Stargazey Pie!
A slice of Highlands astronomical life!
Tues 2nd December 2014

HAS Meeting Notices December 2014

1. **Current News and Dates for your Diary**

- Our updated 2014/15 Programme of Events is available at reception; the details are also on the website at: www.spacegazer.com

- Evening sessions at the observatory are under way: Forthcoming sessions are:
  Saturday 13 December (Members)
  Friday 19 December (Public)
  Saturday 20 December (Members)

  Wrap up warm and always check the website (www.spacegazer..com) to check whether the session is running. Clear skies!

- **The next meeting is on Tuesday 6 January 2015** - this will be a talk by Maarten de Vries of HAS on Planetary Nebulae.

- **Look out for** the Geminid meteor shower on 13 December.

- **January Outreach Day at the Eastgate Centre, Inverness** – advance notice that we will be holding our annual outreach day at the Eastgate Centre on 24th January.This will be followed by a viewing at the Observatory – we will need help with both – if you are able to volunteer for an hour or two please let a committee member know. Many thanks.

- **Suggestion Box** – at reception. Don't forget to let us know if you have any ideas you would like the committee to look at – this is your Society, please help the committee to provide what you are looking for. Or of course speak to a committee member.

- **Replacement of telescope mount –** The mount is on the pier and Paul and Gerry have been trying to align the telescope. Although the declination axis is well adjusted, there are problems with the RA axis and this will mean demounting the telescope and readjusting the adaptor plate. There are also a couple of other issues and unfortunately it means it is all taking longer than expected.

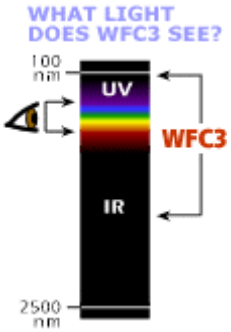
- **Aurorae and Telephone alerts** – should you see an aurora, noctilucent clouds, or anything else of astronomical interest, please alert Paul or Pauline. It is never too late at night to let us know. PLEASE NOTE, the wording of the telephone alert is a little strange. If you receive a telephone call with a disembodied voice beginning, “This call will not cost you anything...” - please don't hang up, it is your aurora alert! Alerts can also be sent by text to your mobile – if you would prefer this option please check with Ronnie that we have you signed up for this.

- **On-line Payments to HAS –** it will very soon be possible to make payments (e.g. membership) to HAS on-line. We will keep you posted as to progress.

Main Event: Early Galaxies by Professor James Dunlop

Professor James Dunlop is from the Royal Observatory Edinburgh. He studied physics at the University of Edinburgh and received a PhD in astrophysics in 1988. He worked with an astrophysics group in Liverpool and then returned to Edinburgh where he is an observational cosmologist who studies cosmic history and the birth of the first galaxies.

Prof Dunlop began by explaining that a step out in distance is a step back in time and took us on a journey from the Royal Observatory in Edinburgh to the Hubble Ultra Deep Field to help us to understand distance and how far back in time we are looking. Photographs from above showed the Royal Observatory in Edinburgh receding into the distance, and on reaching the Hubble Space Telescope we learn that the light travel time is 0.2 milliseconds.

