Fake Cosmology Roleplay

Imagine that you are aliens, living on the distant planet Wergle. Wergle is almost identical to the Earth – a small pleasant planet, orbiting close to a star much like the sun. Wergle has a perfectly normal solar system, and lives in a perfectly normal galaxy, much like our own milky way.

The inhabitants of Wergle are scientific, peace loving creatures with technology similar to our own. They have recently become interested in cosmology, and have built a whole suite of telescopes to study distant galaxies, and hence learn about their universe.

Today, all of Wergle's leading cosmologists have gathered together for a workshop, to discuss the results from there recent observations, and see what they can deduce about Wergle's universe.

You should divide yourselves up into the normal groups of 2-3. Each group is one team of rival cosmologists, competing to crack the mystery of Wergle's universe. Each of you will have one data set. Only by combining all the data-sets will you be able to figure out anything about Wergle's universe. It may or may not be the same as Earth's universe…

For the Tutor.

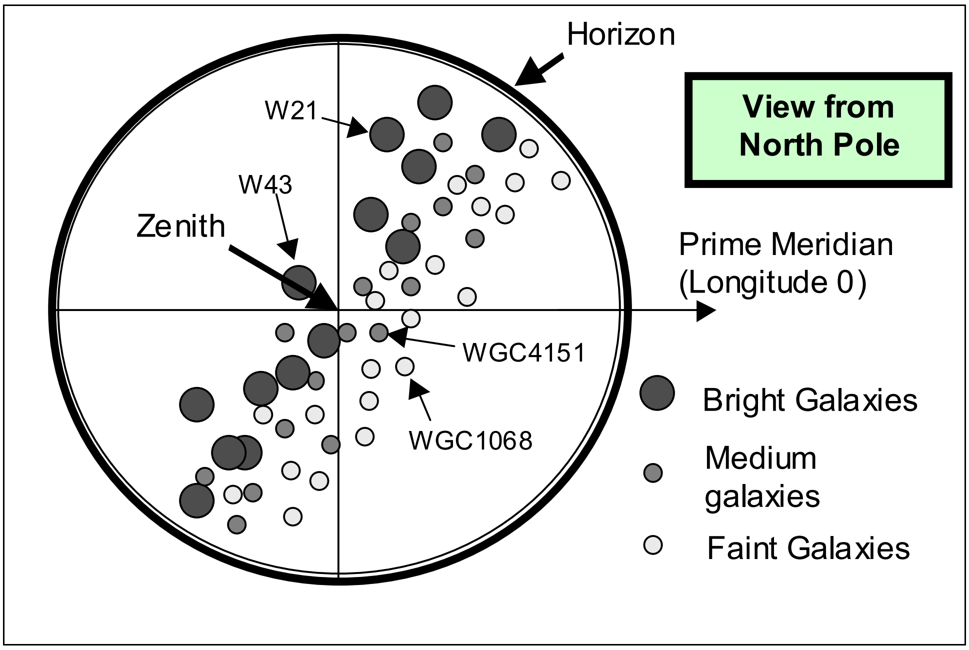
Divide the class into six groups. Each group is necessary to the final answer. Give each group one of the briefing papers. If the class is large, you can give multiple groups copies of the same briefing paper. Get them to exchange information and try and deduce the cosmology of Wergle's universe. It might be nice to award prizes to those coming up with the best ideas.

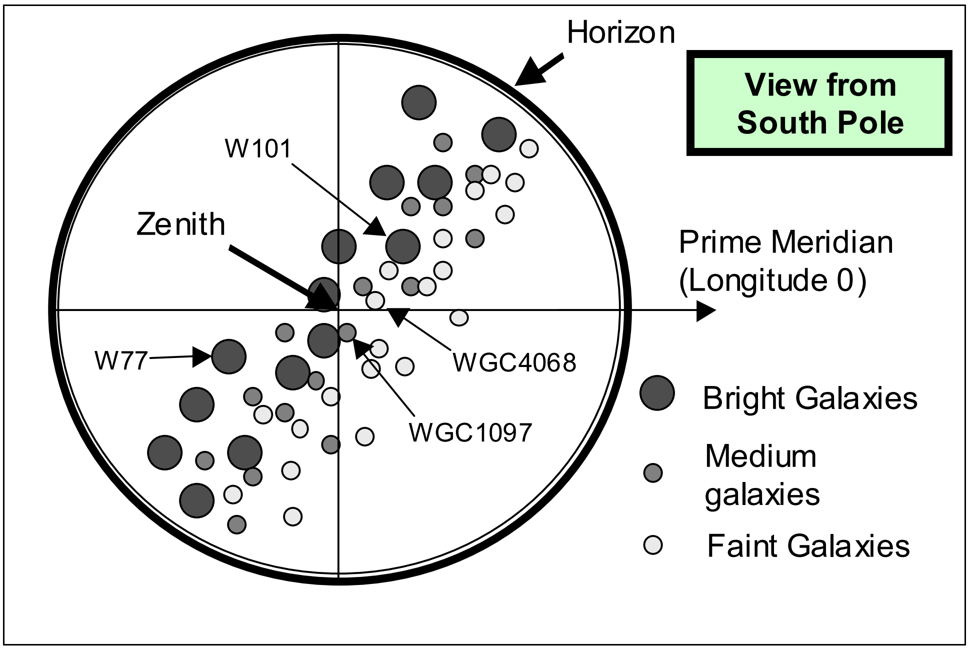
What is the answer? Galaxies in this universe lie close to a spherical surface: they are not distributed uniformly. You can see this because the bright galaxies lie on a plane, while the fainter (further) ones depart from this plane due to the curvature of the sphere.

