PhD in Astronomy How and Why?

A Guide to PhD Programs in Astronomy

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SURVIVOR BIAS

- Born in affluent nation
- Time for studies
- Contacts
- Work very hard
- … but so do many others
- Applied for ~45 faculty jobs
- 1 offer

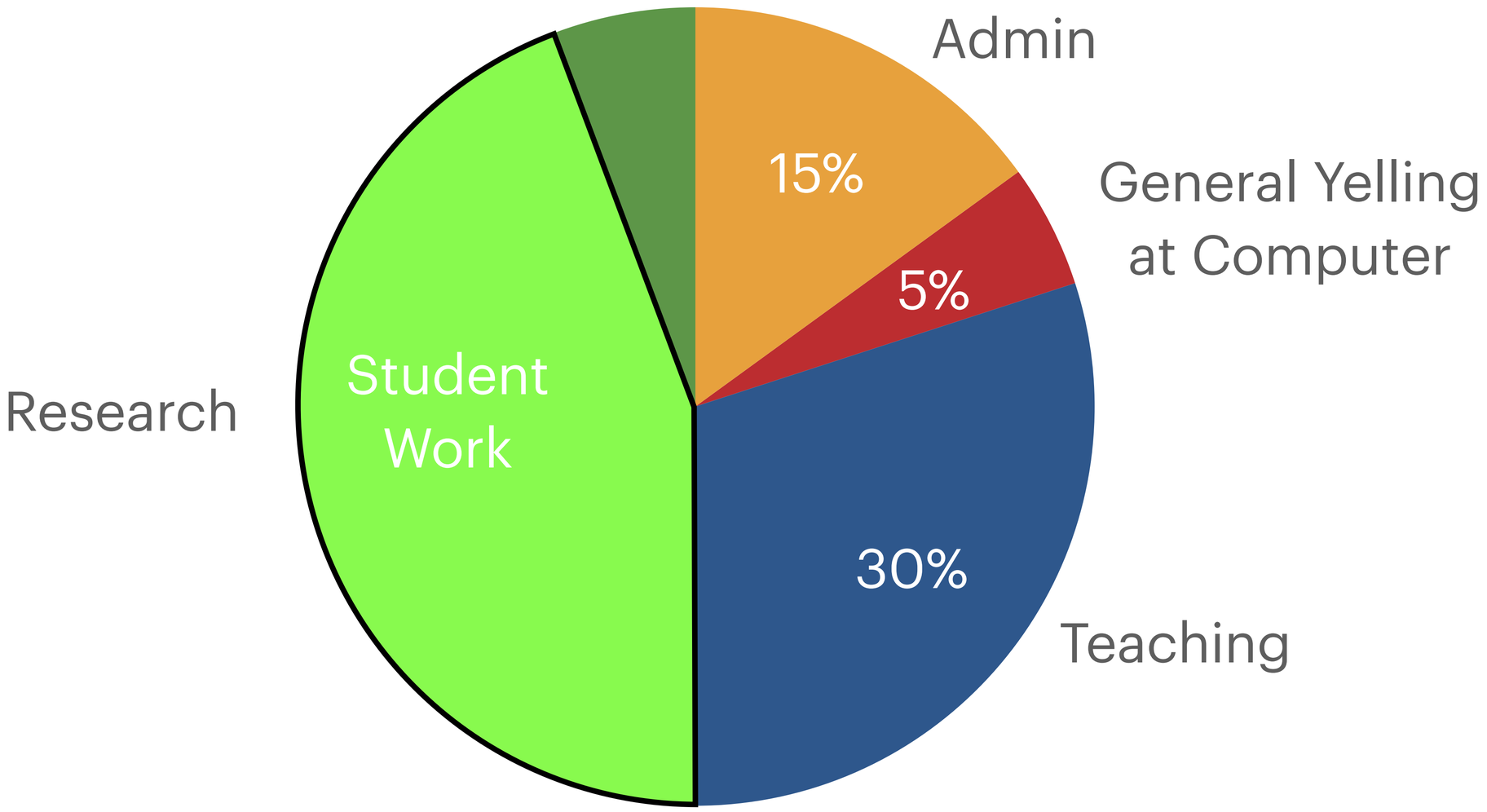
MY JOURNEY

- 1989 yay, I'm alive
- 1995 - 2007 School stuff
- 2008 - 2012 Monash University undergrad
- 2013 - 2017 Université de Genève PhD
- 2017 - 2019 Chicago postdoc (Swiss fellow)
