FAS Newsletter

Federation of Astronomical Societies http://www.fedastro.org.uk

Another Successful FAS Convention

The 2009 FAS Annual Convention was once again held at The Institute of Astronomy, Cambridge. In spite of not being the most convenient location for many people it does seem to be the preferred venue for such events.

After refreshments, kindly organised by members of Cambridge AS, the event got underway with a talk by Dr Haley Gomez of Cardiff University. Her talk, ***Herschel - Unveiling the cool universe***, described the Herschel infra-red telescope and its objectives.

With its 3.5metre diameter mirror it will collect long-wavelength radiation from the coldest and most distant parts of the Universe. In particular, using infra-red this will be able to 'see' through the dust clouds which frustrate most other forms of telescope.

Dr Gomez teased us by saying that some exciting results were being obtained, in particular related to Cass A, but giving more information was 'more than her job was worth. I am sure many of the audience will watch the astronomy press and relevant websites with great interest for further announcements on the progress of this exciting project.

The second talk of the day was due to be Planetary Observing by Damian Peach. However Damian was unfortunately indisposed and so Jerry Workman stood in at the last minute.

Jerry's talk was entitled ***Apollo Revisited*** and he took us through the Apollo project from the early Saturn rocket launches to the Moon Walks to the final days of the project. He felt this was a timely subject as we were celebrating 400 years since the invention of the telescope and 40 years since the first landing on the Moon.

It was refreshing to hear a talk illustrated with slides, instead of the more common PowerPoint presentations. The phrase 'next slide please' is rarely heard these days. Jerry also told the gathering about his recent trip to China to view the eclipse.

The AGM of the FAS was held next and Richard Sargent led the meeting with aplomb. In addition to normal AGM business a significant action was to agree to move the year end of the FAS. This date was delayed by half a year, which had the effect of giving all member societies a half-year holiday on their subscriptions. The reason for this change being the need for FAS Council to calculate the required subscription levels once the insurance premium has been established, rather than the previous system where the premiums had to be 'guessed', with the inevitable risk that entailed.

Eric Hutton, who after many years of distributing the Newsletter and other publications and also handling the insurance scheme, has stood down. Eric was warmly thank for all his past services. The publications distribution will now be undertaken by Steve Williams, whilst the insurance duties will be taken over by the Hon Secretary, Shaun O'dell.

Lord Professor Martin Rees

During the lunch interval delegates took the opportunity to browse around the various trade stand and many were wondering how they would get this telescope or that other expensive goodie past 'her indoors' without being caught!!

The first talk in the afternoon, ***Galaxy Zoo***, was presented by Dr Chris Lintott. He started by taking us from the Big Bang to the expansion of the Universe and to the Sloan Great Wall.

Dr Lintott explained that there was a real problem in analysing galaxies and computer model have proved to be quite unreliable.

It was for this reason that the website www.galaxyzoo.com/ had been created. This allows amateur astronomers and even the general populace to contribute to the professionals by classifying galaxies. He described it as Citizen Science. He also explained that as a direct result of this work a new type of galaxy had been established—the so-called Galaxy Zoo PEA.

Immediately after this talk Richard Sargent

(Continued on page 2)

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Presidents Spot

Greetings to you. I'll begin my article by briefly mentioning a few things from the FAS Convention & AGM held at the Institute of Astronomy, Cambridge on 3rd October. This was a great success with more than 120 attendees who enjoyed four excellent and enjoyable talks, and many trade stands to spend their money at! Already we are starting to plan the 2010 Convention & AGM and would welcome your suggestions on location and speakers.

In my report to the AGM I noted the absence of new volunteers for service on the FAS Council. In 2010 we will be making increased efforts to secure volunteers from member societies for Council posts. Your FAS needs you!

Each year at the AGM the FAS presents the 'Eric Zucker 'award to someone who has made a great contribution to Astronomy education and public outreach. This year the award was given to an amateur astronomer who has been and continues to be a great promoter of astronomy to the public and to other amateur astronomers. A man who for at least the last 15 years has given many lectures to astronomical societies up and down the land – from Cumbria to Kent from the SE to the SW, through the Midlands to East Anglia. Many societies have been grateful for the accomplished talks he has given them over the years. As well as giving talks, this man has also served on the council of the Society for Popular Astronomy, lectured at their meetings and written for Popular Astronomy and is a local officer for the CfDS.

This year's worthy recipient of the Eric Zucker award is Jerry Workman of Loughton AS. On behalf of societies in the Federation of Astronomical Societies thank you very much Jerry for your work.

Most of us know individuals in our astronomical societies who do an awful lot to promote astronomy to the public and/or give talks to societies and/or are active in the campaign for dark skies etc. If you know such an individual and think they deserve wider recognition write to us and tell us about them and their work and we might publish it in the newsletter!

By the time you read this newsletter the International Year of Astronomy will be drawing to a close. Given all the problems going on in the world which dominate the news, and given 'Strictly Come Dancing' and 'The X Factor', IYA 2009 was never going to be high in the media's coverage! Hopefully though the efforts of amateur and professional astronomers in IYA 2009 have increased the people of the world's interest in Astronomy. In the UK astronomical societies up and down the land have increased their public outreach efforts during IYA 2009, and those efforts will still carry on after IYA is over. Give yourselves a big pat on the back. We can also take pride in celebrating 400 years of the telescope, that marvellous invention that gives us amateur astronomers so much pleasure and allows us to see such wonderful sights in the night sky. Enjoy, and best wishes and clear skies to you all.

Jerry Workman receiving the Eric Zucker Award

Richard Sargent

A New Publication on Practical Spectroscopy

I decided to have a go at spectroscopy and so purchased a Star Analyser 100 from Paton Hawksley for a very reasonable £81. However that was the easy bit.

I then took my first image and then realised that processing this was far from straightforward. In order to try to learn more I joined a couple of the yahoo-groups specialising in spectroscopy and was contacted by Ken Harrison offering friendly advice and assistance. Even with his help and searching the internet I realised this part of astronomy seemed very much a 'black art'. It was when I asked Ken whether there were any practical books on the subject that he informed me that he was in course of writing such a book, which is due to be published some time in 2010.

He provided a synopsis of this book and I feel that it may well be just the tool I need to get me up this rather steep learning curve. So for those of you who may be thinking of giving this branch of astronomy a try, the following is a précis of his description of what the book will be all about:

There have been three significant milestones in the history of observational astronomy; the invention of the telescope, photography and the spectroscope. The development of the spectroscope has contributed more to the science than any other telescope accessory. It has been said that 85% of all astronomical discoveries have been made with the spectroscope.

The basic challenge facing the novice is where to start. What equipment will I need? Where can I find a spectroscope? How do I process the CCD image? How do I analyze my first spectrum? These questions and more are addressed in this book. It provides up to date information on equipment, spectroscopes and methods available to the amateur, and more importantly "How to...".

By using amateur telescopes, mountings and CCD cameras currently available, this book will show how, with the addition of a simple spectroscope we can observe and record spectra which reveals the temperature, composition and age of stars, the nature of the glowing gases in nebulae and even the existence of other exo-planets circling around distant stars.

There are three sections in this book:

- *Introduction to Spectroscopy*
- *Obtaining and analyzing Spectra*
- *Spectroscope design and construction*

Each section is independent of the other, so if you want to jump straight into taking your first spectrum, go to Section 2 and get started!

Springer will be the publisher.

Personally this cannot come soon enough for me!!

Frank Johns

(Continued from page 1)

A vital job—folding raffle tickets

presented the Eric Zucker Award to Jerry Workman for his efforts in amateur astronomy over the past 15 years or so, by giving talks in many parts of the country and giving support to many astro-societies and others.

The final talk of the day, ***What will the next generation of telescopes tell us,*** was given by The Astronomer Royal, Lord Professor Martin Rees.

Lord Rees began by saying that he was not a visionary like Arthur C Clarke - then proceeded to indicate that this may not be entirely accurate!

He reminded us of the space developments since sputnik and outlined many of the projects currently on the drawing board. He also said that future manned space missions are more likely to be entrepreneur rather than government funded.

All-in-all an enjoyable day.

Frank Johns

Wycombe AS Celebrate IYA 2009 at Amersham - with a little help from the FAS

To celebrate the International Year of Astronomy 2009 **Wycombe Astronomical Society** held an Open Day for members of the public and their families on Saturday 3rd October in the Sports Hall and grounds of their Headquarters at Woodrow High House at Amersham.

The event included a mobile Planetarium with shows throughout the day, table top displays by the Campaign for Dark Skies, the Society for Popular Astronomy, the Planetarium, and David Hinds Limited who brought along some of their products, and very kindly donated a Celestron 102 SLT telescope as first prize in the raffle.

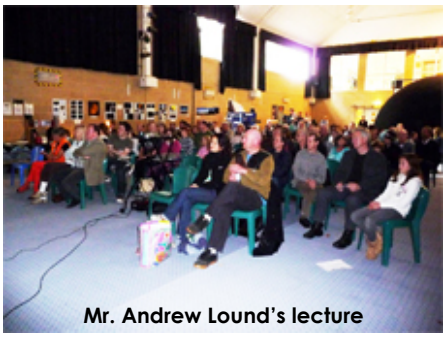
A queue for the Planetarium show

A member of our Society set up his telescope and computer equipment and provided an astro image display. We also had board and wall displays of members photographs, and an archive folder showing past lectures and practical evenings, observing sessions, outings last year which included visits to The Royal Observatory and Herstmonceux, and Astrofest 2009 and the Telescope 400 event at Syon Park in July this year. Also included were reports and photographs of our annual Gliding Evening at our local airfield, and Christmas Party and Quiz.

We were fortunate to have three excellent presentations from Lecturers who are regular visitors to our Society. Professor Stuart Malin who talked about the history of the Royal Greenwich Observatory and past Astronomers' Royal, Mr. Andrew Lound from the Planetary Society who gave us a "Grand Tour of the Solar System and beyond", and our President Heather Couper, and Mr. Nigel Henbest whose title "Cosmic Quest – A History of Astronomy" was followed by a signing of their latest book.

Book signing.

The windy conditions did not deter the children and adults from making and launching water rockets in the grounds of Woodrow, and completing a Quiz on paper of the Solar System which had been set up outside. The winner of the Quiz received a year's membership to our Society.



Mr. Andrew Lound's lecture

The day was well attended, and we hope was enjoyed by all.

The event was kindly sponsored by a grant from the Federation of Astronomical Societies.

Jan Dell
www.wycombeastro.org.uk

Water rocket making

LETTERS

Dear All,

It was with great sadness that I read in the South Wales Evening Post on 14 October of the possible closure of the observatory on the Swansea seafront, home of the Swansea Astronomical Society.

As a resident of Ystradgynlais, I was a young member of the society back in the late 1960s and the inspiration and knowledge gained from the society members was instrumental in my studying astronomy at London

University and subsequently teaching the subject to adults and children alike. It is impossible to measure the effect such voluntary groups have on individuals, but I am sure that many young people have been inspired by viewing the moon, planets and stars through the society's telescopes.

Swansea has one of the most wonderful observatory locations in the UK—surely the Council and the Society can come to some agreement that utilises the wonderful potential of the tangible, and the intangible, aspects of this site.

***Dr John Griffiths**, F.R.A.S.*
Grove Park, London, South East

Hi Frank.

I have just read the leading article in the new issue of the FAS Newsletter.

Our friends in Cornwall may be less than happy when the units described are erected.

I can comment from personal experience having very similar fitments erupt along the road at the rear of my property. Light spill rearwards of the lamp standard is considerable and the light output higher than the previous long-tube exposed units.

What I am experiencing here is a triumph of 'let's light up as much ground as we can' . - Oh and the road as well .

N Morrison
Chairman Crawley A.S.

Yes - with these white lamps being about a quarter the length of the old sodium ones, yet giving the same level of output, the lamp itself does look very bright. So far I have had very little feedback from local astronomers.

However in one instance, in Lostwithiel, the astronomer lives on the hill overlooking the town, which has just had the new lamps installed. He reports a significant reduction in light pollution. I suspect this is more due to the fact that the lamp holder directs the light downwards with very little upward component.

I will watch the development and report in subsequent issues of the Newsletter.

I am in discussion with the lamp manufacturer regarding what filters would best combat the worst effects of these lights (if any!!) and will also report on this as and when I get anything useful.

I do not know how other local authorities will configure their new lights but for the lamps in Cornwall, the brightness can be adjusted on an individual lamp basis. So this leads to the possibility of particularly troublesome lamps being turned down—always providing you can develop a good relationship with the department/ officer concerned.

Editor

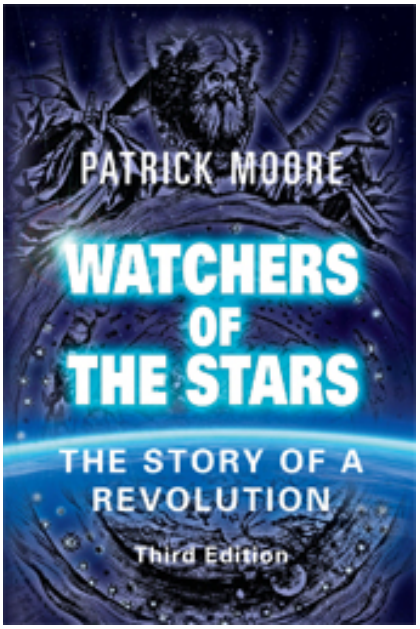
Book Reviews

Watchers of the Stars

by Sir Patrick Moore

Third Edition ISBN: 978-1-904275-36-7
Publisher: Harwood Publishing Ltd £20.00

This is the third edition of this book and after reading it, I now realise what I must have missed by not reading either of the earlier editions.



Having set the scene in the first two chapters, Patrick Moore takes us through the 'golden era' of observation and experimentation—starting with Nicholaus Copernicus.

Up to Copernicus and for quite a few decades after, the official understanding of the workings of the Universe was based on the Earth-centric system. This was based on an amalgam of 'free thinking', religious cant and a ruthless determination to maintain the status quo.

The lives and works of the subjects of this book, namely Copernicus, Tycho Brahe, Johannes Kepler, Galileo Galilei and Isaac Newton are covered together with the inevitable confrontation with the establishment.

Each of the principal characters is put into context describing the intellectual and physical environment of his time. This is done by many anecdotes, illustrations and even tittle-tattle of the time.

The meticulous attention to detail required in observation, calculation and consideration of theories to satisfy the observed data is covered extensively, in a very readable and even entertaining manner.

Finally the whole thing is tied together in a more modern context of where our knowledge is today.

Whilst much of this book is already know to most amateur astronomers and even the general public, there is still a great deal to be learned in it. Not least the tying up of many historical loose ends.

Well worth the price.