In this universe, redshift depends on galaxy temperature, as can be seen from the spectra of bright galaxies. Distance does not change the redshift, but it makes the ratio of line wavelengths go funny – the more distant you are, the funnier the wavelength ratios. The funnyness is in a different sense in the northern and southern hemispheres. From this, you can deduce that the laws of physics are a function both of the galaxy type and of where you lie in the universe!

The Wergle All-Sky Survey Team (WASS). From the Welbourne Observatory.

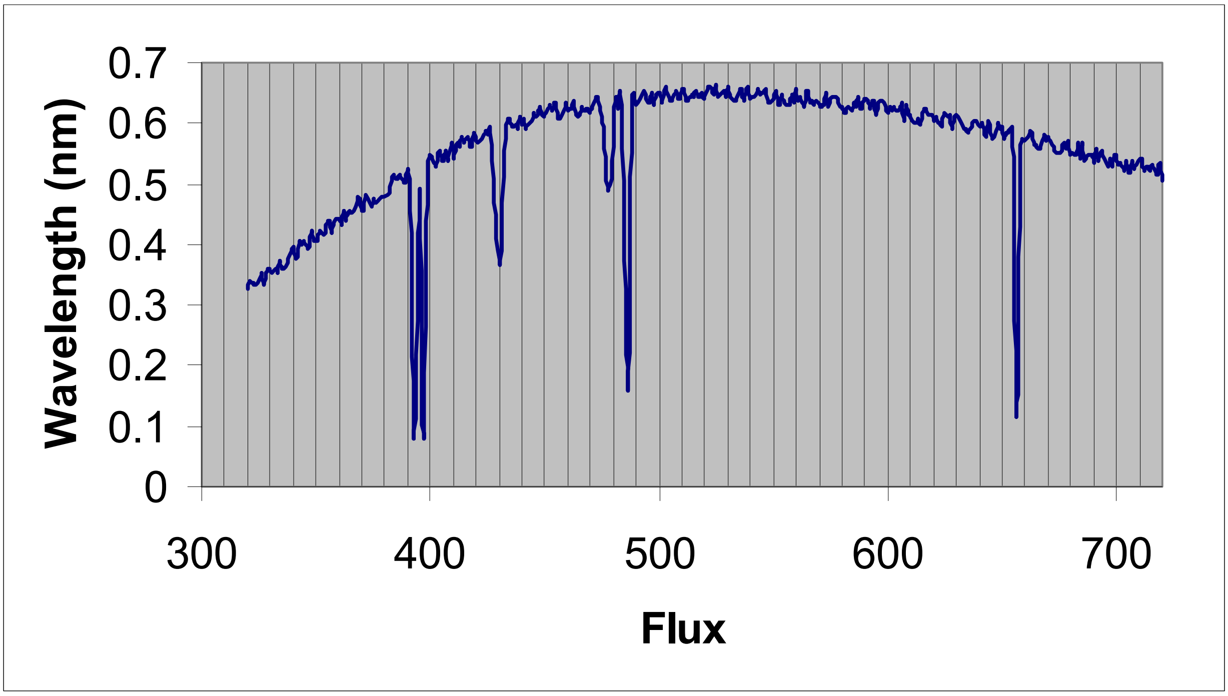
Surely the first step in observing the universe is a good map of what's out there! You decided to produce such a map. You established two observatories, one each at the North and South poles of Wergle. Both observatories were fitted with especially wide-angle telescopes. These telescopes were not powerful enough to obtaine detailed images of everything in the sky, but they make up for this by their enormous fields of view. Between them, the whole sky has been mapped: both the northern and southern hemispheres. Over several years, you have laboriously eyeballed all these maps, and produced a catalogue of the location of every galaxy (down to the faintest you can see with your telescopes).
Here are maps of the sky drawn from this catalogue. Names of some of the better studied galaxies are marked.