- 2020 - 2023 The Ohio State postdoc (NASA fellow)
- 2023 onwards Tufts faculty

MY EXPERIENCE

- My journey
- Supervised ~10 student (half grad, half undergrad)
- 3/4 students gotten into a PhD program
- Aiming for 5/5
- The Ohio State University Grad Admissions for 2 years
- The Ohio State University Bridge Program
- Incoming Tufts Graduate Student Committee
- Many, many conversations....

WHAT IS MY JOB?



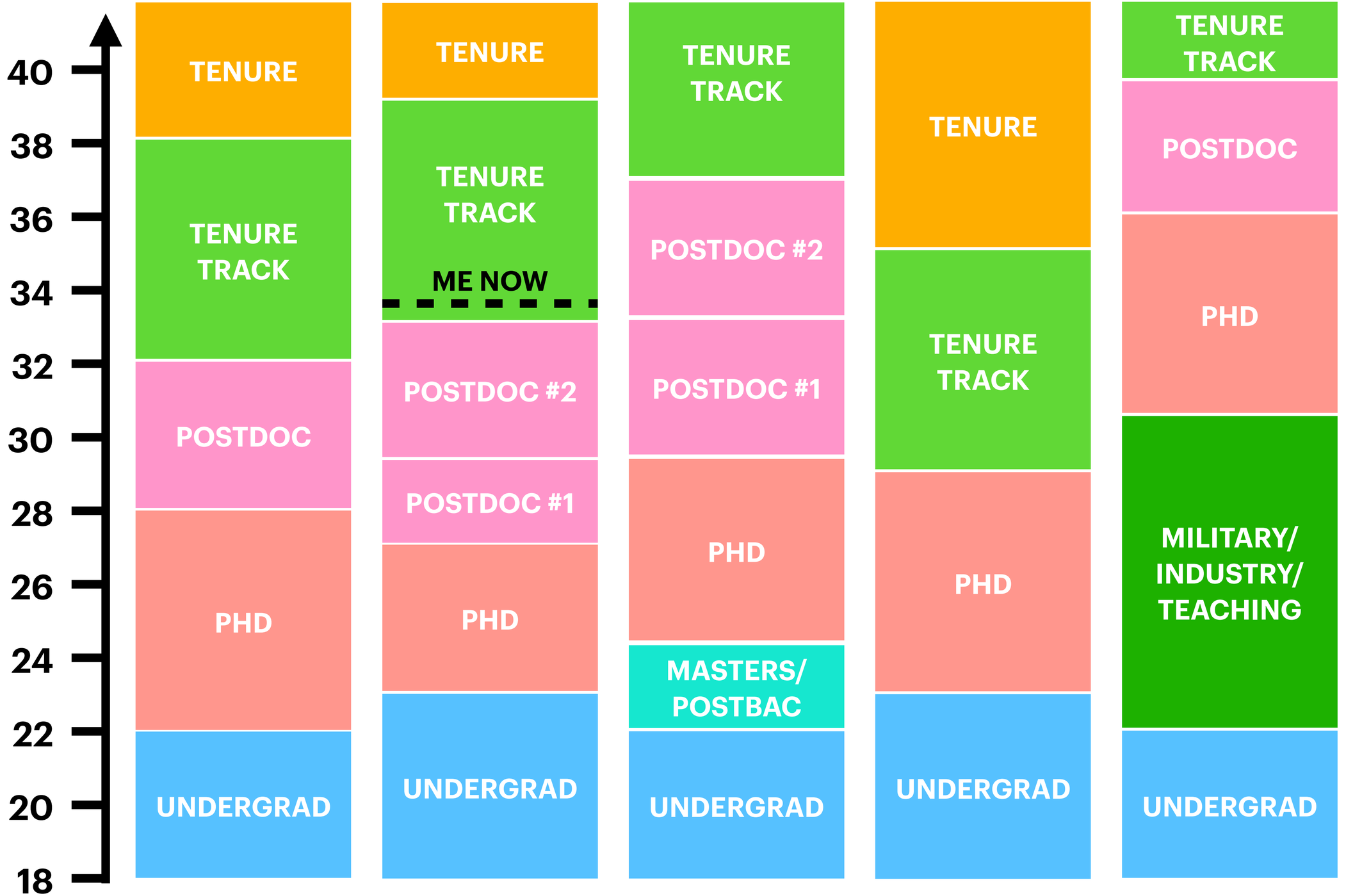
WHAT DO I LOVE ABOUT MY JOB?

