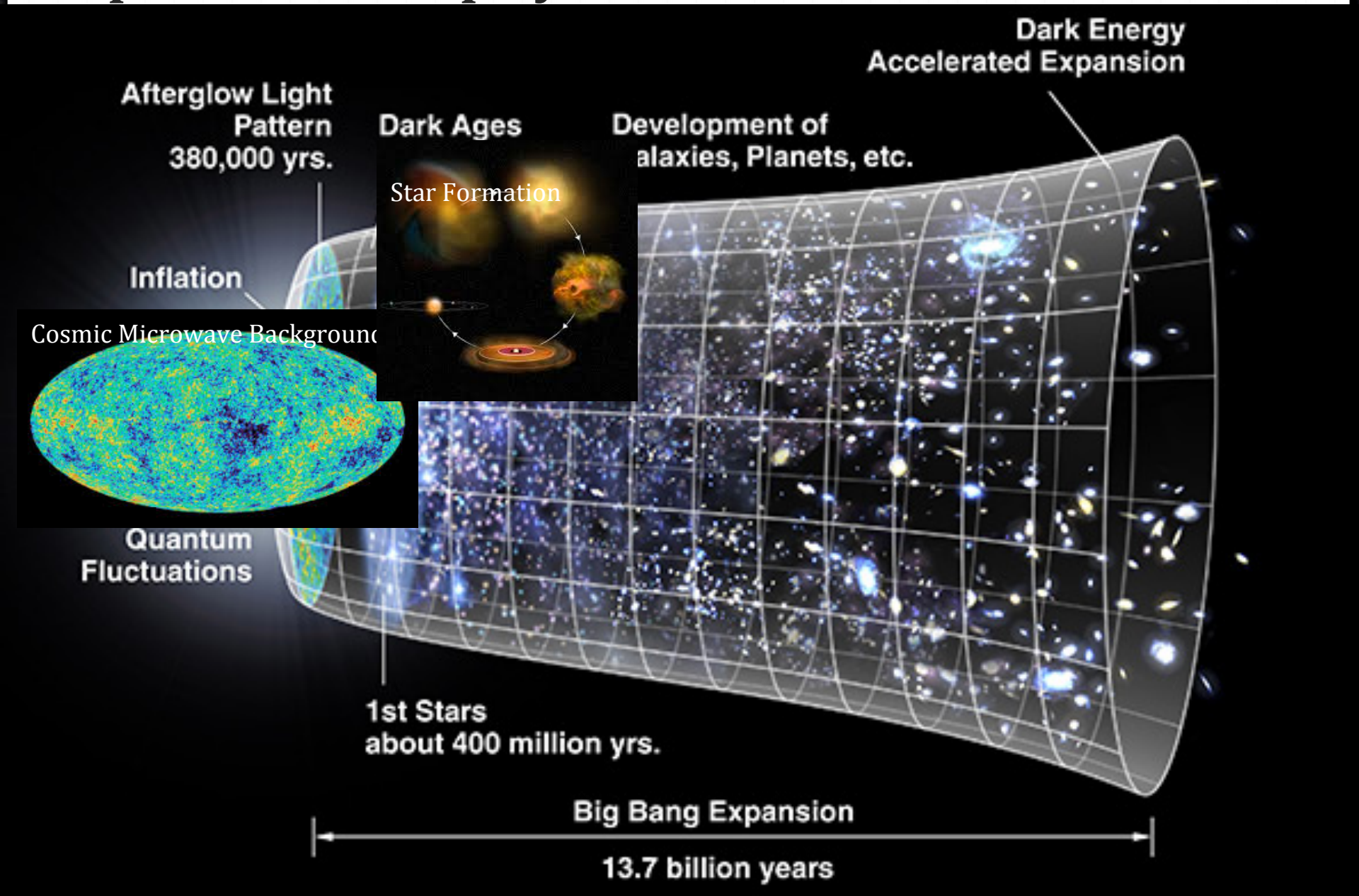

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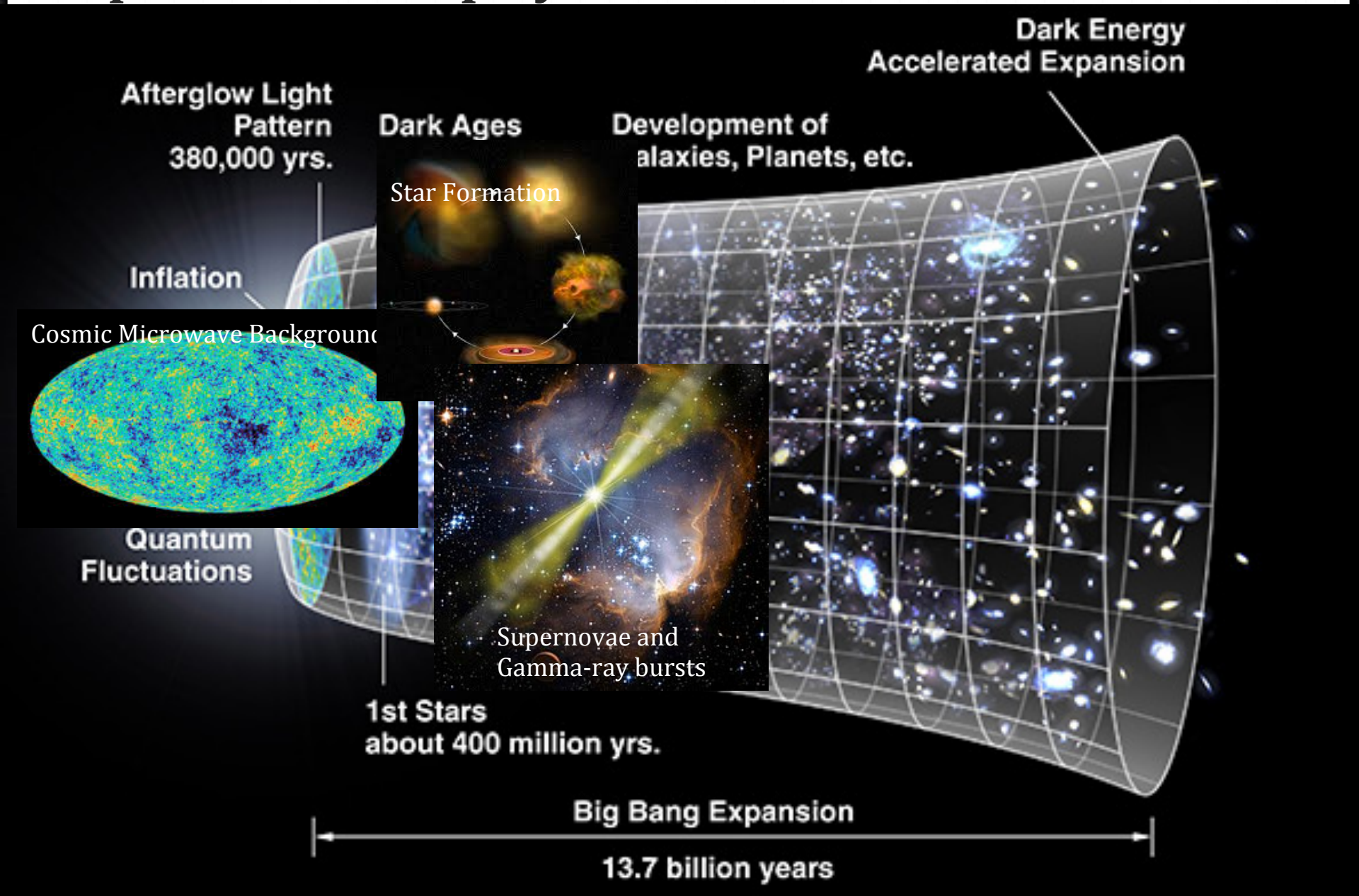