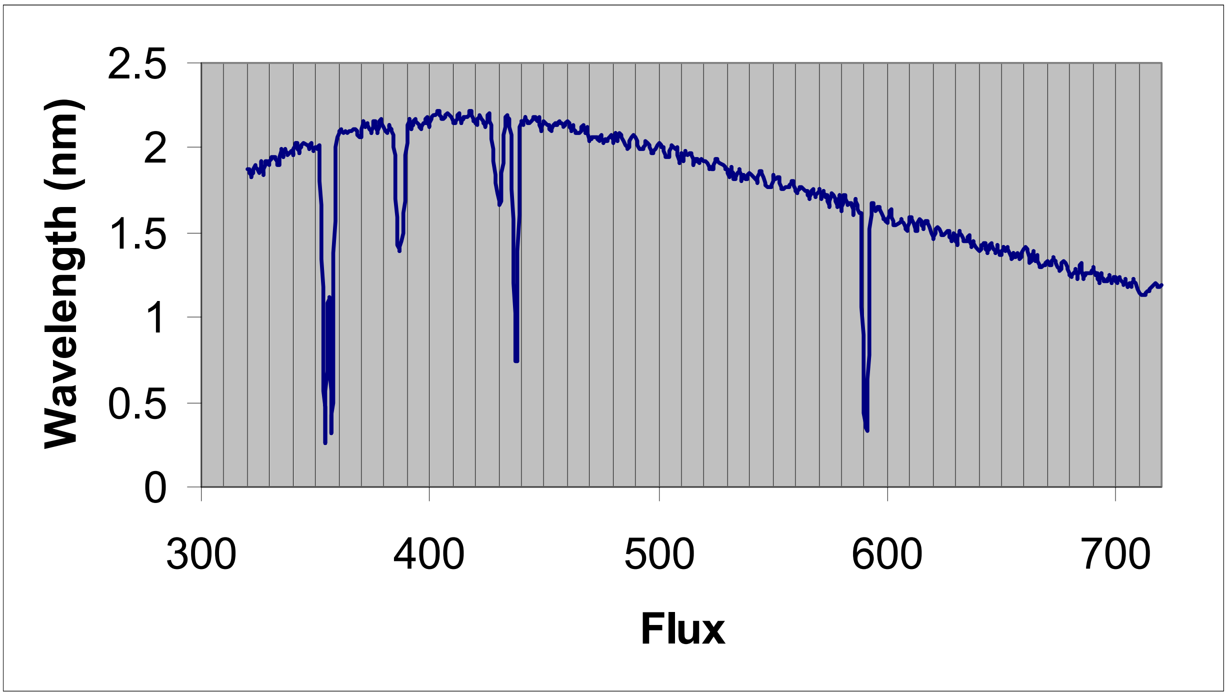


Mt Womblo Spectroscopic Survey Team.
You are an active team of young researchers from Mt Womblo Observatory. You don't have access to any really large telescopes, but you have lots of medium sized ones. You have been using them to do an enormous survey of the spectra of bright galaxies. This survey has only just started, but you have already obtained four high quality spectra. Here are those spectra.