Chris Bunn

Heaven's Touch

by James B. Kaler

Princeton UniversityPress
ESBN 9780691129464 £16.95

If you were to ask Mr. or Mrs. Average of the planet Earth how celestial objects affect the world they live in, you might expect a few answers like 'the Sun provides light and warmth' or 'the Moon makes tides', or even 'asteroids make holes in the ground'. All of these are undoubtedly true, but as this book by James B. Kaler, professor emeritus of astronomy at the University of Illinois, explains, this is but the tip of the iceberg. Planets, comets, stars, galaxies, supernovae and even the Big Bang itself, have, for billions of years touched this 'third rock from the Sun' in ways few have ever considered, and their influence is by no means over.

Beginning with an overview of the type of objects that are 'out there', the author quickly journeys from our Sun, past the planets of the Solar System, out of the Milky Way, past countless galaxies and galaxy clusters and out to the far reaches of the universe. Along the way, darkness, in the form of dark matter and energy, is briefly considered and all the while our attention is drawn not only to the astronomical distances involved but also the colossal length of time it would take to undertake such a journey. How then, could any of these have any effect on the Earth?

To answer that question requires a man of James Kaler's knowledge and experience. Having published over 120 papers in his main research area of dying stars and written several books on the subject of the cosmos and the universe, it is no surprise that the author's explanations of the processes which occur throughout the heavens are detailed. However, they are also described in a manner which is easily understood by anyone with even the most basic of scientific educations. Gravity, the unseen force that keeps our feet on the ground (most of the time) and holds planets, stars, galaxies and even black holes together, affects the Earth in many ways. Tides, the seasons and long term changing climatic conditions, caused by lunar and solar orbits, are just a few of the effects of gravity which are described in great detail.

Cosmic particles and rays of numerous types continue to bombard the Earth and have done so in varying quantities for billions of years. Some pass unnoticed, having almost no interaction with the atoms and molecules which make up the Earth and ourselves, while others can have catastrophic effects. The numerous events and processes which create these particles are described along with an explanation of what has happened in the past or may happen in the future which could, quite literally, be Earth shattering. There is even speculation that without these far reaching effects, life itself may never have arisen.

Collisions and explosions, the creation of chemical elements and the 'disappearance' of matter into black holes are all topics covered with great enthusiasm and humour. Written in a style which reduces complex processes into manageable bites, yet containing numerous facts and figures, this book works well as good read and will also perform as a reference book, allowing the reader to dip in and out if a short explanation of a particular event is required. Overall this is a well written, eye opening account of how we are affected by Heaven's Touch.

Phil Brotherwood

The Sky Handbook

by John Watson and Michael Kerrigan
ISBN978-1-887354-63-9 £14.99
Publisher: Saraband

It is not often that we come across a book that is as different as the Sky Handbook - John Watson takes a holistic approach to his astronomy.

There is a distinct lack of technical astrophysics and a focus on placing astronomy in an historical context. The book starts with a review of the megaliths to be found in the UK before moving on to early views of cosmology around the world

The constellations are given good coverage, not just using the standard maps to be found in every book in the basic genre but also including images from antique maps, Greek history and legend are given a good airing. The solar system is well covered reaching out to the Oort Cloud and including comets and meteors.

Our atmosphere, that thin blue band that appears in space images – the bubble that protects us from oblivion is reviewed with a strong environmental message. Look after our home it is the only one we have. Watson confirms that every snow crystal is unique even though it is based on a basic hexagon.

Clearly a book like this cannot avoid mentioning climate change which is covered carefully. It also includes the effect of global dimming which is holding back global warming. Should this brake be released then the rise in temperature could cause the methane clathrates to break down causing untold problems for Planet Earth.

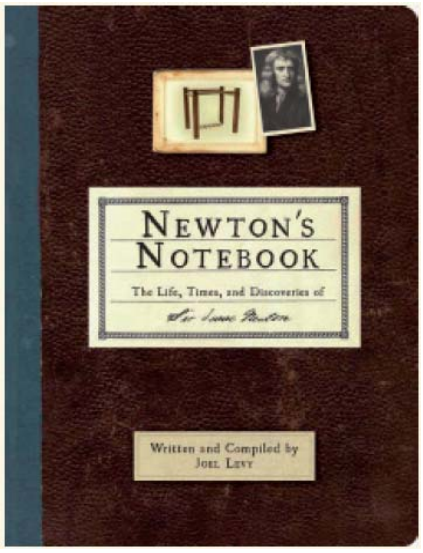
This is not a first book for the novice astronomer but it is one that should find its place on the bookshelf of astronomers wishing to have a wider view of our place in the grand scheme of things.

Brian Sheen

Newton's Notebook - The Life, Times and Discoveries of

By Joel Levy

ISBN: 9780752454931 £11.69 The History Press / Quid Publishing



This is a biography of the life of Isaac Newton, but rather like no other in that it is written and designed in the form of a personal notebook or diary.

The reader is taken from his early days born into a farming family soon after his father had died. When he was at school in Grantham he lodged with an apothecary, John Clark, during which time his scientific interest was nurtured—and more importantly convinced him that farming was not his true metier.

Then to Cambridge University—not as a privileged scholar but as a subsizar—effectively a servant. However his attention to detail took him forward in spite of the arcane approach to learning at Cambridge in those days. Isaac took on the likes of Descartes, and was successful mainly because of his unshakeable belief in experimentation. It was this dedication to practical tests that led him to poke a bodkin behind his eye to check on colour changes in what he was looking at.

His subsequent career in inventing calculus, discovering gravity and many other facets of what interested him is covered in good detail as well as his considerable efforts on optics—for which was amateur astronomers are eternally grateful.

By judicious quoting from his own journals and the inclusion of many direct quotations, *Newton's Notebook,* brings the life of Isaac Newton more clear and understandable than any other book I have read about him

The design layout and the illustrations are key elements in making this book so memorable, in that the direct extracts of his work together with the excellently written dialogue left me feeling a deeper understanding of the man and his many fine achievements.

Would grace any bookshelf.

Jamie Quest

p.s. There is a sister volume—Darwin's Notebook

Equipment Review

A Simple Solution to taking Flats

To get good images ,when doing astro-photography, it is necessary to take dark, bias and flat frames. These go some way to removing the inevitable noise, dust motes and other artefacts.

Dark and bias frames are easy as they only require the fitting of the lens cap. Flats on the other hand are a little more of a problem as they require images to be taken of an evenly lit surface with exactly the same light-train configuration as the light frames, i.e. a change of filter requires it own flat frame.

The main problem is getting the evenly lit surface to image.

One of the best methods is to use the clear sky—just as it is getting light before sunrise. However we all know the problems with this!! Another method is to stretch a white cloth, such as a t-shirt, over the front of the scope, using dawn light or something similar. Others construct a light box—but all these can be either unreliable, bulky or awkward to use.

In my case my refractor extends almost to the surface of the dome and so to use my homemade light box I have to ensure the dome slot is exactly in the right place.

However I think there is an inexpensive and easy solution to this situation.

I came across a material called Electro-Luminescent (EL) light sheets. EL is essentially a flat, flexible light bulb. It consist of a sandwich type structure containing two layers of electrodes with a middle layer of phosphor. When a current is applied across these layers the phosphor emits light.

The EL sheet is fitted with a socket into which a switched unit is plugged. This switched unit has a socket to accept 12 volt. Also supplied is a mains to 12v plug. This means that it can be mains operated or by 12v in the field.

Whilst the EL sheet can be used as supplied I felt that it is a little too flexible for my requirements and for large sheets would surely require some support. I bought an A5 sized unit and sandwiched the EL between some stiff plastic sheet, as will be seen in photo 1. The small blocks are used to ensure the unit holds onto the end of the scope.

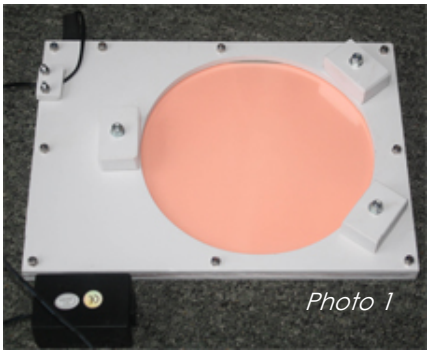


Photo 1

Photo 2 shows the light unit on the end of the 120mm refractor.

In practice it is a simple matter of dropping the unit on the scope after taking the light frames and then taking the flats, before either changing to a different filter—or moving to a different target.

Whilst this gave very good results using a relatively small sheet, it is felt that a test on a much larger sheet should be undertaken to fully evaluate this product. Accordingly I contacted the supplier, Chris Whitelock, and he provided an A3 sized EL sheet. This is being tested by Darryl Sergison at his observatory on St Dennis, Cornwall. However the very poor weather over the past few weeks has interfered and so his test report will have to be held over to the Spring issue.

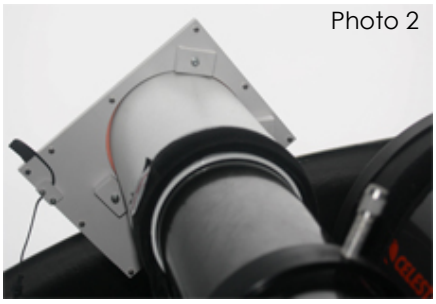


Photo 2

I will await this report with interest as I am in need of a flat solution for my C9.25.

At the time of writing this piece the EL sheets are only available in paper sizes, i.e. A5, A4, etc. However the supplier has been asked if it will be possible for them to be available in square format—although the sheets can be cut to any size.

The A5 sheet cost me £24.97 + £4.85 p&p.

Check out the supplier's website for more information:

www.posterpoweruk.co.uk/

Frank Johns

Weekend weather in Derby fails to dampen Astronomy weekend

- or people's enthusiasm.

Derby & District Astronomical Society and Skylark Holidays celebrated the International Year of Astronomy with the launch of an "Astronomy for Enthusiatic Beginners" over a weekend.

Despite the stormy wet weather of the weekend of 13 – 15 November, Derbyshire based Skylark Holidays successfully held an Astronomy weekend that included a visit to the Derby and District Astronomical Society's Flamsteed Observatory.

The company and the Society had teamed up to pilot the weekend course as a way of introducing people to Astronomy and to contribute towards the objectives of the International Year of Astronomy. The course, which was fully booked, was a combination of tuition and practical observation. Expert Mark Whitehouse explained how to find and identify different planets, described which constellations could be seen in the night sky and customers were shown how to use different telescopes.

Paul Hunt of Skylark Holidays said "It was a pleasure working with Derby and District Astronomical Society to visit their Observatory which added that "extra special bit of interest" for our customers. Everybody appreciated the efforts of Society members, Anthony Southwell and Mike Lancaster for turning out in such mucky weather to open up and give a talk about the observatory. Their friendly approach to Astronomy nurtured peoples interest"

Observation time was subject to weather conditions but a contingency plan of projecting a planetarium on to an indoor wall was welcomed by customers on Friday evening. Commenting on the weather Mark Whitehouse said " The wind and rain made it touch-and-go and we were all disappointed that cloud cover prevented seeing anything from the Flamsteed Observatory. However I was relieved when we got back to our venue at Windlehill Farm to find the skies had cleared enough to get some great views of Jupiter with it moons, numerous constellations including Pegasus and Orion and stars like Vega.

"We had an encouraging level of interest and understand there are not many courses like this "said Paul Hunt, "So we will be adding more to our Programme"

The Flamsteed Observatory of Derby AS

Skylark Holidays offer a range of weekend and midweek breaks including activities such as photography, wine appreciation, walking, spinning and weaving.
The full programme is available at:
www.skylarkholidays.co.uk
or email: paulhunt@skylarkholidays.co.uk

A Wonderful Evening

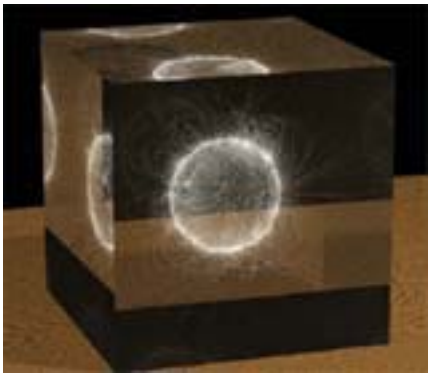
The Society held this year's William Lassell Memorial Lecture for the first time in its new monthly meeting venue of the Quaker Meeting House (QMH) , School Lane, Liverpool on October 16th . The evening was already a special occasion, for the fact that the guest for the meeting was the accomplished speaker and well known science historian Dr Allan Chapman of Oxford University. His subject being the history of the telescope, and how over 400 years, it has changed human understanding of the Science of Astronomy

However the evening was made extra special by the Society presenting a recognition gift to long time member Eric Strach, and a Presentation to both Eric and his wife Margaret being made by Dr Chapman during the evening.

Eric has been a devoted solar observer since the 1950's, and under the guidance of the well know solar, lunar and planetary observer Harold Hill, Eric began recording solar observations in the form of sketching, progressing to hydrogen-alpha, film, and was one of the first to submit CCD imaging observations once digital technology was available to the amateur. Eric has been a member of the Liverpool Astronomical Society for over forty years, and serve as the Society President during its Centenary year in 1981. On October 21st 2009 Eric celebrated his 95th birthday, and it is only due to the unavoidable effects of his grand old age that he has now been force to give up active observations. As he himself has said:-

Sadly the Sun no longer calls to me

It is indeed a remarkable achievement, for Eric, that he has continued to be so devoted to observing our nearest star on an almost daily basis for thirty years following retirement. He has also travelled the world to chase 13 total solar eclipses, and to record the illusive shadow bands. With his loving, & supportive wife Margaret always at his side. During this time he has continually submitted observations to the BAA, and to the Society's newsletter, and has been the author of many papers, and observational guides. He has also been a devoted supporter of the aims of the Liverpool Astronomical Society, and its promotion in the UK and beyond. Indeed it was Eric who was instrumental in the Liverpool society forging strong links with the Vlasim Astronomical Society in the Czech Republic, Eric's homeland. He has and will continue to be an inspiration to all amateur astronomers, no matter what branch of astronomy they are interested in following.



The gift is in the form of a crystal Sun-Sculpture, manufactured and kindly supplied by The *Crystal Nebulae Company* of Nottingham which depicts the active sun on October 21st in the year 2000. The monthly date being Eric's birthday!

Image of sculpture used with kind permission © Crystal Nebulae

Gerard Gilligan

Courtesy LAS Newsletter

The Presentation being Made to Eric Strach by Dr Allan Chapman on Behalf of the Liverpool Astronomical Society – QMH 2009 October 16th.

WIGG ISLAND COMMUNITY PARK ASTRONOMY EVENING
FRI 30 OCTOBER 2009

I arrived, with Geoff Regan, at about 19:00. We decided not to bring any telescopes as the weather looked likely to be very cloudy, with a forecast of lots of rain in the next few hours. Thankfully, some of our other members did bring telescopes.!