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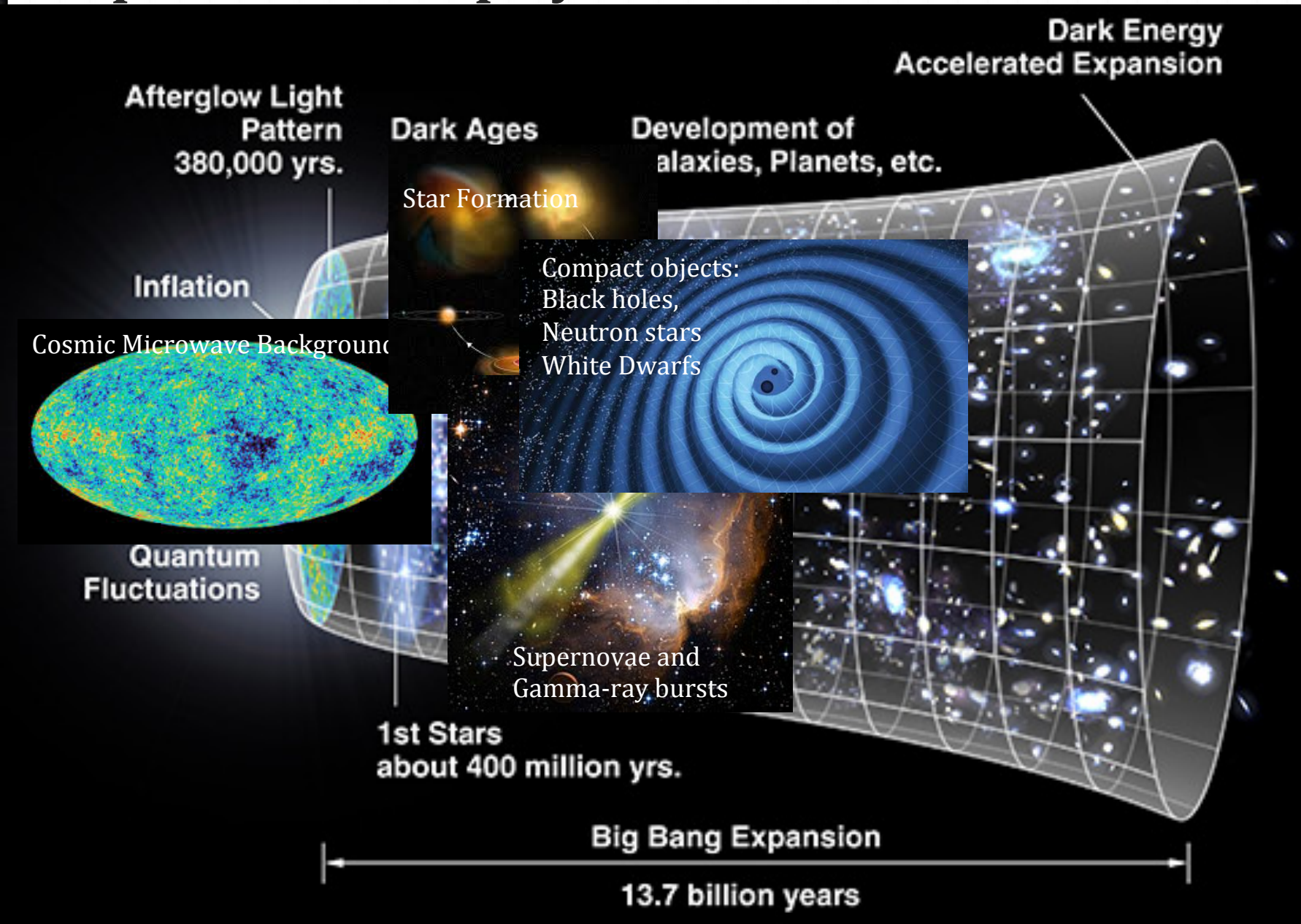

