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WONDERS OF ASTROPHYSICS



Introduction



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Please feel free to ask questions at any time!!!

Research Areas in Astrophysics

Cosmology

Galaxy Formation and Evolution

Gravitational Physics

High Energy Astrophysics

Star & Planet Formation

Stellar Dynamics and Evolution

Instrumentation



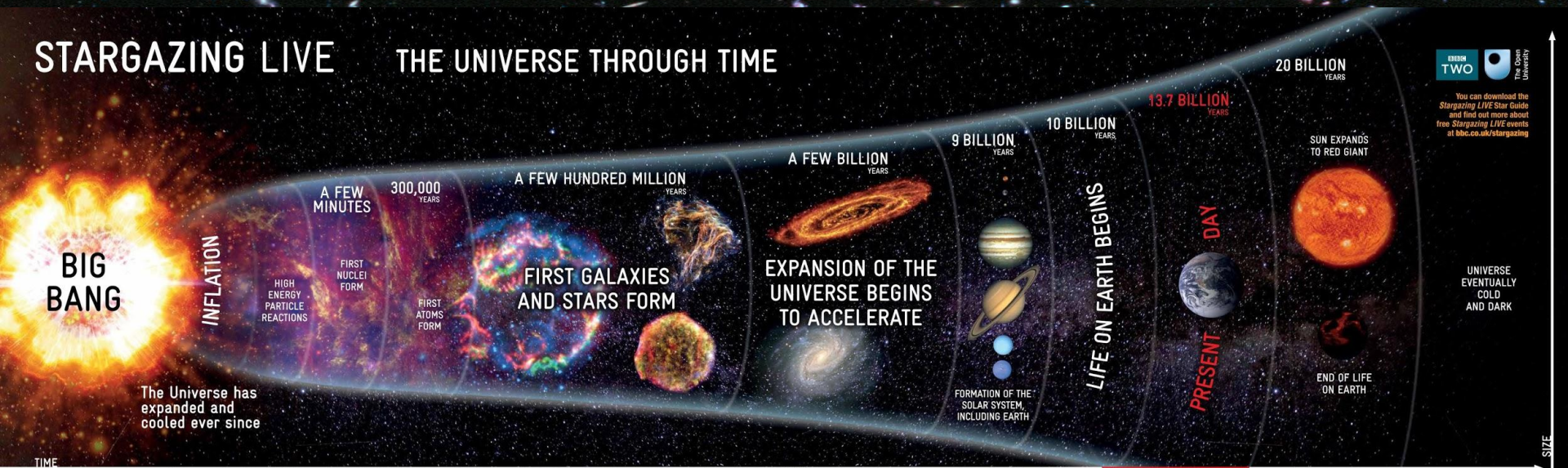
Research Areas in Astrophysics

STARGAZING LIVE

THE UNIVERSE THROUGH TIME



You can download the Stargazing LIVE Star Guide and find out more about free Stargazing LIVE events at bbc.co.uk/stargazing



BIG BANG

INFLATION

A FEW MINUTES
HIGH ENERGY PARTICLE REACTIONS

300,000 YEARS
FIRST NUCLEI FORM
FIRST ATOMS FORM

A FEW HUNDRED MILLION YEARS
FIRST GALAXIES AND STARS FORM

A FEW BILLION YEARS
EXPANSION OF THE UNIVERSE BEGINS TO ACCELERATE

9 BILLION YEARS
FORMATION OF THE SOLAR SYSTEM, INCLUDING EARTH

10 BILLION YEARS
LIFE ON EARTH BEGINS

13.7 BILLION YEARS
PRESENT

20 BILLION YEARS
SUN EXPANDS TO RED GIANT
END OF LIFE ON EARTH

UNIVERSE EVENTUALLY COLD AND DARK

TIME

SIZE

THE BEGINNING
The Universe begins 13.7 billion years ago with an event known as the Big Bang. Both time and space are created in this event.

UNOBSERVABLE UNIVERSE (PAST)

FRACTION OF A SECOND
Rapid expansion occurs during a billionth of a second of a trillionth of a second – the visible Universe is the size of a grapefruit.