Jim Stacey set up his Celestron C6 GoTo telescope. Lawrence Ashworth set up his 4 inch refractor and Dave Bentley set up his 85mm refractor. Graham Roberts had placed some direction signs on the route to this relatively obscure location. Graham had also saved a convenient parking place for my car. We were amazed that we had about 90 visitors for this event.

The Wigg Island Ranger "Ged" had opened up the building quite early to allow some of our early arrivals to set up display equipment - mainly our Laptop PC and PC projector.

Brendan Martin started his talk, "My Favourite Objects Through a Telescope", at about 19:10. By 19:19 the room was so packed that the 49 chairs were not enough and several people were standing at the back of the room. Brendan finished his talk at 19:30 and answered questions for about 10 minutes. We then started a 20 minute tea/coffee break - thanks to the Rangers for providing this.

At 19:46 Graham Roberts announced that, as it was cloudy, several telescopes were looking across the River Mersey. Most of the children quickly ran outside but a bit of rain arrived a few minutes later.

Geoff Regan started his talk, "Our Place in Space", at about 20:00. He finished at 20:40 and then spent another 10 minutes answering questions. We then started to pack our telescopes away. Other LAS members that I spotted at this event were: Graham Rigby, Jim Stacey, Alan Dennott, Jim Lawler and Pam McAdams.

EVENT PICTURES by Jim Stacey:

HERSTMONCEUX 2009

Jan Young

On Saturday 12th and Sunday 13th September Herstmonceux Science Centre held their usual successful open weekend with a programme of lectures, visits to the domes, trade stands (including a beer tent) and an area dedicated to local Astronomy Societies where SAGAS had a stand alongside the Society for Popular Astronomy and several other SAGAS societies, Wealden, East Sussex, Eastbourne, with Basingstoke, Cody and Worthing Astronomers representatives on the SAGAS stand itself.

There were a couple of other societies present who at the time of writing are not members of SAGAS, but hopefully a bit of friendly persuasion may have encouraged them to join in the not so distant future.

Herstmonceux Science Centre Photo Jan Young

The display boards recently purchased by SAGAS were put into good use, as was the even more recently purchased Lunar Globe.

Camping was available once again in the grounds as in previous years, with the exception that for once, this year, the skies were clear overnight. There were comments on the Sunday about the exceptional clarity of the previous night.

Phil Alner from Cody seemed to be enjoying himself with various scientific and interesting 'toys'!

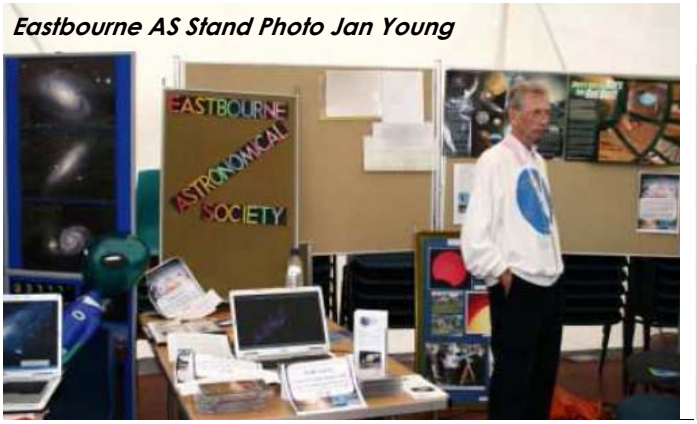
As was usual the venue was visited by the local team of Storm-Troopers on leave from fighting wars in a Galaxy far, far, away.

Phil Alner Cody, Brian Halls Worthing Astronomers & the SAGAS stand. Photo Jan Young

SAGAS Globe Photo Jan Young

East Sussex AS Photo Jan Young

SPA Stand Photo Jan Young

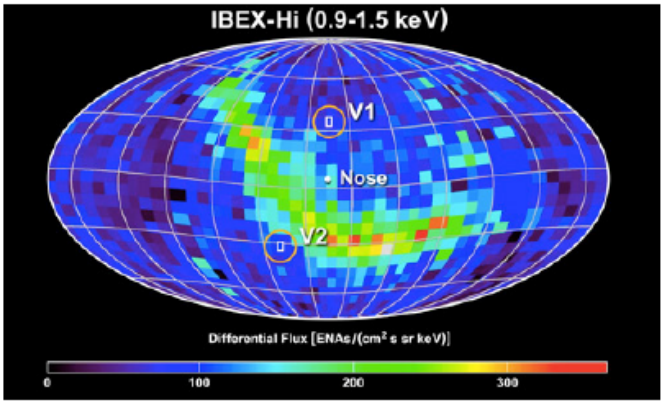


Eastbourne AS Stand Photo Jan Young

Multi-wavelength Astronomy
The new Astronomy

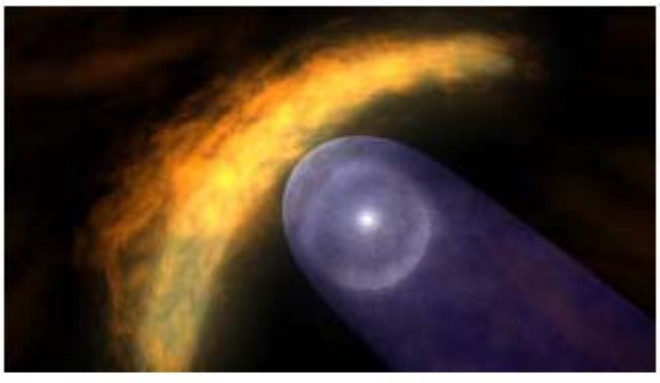
By Brian Finney

IBEX, or Interstellar Boundary Explorer, is the latest in NASA's series of low-cost, rapidly developed Small Explorers Program and it is now producing results – as always size is not everything! In IBEX's case not only is the budget small (in space exploration terms) but the instrument itself is only 23 inches high x 38 inches across and octagonal shaped. It has discovered a ribbon of high energy emissions – energetic neutral atoms (ENAs) - at the edge of the solar system that Voyagers 1 and 2 had passed either side of as shown in the image below. (See background article to better understand the shape of the all sky view below)



Credit Dr. David J. McComas Space Science and Engineering Division at the Southwest Research Institute.

Consider our Solar system as one body moving through space and orbiting about our galactic centre, ie the centre of the Milky Way it will take about 250 million years to complete one orbit at a speed of approximately 220km/sec or 500,000 mph. Unsurprisingly, at that speed a body the size of the solar system with its associated magnetic fields will produce a shock wave in the interstellar medium even though the interstellar medium is almost a vacuum.



Credit NASA/Goddard Space Flight Center

The orange gas in the image above represents the interstellar medium of our Milky Way. The bow shock, labelled 'nose' in the all sky image above, is created because the heliosphere is moving through like a boat through the water, crashing through the interstellar gases. The bright spot represents the Sun at the centre of our solar system.

The Voyager 1 spacecraft was the first to encounter this invisible shock formed as the solar wind piles up against the gas in interstellar space. This boundary, called the termination shock, marks the beginning of our solar system's final frontier. It is the twisting magnetic fields in this termination shock region that protects all the planets from the majority of the harmful cosmic rays produced in space.

IBEX needs to go beyond the region of space controlled by Earth's magnetic field, the magnetosphere, because this region generates radiation and the same high-speed atoms (Energetic Neutral Atoms or ENAs) that IBEX will use to make its pictures. To avoid contamination from local ENAs produced in the magnetosphere, IBEX's orbit took it up to 200,000 miles from Earth to view the termination shock which is billions of miles from Earth.

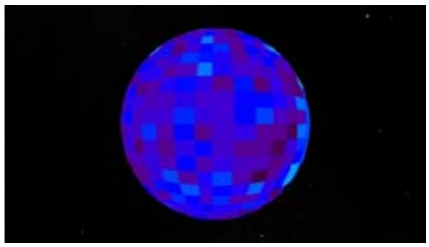
So what are these Energetic Neutral Atoms – these ENAs? They are atoms with no charge that move relatively fast. Previously they had been ionised by the loss of an electron giving them an electrical charge that would cause them to be accelerated in a magnetic field. Once at speed they gain an electron by collision with other neutral atoms by a process called charge exchange thereby becoming neutral themselves but still maintaining their velocity in a straight line from the point of interaction. They continues in a straight line after interaction because the atom now has no charge and is therefore unaffected by magnetic fields and at the same velocity because its mass is largely unchanged; a proton at the centre of the atom is 1836 times heavier than the added electron. ENAs travel at speeds between 100,000 mph to more than 2.4 million mph. Some of these ENAs happen to travel in just the right way so that they enter the IBEX spacecraft for collection at a rate of between 1 per hour and a few per minute to produce the image above. The IBEX data was complemented and extended by information collected using an imaging instrument sensor on NASA's Cassini spacecraft.

To confirm the difficulty of observing the unknown and unseen by the eye, whilst Voyagers 1 and 2 were the first to encounter the termination shock, they passed either side of this ribbon of bright emissions without seeing it. Both Voyager spacecraft are now in the midst of the region where the energetic neutral atoms (ENAs) originate.

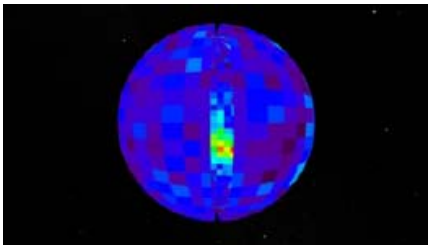
Further reading:
http://svs.gsfc.nasa.gov/vis/a000000/a003600/a003635/
www.nasa.gov/mission_pages/ibex/allsky_pressrelease.html
http://www.nasa.gov/pdf/280255main_IBEXFactSheetOct08.pdf
http://www.ibex.swri.edu/students/What_are_energetic_neutral.shtml

Background to the IBEX article Image Projection of a Spherical Image on to a Flat Surface

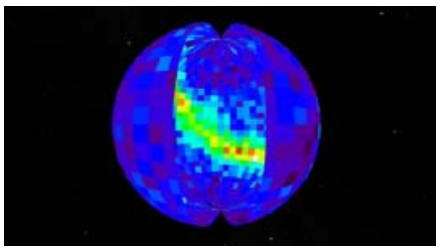
NASA/Goddard Space Flight Center Scientific Visualization Studio has produced a useful visualisation of how the 360 degree sky views from IBEX has been projected as a flat surface ie the page. It has been reproduced below in the hope that it helps with the foregoing IBEX article and image.



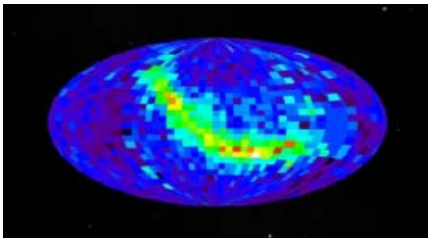
The IBEX craft is inside and at the centre of the sphere (the sky) taking images.



The sphere is split and begins to peel back



The sphere opens further



The sphere is now fully flat on the page – hence the shape of all-sky images

Courtesy: L.A.S. News Circular Dec 2009

SAGAS SEPTEMBER LECTURE REVIEW

Speaker: Dr Mike Leggett FRAS FBIS

Subject: Microwave Astronomy

Mike began his talk by outlining the areas he would cover. He stated that the cosmic microwave background is a major part of microwave astronomy, but by no means all of it.

Microwave astronomy is an astronomical study of radio waves. It consists of sub-millimetre wave astronomy, millimetre wave astronomy, radar astronomy and radio astronomy. The principal areas of study are interstellar molecules, the cosmic microwave background, astrometry by radar, and observations on radio sources (radio galaxies, quasars, pulsars etc.). Radar astronomy is very useful for establishing distances to objects and positioning.

The wavelength is the distance travelled by a wave during a complete cycle. The frequency is the number of times that the cycle repeats per second. This is measured in Hertz. The wavelength and the frequency are proportional to each other. As the wavelength increases, the frequency decreases. As the wavelength decreases, the frequency increases.

Newton observed white light being passing through a glass prism and being split into the colours of the rainbow. Mike showed the solar spectrum with this effect.

Mike next introduced the concept of the electromagnetic spectrum. William Herschel observed that there must be something beyond the visible spectrum and deduced the existence of infra-red. Others later deduced the existence of the ultra-violet range.

Within the microwave range, sub-millimetre wavelengths should perhaps be part of the infra-red range, rather than the radio window as it overlaps the two ranges. Shorter wavelengths are absorbed by the Earth's atmosphere. Longer wavelength radio waves are blocked by it.

Mike took us through the history of radio astronomy from 1888.

In 1888 Hertz discovered radio waves and demonstrated that they can be reflected, refracted, diffracted and polarised as with other forms of radiation. Marconi harnessed this and the government became interested in its practical applications. Marconi sent the first radio transmission across the English Channel in 1899 and across the Atlantic Ocean in 1901. He won the Nobel Prize for Physics in 1909.

The British Air Ministry became interested in work carried out by Robert Watson-Watt in the use of radio for the detection of thunderstorms. From this a radar system for aircraft detection was developed. Five microwave radar stations were established.

In 1937 Grote Reber built the first radio telescope in Illinois using the 23cm radio band. In 1946 Robert Dicke developed a radiometer for measuring sky microwaves and Martin Ryle built the first radio interferometer.

In 1957 the 76-metre Lovell radio telescope at Jodrell Bank was completed. In 1960 Martin Ryle and Antony Hewish developed the aperture synthesis method of interferometry to enable images to be produced from multiple telescopes, with the same angular resolution as one telescope as large as all of them.

The Arecibo radio telescope in Puerto Rico is the largest radio telescope in the world but it cannot move and therefore can only be used to observe a limited area of the sky.

Mike next went through some of the important discoveries that were made in the field of microwave astronomy. In 1931 Karl Jansky, of Bell Labs, detected weak radio emissions coming from the Milky Way. In 1942 J.S. Hey and others detected radio waves coming from the Sun. Later, radio waves were also detected coming from Venus.

Around the same time Ryle, Smith and Elsmore surveyed northern hemisphere radio stars. In 1955 Burke & Franklin studied radio emissions coming from Jupiter. Finally, in 1967 Jocelyn Bell and Antony Hewish discovered the first pulsar, CP1919. This is a rapidly -rotating, regular pulsar and is identified as a neutron star.

Sub-millimetre wave astronomy is concerned with wavelengths between 0.3mm and 3mm. In this branch of microwave astronomy radio and infrared techniques are combined.

Observational studies of the cosmic microwave background are best carried out from locations that are both high and dry. Examples of telescopes where this is carried out are the James Clerk Maxwell Telescope (JCMT) and the Caltech Submillimetre Observatory (CSO), both located in Mauna Kea, Hawaii.