- Students
- Creativity
- Problem solving
- Collaboration
- Travel
- Makes you interesting at parties
- Security

WHAT DO I NOT LOVE ABOUT MY JOB?

- Until Friday April 14th 2023, I had no long-term security (wife too)
- Admin work (even if the administrators are great)
- **Others will often say:** constant asking for money/resources
- **Others will often say:** family/two-body challenges
- **Others will often say:** salary
- **Others will often say:** work-life balance

TYPICAL PATH?



AND MANY OTHER FACTORS...

- Health challenges
- Family growth/support
- Institution switch
- Funding casualties
- Failed exams
- Unemployment
- Global pandemics

WHAT IS THE GOAL OF A PHD?

- World expert (in something)
- Independent researcher
- Leader of future generations

PHD TIMELINE

- 6 years average (USA)
- 2 years of coursework (variety of intensity)
- Qualifying exam (oral and/or written, intensity generally decreasing)
- Can drop out with masters (forced or by choice)
- Defend PhD (failure is very very rare)
- TA work (amount varies significantly)
- Service work (observing, teamwork, data analysis)

WHAT JOBS DO I NEED A PHD FOR?

- Faculty
- Postdoc
- Research scientist at NASA/ESA/Observatory
- Much public outreach work

WHAT JOBS DON'T I NEED A PHD FOR?

- Within astronomy:
  - Some engineering jobs
  - Some IT jobs
  - Some non-research university positions
- Outside of astronomy…
  - Most things…

WHAT ABOUT INDUSTRY?

- A PhD in astronomy is marketable
- A PhD is necessary for some jobs
- Not the most efficient
- BS + masters in data science/computer science/stats
- Internal promotion - balance time commitment of PhD
- Get help from people **not like me**

LET'S TALK MONEY IN ACADEMIA

- Talking USA here...
- Undergrad degree: **negative** $0 - $70k per year
- Masters degree: **negative** $0 - $70k (maybe some TA money)
- Postbacc: $30k (minimal benefits)
- PhD: $20k - $45k (decent benefits)
- Postdoc: $50k - $80k
- Faculty: $70k - $140k starting (consider 9 vs 12 month)

LET’S TALK ESSENTIAL SKILLS

- Creativity
- Problem solving
- Detail-oriented
- Collaboration
- A “can do” attitude
- Work ethic
- “Grit”
- Physics/Maths/Programming/Writing/Communication

LET'S TALK ABOUT THE PATH

PhD

- OSU PhD stats:
  - 240 applicants
  - 16 offers (7 acceptances)
- PhD application fee: $50 - $120
- 12 applications ~ $1000
- $(1 - 16/240)^{12}$ = 56% chance of at least 1 offer
- ^^^ Poor maths

