# Welcome to the Research Skills course!

# Introduction to the module

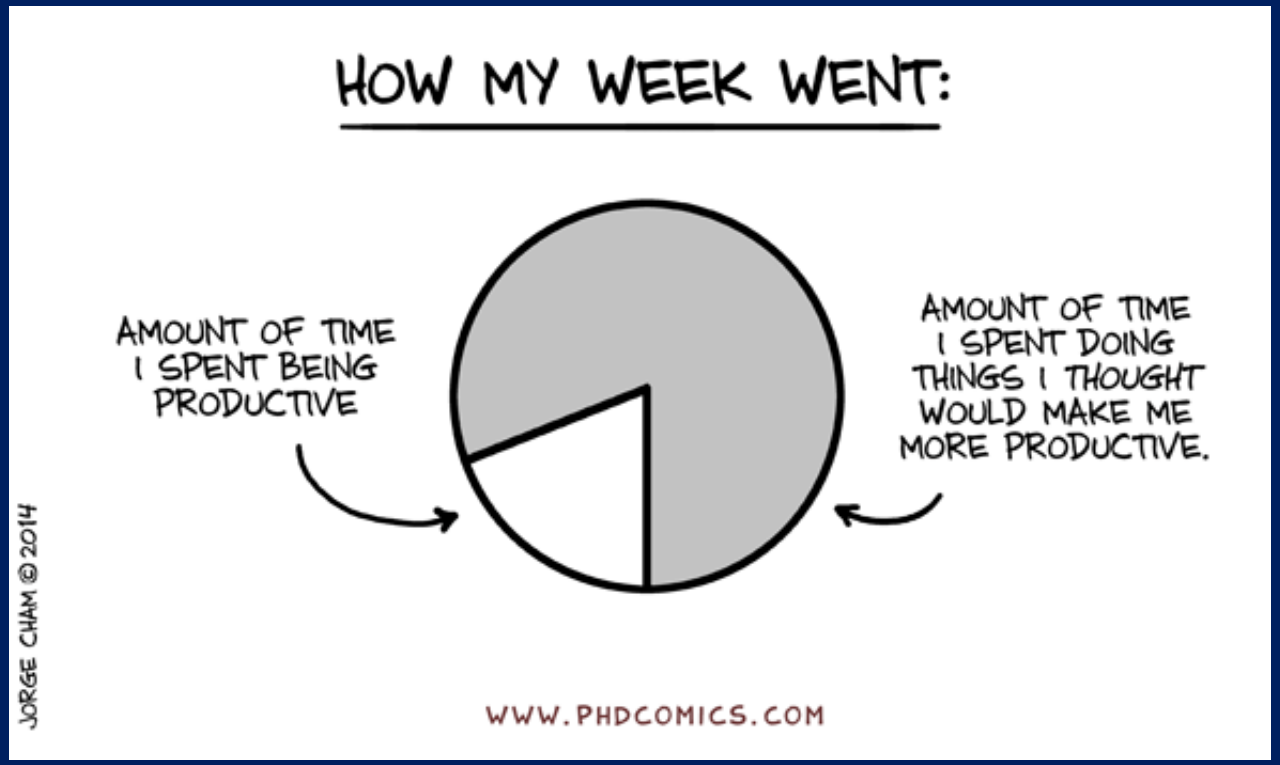
- The Research Skills course aims to provide **practical tips and strategies for becoming a researcher**!
- Represents **20% of the credit** for NPS40012
- Weekly classes **Mondays 10.30-11.30 in AMDC912**
- **No assignments** but full credit awarded for:
  - Attendance of research skills classes (at least 9 out of 12)
  - Submission of project bibliography
  - Submission of report skeleton
  - Submission of presentation skeleton