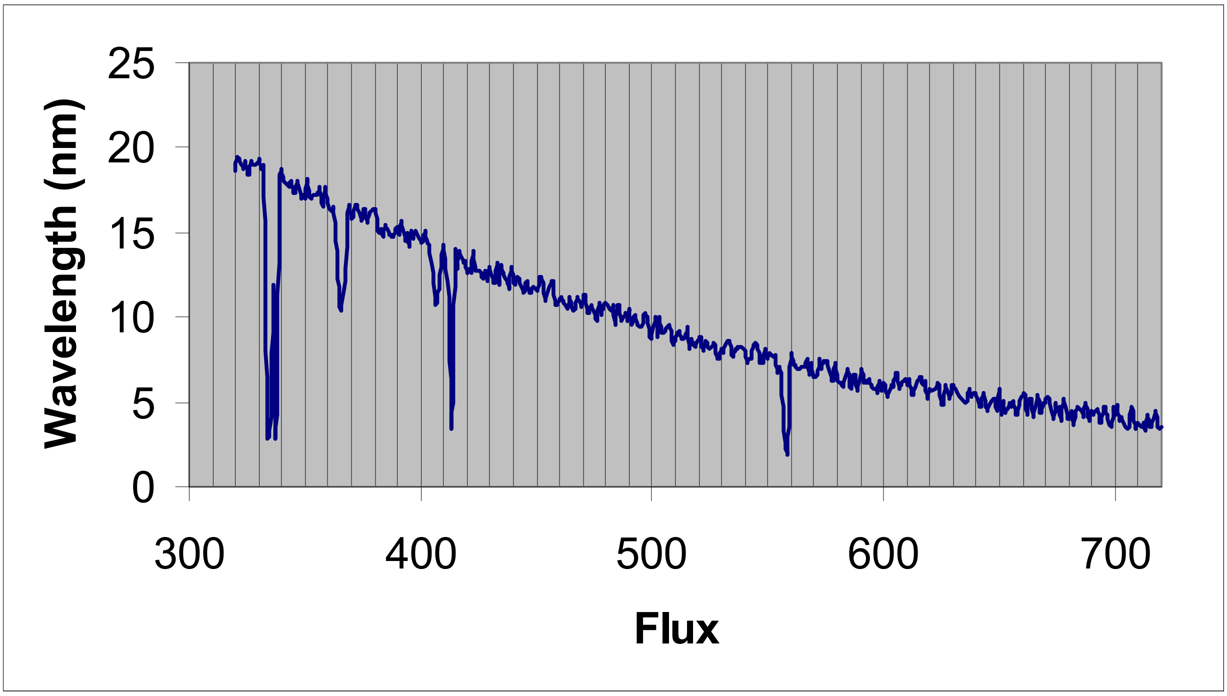
Galaxy W21



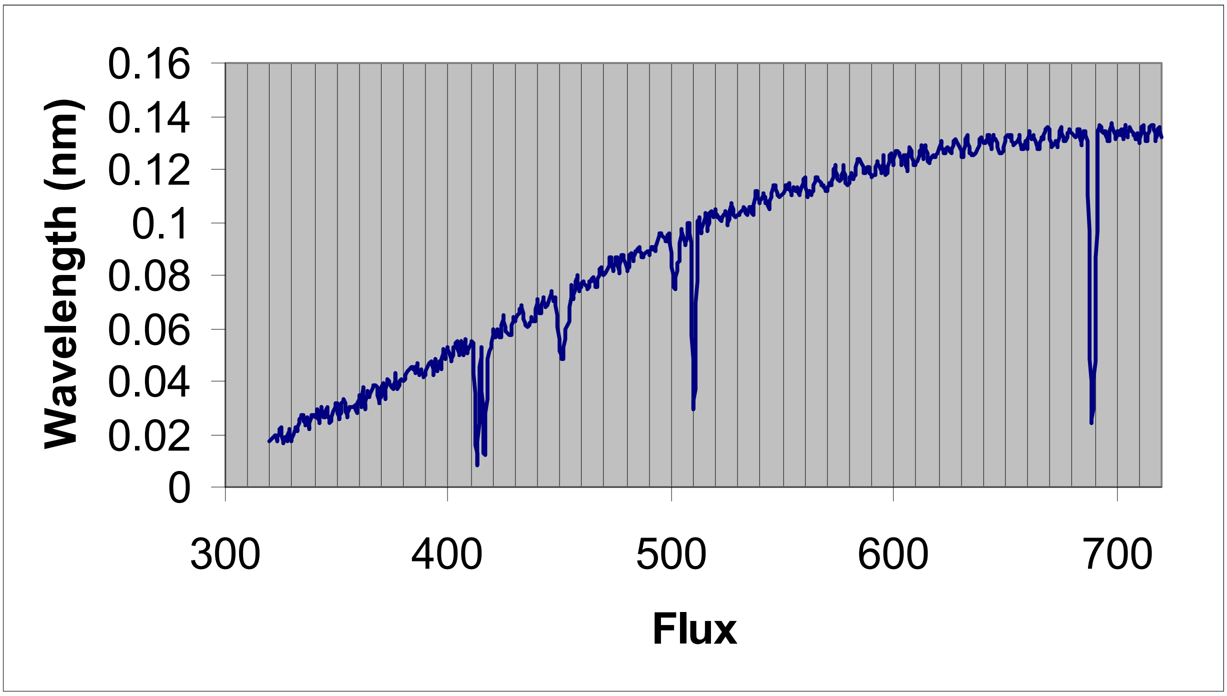
Galaxy W43



Galaxy W77

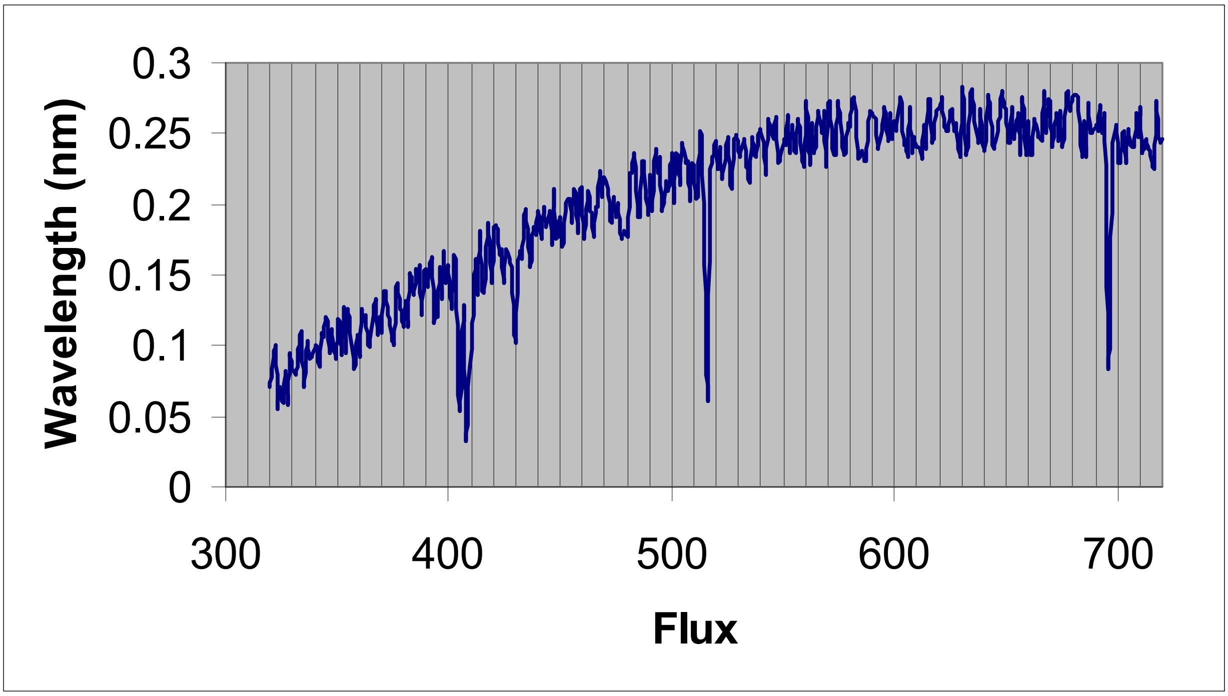


Galaxy W101

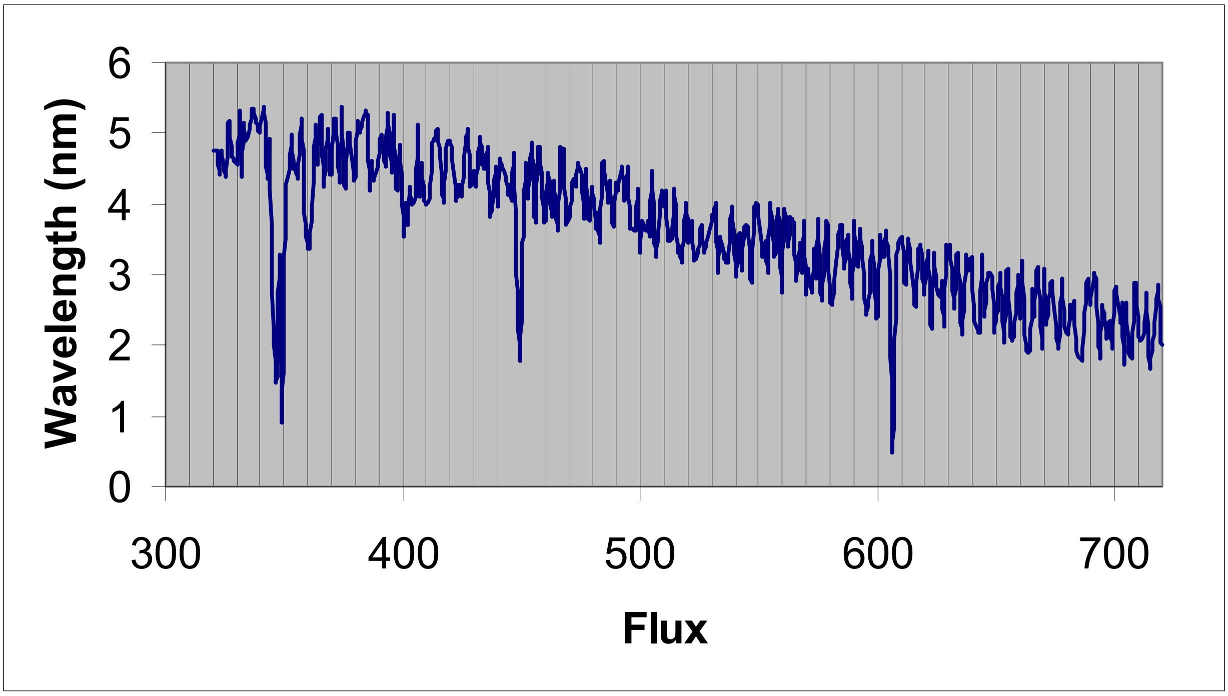


Weminimi Telescope National Facility.
You work with the two giant Weminimi Telescopes: the most sensitive ever built. It is a great privilege to work here, though you often suffer from altitude sickness (both telescopes are on very high mountains). You have been using the power of these telescopes to obtain spectra of faint galaxies: galaxies beyond the power of lesser telescopes. Here are some of your spectra.