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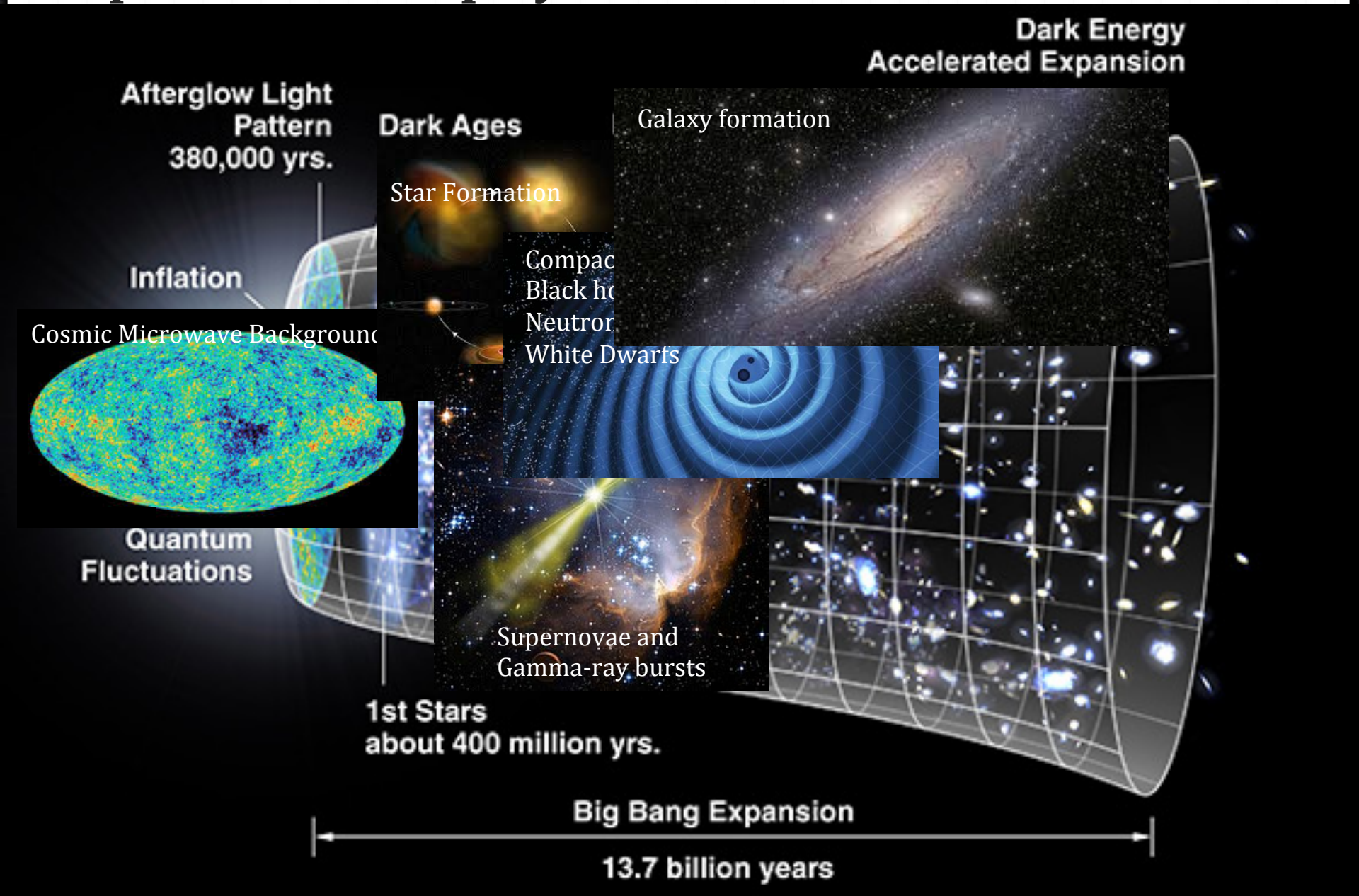

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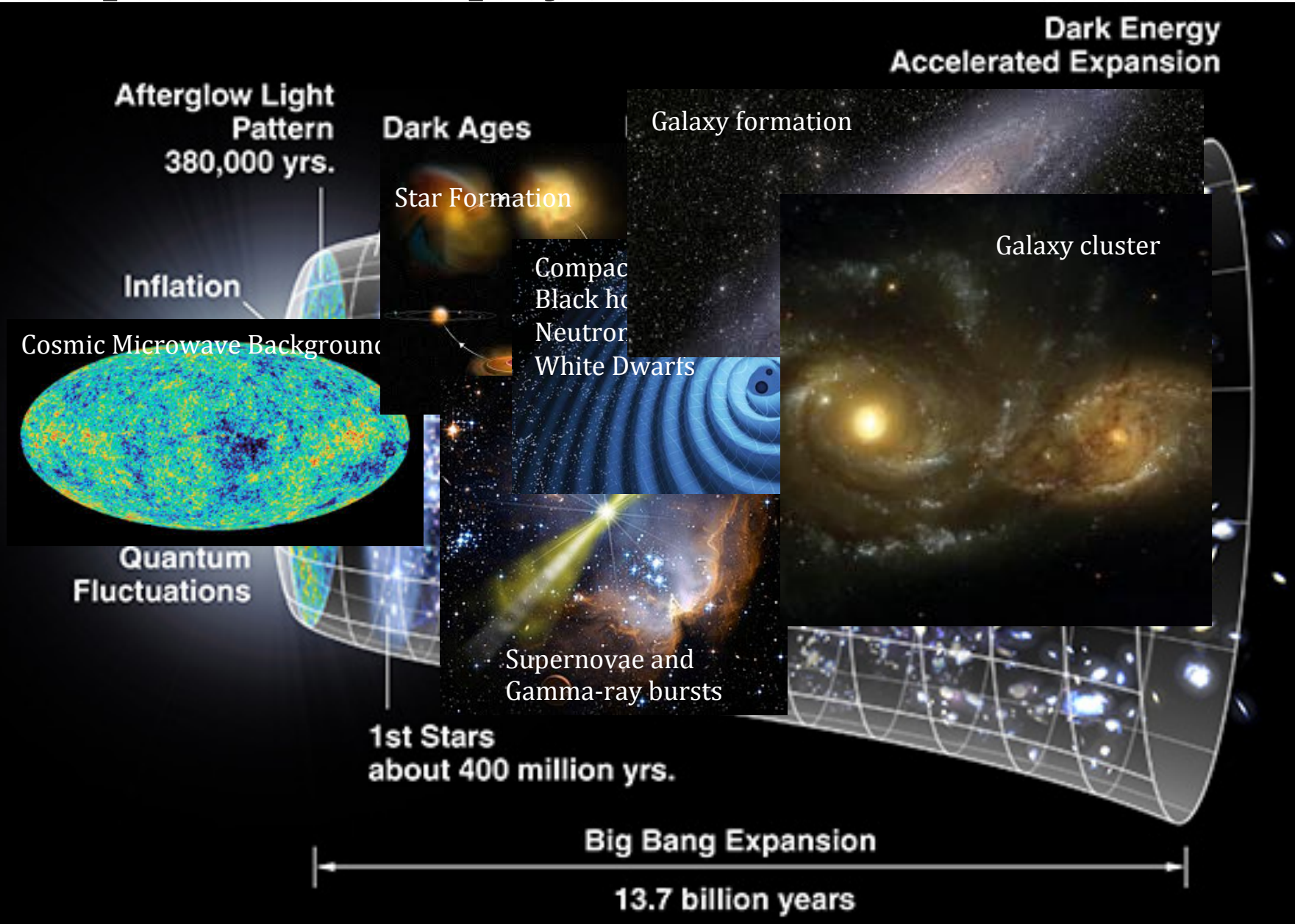