The JCMT has a Cassegrain design and is alt-azimuth mounted. It has a 15-metre antenna of 276 light adjustable panels, and a woven Teflon membrane.

Millimetre wave astronomy is concerned with wavelengths of between 1mm and 10m, so there is some overlap with the submillimetre wavelengths. This branch of microwave astronomy is useful for studying spectra rich in lines from complex interstellar molecules.

Radio astronomy is concerned with radio waves emanating from the Sun, Jupiter, quasars, pulsars and radio galaxies. Emissions with frequencies between 10MHz and 300GHz are observed using radio telescopes.

Mike spoke about components, the frequency range and techniques used in radio astronomy. There are two main types of radio telescopes. These are single steerable dishes (such as that at Arecibo and the Lovell Telescope at Jodrell Bank) and radio interferometers. Single steerable dishes have a maximum diameter of 100m, and have poor angular resolution.

The Lovell Telescope is also one of several in the UK that are linked in an interferometer network called MERLIN. An even larger interferometer is created by linking MERLIN to the European VLBI Network (EVN). VLBI stands for Very Long Baseline Interferometry. Such networks are, or can be, linked to give an aperture the size of the Earth. It could be possible to make it even longer by putting radio telescopes into space.

Mike next talked about the cosmic microwave background. He explained that the question of whether the universe is static or evolving has been an important one in cosmology, and that microwave astronomy has been a key part in answering this. In 1915 Einstein's General Theory of Relativity proposed a static universe, having a constant density with time. In 1917 Willem de Sitter applied the General Theory of Relativity to a universe with a non-constant density with time. Space expands and a form of 'red shift' is observed. In 1922 Alexander Friedmann, in Petrograd, discovered a class of evolving universes that provided a solution to problems posed by the General Theory of Relativity.

In 1912 Vesto Melvin Slipher was the first to observe the galactic 'red shift' in the spectral lines of galaxies, interpreted as the Doppler effect.

In 1923 Edwin Hubble's observations of individual stars in M31confirmed that it is a separate galaxy. Hubble's Law (1929), postulated by Hubble and Milton Humason developed the expanding universe theory.

In 1930 Arthur Stanley Eddington declared that the static universe was inherently unstable. In 1927 Georges-Henri

Lemaitre proposed what became the Big Bang theory with his 'hypothesis of the primeval atom'. In this, the first stage is the big bang, the second is a static phase and the third is indefinite expansion.

In 1946 George Gamow, Ralph Alpher and Robert Herman developed the Big Bang theory. In 1948 Alpher and Herman predicted the background radiation to have a temperature of 5 Kelvin. In contrast to this theory Fred Hoyle, Hermann Bondi and Thomas Gold proposed the Steady State theory, having found heavy elements in the hot interiors of stars. This was a setback for the Big Bang theory.

In the 1960s Ryle surveyed radio galaxies and found that they were more common in the past. This discovery conflicted with the Steady State theory.

In the early 1960s Dicke proposed the idea of oscillating universes, in effect successions of 'big bangs' followed by 'big crunches'.

In about 1960 a 20ft horn antenna was constructed at Bell Labs in Holmdel, New Jersey as part of Project Echo, a communications satellite project. In 1964, Arno Penzias and Robert Wilson, using the 20ft horn antenna, measured the radio signal at a wavelength of 7.35cm and found it had a temperature of 3.5 Kelvin. They had been expecting a temperature of 0 Kelvin, and had even cleared pigeon droppings from the antenna in an effort to explain the unexpected readings, but the readings were found to be definitely due to the cosmos. From their work, Penzias and

Wilson, plus Dicke, had identified the cosmic microwave background.

Also in 1964, David Wilkinson and Peter Roll constructed a small radio telescope to detect the microwave background. In December 1965 they measured the microwave background at a wavelength of 3.2m and found a temperature of about 3 Kelvin.

By mid 1966 they had obtained a value of 3 Kelvin from wavelengths from 21cm to 26m. Wavelengths in the millimeter and submillimetre ranges were more difficult to study. Later Wilkinson measured the smoothness of the cosmic microwave background from a better location in the Arizona desert.

Mike briefly discussed black body radiation. Black bodies are perfect absorbers of radiation that do not reflect or lose any of what they receive. As they heat up, they initially emit infra-red radiation (we feel the heat from a cooker), but as the heat increases the colours appear, red first then orange etc. Eventually the object would appear white hot.

Planck's black body radiation law relates to electromagnetic radiation emanating from a black body at specific temperatures. The early universe was hot, but the red shifts observed are not really the Doppler effect - space itself is expanding.

The microwave background can be measured using a small radio telescope and a Dicke switch, as had been used by Penzias and Wilson at Holmdel. Another way of measuring the cosmic background radiation is to use a bolometer.

Interferometers were used from the late 1970s. Balloons, aircraft, rockets and satellites have all been used as well. Air observation indicated that the Milky Way was flying through the cosmic microwave background in the direction of Leo.

In 1983 a Russian probe, Relikt-1, had mapped most of the sky at 37GHz and then in 1989 COBE (the Cosmic Background Explorer) was launched. This was a NASA mission. Its experiments included the DMR (Differential Microwave Radiometer), which would map the microwave sky and FIRAS, which was intended to found out whether the cosmic microwave background has the predicted spectrum.

The mission result was that COBE produced an all-sky map from 2 years of data. Ripples were found in the cosmic microwave background. The emergence of structure was deduced - the basis for formation of galaxies. FIRAS achieved the most accurate reading for the cosmic microwave background. A third experiment, DIRBE, took images in infrared of comets, galaxies and star-forming regions.

In 2001 the WMAP (Wilkinson Microwave Anisotropy Probe) mission was launched. This had 45 times more sensitivity than COBE, and 33 times the angular resolution. It was able to obtain full sky coverage in 5 wavelengths.

Another mission, Planck, was launched in May 2009, with the intention of further studying the cosmic microwave background. Planck has superior sensitivity, angular resolution and frequency range. It is making specific investigations into rotational energy levels.

Mike spoke next about energy level transitions. Microwave spectroscopy is the best tool for the study of interstellar molecules. If more than one atom is present, molecules can rotate about an axis.

Molecular line radio astronomy is the study of spectral lines emitted by interstellar clouds. This study is subdivided into diffuse clouds and molecular clouds, the latter being further subdivided into small and giant clouds.

Diffuse molecular clouds are found at high galactic latitudes.

Of the molecular clouds, the small-types mostly contain molecular hydrogen (H2). Giant molecular clouds are abundant with CO, with some ammonia and H2. There is a giant molecular cloud behind the optically visible Orion nebula.

W.S. Adams discovered carbon dioxide in the infra-red spectrum of Venus in about 1935. In the 1940s Andrew McKellar calculated the temperature of interstellar space to be about 2.4 Kelvin. Before 1963 only a few simple molecules, such as methylidyne (CH) and cyanogens had been found in space, but then hydroxyls were discovered by Jodrell Bank. In the late 1960s Iosif Shklovski discovered ammonia molecules in molecular clouds. This was followed in 1969 by the identification of water, formaldehyde and carbon monoxide molecules. Since then more than 120 further molecules have been identified.

The SWAS (Sub-millimetre Wave Astronomical Satellite) mission was launched in December 1998 and was active in examining microwaves from water, molecular oxygen, atomic carbon and carbon monoxide in interstellar clouds, until 2004. It was then reactivated in 2005 in order to observe the Deep Impact Probe's collision with Comet P/Tempel 1.

Finally, Mike spoke about the search for the extra-terrestrial intelligence (SETI). H.C. van de Hulst had predicted the existence of interstellar hydrogen. In 1951 Edward Purcell and Harold Ewen detected it.

In 1959 Giuseppe Cocconi and Philip Morrison first discussed the idea of searching for extraterrestrial life. In 1960 Frank Drake initiated the first search by radio telescope, concentrated on Tau Ceti and Epsilon Eridani. A large amount of the work in this field is concentrated on the 'waterhole' region of the microwave window, wavelengths between about 18cm, at which hydroxyl radiates, and 21cm, at which hydrogen radiates. As the combination of these two forms water, this range is deemed to be the primary target for the search for extraterrestrial life.

At the conclusion of his extremely comprehensive talk, Mike outlined how microwave astronomy had helped us to understand the evolution of the universe from the big bang leading to a dark age (opaque universe), followed by the first light of the early stars and then on to the visible universe.

Richard Godley

For those interested in reading further, the reference list provided by Mike included:

Books

- Anon, Exploring the Universe with MERLIN, Nuffield Radio Astronomy Laboratories, 1995
- Marcus Chown, Afterglow of creation: From the fireball to the discovery of cosmic ripples, Arrow, 1993
- Stuart Clark, Redshift, University of Hertfordshire Press, 1997
- Stuart Clark, Towards the Edge of the Universe: A Review of Modern Cosmology, John Wiley/Wiley-Praxis Series in Astronomy and Astrophysics, 1997
- Charles R Cowley, An Introduction to Cosmochemistry, Cambridge UP, 1995
- Nigel Henbest & Michael Marten, The New Astronomy, Cambridge UP, 2nd edition, 1996
- Mark H Jones & Robert J A Lambourne (eds), An Introduction to Galaxies and Cosmology, OU/Cambridge UP, 2004
- Dr Tony Jones, The Lovell Telescope at Jodrell Bank, Nuffield Radio Astronomy Laboratories, 1995
- David, Ian, John & Margaret Millar, The Cambridge Dictionary of Scientists, Cambridge UP, 1996
- Iain Nicolson, Dark Side of the Universe: Dark Matter, Dark Energy, and the Fate of the Cosmos, Canopus, 2007
- Douglas A Skoog & Donald M West, Principles of Instrumental Analysis, Holt-Saunders International Editions, 2nd edition, 1980
- M Talevi, J Tauber & T Passvogel (co-ordinators), Planck: Looking back to the dawn of time, ESA, BR-275, February 2009
- Monica Talevi (co-ordinator), Monica Salome & Jan Tauber (compilers), Planck: A Mission to Understand the origin and Evolution of our Universe, ESA, BR-159, 2006
- Gareth Wynn-Williams, The Fullness of Space: nebulae, stardust, and the interstellar medium, Cambridge UP, 1992

Papers & Articles

- Edwin Bergin, Chemistry in the Void, Chemistry and Industry, 15 October 2001, pp658 - 662
- Gerald Crone, Anders Elfving, Thomas Passvogel, Göran Pilbratt & Jan Tauber, Unveiling the Universe: Two Missions to Unlock the Secrets of the Cold Cosmos [Herschel & Planck], ESA Bulletin, 128, November 2006, pp11 – 17

Websites

- ESA Planck: http://www.esa.int/SPECIALS/Planck/index.html http://sci.esa.int/science-e/www/area/index.cfm?fareaid=17
- James Clerk Maxwell Telescope http://www.jach.hawaii.edu/JCMT/
- Jodrell Bank http://www.jb.man.ac.uk/
- NASA Cosmic Times http://cosmictimes.gsfc.nasa.gov/1965/guide/murmur.html
- NASA Legacy Archive for Microwave Background Data Analysis (LAMBDA)
- Information about COBE and other microwave and IR satellites: http://lambda.gsfc.nasa.gov/
- NASA Missions: http://nasascience.nasa.gov/missions/
- Submillimetre Wave Astronomy Satellite (SWAS): http://www.cfa.harvard.edu/swas/swas.html
- Wilkinson Microwave Anisotropy Probe: http://map.gsfc.nasa.gov/

IMAGE SAMPLING by Trefor Harries

When projecting an image onto a CCD for astrophotography one question that naturally arises is how big to make the image. It might seem desirable to make it as big as possible so as to minimise the subsequent enlargement required but there are some obvious snags to this. The maximum possible image size is that which would exactly fill the CCD sensor, but any drift in the image position would result in part of the image being lost off the frame which could not be recovered during the alignment and stacking stage of any post-processing. This problem will be compounded by the fact that a large image will also be a dim one since it requires a high magnification, which in turn means a long exposure time requiring more accurate tracking. Add to this the other drawbacks of high magnification, namely the extra demands put on the optics, and the effects of less-than-perfect seeing conditions. As the image size is reduced however, it occupies fewer photosites on the sensor array, limiting the ultimate resolution attainable, and requiring more enlargement. So how should the optimum image scale be determined ? This is the question addressed here. In order to answer it we must consider the capabilities of the telescope, the nature of the resulting image and the limitations of the detector. The effect of atmospheric turbulence is another influence.

First, let's define some of the parameters which will be used :

a_{airy}	Angular diameter of Airy disc (radians) to first dark diffraction ring	
d_{airy}	Linear diameter of Airy disc to first dark diffraction ring	
l	Wavelength of light	(taken as 700 nm)
A	Aperture of telescope	
F	Focal length of telescope	
f	Focal ratio of telescope (= F/A)	
d	Diameter of image on CCD sensor	
W_{sens}	Width of sensor	
H_{sens}	Height of sensor	
W_{pix}	Width of sensor pixel	= W_{sens} / N_{wpix}
H_{pix}	Height of sensor pixel	= H_{sens} / N_{hpix}
N_{wpix}	Number of width pixels	
N_{hpix}	Number of height pixels	
a_o	Angular diameter of object	
a_{sens}	Angular field of view of sensor	
a_{pix}	Angular field of view of sensor pixel	
L_{sens}	Size of sensor	
L_{pix}	Size of pixel	
N_{pix}	Number of pixels across sensor (horizontal or vertical)	

Next, we consider some useful preliminary aspects. These are to do with the image size at prime focus and the angular field of view at various levels. After this we will consider some characteristics of the image formed at the prime focus by the objective lens or mirror and see how this provides a criteria for establishing an optimum image scale on the sensor.

Image Size at Prime Focus

The first thing we will investigate is the image size at prime focus since this is first technique to consider when deciding how to obtain a photograph.

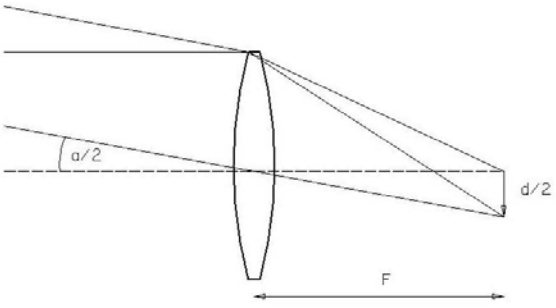


Fig. 1 : Image size at prime focus

Fig. 1 shows a lens of focal length F projecting a prime focus image onto the focal plane.

The angular size of the object is a and the diameter of the image is d.