LET'S TALK ABOUT THE PATH

Postdoc

- ~ 100 postdoc opportunities per year (and growing)
- Gateway from PhD to faculty
- Independent research
- National fellowship: full autonomy, most prestigious
- Local fellowship: largely autonomous, still prestigious
- PI postdoc: between zero and full autonomy, less prestigious
- Hubble fellowship: 450 applications, 25 fellows (5.5% success)
- PI postdoc: 30 applications, 1 postdoc (3.3% success)

LET’S TALK ABOUT THE PATH

Faculty

- ~ 50 faculty opportunities per year
- 100 - 200 applicants
- Longlist (zoom interview): ~ 12 people
- Shortlist (in person interview): ~ 6 people
- Chosen: 1
- Short time to strike: ~2-3 years

LET'S TALK ABOUT THE PATH

Mine

- PhD: personal connection, not representative
- Postdoc #1: Swiss fellowship, 25% success rate
- Postdoc #2: Hubble fellowship, 5.5% success rate
- Faculty search 45 applications over 2 years
- 13 longlist
- 7 shortlist (Tufts, Yale, Virginia, SMU, Texas Tech, Wayne State, Hawaii)
- 1 offer

LET'S TALK ABOUT THE PATH

Mine

- 15 first-author papers (43 total)
- 11 students (7 student-led papers)
- Great schools and letters
- 80+ talks
- $350,000+ grant money
- 460+ observing nights
- Most prestigious fellowship in astronomy (Hubble)
- … all of that for a 1/45 faculty job success

TL;DR
THE PATH IS NARROW AND COMPETITIVE

THINK THEN DISCUSS...

- Why do I want to go to grad school?
- Do I love doing (or the idea of) teaching or research or both?
- What scientific questions would I love to see answered?

STILL WANT TO APPLY?

APPLICATION BASICS

- Late November through mid January
- $50 - $120 fee (non-refundable, ask for waivers)
- Zoom interviews in January
- First-round decisions in January/February
- Waitlist decisions by April
- Often you hear nothing

ROUGHLY THREE FLAVOURS OF ASTRO

- Astronomy department (e.g. Ohio State, Michigan, Texas, Harvard, BU)
- Physics & Astronomy department (e.g. Tufts, Michigan State, UCLA)
- Physics department (the rest)

PHYSICS vs ASTRO

- Physics PHD has:
  - More coursework (typically tougher)
  - Little to no astro coursework
  - More rigorous quals
  - More university options
  - Greater range of uni prestige
  - Cares more about grades - astro more about research (to an extent)

APPLICATION CONTENTS

- Personal statement
- Past research summary and/or future research interests
- Writing sample
- DEI statement
- CV
- Official or unofficial transcripts
- Letters of reference (2-3)

HOW IS A PHD APP JUDGED?

- GPA
- Specific grades and trajectory
- ~~GRE~~
- Letters of reference (2-3)
- Research experience
- Publications
- Misc (leadership, teaching, other jobs, charity, public outreach etc)
- Application (writing sample, personal statement, DEI statement etc)

GPA REQUIREMENTS

- Anecdotal rather than hard numbers, e.g.
- https://astronomy.utexas.edu/academics/graduate-program/prospective-student-information/tips-for-applying

> What is the minimum GPA required?
>
> UT Austin enforces a minimum 3.0 GPA for all of its graduate programs. Beyond that, the UT Astronomy Department does not have a GPA cutoff that it uses in reviewing applications to our program.