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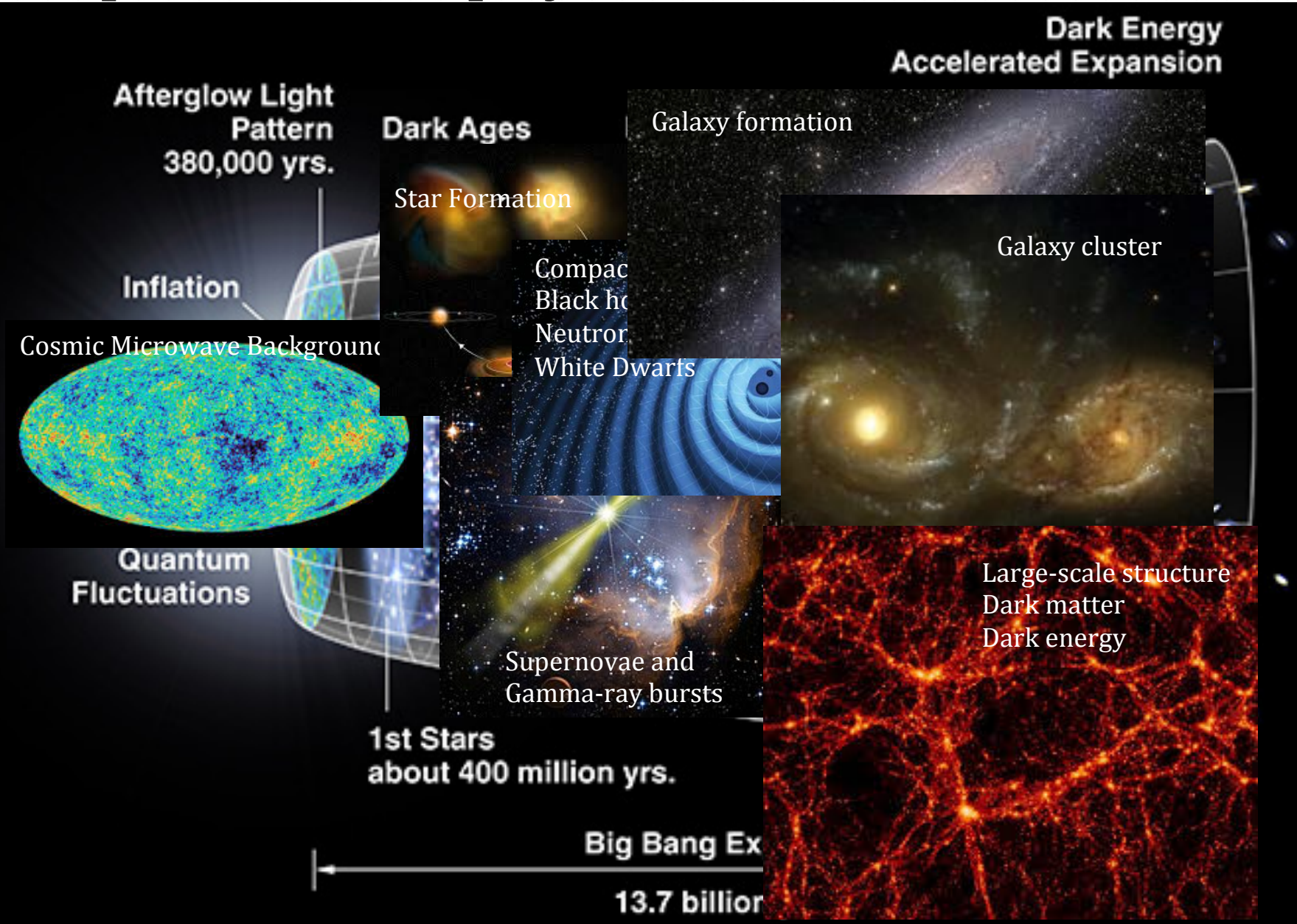

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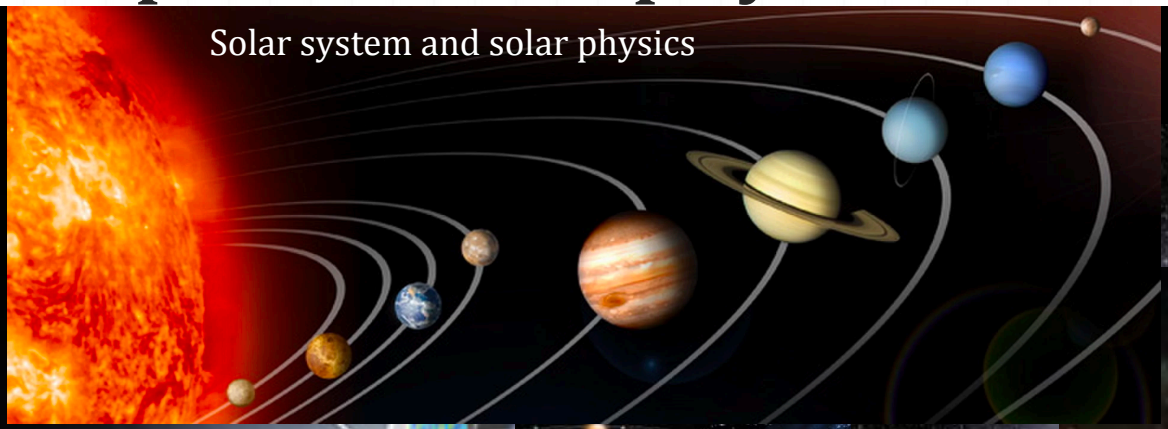

