

Stargazey Pie!

A slice of Highlands astronomical life!

Tues 9th Apr 2013

INTRODUCTION

April was our AGM and so you should have received all relevant AGM related documents by email before the meeting. If you have any questions, please contact our Secretary, Caroline Woods, directly.

- **Current News and Dates for your Diary.** Tonight is our Society AGM. Hopefully you will have received copies of the Agenda, Annual report for 2013 and minutes of the 2012 AGM via post or e-mail but if you have not, please see Caroline as a few copies will be available at the front desk. We will be keeping the AGM short and sweet so as to give our guest speaker Bill Chaplin the time he deserves for tonight's talk on "Astero-seismology"! There will be no discussion group tonight after the tea break due to time constraints so instead we are having an extended question session with our speaker.

We are now at the end of our 2012/2013-membership period and the 2013/2014 period will start tonight, so please collect a membership form from Paul or Caroline. Subscription fees for the 2013/2014 period will be available to look over and Paul will be available to collect your completed forms and fees during the tea break.

HAS Trip to St. Andrews Observatory - This has been organised for Saturday the 20th of April and will cost £20 per member. Please see Pat Escott or Paul tonight if you still wish to go and to make your payments, remember this is a HAS exclusive tour around the home of the largest operational telescope in the country as well as a look at the University's research into extra-solar planets!

The Inverness Archive Centre will be having an **Astronomy Practical Day** on Saturday 27th of July, Pat and Pauline will be looking for volunteers to help out.

HAS members have been formally invited to the **Orkney Science Festival**, which will be taking place between the 4th and 11th of September. Members will have to make their own arrangements for travel and accommodation but please see Pat Escott, Paul or Maarten with any queries as they have attended the festival before and will be able to provide information.

And Finally - If you would like to receive our monthly newsletter Stargazey Pie, please see or contact Caroline; also if you have changed your e-mail address recently, please let her know!

- **Solar Saturdays.** Our Solar Observing sessions will be starting on the 27th of April and will be held at the JSL Observatory in the Culloden Battlefield car park between 2pm and 4pm. They are a fantastic opportunity to observe our nearest star and all solar activity. Needless to say though, they are weather dependant! Please check the website for further updates.

- **The next Meeting** is on Tuesday the 7th of May – We have guest speaker Duncan Forgan coming to give us his talk “Extrasolar Planets and Extraterrestrial Intelligence”! As we have a guest speaker we will not be having a beginner’s group after the main talk but instead we will have a discussion group with our speaker where members will have a chance to question Duncan on his field of research in more detail.
- **The Aurorae and Telephone alerts.** Should you see an aurora, noctilucent clouds, sprites or anything else of astronomical interest, please alert Pauline or Paul. It is never too late at night to let us know. (Wicked laughter... -Ed)
- **New Committee members and volunteers welcome.** As always, if you feel you could dedicate some time to volunteer within the society or even just to let us know if you think there are suitable changes we could make to some of our processes, please let us know! We are into a new society year and your committee will strive to continue to keep members up to date with any upcoming events or astronomical news but we always have time for input from our members and your feedback and help is very much appreciated.

The AGM

Being April, we had our AGM, which was swiftly dealt with.

After Arthur welcomed everyone, the 2012 minutes were approved.

There was one matter arising in the Trustees report, in that Stargazey Pie is now written by Pauline or Michael and not Antony as stated, as he has now retired from this - although he still writes Highland Skies and continues to upload Stargazey Pie to our website. (And acts as Editor! – Ed) There was no Stargazey Pie last month because neither Pauline nor Michael was present and thus unable to write it. An excellent piece of news is that subscriptions are to be reduced because the Society’s bank balance is healthy thus the members can benefit.

Subscription rates:	Standard	£20.00
	Family	£32.00
	Student/unemployed	£ 6.00
	Children/visitors	£ 2.00

Next came the election of Office Bearers –

Arthur was re-elected for another year.

Caroline, who became Secretary when Pat Williams resigned, was formally re-elected as Secretary. Although Paul has served his term, because there had been a change in Secretary, it had been decided he should stay on as Treasurer for another year to ease this change.

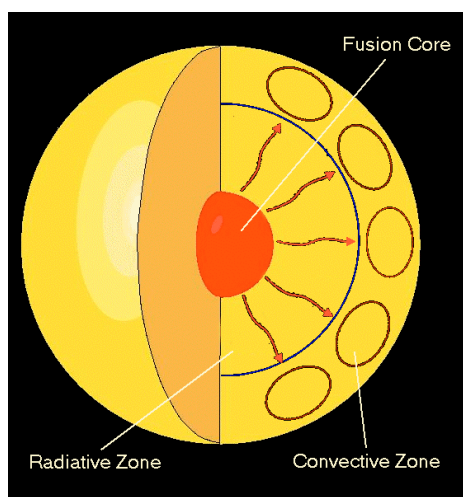
Arthur professed his thanks and gratitude once again for all that Pat Williams has done for the Society over many years as Secretary or as a Committee member.