From Fig. 1 : $\tan (a / 2) = (d / 2) / F$

so $d = 2 F \tan (a / 2)$ ..... (1)

For small angles this can be approximated to a simpler expression :

$d = a F$ (a in rads) ..... (2)

or : $d = a F / 57.3$ (a in degrees) ..... (3)

Sensor Field Of View at Prime Focus

Another parameter that is sometimes used is the angular field of view of the CCD sensor at prime focus. Transposing equation (1) and substituting a_{sens} for a and L_{sens} for d :

$a_{sens} = 2 \arctan [L_{sens} / (2F)]$..... (4)

or, using equation (3) :

$a_{sens} = 57.3 L_{sens} / F$ degrees ..... (5)

Field Of View Of A Single Pixel

It will also be useful sometimes to consider the angular field of view of a single photosite (pixel) on the sensor.

Pixel size = Sensor size / Number of pixels (for horizontal or vertical dimensions)

$L_{pix} = L_{sens} / N_{pix}$

Putting this into equation (5) and substituting a_{pix} for a_{sens} :

$a_{pix} = 57.3 L_{sens} / (F N_{pix})$ or

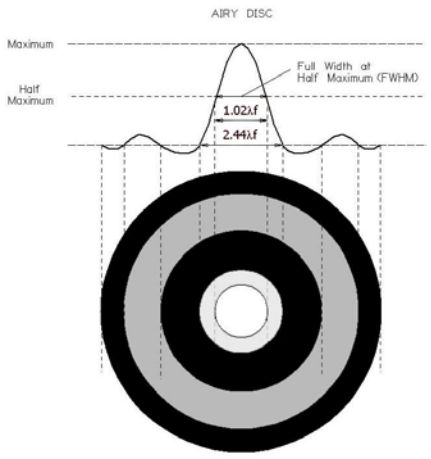
$a_{pix} = 57.3 L_{pix} / F$ ..... (6)

Image Characteristics

Since we are interested in the quality of the final image, i.e. the resolution, we must investigate the limits to the smallest level of detail achievable. To pursue this lets consider the effects on an ideal point source of light such as might be represented by a very faint star.

Due to the wave aspect of the nature of light a point source of light can never be perfectly preserved in an optical system since the process of focusing rays from different light paths can never eliminate the inevitable phase differences. The end effect is that when a point source of light is imaged by a lens or mirror the result is not a pin-prick spot of illumination but a circular area of variable brightness known as an Airy disc. This has a well characterised distribution of brightness as shown in figure 1 :

Fig. 2 Airy Disc



Characteristics Of The airy disc

$a_{airy} = \frac{2.44\,l}{A}$ radians

$d_{airy} = \frac{2.44\,lF}{A} = 2.44lf$ metres

$a_{FWHM} = \frac{1.02l}{A}$ radians ..... (7)

$d_{FWHM} = \frac{1.02\,lF}{A} = 1.02lf$ metres ..... (8)

CCD Sampling And The Point Spread Function
(Focal length for critical sampling)

Some more parameters :

N_{phot}	Average number of photons captured
F	Photon flux (photons per area per second)
A_p	Collecting area of photosite
T	Integration time
Q	Quantum efficiency of photosite (electrons per photon)
N_e	Number of electrons
d_{PSF}	Diameter of Point Spread Function
d_{FWHM}	Diameter of Airy disc (full width at half maximum)
d_{pix}	Diameter of sensor pixel

The value of a photosite in the sensor depends upon the number of photons it has captured.

$N_{phot} = FA_pT$
$N_e = QN_{phot}$

So for a group of photosites that all receive the same illumination, N_e will be the average number of electrons released by each site. Since this is only an average and is subject to random fluctuation the standard variation will be $\sqrt{N_e}$. This random variation will represent a noise signal, and the signal to noise ratio SN will be :

$SN = N_e / \sqrt{N_e} = \sqrt{N_e}$

The Point Spread Function of the telescope image refers to size and shape of the actual image of a point source of illumination. Ideally this is equal to the Airy disc but, inevitably, there will be other factors to degrade this, e.g. optical aberrations, atmospheric turbulence, tracking errors etc. The CCD will also add the noise signal just mentioned. Hence we have :

$d_{PSF} \geq d_{FWHM}$

Electronics engineers are familiar with the Nyquist theorem for calculating the minimum frequency at which a signal must be sampled in order to preserve the information contained by it. This says that for the sampling to reveal the detail of the original with reasonable fidelity, the sampling frequency must be at least twice the highest frequency present in the original signal. If the sampling rate is lower than this the detected signal will not faithfully represent the original, as much of the detail will have been lost (and if it is much lower than this the detected signal will be a gross distortion of the original). This situation is referred to as undersampling.

If the sample rate is exactly twice the highest frequency in the original then this is just adequate to preserve most of the detail in the original. This is called critical sampling. If the sampling rate is further increased the amount of detail detected will increase, but only marginally. This is called oversampling. This theorem is not restricted to any particular domain, and can be applied spatially as well as temporally, so we can legitimately consider the photosites in a CCD array to be sampling the image that is falling upon the sensor. Hence, we can approximate the Nyquist condition for critical sampling with :

$d_{pix} = d_{PSF} / 2$

And even for an ideal case where $d_{PSF} = d_{FWHM}$ we have from (8) :

$$d_{pix} = \frac{1.02\,lF}{2A} = \frac{0.51\,lF}{A} = 0.51lf$$

The only parameter that we can usefully vary in this is f (i.e. F and/or A) which could be accomplished by introducing a Barlow lens into the optical system, or using eyepiece projection, or even substituting another telescope. For a given telescope then we have :

$$F = \frac{A\,d_{pix}}{0.51l} \quad \text{..... (9)}$$

This represents the focal length required to provide critical sampling of the resulting image by the sensor array. A good way to summarise this is to consider the initial resolution of the prime focus image in terms of the point spread function. For simplicity we will disregard the degradation of the image due to optics, atmospherics etc., as this is a rather indeterminate contribution, and equate the point spread to the diameter of the Airy disc, i.e. $d_{PSF} \approx d_{FWHM}$. The number of point spread diameters (let's call them 'points'), N_p, contained in the image diameter, d_i, will be :

$N_p = d_i / d_{FWHM}$ which from (3) and (8) is :

$$N_p = \frac{a_o F / 57.3}{1.02\,lF/A} = \frac{a_o A}{58.446l} = \frac{a_o A}{0.041} \text{ for } l = 700 \text{ nm} \text{ .....(10)}$$

Notice that this depends on only two factors; the angular size of the target object and the aperture of the telescope. This is the best resolution we can hope for ; there are many things that can degrade this but nothing that can improve it, although it may be possible to compensate for some of the degradations by subsequent image processing.

We could adopt this as a measurement to describe this initial resolution. Let's call it PPI (points per image), a little analogous perhaps to the dpi (dots per inch) used to describe printing resolution.

So, once we have established our PPI from (10), we are stuck with it. Increasing the image scale with greater magnification will not change this since the point spread will increase at least as fast as the image scale, as established by (8). What will change is the size of the sensor elements relative to the point spreads and it is this that can be used to gauge the degree of image sampling. When we have increased the image scale (and the point spread diameter !) to twice the diameter of a sensor element then we can consider the Nyquist criteria to have been met. Any further increase in image scale will result in a larger point image diameter and would be equivalent to going to an oversampling situation. Little would be achieved by this in revealing further detail. What is happening in this situation is that there will be more sampling points per area of image, but the ultimate resolution inherent in the image is decreasing because of the larger point spread.

Sampling the image ever more finely achieves nothing when the image itself is getting ever more fuzzier ! Also, since the other consequence would be a dimmer image requiring longer exposure, greater tracking problems etc. there is little to be gained here. If the image scale is much less than this then the resolution is going to be limited by the size of the sensor elements. So, to make life as easy as possible we need to match the point spread function of our image to the dimensions of our sensor elements, which we can do by carefully selecting the focal length at which the image is made. A longer focal length will mean more difficult imaging, and a shorter focal length will mean that we will not fully reveal the detail in the original image. Hence we should use equation (9) to calculate our ideal focal length and provide for this by modifying the optical system with Barlow lenses, focal reducers, projection eyepieces etc. as needed.

Example 1
As an example lets assume a 150 mm Refractor at f8 and a Canon EOS 1000D Digital SLR camera which has a sensor size of 22.2 x 14.8 mm comprising 3888 x 2592 photosites.
We have :

l	$= 700 \times 10^{-6}$ mm
A	= 150 mm
W_{sens}	= 22.2 mm
H_{sens}	= 14.8 mm
N_{wpix}	= 3888
N_{hpix}	= 2592
W_{pix}	$= W_{sens} / N_{wpix} = 22.2 / 3888 = 5.71$ microns
H_{pix}	$= H_{sens} / N_{hpix} = 14.8 / 2592 = 5.71$ microns

So d_{pix} = 5.71 microns

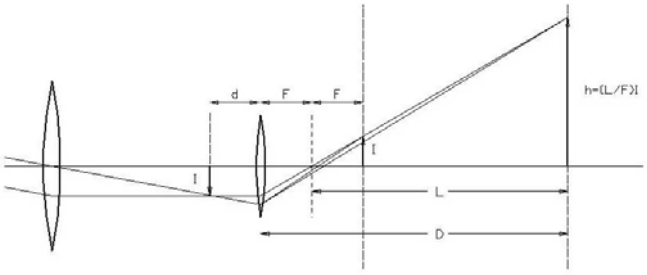
For critical sampling this requires from (9) a focal length of

$$F = \frac{150 \times 5.71 \times 10^{-3}}{0.51 \times 700 \times 10^{-6}} = 2400 \text{ mm}$$

The normal focal length is A x f = 150 mm x 8 = 1200 mm, so critical sampling can be achieved quite simply by incorporation of a x2 Barlow lens.

Equation (9) then provides a value of F which will give an appropriate image scale insofar as the characteristics of the camera and telescope will be matched for good image resolution. This is not the whole story however as no account has been taken of the actual image size which, of course, will depend upon the angular size of the target object. For small objects greater magnification may be desirable to reduce the need for subsequent enlargement, so the final image scale may be larger than equation (9) would suggest. A common way of achieving this is by eyepiece projection.

Eyepiece Projection Fig. 2 : Projection Geometry



I	Prime focus image
d	Prime focus image to eyepiece distance
D	Projection distance (eyepiece to image plane)
F	Focal length of eyepiece
E	Image enlargement over prime focus

Fig. 2 shows an arrangement for eyepiece projection. Here, the projection distance D is determined by the distance, d, of the eyepiece relative to the prime focus image formed by the objective. If d = F then light rays from any point on the image will be exiting the eyepiece in parallel, forming a virtual image at infinity to an eye placed behind the eyepiece and no real image projection will result. Another way of interpreting this is to say that a real image is produced, but at infinite distance, i.e. D = ∞. If d > F then a real image will be projected as shown, and as d is further increased D will decrease. From Fig. 2 it can be seen that if D = 2F then the enlargement E = 1.

Generally : $D = L + F$

and $h = I\,(L/F)$

so $L = hF / I$

and $D = (hF / I) + F$

but $E = h / I$

so $D = (E + 1)\ F$ ..... (11)

E.g. for an f6.3 telescope using a 25 mm eyepiece, to get an enlargement over a prime focus image of 4x, the distance of the CCD from the eyepiece must be set up from equation (11) :

$$D = (4 + 1) \times 25 = 125 \text{ mm}$$

This must be set and then the eyepiece-to-objective distance adjusted for focus.

Although eyepiece projection permits a large degree of magnification it has to be said that most eyepiece optics are not designed for projection and consequently will introduce some degradation to the image. An eyepiece has greater demands on its optics than an objective lens largely due to the greater angles it has to accommodate; an objective typically has a field of view of no greater than 1-2 degrees whereas an eyepiece may have 70-80 degrees or even more. However, for very small objects such as planets this may be the only option.

Angular Field Of View At Critical Sampling

As a gauge of the image quality to be expected, the image scale in terms of angular field of view per pixel is often a useful measure. This is usually expressed as arcseconds per pixel.

From (6) we can derive for the angular FOV per pixel :

$$a_{pix} = 57.3\ d_{pix} / F$$

Also from (9) we have the focal length for critical spatial sampling of the image :

$$F = \frac{A\ d_{pix}}{0.511}$$

So we can say that critical sampling corresponds to an angular FOV per pixel of :

$$a_{pix(crit)} = \frac{57.3 \times 0.511}{A} = \frac{0.020456}{A} \text{ ° / pixel}$$

$$a_{pix(crit)} = \frac{0.020456 \times 3600}{A} = \frac{73.64}{A} \text{ arcsecs / pixel} \quad .....(12)$$

Example 2

For A = 150 mm $a_{pix(crit)} = 73.64 / 150 = 0.491$ arcsecs / pixel

This should agree with the situation in example 1 where

$a_{pix} = (57.3 \times 5.71 \times 10^{-3} \times 3600) / 2400 = 0.491$ arcsecs / pixel μ

In practice the image scale that can be usefully used will be limited by the factors previously mentioned for oversampling. There are no hard-and fast rules for this but typical values in arcsecs / pixel for desirable image scales might be :

For views of constellations	: 30
For views of open clusters	: 5
For many deep sky objects	: 1-2
Planets	: < 1

Magnification v Subsequent Enlargement

Let's assume that in example 2 we capture an image of the Moon and another of Mars both at critical spatial sampling as determined by (9). The Moon presents an angular diameter of 29 minutes = 1740 arcsecs, while Mars at its nearest presents 25 arcsecs. So we have :

At critical sampling :
For Moon $a_o = 1740$ arcsecs
This occupies $a_o / a_{pix} = 1740 / 0.491 = 3544$ pixels

For Mars $a_o = 25$ arcsecs
This occupies $a_o / a_{pix} = 25 / 0.491 = 51$ pixels

For the previous example of a Canon EOS 1000D whose sensor has an array of 3888 x 2592 pixels, Mars would give an undersize image, while the Moon's image would be too large for the sensor if it is required to capture the whole disc. Obviously for the case of the Moon, we can simply use a lower value of F. For Mars, such an undersized image will require a large subsequent enlargement to provide a useable final image. This would look very 'blocky' from an initial image that was only 51 pixels wide so we would probably wish to increase the magnification when capturing the initial image. The detail in the magnified image will be subject to the same limits to the resolution but this will probably appear less obtrusive than the 'blockiness' in the unmagnified image, and a degree of sharpening may be achievable during image processing. If we provide more magnification by resorting to using eyepiece projection, the point spread function may be further degraded because of additional optical aberrations and sensitivity to atmospheric movements. All this means that to use a large degree of oversampling requires several conditions to be met as far as possible :

- Excellent seeing conditions
- Quality optics
- Accurate tracking (if long exposures used)

In summary, then, it seems that the image scale should initially be aimed at the value provided by equation (9) to get the optimum compromise between resolution and magnification. This should be achieved using prime focus, with the addition of a Barlow lens if necessary. If this results in too small an image then more magnification will have to be resorted to e.g. by employing eyepiece projection. This will require good optics, good seeing conditions and a good mount for tracking.