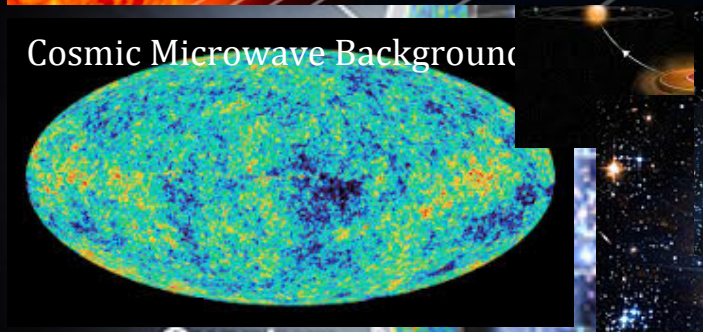

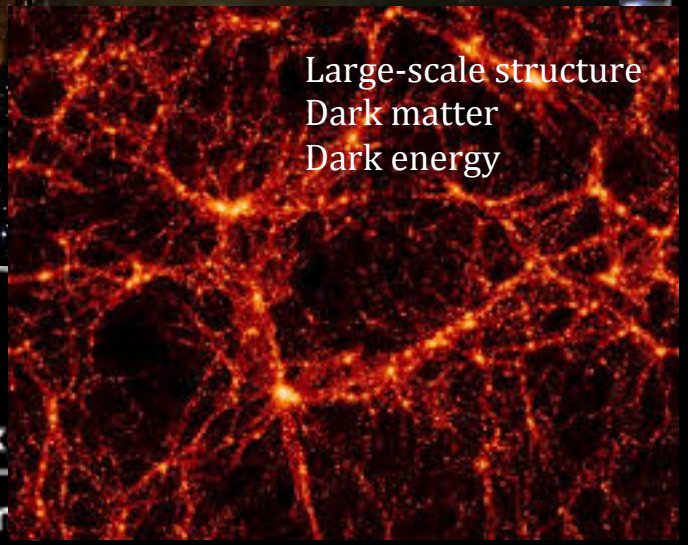

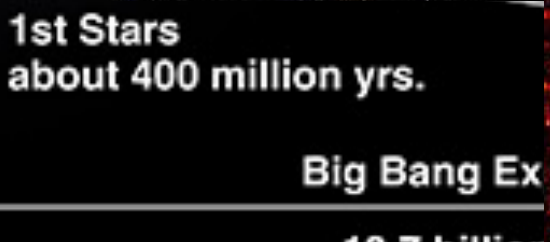

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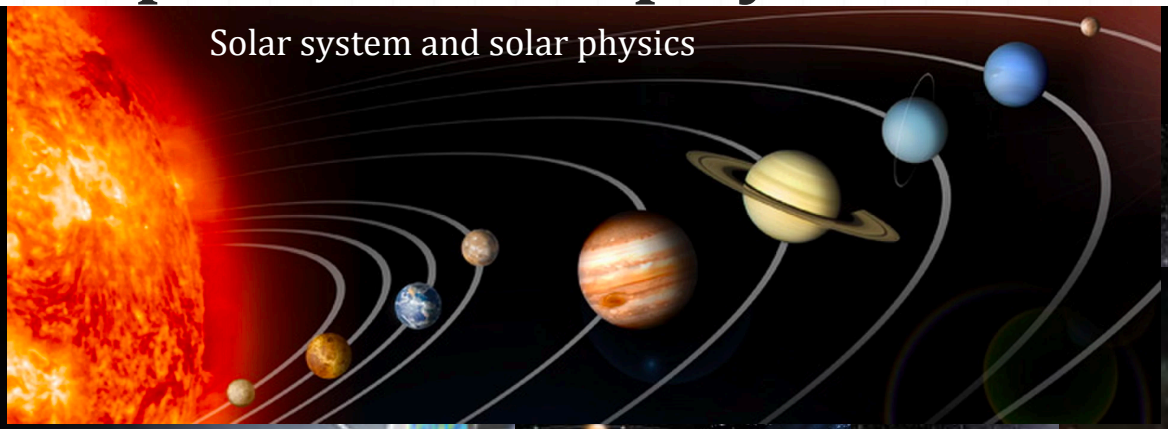