# Honours Astrophysics & Physics Research Skills course

| Week | Date | Topic | Facilitator(s) | Deliverable |
|---|---|---|---|---|
| 1 | 3 Mar | Project planning | Chris Blake, Greg Poole | |
| 2 | 10 Mar | How to find and use references | Chris Blake, Wesley van Kempen | |
| 3 | 17 Mar | How to read a science paper | Chris Blake, James Chon | Bibliography |
| 4 | 24 Mar | How to start writing | Michelle Cluver | |
| 5 | 31 Mar | Good habits for writing | Michelle Cluver | |
| 6 | 7 Apr | How to use AI tools | Darren Croton | Report skeleton |
| 7 | 14 Apr | How to make a scientific figure | Ryan Shannon | |
| 8 | 28 Apr | How to determine the errors in your measurements | Chris Blake | |
| 9 | 5 May | Good coding practice | Rory Elliott, Lydia Haacke, Tyson Dial | |
| 10 | 12 May | How to manage your data | Adam Deller | |
| 11 | 19 May | How to communicate science | Sara Webb | |
| 12 | 26 May | How to plan a research presentation | Ryan Turner | Presentation skeleton |

# Research Skills Class 1:

## Project planning



# What is “project planning”?

- Having a **structured approach** to planning and handling tasks, using simple tools and habits, so you can deliver what’s needed and make your life easier!

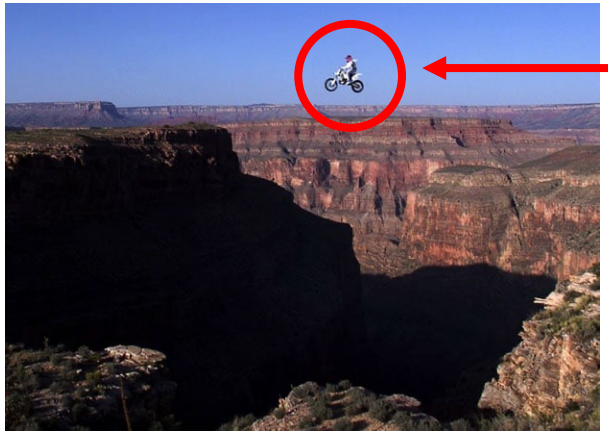
# Project planning “survival guide”!

## What do you need …??

- Split project into chunks/milestones
- Priorities for each
- Project timeline
- Method for recording progress

*If your project has “risks” involved, e.g., if you need to access to lasers or other equipment which is not guaranteed, you should probably also think about “contingency planning”

# Breaking it down



Many of us approach projects like this ☺

A better approach is to break down your big goal into smaller chunks

- Makes the goal feel more manageable
- Helps track your progress and avoid last-minute scrambles
- Easier to get feedback on each part (helps your supervisor help you)


You'll need to know when each chunk is finished – using "milestones"

# Let's see an example …

**Project goal**: *"Measure the growth rate of cosmic structure using galaxy motions"*

??

Breaking it down into chunks:

- Review the literature which explains why my work is interesting
- Download galaxy dataset and understand the meaning of the columns
- Create a computer code to measure correlation function of the dataset
- Research the theoretical equations to compare with the measurement
- Create a computer code to evaluate equations and fit the growth rate
- Write your thesis!

# Let's see an example …

**Project goal**: *"Measure the growth rate of cosmic structure using galaxy motions"*

??

Milestones for each chunk:

- I have listed the key contributions of my work to the field
- I can plot different columns of the data and the results make sense
- I have successfully validated the code using a test dataset
- I have written the equations in a document
- I have fit for the parameter and validated the result
- Thesis is submitted ☺

# Let's see an example …

**Project goal**: *"Measure the growth rate of cosmic structure using galaxy motions"*

??