- “Almost all admitted students have 3.8+”

GPA REQUIREMENTS

- “Below 3.7 is tricky for PhD programs”
- “Below 3.5 is tricky for masters”
- “3.85 GPA, 0/12 success”
- “3.85 GPA, 2 publications, 2/12 success on 2nd try”
- “3.87 GPA, 3 publications, 3/11 success”
- “4.0 GPA, 3 publications, 4/12 success”
- “We had to lower our official GPA requirements for this student because their research experience and letters were so strong”

CLASS REQUIREMENTS

- Major in physics or astrophysics
- Major in related field (maths/comp. sci) with some astro coursework
- Good grades in important subjects
- Trajectory

GRE REQUIREMENTS

- I’m sorry/you’re welcome… it’s gone
- Occasionally you can provide it
- Physics values it slightly more than astronomy
- Expensive
- Poor probe of grad school success
- Biases

RESEARCH REQUIREMENTS

- Research experience basically required
- Taken over from GRE
- Biases also exist
- 1 semester minimum
- Publications preferable
- 1st author publication very useful

LETTERS OF RECOMMENDATION

- Another benefit of doing research
- Helpful if not all Tufts
- You 100% can instruct your writers
- Give clear & early instructions and reminders (it is not rude)
- Cover different strengths (e.g. leadership/programming/mentorship/maturity/grit/personal challenges)
- Does not have to be faculty - consider connection strength

PERSONAL STATEMENT

- Avoid generic “as a kid I looked up into the stars…” crap
- Quantifiable
- Open minded
- Talk about overcoming challenges (not JUST the challenges themselves)
- Get 2-3 people to read it - be open to feedback

DEI STATEMENT

- Diversity Equity Inclusion
- Not overly common but do exist
- We don’t expect you to have solved systematic racism by the age of 22
- Do you have the finger on the pulse of student issues?
- Research events/actions/initiatives at each school
- Show-off any experience helping/leading
- Can describe personal challenges

AFFIRMATIVE ACTION @ SUPREME COURT

- Racial quotes are illegal (and have been since the 60's)
- Now admissions cannot consider race at all (positively or negatively)
- Admissions **can** consider personal challenges
- Those challenges **can** relate to race

"Nothing in this opinion should be construed as prohibiting universities from considering an applicant's discussion of how race affected his or her life, be it through discrimination, inspiration or otherwise." - Chief Justice John Roberts Jr.

IF I GET AN INTERVIEW

- Research the department very well!
- Understand your past research: what **AND** why?
- Show enthusiasm
- Base answers in your past - show grit

HOW TO PICK SCHOOLS?

- Idea: have a $$$ budget, not a number budget
- Give schools a competitiveness score out of 5
- Create a distribution (e.g. 5,4,4,3,3,3,2,2,2,2,2)
- Weight distribution by your CV - get **honest** opinions
- 6 years is a long time - make sure you'll enjoy it!
- Prime of your life

BACKUP/ALTERNATIVE

- European PhD
  - Direct entry hard, masters or significant research expected
  - 4 years
  - Specific project
  - Wildly varying pay and benefits ($15k - $65k)
  - Weird start times
  - No centralized posting (AAS job register has some)

BACKUP/ALTERNATIVE

- European masters
  - 2 years
  - Free (or basically) in many countries (but living expenses?)
  - Cultural experience
  - Largely astro coursework
  - No PhD position guaranteed (but stronger application)
  - Apply on regular cycles (check university website)

BACKUP/ALTERNATIVE

- US masters
  - 2 years
  - Can be very expensive
  - TA possibilities (but not guaranteed)
  - Rare in astronomy, more common in physics
  - Intense coursework can make research tough
  - Can transfer credits
  - Increased employability outside of academia

BACKUP/ALTERNATIVE

- Postbacc
  - Varied time (e.g. 1 semester, 1 year)
  - Paid (~$30k annual)
  - Or unpaid
  - No classes - lots of research focus
  - Hard to find positions (AAS job register, academic jobs online, specific department websites)

BACKUP/ALTERNATIVE

- Industry/teaching etc
- Time off?

You are not a failure if you did not get into a PhD program straight out of undergrad

SUMMARISE

- Getting into a PhD is a hard step on a hard road
- We all have different paths
- We are here to support you on whatever that path is

QUESTIONS/DISCUSSION?