The Main Event: 'Asteroseismology' by Prof. Bill Chaplin

We were very lucky to have Professor Bill Chaplin from the University of Birmingham to talk to us about Asteroseismology. He has a BSc Hons in Physics and Astrophysics and a PhD in stellar physics (on asteroseismology) both qualifications from Birmingham University. In addition he has a teaching qualification. Bill Chaplin is the lead in the area of the Kepler Mission devoted to the asteroseismic investigation of solar-type stars, and coordinates the work of 170 international scientists. He has co-authored many research papers and has written a book on helioseismology. In his spare time he likes to watch Rugby.

Kepler was launched in 2009 to detect potentially habitable planets. It has been working for four years and will continue for three and a half more.

Asteroseismology is the natural music of the stars. Through sound waves we can determine the structure and properties of a star. In order to find out if a planet could be habitable, we need to first be able to characterise its parent star.



The Sun resonates like a musical instrument. A musical instrument resonates in a number of different tones and the same thing happens in a star. In the core of a star, nuclear fusion reactions occur and the energy is carried out by photons. Up to about two thirds of the way out, radiation carries this energy (the radiative zone). The last third moves parcels of hot gas by convection (the convective zone). Sound originates within the narrow layer just beneath the surface, is trapped within the star and bounces off these different layers – this is how we know they exist.

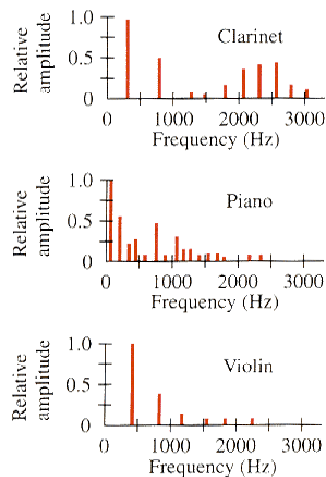
We cannot hear the sound produced – space is a vacuum – but also because the pitch is too low for our ears. However we can see the sound waves produced, due to gas moving back and forth, so we see the star moving in and out as though it is breathing. This is the physical manifestation of sound trapped in the star. The oscillation typically lasts about five minutes in the Sun. The movement is tiny, only a few tens of meters, when compared to the size of the Sun but it's possible to measure the speed of the in and out movement and the changes in brightness which may only be a few parts in a million.

Helioseismology is the study of the Sun's interior by the analysis of its oscillations and sound waves passing through it. In the 1970's it was discovered that the Sun was breathing in and out. Prior to helioseismology, we didn't have a way to look into the Sun and all we could see was light coming from the Sun. If we can measure the properties of these resonances (oscillations), we can discover what the interior of a star looks like. Sound varies according to the type of gas it is passing through and also the size of a star. By analogy to a musical instrument, if you change the size of an instrument this changes the pitch. Large instruments will produce a low pitch, small instruments a high pitch. Large stars resonate in lower tones, small stars resonate with a higher pitch as will stars that are hot because sound moves faster through hot gas. This allows us to build up a picture of a star. Sunquakes are oscillations of the Sun and the resulting squiggles resemble a seismograph.

Asteroseismology is the study of stellar oscillations in order to determine the internal structure and global properties of stars.