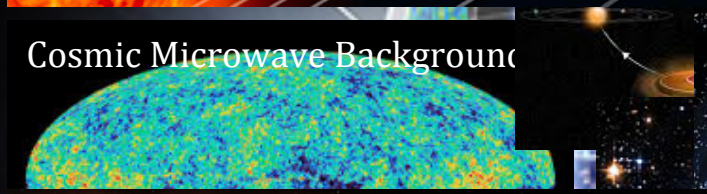

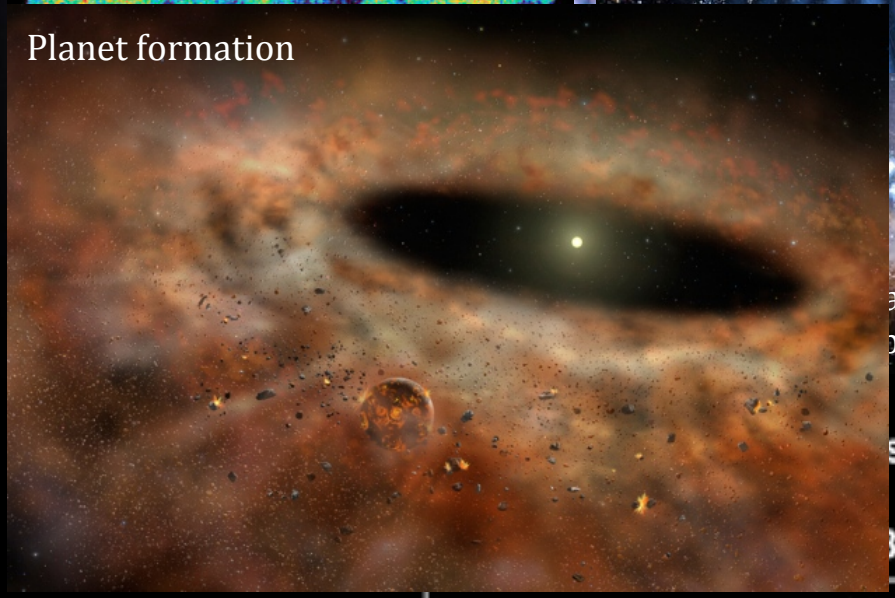

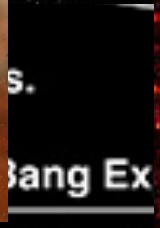

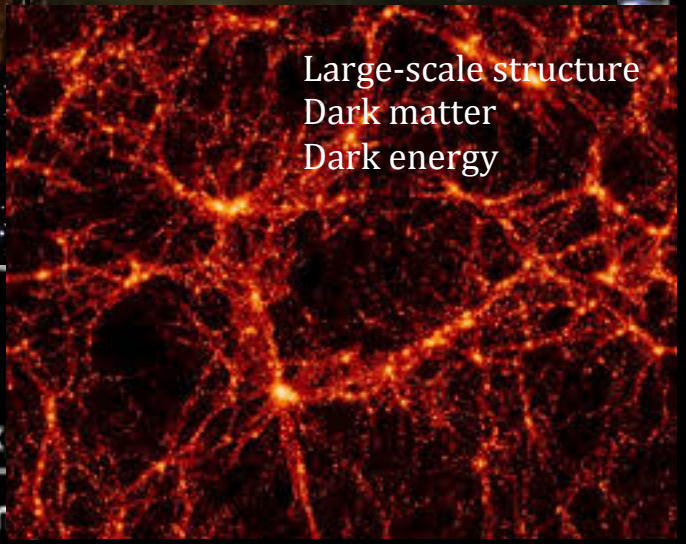

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