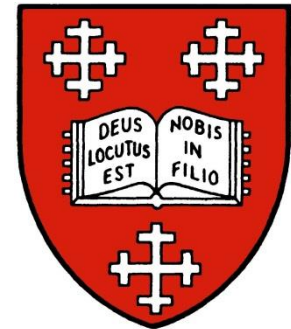


Careering Through Astronomy

Jocelyn Bell Burnell

Oxford Astrophysics
and
Mansfield College



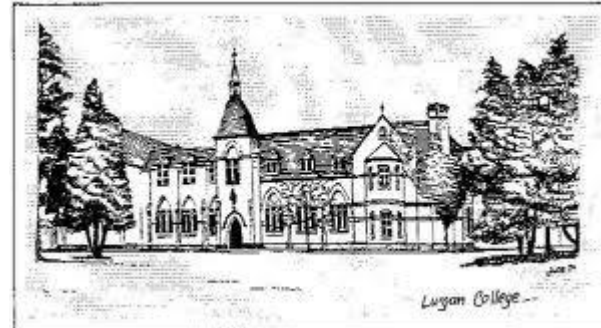
Contents

- How I got here
- Women in physics today and tomorrow
- Big questions in astrophysics



What Jocelyn did

- Failed the N. Irish equivalent of the 11+.
- Next term came top in first science exam, ahead of all those who had passed 11+.
- To boarding school in York at age 13. A and S levels in Maths, Further Maths and Physics.



Higher Education

- Physics degree at Glasgow University
- To Cambridge to do a PhD in Radio Astronomy



Cambridge as a PhD student

- Imposter syndrome
- Congratulations on your engagement
- Silence on your major astrophysical discovery!



In the field – building the radio telescope

Family life

- Got married as I finished the PhD – husband worked in Local Government.
- He moved jobs every 7 years or so, to get promotion
- Son born 4 – 5 years later
- Few child-minding facilities as mothers not expected to work



Hanging in there!

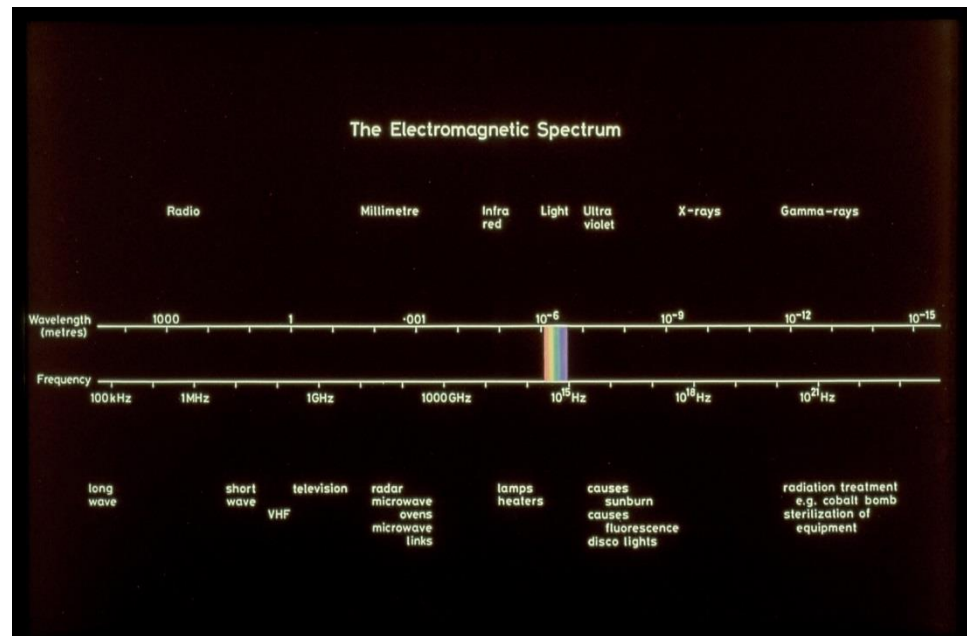


- My 'career' was really a succession of jobs.
- Felt a bit like snakes and ladders!