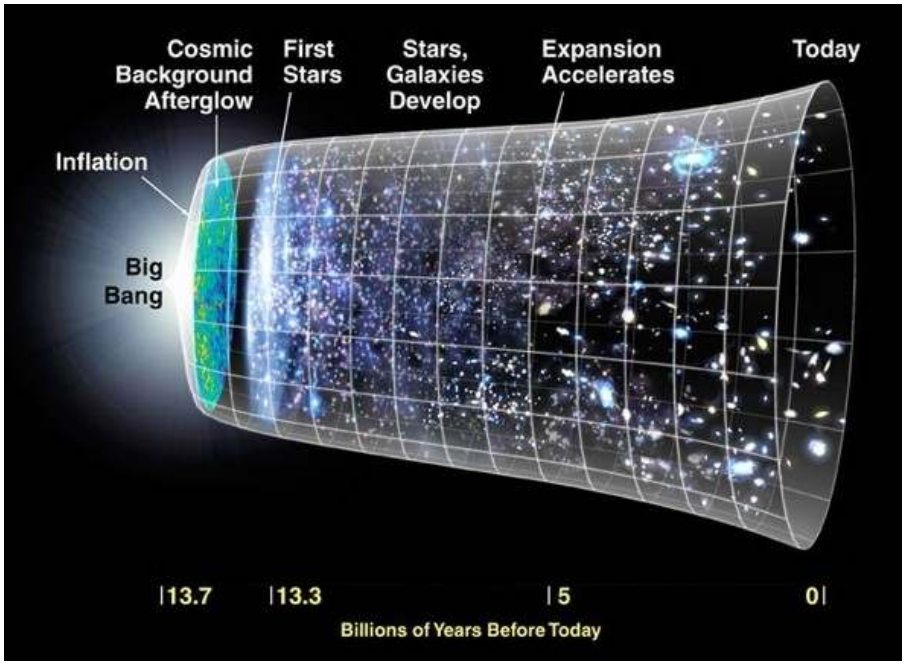


Hubble holds the key to seeing farther. Its new instruments include wide field camera 3, which has an ultraviolet and near infrared camera containing 17 filters of different wavelengths. The galaxies seen through some of the filters are not seen through others; these are known as 'drop out' galaxies – we can see faint distant galaxies in some bands (filters) but not others and this tells us that some of these galaxies are farther away than others.

The reason astronomers study things a long way away is to study them as they were a long time ago otherwise they could just study things nearer. They may just be smudges but they are the farthest things back in time.

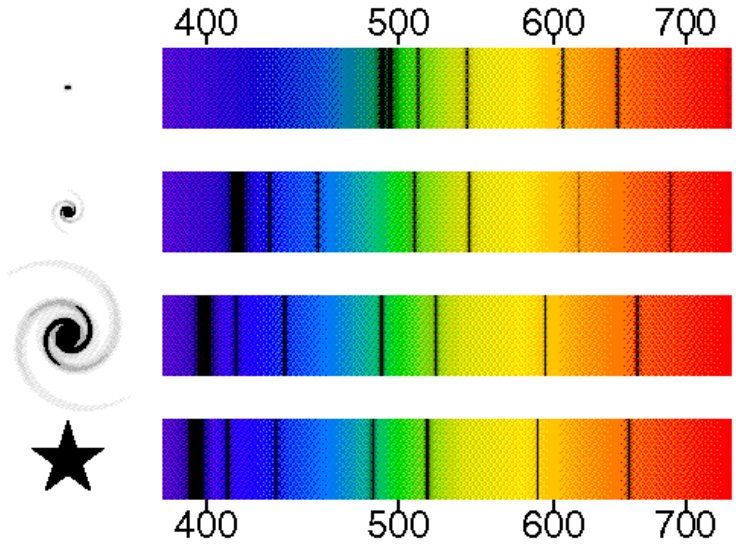
Continuing with distance and time, the light travel time to the Sun is 8½ minutes (93 million miles away), to Pluto is 5 hours (4000,000,000 miles away) and to Proxima Centauri 4.2 years (4.2 light years is about 25,000,000,000,000 miles). Andromeda is our closest largest galaxy at 2.4 million light years away so it takes 2.4 million years for light to reach us and we therefore are looking back as it was 2.4 million years ago. Our Local Group of galaxies would take perhaps 10 million years to cross and there are millions and millions of galaxies gathered into clusters and superclusters. Eventually we can look back to the farthest galaxies as in the Hubble Ultra Deep Field, which is a multiple exposure of one point of the night sky which allows us to see 90% all the way back to the Big Bang.

We need the microwave background to see farther back in time – this is a heat map of the early universe, which we are seeing as it was over 13 billion years ago. The microwave background is light that has been stretched to microwave wavelengths at a time about 380,000 years after the Big Bang when the temperature of the universe cooled to 2.73° K.



The universe at this time was cold, hydrogen and helium atoms were all neutral and it was dark – no stars. This was known as the dark ages. The very slightly denser regions that we can see in the microwave background began to contract under gravity and began to form the first stars which very quickly gathered together to form the first galaxies. The universe became reionised.

How can we tell how far away something is? The faster something moves away from us the farther away it is due to the expansion of the universe. How do we measure this? By looking at the redshifting of the light – wavelengths move into the redder regions of the spectrum.