Cassini Captures Ghostly Dance of Saturn's Northern Lights

In the first video showing the auroras above the northern latitudes of Saturn, Cassini has spotted the tallest known "northern lights" in the solar system, flickering in shape and brightness high above the ringed planet.

The new video reveals changes in Saturn's aurora every few minutes, in high resolution, with three dimensions. The images show a previously unseen vertical profile to the auroras, which ripple in the video like tall curtains. These curtains reach more than 1,200 kilometers (750 miles) above the edge of the planet's northern hemisphere.

Auroras occur on Earth, Jupiter, Saturn and a few other planets, and the new images will help scientists better understand how they are generated.

"The auroras have put on a dazzling show, shape-shifting rapidly and exposing curtains that we suspected were there, but hadn't seen on Saturn before," said Andrew Ingersoll of the California Institute of Technology in Pasadena, who is a member of the Cassini imaging team that processed the new video. "Seeing these things on another planet helps us understand them a little better when we see them on Earth."

Auroras appear mostly in the high latitudes near a planet's magnetic poles. When charged particles from the magnetosphere ~ the magnetic bubble surrounding a planet ~ plunge into the planet's upper atmosphere, they cause the atmosphere to glow. The curtain shapes show the paths that these charged particles take as they flow along the lines of the magnetic field between the magnetosphere and the uppermost part of the atmosphere.

The height of the curtains on Saturn exposes a key difference between Saturn's atmosphere and our own, Ingersoll said. While Earth's atmosphere has a lot of oxygen and nitrogen, Saturn's atmosphere is composed primarily of hydrogen. Because hydrogen is very light, the atmosphere and auroras reach far out from Saturn. Earth's auroras tend to flare only about 100 to 500 kilometers (60 to 300 miles) above the surface.

The speed of the auroral changes in the video is comparable to some of those on Earth, but scientists are still working to understand the processes that produce these rapid changes. The height will also help them learn how much energy is required to light up auroras.

"I was wowed when I saw these images and the curtain," said Tamas Gombosi of the University of Michigan in Ann Arbor, who chairs Cassini's magnetosphere and plasma science working group. "Put this together with the other data Cassini has collected on the auroras so far, and you really get a new science."

Ultraviolet and infrared instruments on Cassini have captured images of and data from Saturn's auroras before, but in these latest images, Cassini's narrow-angle camera was able to capture the northern lights in the visible part of the light spectrum, in higher resolution. The movie was assembled from nearly 500 still pictures spanning 81 hours between Oct. 5 and Oct. 8, 2009. Each picture had an exposure time of two or three minutes. The camera shot pictures from the night side of Saturn.

The images were originally obtained in black and white, and the imaging team highlighted the auroras in false-color orange. The oxygen and nitrogen in Earth's upper atmosphere contribute to the colorful flashes of green, red and even purple in our auroras. But scientists are still working to determine the true color of the auroras at Saturn, whose atmosphere lacks those chemicals.

The Cassini-Huygens mission is a cooperative project of NASA, the European Space Agency and the Italian Space Agency. The Jet Propulsion Laboratory, a division of the California Institute of Technology in Pasadena,

ScienceDaily (Nov. 26, 2009)

This still image from a video shows the tallest known auroras in the solar system, rippling high above Saturn.
(Credit: NASA/JPL/Space Science Institute)

Spitzer Telescope Observes Baby Brown Dwarf

NASA's Spitzer Space Telescope has contributed to the discovery of the youngest brown dwarf ever observed -- a finding that, if confirmed, may solve an astronomical mystery about how these cosmic misfits are formed.

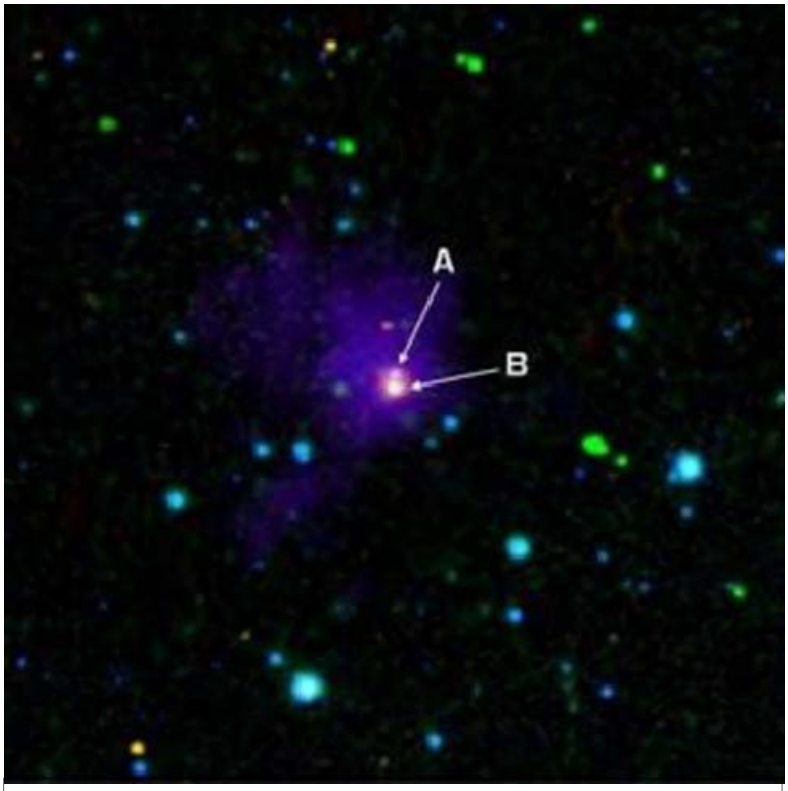
Brown dwarfs are misfits because they fall somewhere between planets and stars in terms of their temperature and mass. They are cooler and more lightweight than stars and more massive (and normally warmer) than planets. This has generated a debate among astronomers: Do brown dwarfs form like planets or like stars?

Brown dwarfs are born of the same dense, dusty clouds that spawn stars and planets. But while they may share the same galactic nursery, brown dwarfs are often called "failed" stars because they lack the mass of their hotter, brighter stellar siblings. Without that mass, the gas at their core does not get hot enough to trigger the nuclear fusion that burns hydrogen ~ the main component of these molecular clouds ~ into helium. Unable to ignite as stars, brown dwarfs end up as cooler, less luminous objects that are more difficult to detect ~ a challenge that was overcome in this case by Spitzer's heat-sensitive infrared vision.

To complicate matters, young brown dwarfs evolve rapidly, making it difficult to catch them when they are first born. The first brown dwarf was discovered in 1995 and, while hundreds have been found since, astronomers had not been able to unambiguously find them in their earliest stages of formation until now. In this study, an international team of astronomers found a so-called "proto brown dwarf" while it was still hidden in its natal star-forming region. Guided by Spitzer data collected in 2005, they focused their search in the dark cloud Barnard 213, a region of the Taurus-Auriga complex well known to astronomers as a hunting ground for young objects.

"We decided to go several steps back in the process when (brown dwarfs) are really hidden," said David Barrado of the Centro de Astrobiología in Madrid, Spain, lead author of the paper on the discovery in the *Astronomy & Astrophysics*journal. "During this step they would have an (opaque) envelope, a cocoon, and they would be easier to identify due to their strong infrared excesses. We have used this property to identify them. This is where Spitzer plays an important role because Spitzer can have a look inside these clouds. Without it this wouldn't have been possible."

Spitzer's longer-wavelength infrared camera penetrated the dusty natal cloud to observe a baby brown dwarf named SSTB213 J041757.



This image shows two young brown dwarfs, objects that fall somewhere between planets and stars in terms of their temperature and mass. Image credit: (Credit: NASA/JPL-Caltech/Calar Alto Observatory/Caltech Submillimeter Observatory)

The data, confirmed with near-infrared imaging from Calar Alto Observatory in Spain, revealed not one but two of what would potentially prove to be the faintest and coolest brown dwarfs ever observed.

Barrado and his team embarked on an international quest for more information about the two objects. Their overarching scientific objective was to observe and characterize the presence of this dusty envelope ~ proof of the celestial womb of sorts that would indicate that these brown dwarfs were, in fact, in their earliest evolutionary stages.

The twins were observed from around the globe, and their properties were measured and analyzed using a host of powerful astronomical tools. One of the astronomers' stops was the Caltech Submillimeter Observatory in Hawaii, which captured the presence of the envelope around the young objects. That information, coupled with what they had from Spitzer, enabled the astronomers to build a spectral energy distribution ~ a diagram that shows the amount of energy that is emitted by the objects in each wavelength.

From Hawaii, the astronomers made additional stops at observatories in Spain (Calar Alto Observatory), Chile (Very Large Telescopes) and New Mexico (Very Large Array). They also pulled decade-old data from the Canadian Astronomy Data Centre archives that allowed them to comparatively measure how the two objects were moving in the sky. After more than a year of observations, they drew their conclusions.

"We were able to estimate that these two objects are the faintest and coolest discovered so far," Barrado said. Barrado said the findings potentially solve the mystery about whether brown dwarfs form more like stars or planets. The answer? They form like low-mass stars. This theory is bolstered because the change in brightness of the objects at various wavelengths matches that of other very young, low-mass stars. While further study will confirm whether these two celestial objects are in fact proto brown dwarfs, they are the best candidates so far, Barrado said. He said the journey to their discovery, while difficult, was fun. "It is a story that has been unfolding piece by piece. Sometimes nature takes its time to give up its secrets."

These observations were made before Spitzer ran out of its liquid coolant in May 2009, beginning its "warm" mission.

The paper's other authors are M. Morales-Calderon, Centro de Astrobiología and Spitzer Science Center; A. Palau and A. Bayo, Centro de Astrobiología; I. de Gregorio-Monsalvo, European Southern Observatory; C. Eiroa, Universidad Autónoma de Madrid; N. Huelamo, Centro de Astrobiología; H. Bouy, Instituto de Astrofísica de Canarias and European Space Agency; O. Morata, Institute of Astronomy and Astrophysics and National Taiwan Normal University; and L. Schmidtobreick, European Southern Observatory.

More information on the Spitzer Space Telescope is online at http://spitzer.caltech.eduand http://www.nasa.gov/spitzer .

ScienceDaily (Nov. 24, 2009)

Solar Tsunamis Are Real, NASA Says

Incredibly powerful waves of plasma rippling across the surface of the sun and dubbed "solar tsunamis" were first observed years ago, but were thought to be an optical illusion. Scientists have now confirmed, though, that they are really real.

When scientists first saw the phenomenon, it was hard to believe that a towering wave of hot plasma was actually racing along the sun's surface. One of the waves rose up higher than the diameter of Earth and rippled out from a central point in a circular pattern millions of miles wide, like a gargantuan pattern of waves created by a pebble dropped in a pond.

Skeptical observers suggested it might be a shadow of some kind – a trick of the eye. But new observations from NASA's STEREO (Solar Terrestrial Relations Observatory) spacecraft are telling researchers that this controversial phenomenon isn't an illusion.

This week, NASA released a remarkable video of a solar tsunami.

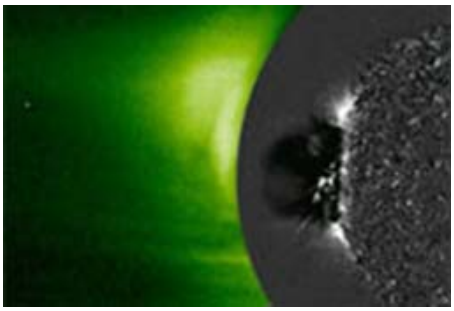
"Now we know," said Joe Gurman of the Solar Physics Lab at NASA's Goddard Space Flight Center in Greenbelt, Md. "Solar tsunamis are real."

Reality confirmed

The twin STEREO spacecraft confirmed their reality in images captured in February when sunspot 11012 unexpectedly erupted. The blast hurled a billion-ton cloud of gas (acoronal mass ejection, or "CME") into space and sent a tsunami racing along the sun's surface.

STEREO recorded the wave from two positions separated by 90 degrees, giving researchers an unprecedented view of the event.

"It was definitely a wave," said Spiros Patsourakos of George Mason University in Virginia and lead author of a paper reporting the finding in the Astrophysical Journal Letters.



"Not a wave of water," he adds, "but a giant wave of hot plasma and magnetism."

The technical name is "fast-mode magneto-hydrodynamical wave" – or "MHD wave" for short. The one STEREO saw reared up about 62,000 miles (100,000 km) high, and raced outward at 560,000 mph (250 km/s) packing as much energy as 2,400 megatons of TNT.

Solar tsunamis were discovered back in 1997 by the Solar and Heliospheric Observatory (SOHO). In May of that year, a CME blasted up from an active region on the sun's surface, and SOHO recorded a tsunami rippling away from the blast site.

"We wondered," Gurman recalled, "is that a wave – or just a shadow of the CME overhead?"

Stereo view

SOHO's single point of view was not enough to answer the question–neither for that first wave nor for many similar events recorded by SOHO in years that followed, until STEREO launched in 2006. The mission uses two spacecraft — one orbiting the sun ahead of the Earth, the other behind it — to get, literally, a stereo view of the sun.

"We've seen the waves reflected by coronal holes (magnetic holes in the sun's atmosphere)," Vourlidas said. "And there is a wonderful movie of a solar prominence oscillating after it gets hit by a wave. We call it the 'dancing prominence.'"

Solar tsunamis pose no direct threat to Earth. Nevertheless, they are important to study, scientists say.

"We can use them to diagnose conditions on the sun," Gurman said. "By watching how the waves propagate and bounce off things, we can gather information about the sun's lower atmosphere available in no other way."

"Tsunami waves can also improve our forecasting of space weather," Vourlidas added, "Like a bull-eye, they 'mark the spot' where an eruption takes place. Pinpointing the blast site can help us anticipate when a CME or radiation storm will reach Earth."

SPACE.com 25 November 2009

Space Station Crew Will Shrink to Two

By Clara Moskowitz

The International Space Station, which was crowded last week with 12 astronauts onboard, is set to go down to a crew of two Tuesday.

Seven astronauts departed the station Nov. 25 on the space shuttle Atlantis, and now three more station residents are set to undock from the orbital outpost Monday at 10:56 p.m. EST (0356 GMT Tuesday) to land their Russian Soyuz spacecraft at 2:16 a.m. EST (0716 GMT) Tuesday in Kazakhstan.

The barebones remaining crew of two — NASA astronaut Jeff Williams and Russian cosmonaut Maxim Suraev — will be left to handle the space laboratory themselves for about three weeks.

"Jeff once told me that this will be the best time," Suraev said during an in-flight news conference last week. "Right now we have so many people onboard, so I haven't had the chance to be onboard with just two crewmembers. What we're planning to do is just the regular work, our regular activities."