Subsequently...

- As a researcher, a university lecturer, a tutor, a manager, a Professor, a HoD, a Dean, a PR-and-outreach person.

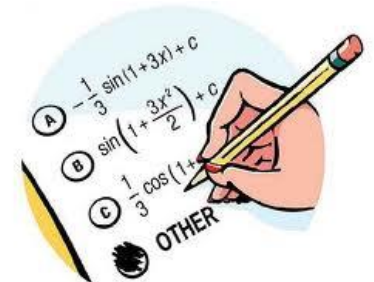
‘Career’ peaking late (70+!)



WOMEN IN PHYSICS TODAY

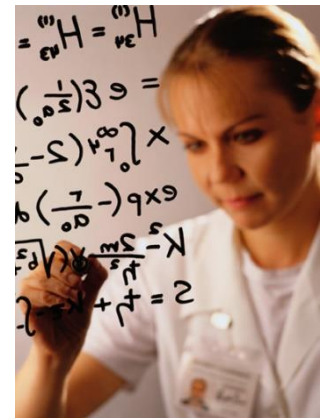
2012 Scottish school physics data

- **Standard Grade:** girls make up 30% of the class (and get 38% of the Grade 1's)
- **Highers:** girls make up 28% of the class (and get 33% of the Grade A's)
- **Conclusion** – girls **can** do physics (but don't always do it)!

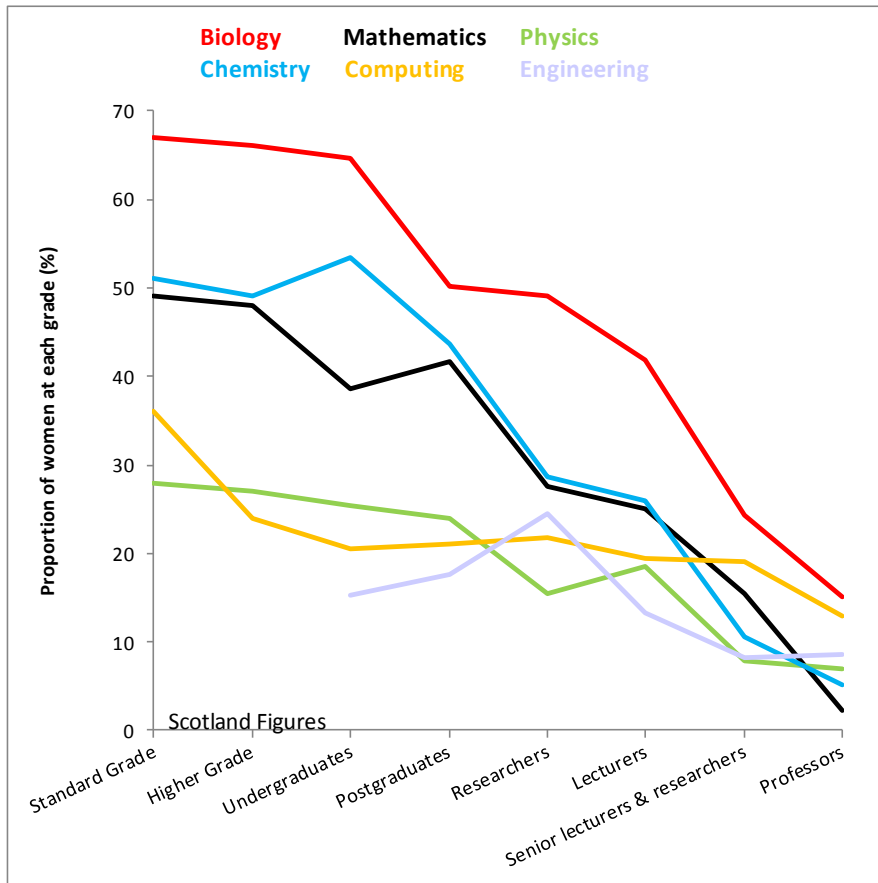


It's different for girls – IoP study (England)

- Girls are **more likely** to do physics if in a single-sex school. For English State-supported schools:
- 1.8% of girls in co-ed school do A level physics
- 4.3% of girls in single sex school do A level physics
- (Similarly at Higher Education)
- What is this telling us?