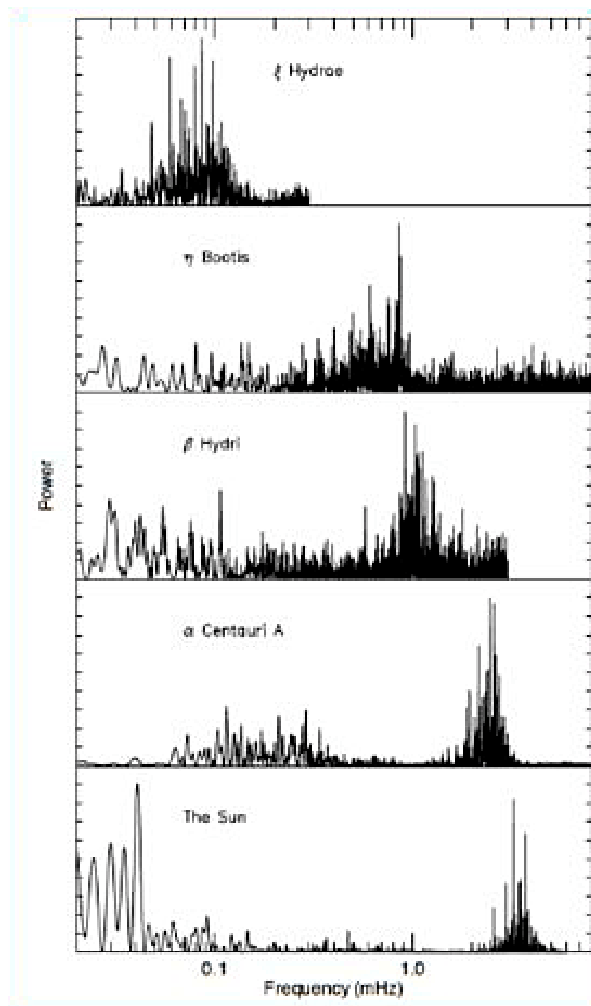
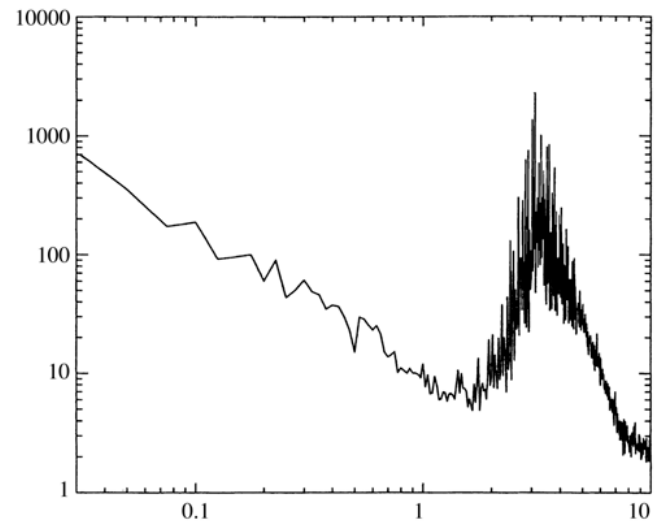
Kepler spends its time staring continuously at one part of the sky monitoring 150,000 stars. Bill Chaplin is involved the Kepler asteroseismic science consortium which was established five years ago. They are looking in particular at solar-type stars.

The shapes of the spectra change as the instruments play different notes.



A musical instrument produces fundamental tones and then lots of harmonics.

The frequency spectrum of the Sun (on the right) is in micro-hertz, so at a much lower pitch. Here there is strong amplitude but narrow frequencies.



The Sun resonates many octaves below what the human ear can hear. By measuring the peaks and the range it can provide information on the Sun or a star. Large stars produce a low pitch and small stars a high pitch.

In addition by studying different stars it is possible to see what our Sun may have looked like in the past as well as what it will look like in the future. As a solar-type star increases in size it increases in age. Look at the diagram on your left, the Sun is at the bottom then as you move up the stars tend to age and grow larger so the pitch or frequency becomes lower.

The oscillations we see in stars are like a Rosetta stone, which we can then use to determine the star's properties.

Asteroseismology is important when looking for habitable planets with Kepler as it can determine the

type of star, how it evolves, its impact on habitability and how our Sun affects life on Earth.

Kepler detects planets by the transit method – a drop in light indicates a planet has passed in front of its parent star. A drop in light of 1% indicates a Jupiter sized planet whereas a drop in light of 0.01% indicates an Earth sized planet. 2740 candidate planets have been found so far. One in six stars should have one Earth sized planet. If a planet is habitable it should be in the habitable zone. This zone varies according to the size of the star. To measure the size of a planet we need to know the size of the star. Asteroseismology is used to determine the size of the star and thus the size of the planet and whether it is in the habitable zone by working out its brightness.

Kepler 22 is a super Earth and lies at the inner edge of the habitable zone. The size of the star and therefore size of planet and where the habitable zone is, was worked out using asteroseismology. Otherwise it is not possible to determine whether the planets found really are habitable.

Hot off the press is the discovery of a Mercury sized exoplanet, Kepler 37, orbiting a small star hosting three small planets. The only way to determine the size of this tiny planet was through asteroseismology.

So Kepler is not just about finding planets; by using asteroseismology it is possible to work out the size and mass of these planets and whether they could be in the habitable zone.

Thank you Professor Chaplin for a very interesting talk.

Pauline Macrae

Next month: We are very lucky to have another outside speaker, this time in the form of Dr. Duncan Forgan who will be wondering about extraterrestrial intelligence (are there aliens amongst us?) and extrasolar planets.

Until then, why not come along to one of our Solar Saturday observing sessions.