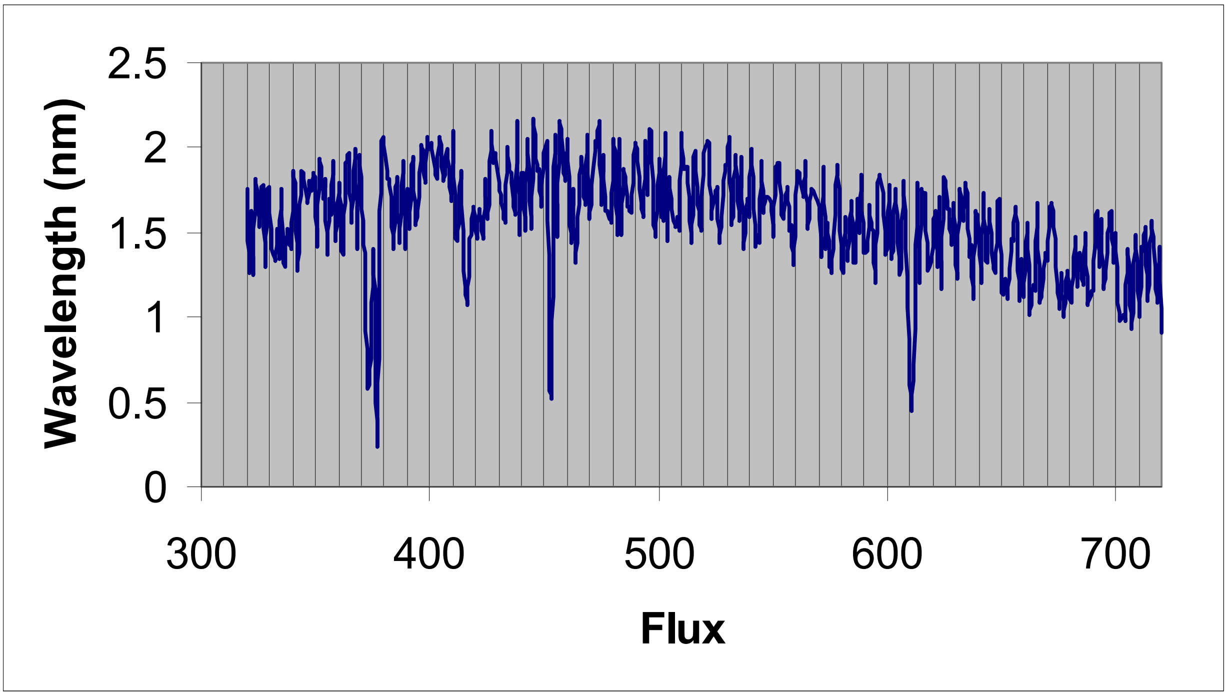
Galaxy WGC4151



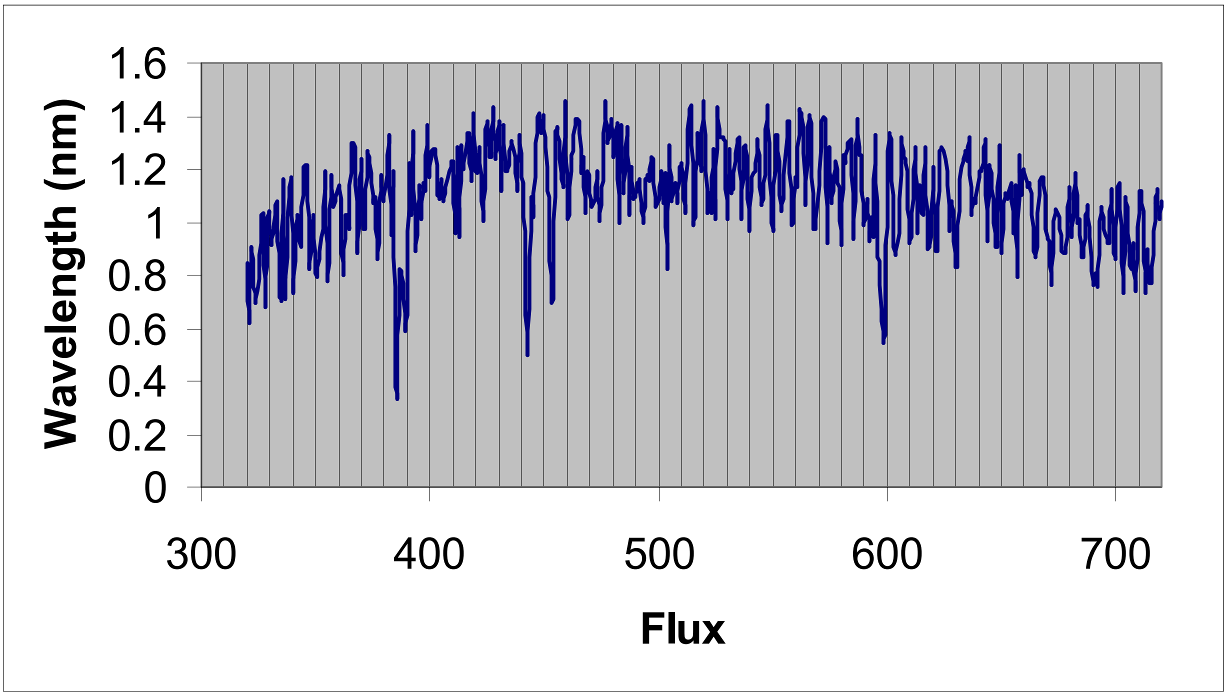
Galaxy WGC1068



Galaxy WGC1097



WGC4068



Big-D Consortium: Wibbly National Observatory.

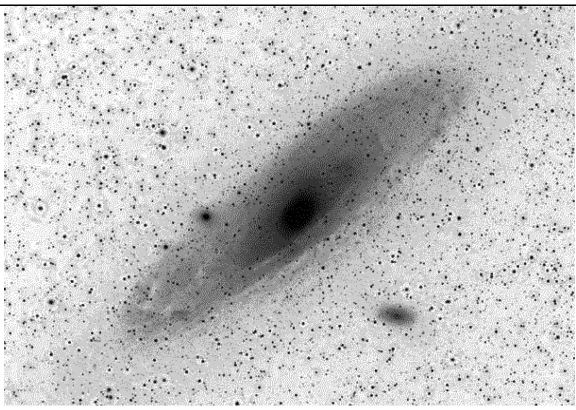
You are the leaders of an international consortium, interested in exploding stars: Supernovae. You have discovered that one particular type of supernova (Type 1a) always have the same real maximum brightness. It was an incredible important discover, and has won you the Wobel prize already.