The two spaceflyers will each have more daily maintenance jobs than they do when the normal crew of six long-term residents is at the station. Though they may have to cut down on the amount of science research they can accomplish, Williams and Suraev should be able to handle the workload, NASA said.

"We won't overload the crew with a lot of tasks," said Dan Hartman, manager of space station integration and operations. "We feel very comfortable going into it."

In fact, Williams is an old hand at serving on small crews: He was one of two astronauts working on the space station during Expedition 13 in 2003, when shuttle flights were put on hold following the tragic Columbia accident.

"I spent three months as part of a crew of two with Pavel [Vinogradov], and we had a great time," Williams told SPACE.com. "The loneliness was not an issue. There's so much contact with the ground... that it's not an issue."

Williams was recently promoted to commander of the space station's Expedition 22 mission after the outgoing commander, Belgian astronaut Frank DeWinne, relinquished control during a change-of-command ceremony Nov. 24.

"You've set the bar very high for me but also for those that follow us," Williams told DeWinne, the first station commander to represent the European Space Agency.

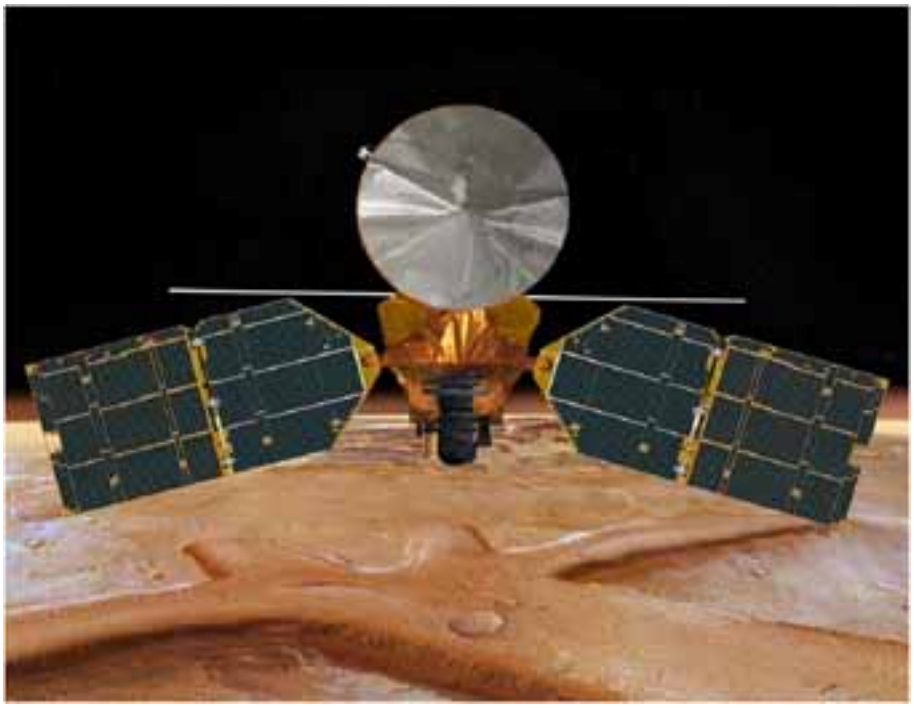
DeWinne is set to end his six-month space voyage and return to Earth Tuesday along with Expedition 21 flight engineers Bob Thirsk of Canada and Russian cosmonaut Roman Romanenko. All three have spent 186 days on the station, overseeing the addition of a new science porch on the station, the arrival of the first Japanese unmanned cargo ship, and three visiting shuttle flights.

Williams and Suraev are due to be joined by three more crewmembers — Russian cosmonaut Oleg Kotov, Japanese astronaut Soichi Noguchi, and NASA astronaut Timothy Creamer — arriving on a Soyuz spacecraft Dec. 23.

Space.com 30 November 2009

MRO Comes Out of Safe Mode

Written by Nancy Atkinson



Artist impression of MRO. Image credit: NASA/JPL

The latest word on the Mars Reconnaissance Orbiter is that the spacecraft has successfully come out of safe mode. The various instruments, including the HiRISE camera are still "safed" at this point, and engineers are waiting for acquisition of signal to confirm mapping orientation. MRO spontaneously rebooted its computer on Aug. 26, and since this was the fourth time this type of event had occurred, flight engineers decided to keep the spacecraft in safe mode, and have been working to figure out possible root causes, as well as repercussions if these events were to continue to happen. Several protective files were uploaded to MRO in late November, with hopes of returning the orbiter to its regularly scheduled research and relay activities. Once engineers check out of all the science instruments, normal science operations may resume next week.

"The patient is out of danger but more steps have to be taken to get it back on its feet," said Mars Reconnaissance Orbiter Project Manager Jim Erickson.

Since August, the team worked painstakingly on a plan to ensure the safety and operation of the orbiter. "This process is to bulletproof the spacecraft against a remote vulnerability that our team identified," said Erickson. "Meanwhile, analysis of possible root causes for the four reboots this year continues as another important part of our path toward resuming science operations."

The preventive care required amending some data files in the computers' non-volatile, or "flash" memories where the computers check for default settings when they reboot.

The four reboots involved a device, called the "computer module interface controller," that controls which of two redundant main computers on the spacecraft is active. Still undetermined is whether trouble lies with that controller itself or with a voltage glitch elsewhere on the spacecraft. The Aug. 6 reboot, though not the other three, prompted a switch from one computer to its backup twin. More than 100 factors are under consideration as possible root causes.

MRO has six instruments on board to examine Mars in detail, from subsurface layers to the top of the atmosphere.

"The precautionary steps we are taking are not driven by the calendar, but by our commitment to care for this valuable national resource," Erickson said. "We are all eager to have science observations resume as soon as a properly cautious process allows."

Universe Today—December 8th, 2009

Dating a Cluster – A New Trick

Finding the ages of things in astronomy is hard. While it is undoubted that the properties of objects change as they age, the difficulty lies in that the initial parameters are often so varied that, for most cases, finding reliable ages is challenging. There's some tricks to do it though. One of the best ones, taught conceptually in introductory astronomy courses, is to use the "main sequence turn-off" of a cluster. Of course, applying any of these methods is easier said than done, but a new method may help alleviate some of the challenges and allow for smaller errors.

The largest difficulty in the main sequence turn-off method lies in the inherent scatter caused by numerous sources that must be accounted for. Stars that lie along the same line of sight as the cluster being observed can add extraneous data points. Any interstellar reddening caused by gas may make stars appear more red than they should be. Closebinary stars that cannot be spatially resolved appear brighter than they should be as an individual star. The amount of heavy elements in the star will also effect the fitting of the model. All of these factors and more contribute to an uncertainty in any calculation that requires an accurate Hertzsprung-Russell Diagram. Tricks to correct for some of these factors exist. Others cannot (yet) be accounted for.

Thanks to all these problems, fitting the data can often be challenging. Finding the point where the cluster "peels away" from the main sequence is difficult, so one of the tricks is to look for other points that should have significant numbers of stars to provide extra reference points for fitting. Examples of this include the horizontal branch and the red clump.

The new technique, developed by a large team of international astronomers, uses "a well defined knee located along the lower main sequence" which they refer to as the Main Sequence Knee (MSK). This "knee" appears in H-R diagrams of the clusters taken in the near-infrared and is largely independent of the age of the cluster. As such, it provides a stable reference point to improve corrections for the general main sequence turn-off method. Additionally, since this system uses infrared wavelengths, it is less prone to contamination between gas and dust.

To test this new method, the group selected a globular cluster (NGC 3201) as a test case. When their method was applied, they found that their derived age for the cluster was consistent with ages derived by other methods.

However, the new method is not without difficulties of its own. Since the knee is at the faint end of the main sequence, this requires that exposure times for target clusters be sufficiently long to bring out such faint stars. Fortunately, with new telescopes like the James Webb Space Telescope, these faint stars should be in reach.

Written by Jon Voisey
Universe Today

New Findings Say Mars Methane Comes from Life or Water — or Both

A new paper due to be published Wednesday 9th December 2009 rules out the possibility that methane is delivered to Mars by meteorites, boosting the idea that the short-lived gas perhaps could be generated by either life or water, or maybe even both. Microorganisms living in the Martian soil could be producing methane gas as a by-product of their metabolic processes, or methane might be created as a result of reactions between volcanic rock and water. Either way, the prospect is exciting.

Methane on Mars was first detected in 1999, again in 2001 and 2003, which was widely reported, but not much was known about the origin or amount of the gas on Mars.

In January 2009, scientists analyzing data from telescopic observations and unmanned space missions announced that the methane on Mars is being constantly replenished by an unknown source and they are keen to uncover how the levels of methane are being topped up.

Methane has a short lifetime of just a few hundred years on Mars because it is constantly being depleted by a chemical reaction in the planet's atmosphere, caused by sunlight.

Some researchers proposed meteorites might be responsible for Martian methane levels because when the rocks enter the planet's atmosphere they are subjected to intense heat, causing a chemical reaction that releases methane and other gases into the atmosphere.

However, the new study, by researchers from Imperial College London, shows that the volumes of methane that could be released by the meteorites entering Mars's atmosphere are too low to maintain the current atmospheric levels of methane. Previous studies have also ruled out the possibility that the methane is delivered through volcanic activity.

"Our experiments are helping to solve the mystery of methane on Mars," said Dr. Richard Court, co-author of the study. "Meteorites vaporizing in the atmosphere are a proposed methane source but when we recreate their fiery entry in the laboratory we get only small amounts of the gas. For Mars, meteorites fail the methane test."

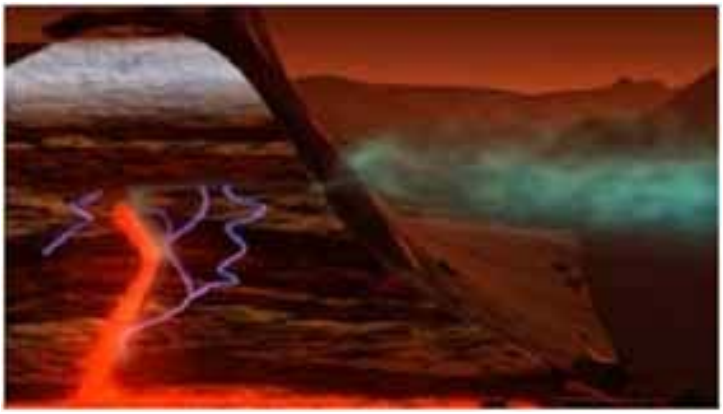
The team used a technique called Quantitive Pyrolysis-Fourier Transform InfraredSpectroscopy to reproduce the same searing conditions experienced by meteorites as they enter the Martian atmosphere. The team heated the meteorite fragments to 1000 degrees Celsius and measured the gases that were released using an infrared beam.

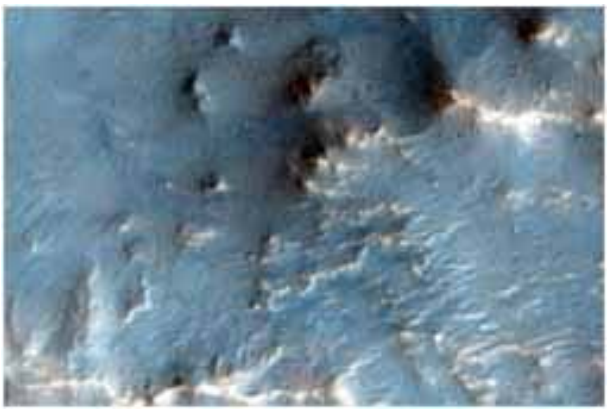
When quantities of gas released by the laboratory experiments were combined with published calculations of meteorite in-fall rates on Mars, the scientists calculated that only 10 kilograms of meteorite methane was produced each year, far below the 100 to 300 tons required to replenish methane levels in the Martian atmosphere.

The researchers say their study will help NASA and ESA scientists who are planning a joint mission to the red planet in 2018 to search for the source of methane. The researchers say now that they have discovered that meteorites are not a source of Methane on Mars, ESA and NASA scientists can focus their attention on the two last remaining options.

"This work is a big step forward," said co-author Mark Sephton. "As Sherlock Holmes said, eliminate all other factors and the one that remains must be the truth. The list of possible sources of methane gas is getting smaller and excitingly, extraterrestrial life still remains an option. Ultimately the final test may have to be on Mars."

Written by Nancy Atkinson
Universe Today
December 8th, 2009





SOCIETY ROUND UP

ABERDEEN AS www.aberdeenastro.org.uk
2nd Tues at Cromwell Tower Observatory, King's College, Old Aberdeen
Email: aas@aberdeenastro.otg.uk

ABINGDON AS www.abingdonastro.org.uk
2nd Mon at Methodist Church Hall, Dorchester Crescent, Abingdon
Email: chris.c.holt@ntlworld.com

Jan 11:	Exoplanets	Dr F Pearce
Feb 8:	E Large Telescope	Dr F Clarke
Mar 8:	Astronomy & Early Royals	Dr A Chapman

ADUR AS www.adur-astronomical.com
1st Mon at Southwick Community Centre, Southwick, Sussex
Email: robin-Durant@btconnect.com

ALTRINCHAM & DISTRICT AS
www.astroadas.org.uk
1st Fri (exc Jul & Aug) at Scout's Building on Park Road, Timperley. Altrincham
Geoff Flood 0161 980 1675
email: geoffrey513flood@btinternet.com

AS OF GLASGOW
www.astronomicalsocietyofglasgow.org.uk/
Meetings 3rd Thurs. at Room 345, Uni of Strathclyde (Montrose St entrance)
Email: DDegan@aol.com

AMATEUR ASTRONOMY CENTRE
www.astronomycentre.org.uk
Off A681 halfway between Todmorden & Bacup
e-mail: membership@astronomycentre.org.uk

ANDOVER AS www.andoverastronomy.org.uk
3rd Thur (exc Aug) at Grateley Village Hall.
e-mail: secretary@andoverastronomy.org.uk

ASHFORD AS www.ashfordastro.org.uk
Last Fri (exc Bank Hols) 19.30 at Woodchurch Memorial Hall, Front Road, Woodchurch. TN26 3QB
Drew Wagar e-mail: drew@wagar.org.uk

AYLESBURY AS www.aylesbury-astronomy.org.uk
1st Mon (exc Bank Hols) at the Scout Hut, Oakfield Road, Aylesbury.
Sue Macdonald sumacdonald@tiscali.co.uk

AYRSHIRE AS http://ayrastro.thesmallearth.com/
1st Tues at Ayr College
email: gm0dig@hotmail.com

BASINGSTOKE AS www.basingstokeas.org.uk/
4th Thurs at Cliddesden Primary School
email: john.stapleton@tesco.net

BASSETLAW AS http://beehive.thisisnottingham.co.uk/bassetlawastro
Meets at The Village Hall, Tylden Rd, Rhodesia, Notts. S80 3HL
Andrew Patten email: andrew_patton@talk21.com