Leaky pipeline – Scottish data



Proportion of each cohort that is female from Standard grade to prof, by STEM subject.

Similarly for the UK.

In other countries?

- Is this peculiar to Britain?
- International data – professional astrophysicists who are female
- These are women who will have physics degrees.....



Women in astrophysics around the world

| Country | % female | Country | % female |
|--------------------|----------|-------------|----------|
| Argentina | 37 | Belgium | 15 |
| Ukraine | 27 | Poland | 13 |
| Italy | 25 | Sweden | 13 |
| France | 24 | Canada | 12 |
| Brazil | 23 | USA | 12 |
| Spain | 18 | UK | 12 |
| Mexico | 17 | Netherlands | 12 |
| Russian Federation | 17 | South Korea | 10 |
| Greece | 16 | Germany | 10 |
| China | 15 | India | 8 |
| Australia | 15 | Japan | 6 |

Average all member countries: 15% female

Table 1. The proportion of professional astronomers who are female, country by country, as compiled by the International Astronomical Union. Only those countries with more than 100 members are considered.

So.....

- **Limiting factor is culture, not women's brains**
- Numbers low because these tend to be the more senior women
- Similar distributions for physics, maths...
- www.iau.org/administration/membership/individual/distribution/

Serious attempt to be women-friendly



- Athena SWAN scheme to recognise UK universities and Departments that are women-friendly

Is your Physics Department one of these?

- Birmingham, Bristol, Cambridge, Edinburgh, Glasgow, Imperial College, Lancaster, Leeds, Leicester, Liverpool, Manchester, Nottingham, Open, Oxford, Queens University Belfast, Reading, Royal Holloway, Sheffield, Strathclyde, Sussex, Warwick, York
- These physics departments all hold an Athena SWAN award
- More being added.



TOMORROW'S BIG QUESTIONS IN ASTROPHYSICS

What's hot in astrophysics?

- A biased, partial assessment of the new, exciting areas in astrophysics
- Gravitational Waves (Sheila Rowan, Sun pm)
- Transient astronomy
- Dark matter
- Dark energy

Transient astronomy – the dynamic sky

- CCD and computing developments allow us to look for things that vary in brightness on short timescales
- Variable/exploding stars
- Microlensing /flares
- Bursts (gamma, radio)
- Transits of planets



LSST: 8.4 m diameter mirror; being built in Chile; at least 1 million alerts each night!

DARK MATTER

Problem looking for a solution



- Galaxies rotating so fast they ought to centrifuge apart
- We see many no evidence of this

And on a larger scale...



- Individual galaxies move so fast clusters of galaxies should have dispersed
- They haven't!
- What's holding them together?

FORS1 First Light : Distant Cluster of Galaxies

We have had to invent 'dark matter'

- Material which does not shine but has gravity
- Has to be non-baryonic (not made of protons, neutrons ...) since the amount of deuterium would be very different otherwise
- When we identify this there will likely be a major revolution in our understanding of physics