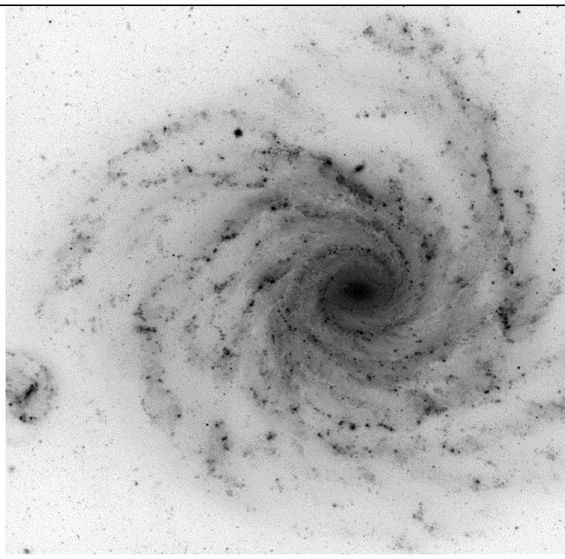
You don't know what this constant maximum brightness is, but you do know it is always the same. This means that you can use these Type 1a supernovae to estimate relative distances. As they all have the same real brightness, any differences between the observed brightnesses must be due to variations in distance: ie. the fainter ones will be further away.