Priorities for each chunk:

Review the literat… which explains why my work is interesting — 4

Download galaxy da… and understand the meaning of the columns — 2

Create a computer … to measure correlation function of the dataset — 3

Research the theore… equations to compare with the measurement — 5

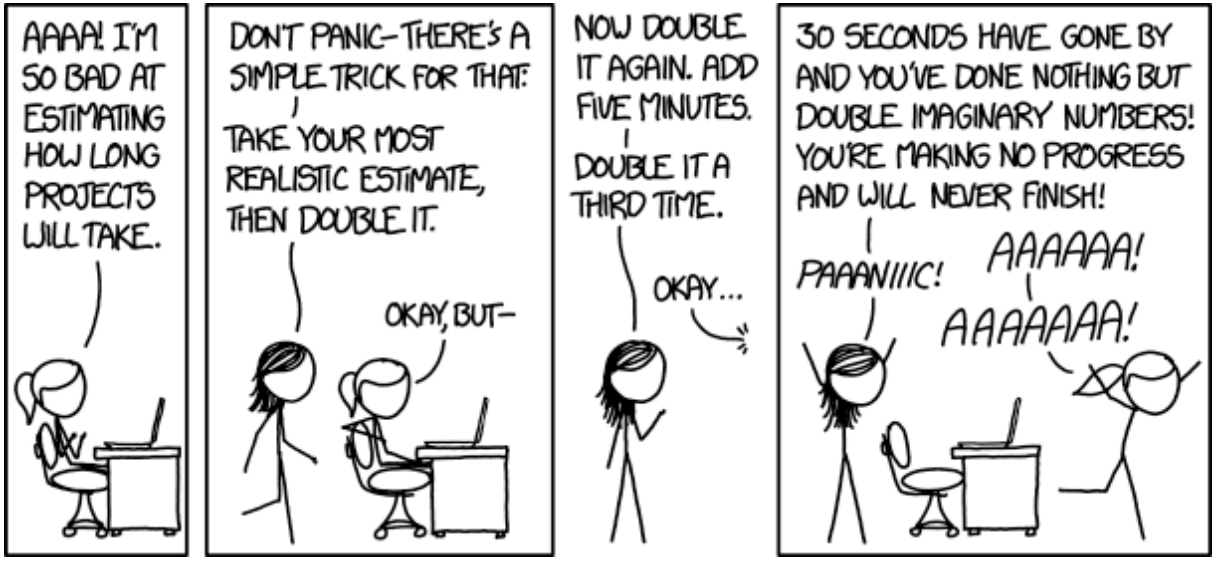
Create a computer … to evaluate equatio… and fit the growth rate — 6

Write your thesis! — 1

# The power of “no” !


- **Prioritisation** can be very helpful in judging when to include or exclude a potential new research task
- If you add an extra task, it means not doing something else – **how do the priorities compare?**

# The dreaded timeline




- Now we've identified the parts of our project, we need to plan **how much time** to spend on each
- Common time underestimates are **coding** and **writing**
- **Simple visualization of a timeline** is often effective
  (This is sometimes called a "Gantt chart" ☺)

# The dreaded timeline

*Here is a simple example based on the above project:*

**Weeks of semester** →

| Activity | Priority | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Literature review | 4 | | | | | | | | | | | | |
| Understand dataset | 2 | | | | | | | | | | | | |
| Measurement code | 3 | | | | | | | | | | | | |
| Understand theory | 5 | | | | | | | | | | | | |
| Fit theory | 6 | | | | | | | | | | | | |
| Write thesis | 1 | | | | | | | | | | | | |

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Can turn these green as you achieve them!

Which tasks can happen simultaneously?

Which tasks need to be finished before others can start?

# What happens when it goes wrong?

- Research and life are unpredictable, and timelines often don't work out – **this is normal**!
- You'll need to **regularly re-visit and refine your goals and timelines** ☺
- It's better to do this in a planned way as the semester unfolds, rather than under pressure at the end!
- Easy to do this using the **priorities** you recorded
- It's best to **protect your writing time** as much as possible – usually better to change the project aims

# What happens when it goes ~~wrong~~ normally?

**Old goal**: *"Measure the growth rate of cosmic structure using galaxy motions"*

| Activity | Priority | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Literature review | 4 | | | | | | | | | | | | |
| Understand dataset | 2 | | | | | | | | | | | | |
| Measurement code | 3 | | | | | | | | | | | | |
| Understand theory | 5 | | | | | | | | | | | | |
| Fit theory | 6 | | | | | | | | | | | | |
| Write thesis | 1 | | | | | | | | | | | | |