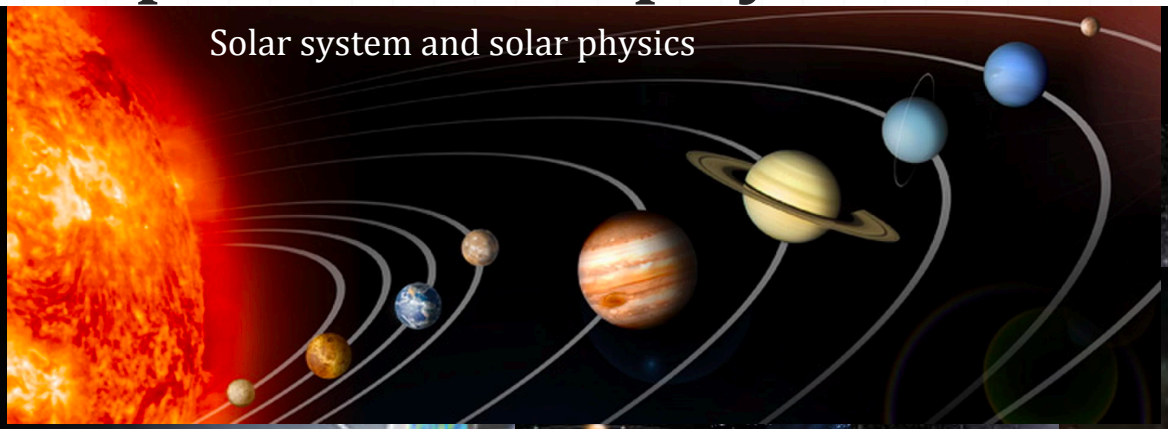
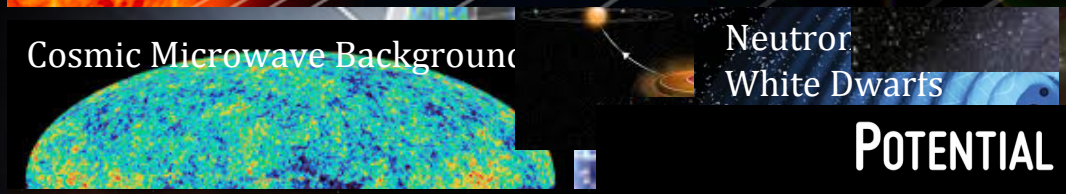
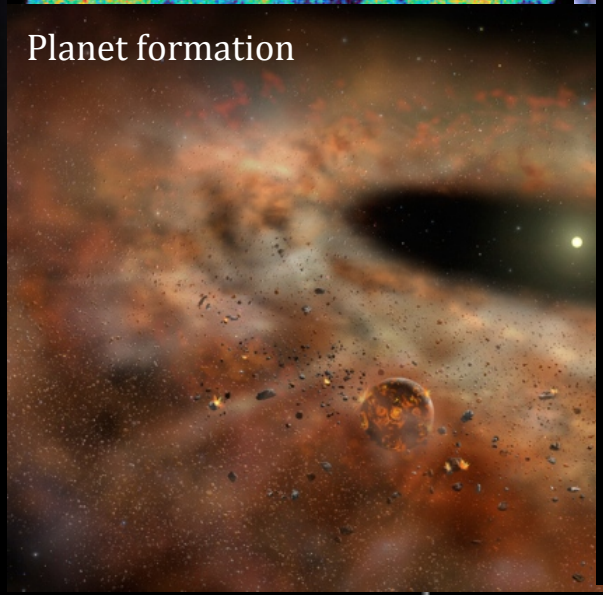
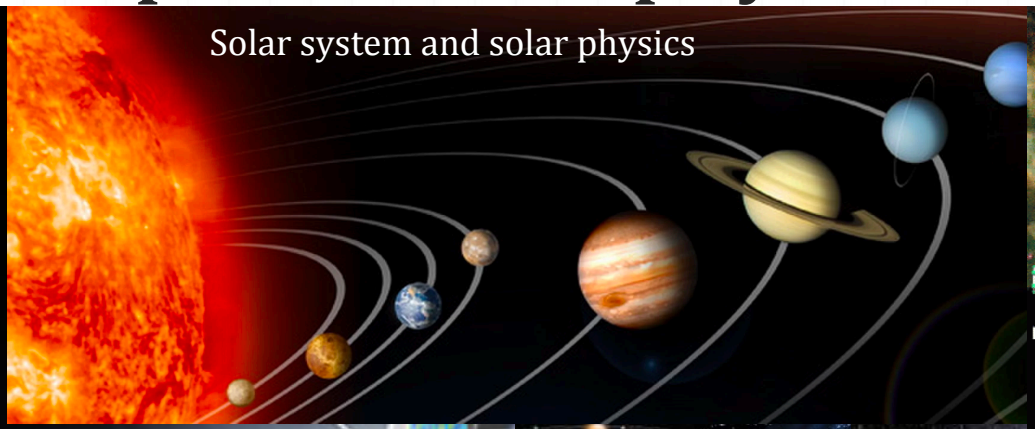
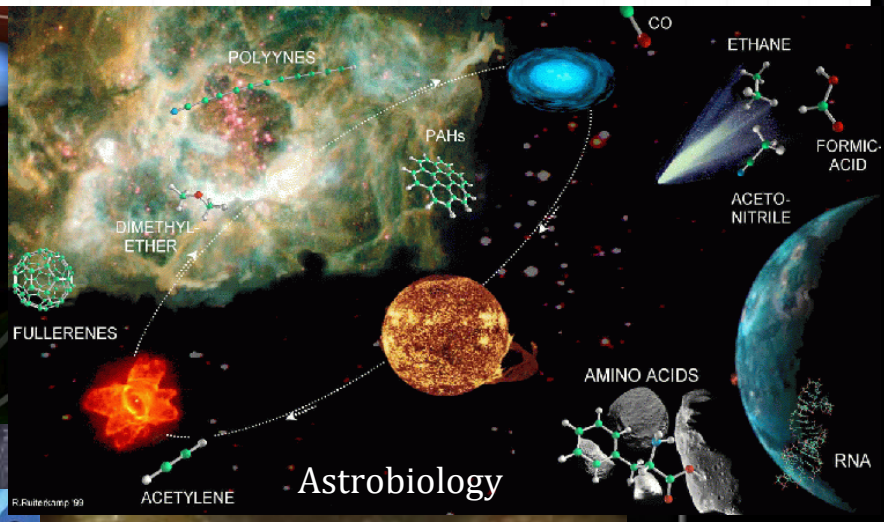