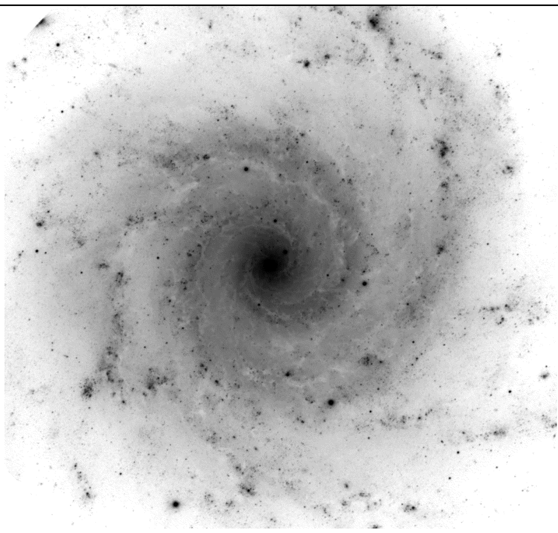
Using a wide range of telescopes, you have recently succeeded in finding a Type 1a supernova in eight galaxies. You measured the peak brightness for all eight. These results are listed in the table below.

Galaxy Name	Photons per square metre per second arriving from this supernova at its maximum brightness.
W21	9,700
W43	10,430
W77	11,780
W101	9,200
WGC1068	97
WGC1097	650
WGC4068	52
WGC4151	280

Wubble Space Telescope Science Institute.
You work with the world-famous Wubble Space Telescope. You have used its superb image quality to obtain pictures of many galaxies, both near and far. Here are those pictures.


W21


W43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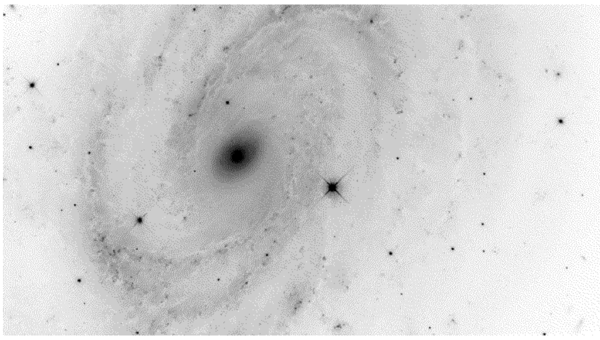
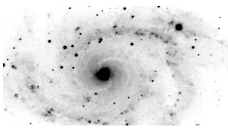
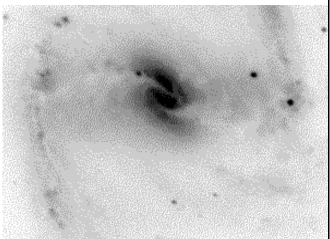

W101


WGC1068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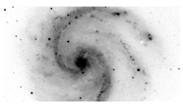
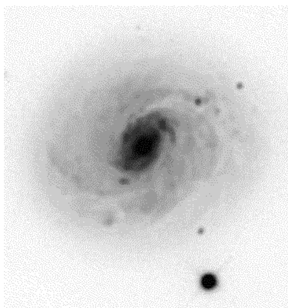

WGC4068


WGC4151

Widney Special Research Centre for Theoretical Astrophysics

You are laboratory astrophysicists, interested in the spectra of stars and galaxies. There are hundreds of astronomers out there taking spectra of things. And these spectra are useless unless they can identify what is present in them. That's where you come in.

In your lab, you take various mixtures of gasses and heat them up to conditions similar to those found in stars and galaxies. You then shine beams of light through the gas and see what wavelengths are absorbed. It is a slow and laborious job, but the results (listed below) are vital.

Wavelength	Ion or molecule, and line name (if any)
3933	Ca II (Calcium K – ionised Calcium)
3968	Ca II (Calcium H – ionised Calcium)
4026	He I (Neutral Helium)
4101	H I (Hδ – Neutral Hydrogen)
4226	Ca I (neutral Calcium)
4300	CH (G-band) – any molecules with carbon-hydrogen bonds
4340	H I (Hγ)
4471	He I
4584	TiO (like all TiO lines, a broad absorption band)
4625	TiO (Any molecules with titanium oxygen bonds)
4761	TiO
4780	MgH (any molecules with Magnesium Hydrogen bonds)
4861	H I (Hβ)
4954	TiO
5167	TiO
5448	TiO
5497	TiO
5759	TiO
5810	TiO
5847	TiO
5862	TiO
6158	TiO
6563	H I (Hα)
7054	TiO