*Ooops, this high-priority task took 7 weeks rather than 4 weeks. Installing python a nightmare. Data is corrupted. Computer is broken. First attempt at algorithm would take 100 years to run.*

# What happens when it goes ~~wrong~~ normally?

**New goal**: *"Measure the ~~growth rate of cosmic structure~~ correlations between galaxy motions"*

| Activity | Priority | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Literature review | 4 | | | | | | | | | | | | |
| Understand dataset | 2 | | | | | | | | | | | | |
| Measurement code | 3 | | | | | | | | | | | | |
| Understand theory | 5 | | | | | | | | | | | | |
| ~~Fit theory~~ | ~~6~~ | | | | | | | | | | | | |
| Write thesis | 1 | | | | | | | | | | | | |

This activity can be removed because it's the lowest priority

This activity is unchanged because it's the highest priority

# Document and communicate!

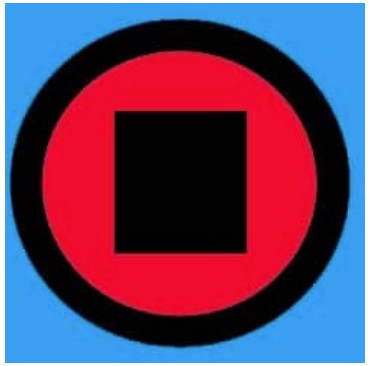
- Maintain a **log-book** (paper or digital!) where you track your progress, decisions and intermediate results
- Meet at least **once a week** with your supervisor
- **Write up as you go!** (whilst fresh in your mind)

# Staying focused and motivated

- The typical state of research is for something not to be working ☺. **How can you stay motivated?**
- Break tasks into smaller chunks which are more manageable. *Enjoy the "small wins"!*
- Work for a focused period and then take a break or enjoy a reward (e.g. search for "Pomodoro technique")
- Identify the style of research activity you find most enjoyable or rewarding
- Enjoy the community with your fellow students and research group. *Everyone feels the same way!*

# What do you think?

Is there any planning approach you might try **starting**?



Is there any work habit you might try **stopping**?

Are you already using a planning approach which you'll **continue**?

# Activities to try

- Create a list of chunks, milestones and priorities for your project
- Arrange these pieces onto a visual timeline
- If your project has any “risky” parts (e.g. access to specialized equipment), write down some potential alternatives

That’s all for today!

# Example for an experimental project

**Project goal**: *"Synthesise spherical crystalline silicon nanoparticles of size 100 – 200 nm"*

??

Breaking it down into chunks:

- Review the literature which explains why my work is interesting
- Learn the laser ablation nanoparticle synthesis experimental apparatus
- Create and conduct experiments to test size & sphericity of particles
- Research theoretical equations to optically characterize the particles
- Create a computer code to simulate the expected results
- Write your thesis!

# Example for an experimental project

**Project goal**: *"Synthesise spherical crystalline silicon nanoparticles of size 100 – 200 nm"*

??

Milestones for each chunk:

I have listed the key contributions of my work to the field

I can operate laser ablation setup to create nanoparticles

I have set up apparatus to test the sphericity and size of the particles

I've simulated all the theoretical equations to interpret the results

I have conducted experiments and validated with theory

Thesis is submitted ☺

# Example for an experimental project

**Project goal**: *"Synthesise spherical crystalline silicon nanoparticles of size 100 – 200 nm"*

??

**Weeks of semester** →

| Activity | Priority | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Literature review | 4 | | | | | | | | | | | | |
| Learn the set-up | 2 | | | | | | | | | | | | |
| Create new set-up | 3 | | | | | | | | | | | | |
| Conduct experiment | 5 | | | | | | | | | | | | |
| Fit theory | 6 | | | | | | | | | | | | |
| Write thesis | 1 | | | | | | | | | | | | |