1 SECOND
The Large Hadron Collider at CERN is recreating the conditions that prevailed a fraction of a second after the Big Bang.

100–1000 SECONDS
Nuclei of hydrogen, helium, lithium and other light elements form.

300,000 YEARS
We can detect radiation from the early formation of the Universe back as far as this point. Before this, the Universe is opaque: it's as if a veil has been pulled over it.

POTENTIALLY OBSERVABLE UNIVERSE (PAST)

A FEW HUNDRED MILLION YEARS
Matter clumps together under its own gravity forming the first protogalaxies and within them, the first stars. Stars are nuclear furnaces in which heavier elements such as carbon, oxygen, silicon and iron are formed. Massive stars exploding as supernovae create even heavier elements. Such explosions send material into space ready to be incorporated into future generations of stars and planets.

A FEW BILLION YEARS
Initially, the expansion of the Universe decelerated – but a few billion years after the Big Bang, the expansion began to accelerate. The acceleration is caused by a mysterious force known as 'dark energy', the nature of which is completely unknown.

9 BILLION YEARS
The Sun, along with its eight planets, and all the asteroids, comets and Kuiper Belt objects, such as Pluto, form from the debris left behind by earlier generations of stars.

10 BILLION YEARS
The first life appears on Earth in the form of simple cells. Impinging comets and asteroids might have contributed organic molecules to Earth. Life spreads across the globe.

TODAY

13.7 BILLION YEARS
This is where we are today. Using our own ingenuity, humanity is probing the depths of the Universe and trying to unravel its mysteries, from our tiny, home planet, Earth. The visible Universe contains billions of galaxies, each comprising billions of stars. Within our own Galaxy, hundreds of exoplanets have been discovered orbiting other stars.

FUTURE

20 BILLION YEARS
In a few billion years the Sun's outer layers will expand as it turns into a Red Giant star. Life on Earth will become impossible. Expansion of the Universe will continue to accelerate.

10¹⁰⁰ YEARS
Stars no longer form: matter is trapped in black holes or dead stars. Protons decay and black holes evaporate, leaving the Universe to its ultimate fate as cold, dead, empty space, containing only radiation, which itself too will eventually disperse.

1st yr PhD. 3rd yr PhD. Post-doc Ass. Prof. Full Prof.

WHAT YOU BROUGHT TO SEMINAR AND WHAT IT SAYS ABOUT YOU:

Stuff to take notes:
First year. Foolishly
thinks he'll ever
need notes again.



Reading
material: Third
year. Just
here for show.



Didn't bring
anything:
ABD/Postdoc.
Has nothing
better to do.



Laptop: Young
Assistant Professor.
Working on three
proposals at the
same time.



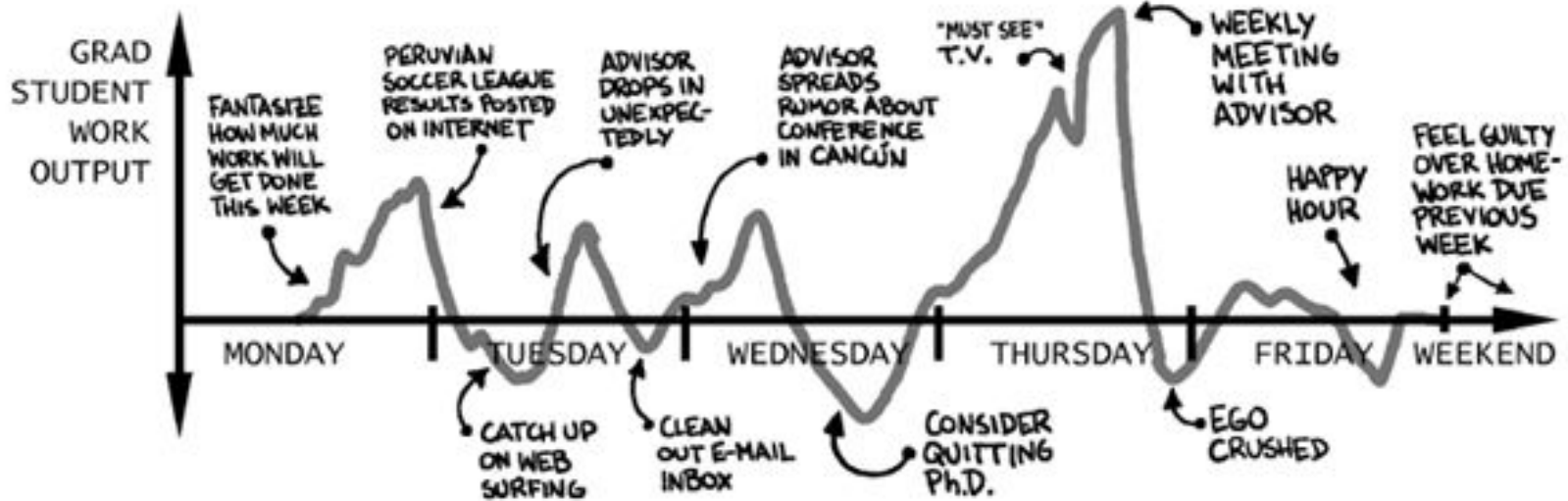
Playing with latest
Gadget/Gizmo:
Full Professor.
Loooves new toys.