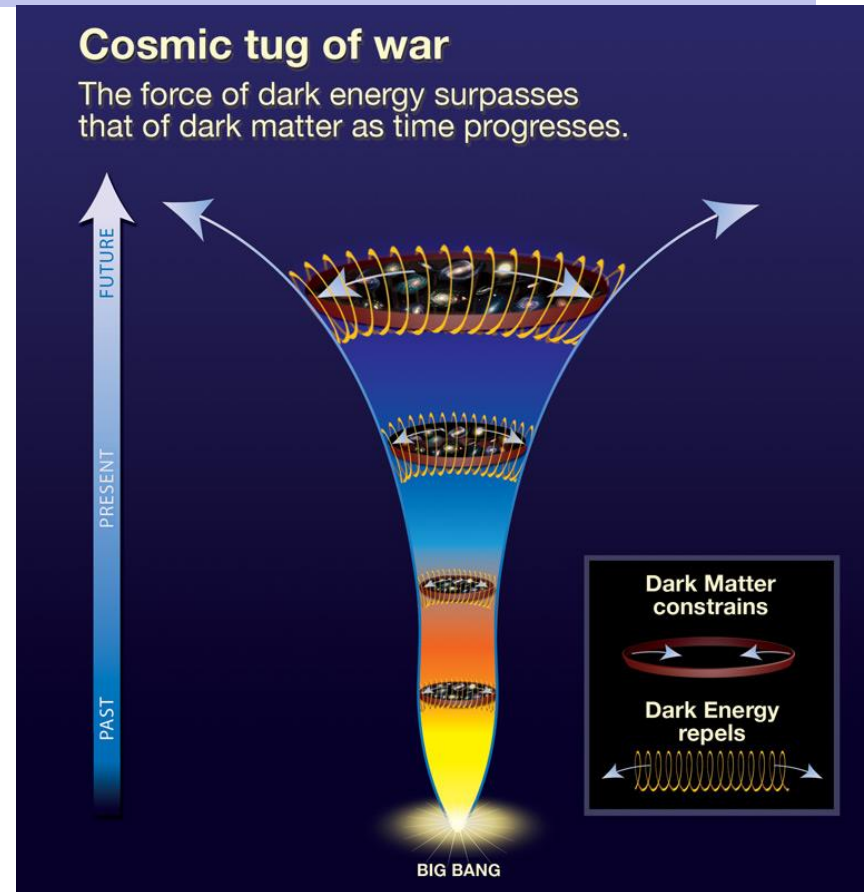


DARK ENERGY

(with apologies for astrophysicists' unimaginative naming of things!)

Supernovae and dark energy

- Some supernovae have turned out to be fainter than expected
- It seems they are further away than expected
- Something (called dark energy) is causing the universe to expand **faster** than expected



What is dark energy?

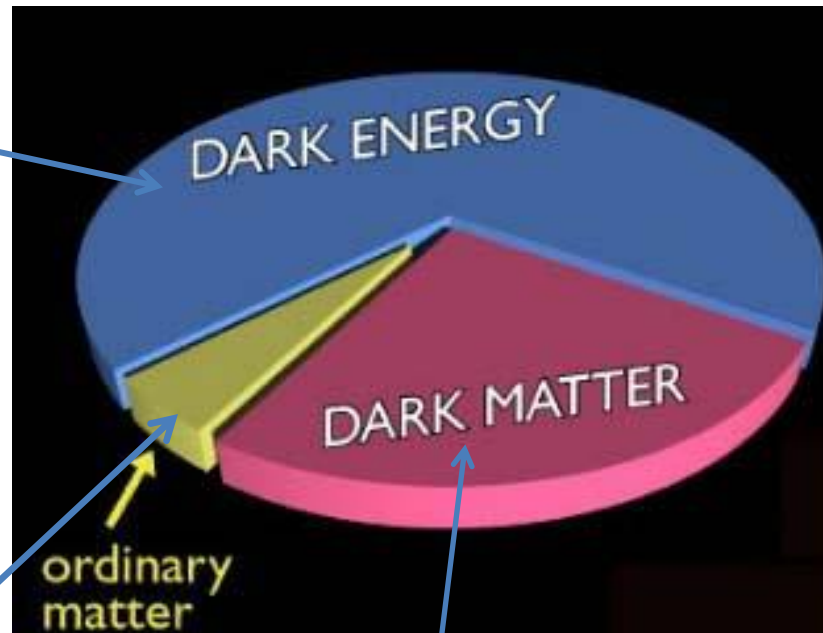
- We-ee-ll, it's! (Not understood)
- It accounts for about three-quarters of the matter-energy of the universe (and dark matter is approx another quarter).
- My hunch – understanding dark energy will provoke a paradigm shift in how we understand the universe.



What we now know about the content of the Universe

(Are we are going backwards?)

Something is making the Universe expand faster



All we have learnt lies in this sector!

Something else is holding galaxies and clusters of galaxies together

BRIGHT YOUNG ASTRONOMERS NEEDED!



The End