Light from a very distant galaxy has shifted far to the right

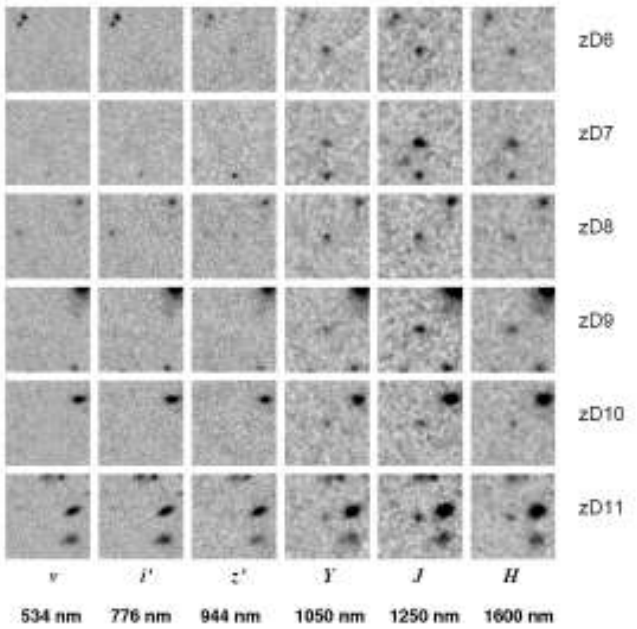
Light from a distant galaxy has shifted to the right

Light from a galaxy has shifted a little to the right

Light from a nearby star

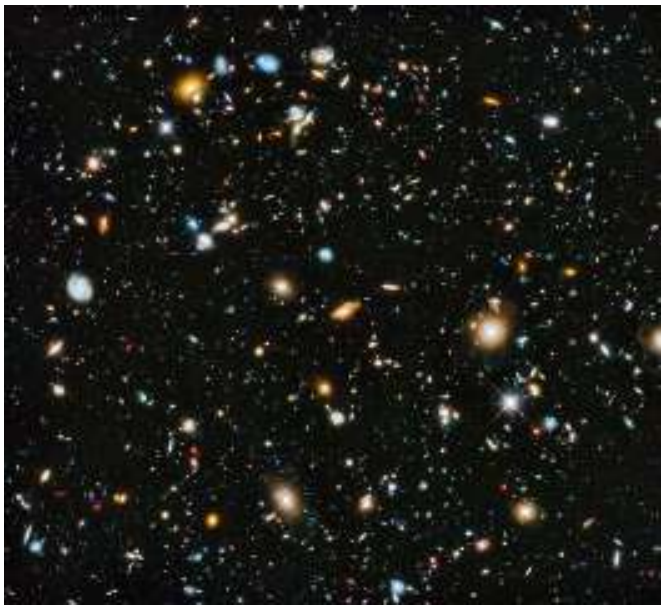
This is like the noise of a siren as it passes you – the noise is high pitched as it comes towards you and becomes lower in pitch as it moves away from you. This is known as the Doppler shift. When light is shifted towards the red end of the spectrum the object is moving away from you and the more it is shifted the father away the object. When light has shifted so far to the red end of the spectrum that you can no longer see the object then Infrared filters are required.

Astronomers look for objects that 'drop out' i.e. become invisible in the Hubble optical camera but they can be seen in Infrared wavelengths.



Red shift = z. The higher the 'z' number the greater distance. So a galaxy with a redshift of 10 - 12 will be seen in final filter (the 17th filter).

In order to see farther the James Webb Telescope, which will use mid IR wavelengths, should allow astronomers to see greater than a redshift of 12 (z >12). However, if this telescope goes wrong it is not possible to mend it as it will be too far away. It will be launched in 2018 if all goes well. Royal Observatory Edinburgh made some of the instruments.



The farthest galaxies seen in the Hubble Ultra Deep Field are not the first galaxies because they look too red to be made out of just hydrogen and helium and are similar in colour to closer (and thus more recent) galaxies. Therefore they must contain other elements. The first galaxies and thus first stars were only made out of hydrogen and helium as these were, apart from a little lithium, the only elements made in the Big Bang.

It is stars that create all the elements found in the universe today both during their lifetime and also when they explode as supernovae. The first stars are thought to have been giants and are known as pop 111 stars. They didn't last long and then exploded as supernovae spreading all the elements they made throughout the universe to give subsequent generations of stars (population 11 and population 1 stars) the composition we find in stars today and making possible the formation of planets and all living things. Thus all subsequent stars will have a different composition to these first stars.

These first large stars have not been found because they will have gone through their lives very quickly and will have all exploded. Astronomers are still searching for these very first stars in the very first galaxies but hopefully the James Webb Telescope will enable them to be found. They need to be able to look back in time to the dark ages (before the first galaxies formed) and then all they have to do is look a little further forward and the first galaxies should be there.

Thank you Professor Dunlop for a fascinating talk about the earliest galaxies and giving us an idea of just how far away they are in the universe.

Pauline Macrae

Next time we have Maarten talking to us about those beautiful objects peppering our Galaxy and beyond: planetary nebulae. His talk will be followed by lots of tea and biscuits.

Last but not least: Paul wishes to sell his 5" Helios achromatic refractor, complete with its EQ-5 mount and RA drive motor. Please get in touch with Paul if you are interested.