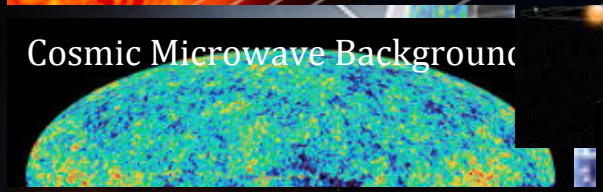


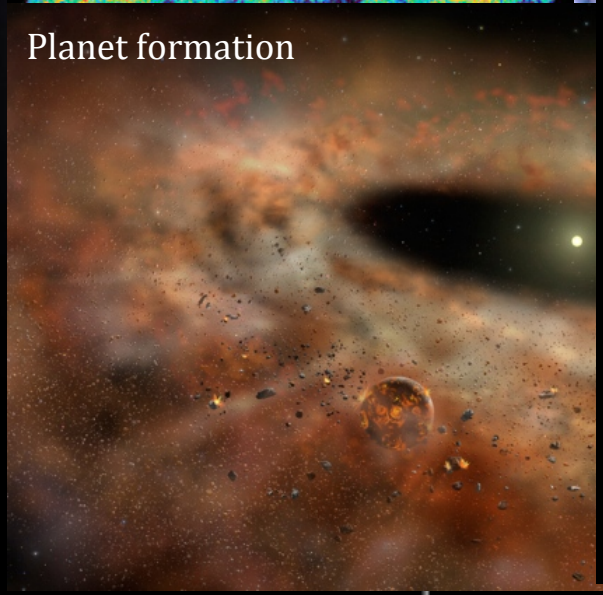


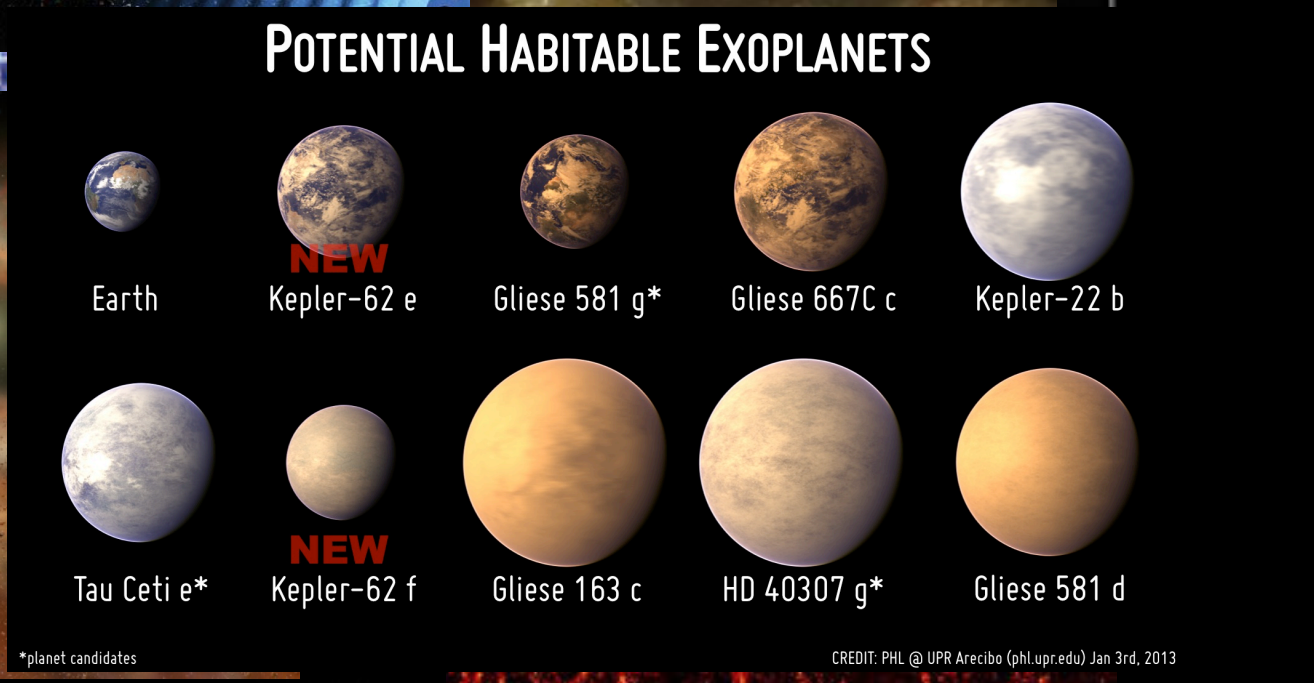
Topics in astrophysics





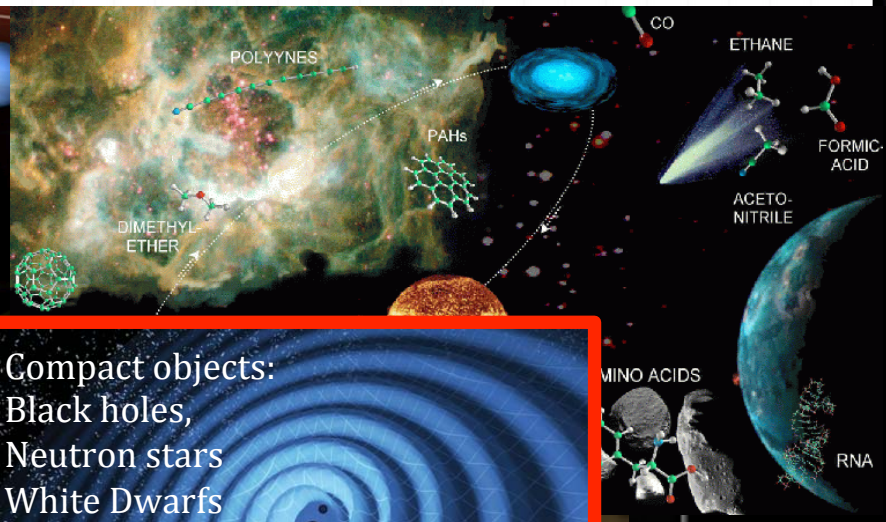


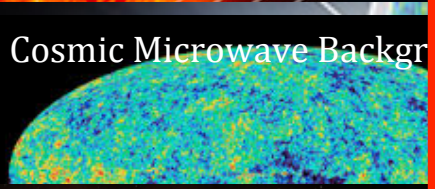


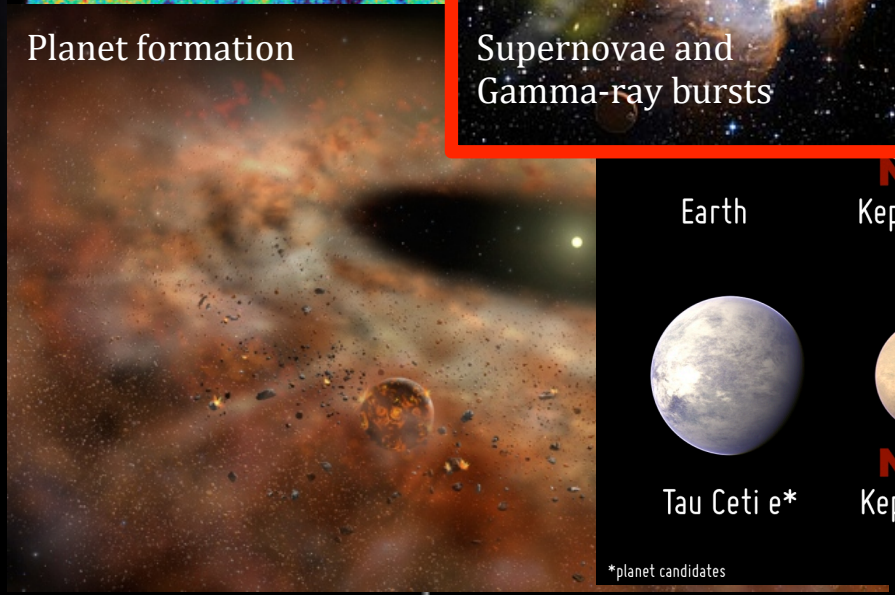


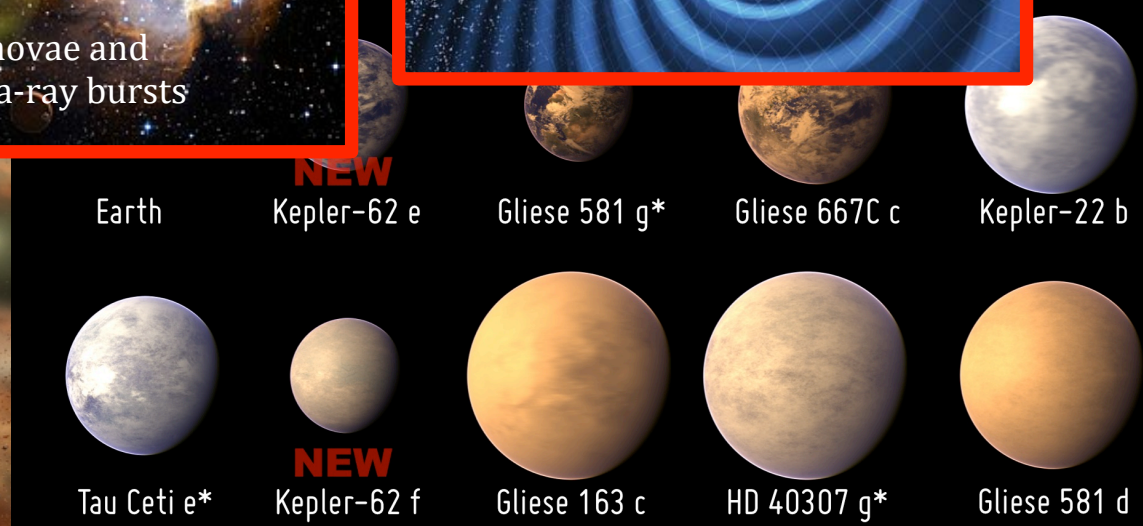
13.7 billion

Topics in astrophysics









13.7 billion