Day to day life of an Astrophysicist



Day to day life of a PhD Student

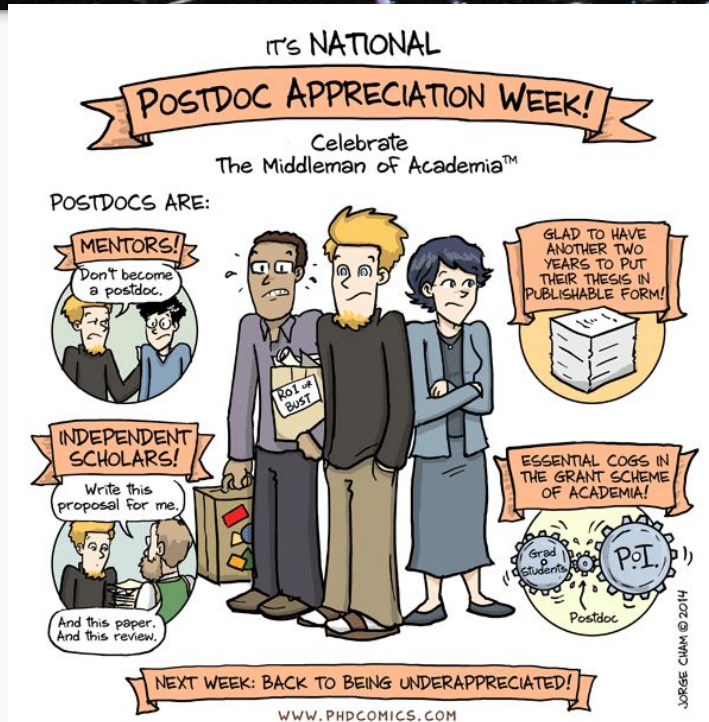


How do you think that grad students spend most of their time?

- A) Reading, Doing HW, TA-ing
- B) Doing research (analyzing data, coding, etc.)
- C) Drinking coffee, eating Colloquium cookies 🍪
- D) Writing thesis
- E) Else?



Day to day life of a Post-doc



How do you think that post-docs spend most of their time?

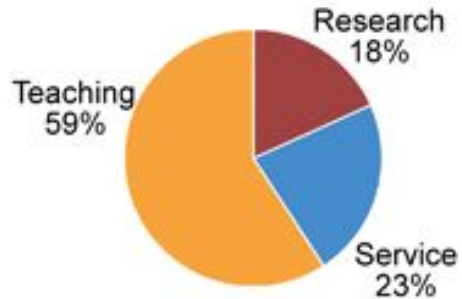
- A) Reading / Writing papers (2)
- B) Doing research (coding, analyzing data, ..) (1)
- C) Drinking more coffee / Eating Colloquium cookies 🍪 (3)
- D) Job applications / Looking for faculty positions (4)



Day to day life of a Professor

HOW PROFESSORS SPEND THEIR TIME

How they actually spend their time:



Source: Higher Education Research Institute Survey (1999)

How departments expect them to spend their time:



How Professors would *like* to spend their time:

Don't tell me what to do

JORGE CHAM © 2008

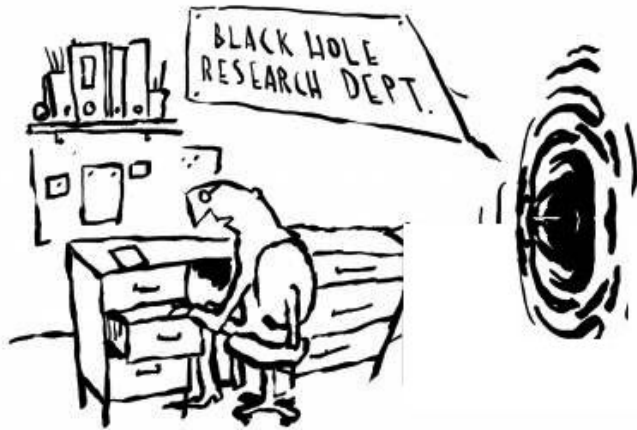
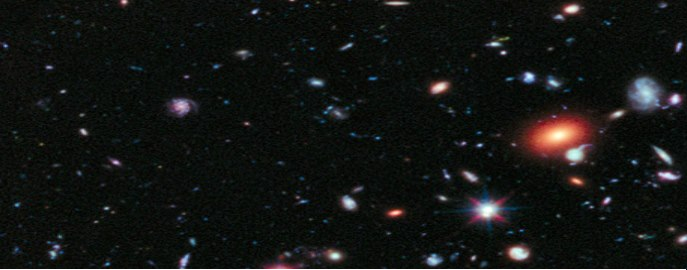
How do you think that professors spend most of their time?

- A) Supervising/Mentoring (3)
- B) Doing Research (5 🍎)
- C) Teaching (2)
- D) Reading / Writing Proposals (1)
- E) Meetings (4)

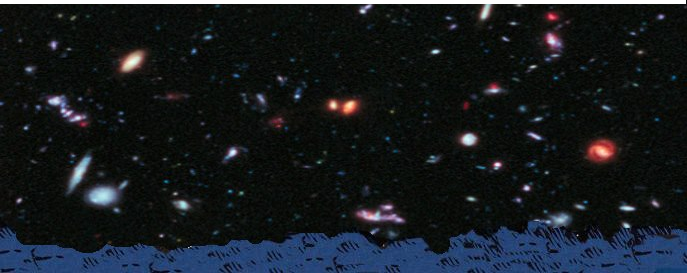


What we wish we knew!





"Now where's that pen?"



Pros

Travelling the world

Doing what you love 24/7

Remaining young in spirit

Working with people from
all over the world

It is a Great Job!

It is a Great Job!

It is a Great Job!

Cons

Travelling too much

Well, 24/7...

Never growing up

Communication can be a challenge
sometimes

Very Long and competitive path!!!

Two body problem / moving around

You will not get rich!!!

Skills & Careers

Skills that you will be developing as a PhD:

- Mathematics / Physics
- Problem Solving
- Programming
- Writing / Presenting Skills

Academic Career: PhD → Couple of Post-docs → hard work
→ Faculty position

Big Data Analysis: Makes a lot of money \$\$\$.

Software Development: Medical Imaging

Federally Funded Research & Development Centers: (DoD,
DoE)

Scientific Writing/Public Outreach: Neil DeGrasse Tyson

Science Policy: AAS, AAAS, APS

Resources

Links to Academic Websites:

AAS: aas.org, aas.org/learn/careers-astronomy

APS: aps.org

Job rumor mill: www.astrobetter.com/wiki/Rumor+Mill

ArXiv: arxiv.org

ADS: adsabs.harvard.edu

CUWIP: www.aps.org/programs/women/workshops

[/cuwip.cfm](http://cuwip.cfm)

Links to Popular Science Websites:

Data Science: www.datasciencecentral.com

PhD Comics: phdcomics.com/comics.php

CSWA: www.aas.org/cswa

Blogs:

- rasmussen.edu/student-life/blogs/main/11-rarest-careers
- scienceblogs.com/catdynamics/2012/01/13/you-are-at-university



Thank You!

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Message to take away!!!