BATLEY & SPENDBOROUGH AS
Every Thurs at Milner K Ford Observatory, Wilton Park, Batley
I Newsome 01924-443860
email: bevian11@hotmail.com

BECKINGTON AS www.basnet.org.uk
3rd Fri (exc Jul, Aug & Dec) at Beckington Baptist Church Hall, Beckington,
email: info@basnet.org.uk

BEDFORD AS www.bedsastro.org.uk
Last Weds, Bedford School, Burnaby Road, Bedford, MK40 2TU
Email: society@bedsastro.org.uk

BIRMINGHAM AS www.birmingham-astronomy.co.uk
Every Weds at Aston Uni. & Last Tues—lecture
Email: john.spittle@homecall.co.uk

BLACKPOOL & DISTRICT AS
www.blackpoolastronomy.org.uk
1st Wed of month at St Kentigern's Church Hall, Newton Drive, Blackpool
Terry Devon Tel: 01253-625975
email: info@blackpoolastronomy.org.uk

BOLTON AS www.boltonastro.org.uk
1st & 3rd Tues at Bolton TIC Centre on Minerva Road (nr Bolton Royal Hospital)
Peter Miskiw. Email: petermiski@hotmail.com

BRADFORD AS www.bradfordastronomy.co.uk
Alt Mons in upstairs room at Eccleshill Library, Bolton Road, Bradford, BD2 4SR
Hilary on 01274 672570. johnbards@blueyonder.co.uk

BRANNEL ASTRONOMY
www.brannelastronomy.com
1st & 3rd Fri at Brannel School, St Stephens, Cornwall .
Frank Johns, 01637-878020
e-mail: frank@laplage.demon.co.uk

BRECKLAND AA www.brecklandastro.org.uk/
2nd Fri at Recreation Centre, B1077 Watton Road, Great Ellingham
Rod Crockford. Email: rod_crockford@yahoo.co.uk

Jan 8:	Planetarium Show	Mike Cripps
Feb 12:	Radio Astronomy	Jeff Lashley
Mar 12:	Rocketry	Rod Stevenson
Apr 9:	Astrophotography	Nik Szymanek
May 14:	2009 Eclipse & AGM	Jerry Workman
Jun 11:	Galaxy Zoo	Dr C Lintott

BRIDGEND AS
www.bridgendastronomicalsociety.co.uk
2nd Fri (Sept-May) Parc Slip Nature Reserve, Aberkenfig.
Email: clivedown@btinternet.com

BRISTOL AS www.bristolastrosoc.org.uk
Every Fri at Bristol Grammar School, University Road
Simon Smith, email: secretary@bristolastrosoc.org.uk

CALLINGTON CAG www.callington-astro.org.uk
1st & 3rd Sat (exc Aug), at Space Centre, Callington Community College.
Beccy Watson; callintonastro@kimwatson99.fsnet.co.uk

CARDIFF AS www.cardiff-astronomical-society.org
Alt Thurs, Sep-Jul, at Dept Physics & Astronomy, Univ. of Wales, 5 The Parade.
David Powell, 029 2055 1704.
Email CAS@ilddat.demon.co.uk

Jan 7:	3 sides to the Sun	Nick Howes
Jan 21:	To infinity & beyond	Andrew Green
Feb 4:	400 yrs of the telescope	Prof M Edmunds
Feb 18:	Can we take cosmology seriously	Profs M Disney & S Eales
Mar 4:	Star Formation History	Dr E Pascale
Mar 18:	Infrared Astronomy	Prof M Griffin
Apr 15:	Messier Marathon	Grahame Carter
Apr 29:	Venus & Venus Express	Prof F Taylor
May 13:	Practical Astronomy	B Sheen
May 27:	How outer planets were not discovered	Colin Steele

CAROLIAN AS www.carolianastro.org.uk
Contact: Chris Ashman 01562 743758.
Email: info@carolianastro.org.uk

CASTLE POINT AC www.cpac.org.uk
Every Weds at St Michaels Church, St Michaels Rd, Daws Heath, Hadleigh. 2nd & 4th Weds: Beginners/ Observing. Other Weds: talks & group events
01702 434449. Email: secretary@cpac.org.uk

CHESTER AS www.cpac.org.uk
Last Weds (no meeting Aug & Dec) at Burley Memorial Hall, Waverton, Chester
Tim Colegate-. Email: tjcsmith@btinternet.com

CHIPPING NORTON AAG www.cnaag.com/
3rd Mon Robin Smitten 07900-858690.
Email: robin@chippingnortontheatre.com

CLACTON AS www.clactonastronomy.co.uk
1st Thurs (exc Aug) at Quakers House, Granvile Road, Clacton-on-Sea. CO15 6BX
David Pugh 01255 429849 e-mail pugh-d@sky.com

Apr 1:	Telescopes of the future	Dr L Sproats
May 6:	New Adventures in Imaging	Nik Szymanek
Jul 1:	Eclipses of 2008 & 9	Jerry Workman

CLEETHORPES AS
www.cleethorpesastronomy.co.uk
Meetings held at the Beacon Hill Observatory, Cleethorpes, start at 7.30pm.
Paul Thompson 01472 233552
e-mail paul@cleethorpesastronomy.co.uk.

CLYDESDALE AS www.clydesdaleastro.org.uk
2nd Mon at Dunglass House, Ayr Road, ML11 9TU
Contact: Lyn Smith 07725 347711. e-mail: clydesdaleastro@hotmail.co.uk

Jan 11:	Night with V L Telescope	Dr R Gilmour
Feb 8:	Galaxies & Black Holes	Prof I Robson
Apr 12:	Finding Supernovae	Tom Boles

CORNWALL AS www.CornwallAS.org.uk
2nd Tues & 4th Thurs at WI Hall, Mabe, Penryn..
Robert Beeman (01326-341164)
Email: info@CornwallAS.org.uk

COTSWOLD AS www.cotswoldas.org.uk
2nd Sat at Millenium Hall, Bishop Road, Shurdington, Cheltenham.
Callum Potter (01684-773256)

COVENTRY & WARWICK AS http://uk.geocities.com/covwaras/
2nd Fri at Earlsdon Methodist Church Hall, Earlsdon Ave South, Earlsdon
email: cov_wark_as@yahoo.co.uk

CRANBROOK & DISTRICT AS www.cadas.com/
2nd Mondays at Cranbrook School Observatory.

CRAWLEY AS http://uk.geocities.com/crawleyas/
3rd Fri (exc July & Aug) at Ifield Community Centre. 7.30 pm.
Jim Swift 01293-882560
E-mail: cytron@btinternet.com

CROYDON AS www.croydonastro.org.uk
2nd Fri during term time at Royal Russell School, Coombe Lane
Paul Harper email: chairman07@croydonastro.org.uk

DALGETY BAY AC http://db-astro.org
Meets at The Kabin, junct Moray Way South & Regents Way.

DERBY & DISTRICT AS www.derbyastronomy.org
1st Fri (exc July) at 7.30 at Friends Meeting House, St Helen's St, Derby

DONCASTER AS www.donastro.org.uk
2nd & 4th Thurs at Church House—behind St George Minster, Doncanster.
Mrs Lesley Hardware on 01302-743352
email: secretary@donastro.org.uk

DUMFRIES AS Society web-site www.astronomers.ukscientist.com
Monthly meetings at the St. George's Churchhall, George Street, Dumfries
Email: lesley.burrell@btinternet.com or 01387 269762

EASTBOURNE AS www.EastbourneAS.org.uk
Saturdays at the Willingdon Memorial Hall, Church Street, Willingdon p.m.
Bob Cripps, tel. 01323 732067
email bobwcripps@btinternet.com

EAST RIDING ASTRONOMERS
www.eastridingastronomers.org.uk
3rd Mon at the Friends Meeting House, Quaker Lane, Beverley.
Tony Scaife, email astrogen@astrogen.karoo.co.uk

EAST SUSSEX AS www.esas.org.uk
1st Thurs. St Mary's School, Wrestwood Road, Bexhill-on-Sea. TN40 2LU
Andy Lawes Tel. 01424 819450
email andy@esas.org.uk

7 Jan: Galileo—400 years of the 'scope	Simon Allen
4 Feb: The Herschel Telescope	Dr Seb Oliver
4 Mar: Spectroscopy in astronomy	David Pulley
1 Apr: Current Status of 'Big Bang'	Dr D Parkinson
6 May: Space in next 50 yrs	Dr D Whitehouse

FALKIRK ASTRONOMERS www.astronomy-falkirk.co.uk
2nd Weds (exc June/July) at Old Peoples Welfare Hall, Laurieston, Falkirk.
email: malcolm@astronomy-falkirk.co.uk

FARNHAM AS www.farnham-as.co.uk
Meet 2nd Tues at Willis Hall, Sandy Lane, Church Cookham, Fleet
Barry Bellinger, tel. 07748766610
barry.bellinger@nokia.com

FLAMSTEED AS www.flamsteed.info
1st Mon at Royal Observatory & National Maritime Museum, Greenwich.
Friends Office. tel. 020 8312 6678
E-mail: jjbendall@btinternet.com

FURNESS & SOUTH LAKELAND AS
www.furness-astrosociety.org.uk
1st Fri (exc Jul/Aug) at Trinity Church Centre, Warwick St. Barrow-in-Furness
Richard Alldridge, 01229 826864
Email: Richard@alldridge.worldonline.co.uk

GUERNSEY AS www.astronomy.org.gg
Every Tues at the Observatory, Rue Lorier, St. Peters, Guernsey.
Debby Quertier. 01481 725760
Email: quertiers@thomasmiller.com

GUILDFORD AS www.guildfordas.org
1st Thurs at Guildford Institute, Ward Street, Guildford
John Axtell. 01932 341036 johnaxtell42@aol.com

HAMPSTEAD GARDEN SUBURB AS
Last Wed at Free Church Hall, Northway, London NW11.
Dianne Fishman 020 8458 4038
email: hgsas@dfish.demon.co.uk

HAMPSHIRE ASTRONOMICAL GROUP
www.hantsastro.org.uk
Wed & Fri at Observatory, Hinton Manor Lane, Clanfield. Main monthly lecture 2nd Fri (exc Aug) Clanfield Memorial Hall, South Road, Clanfield
Graham Bryant 02392 241764
email: graham.bryant@hantsastro.org.uk
or graham.g.bryant@btinternet.com

HANTS ASTRO.ORG www.hantsastro.org
David Woods 023 9261 7092
email: subscribe@hantsastro.org

HARROGATE AS
Last Fri at The Green Hut, Harlow Community Centre, Harlow Ave.
Email: patsyorio@tiscali.co.uk

HAVERING AS http://homepages.tesco.net/~nik.szymanek/havering.htm
3rd Wed at Cranham Community Centre, Marlborough Gardens, Cranham. Contact: Frances Ridgley 01708 227397

HEART OF ENGLAND AS www.hoeas.co.uk
Last Thurs Furnace End Meeting Site, The Old Exchange, Shustoke, Warwickshire
email: hoeas@tiscali.co.uk

HEBDEN BRIDGE AS
Meetings at Hope Baptist Church Rooms at approx 4 week intervals.
Len Entwhistle (01422-378368) or visit FAS webpage.

HEREFORD AS
Meet 1st Thurs at Kindle Centre, Hereford .
Contact: Paul Olver (01432-761693)
email: info@hsastro.org.uk.

HERTFORD AS http://hag.110mb.com/hag/
Meet Cricket Pavilion, Hertingfordbury
Contact: Marion email: secretary@hertsastro.org.uk.

HERSCHEL AS www.herschel-astrosoc.co.uk
Email: hasadmin@gmail.com

HIGHLANDS AS www.spacegazer.com
1st Tues at The Green House, Beechwood Business Park North, Inverness.
Eric Walker, Tel: 01349 863821
email: pat.williams@ndirect.co.uk

HORSHAM AS www.horshamastronomy.co.uk
1st Wed at Christs Hospital School, Horsham, West Sussex.
Richard Griffith
email: secretary@horshamastronomy.co.uk

HUDDERSFIELD A & P SOCIETY
www,huddersfieldastronomy.org.uk
Every Fri at 4A Railway Street.
Email: marcus.armitage@ntworld.com

HULL & EAST RIDING AS www.heras.org.uk
2nd Mon at Room S25, Wilberforce Bldg, Uni of Hull, Cottingham Road, Hull
Mark Evans, Secretary.
E-mail: mark.Heras@merrydowncontrolware.co.uk

ILKESTON & DISTRICT AS
2nd Tuesdays at Hayloft Erewash Museum, Ilkeston, Derbyshire
Mary McMulty, tel. 01298 78234
email: mintaca@msn.com

IRISH AA www.irishastro.org
Meets at Bell Lecture Theatre, Physics Building, Queen's Uni, Belfast
e-mail: iaa@irishastro.org

ISLE OF MAN AS www.iomastronomy.org
1st Thurs at the IOM Observatory, Foxdale.
James Martin e-mail: ballaterson@manx.net

JAVEA & DISTRICT AS www.U3ADenia.org
Meets 1st Mon at 3pm at Hotel La Racona, Denia, Costa Blanca
Email: edmo734g@midasdsl.com

JERSEY AC www.jerseyastronomyclub.org.je
Meets 2nd Mon at Sir Patrick Moore Astronomy Centre, Les Creux, St Brelade.
Anthony Isherwood. 01534-744510
e-mail: kannyfixit@jerseymail.co.uk

KIELDER OBSERVATORY AS
www.kielderobservatory.org
Lyn Henderson. Tel: 0191-4261708
e-mail: lynhenderson@blueyonder.co.uk

KNOWLE AS www.knowleastro.org.uk
1st Mon (+/- 1 wk for BH exc Aug) at St George & St Theresa's Parish Centre, Dorridge, Solihull.
Nigel Foster. 21 Speedwell Dr, Balsall Common, Coventry CV7_7AU Tel: 01676-535941

LEEDS AS www.leedsastronomy.org.uk
2nd & 4th Wed at The Friends Meeting House, Carlton Hill, 188 Woodhouse Lane, Leeds LS2 9DX–19.30
Mailto: xavier@leedsastronomy.org.uk or xvermeren@gmail.com

LEICESTER AS www.leicester-astronomical.co.uk
Meets 2nd and 4th Tues 19:30. National Space Centre, Exploration Drive, Leicester
Chris Gutteridge 0116 270 0596
email: chris@gutteridge.co.uk

LETCHWORTH & DISTRICT AS
Meets last Wednesday of the month at Plinston Hall, Letchworth: 7:45pm
Nick Ellis e.mail: ellis.nick@virgin.net

LINCOLN AS www.lincolnastronomy.org/
1st Tues (exc Jan) at 23 Westcliffe St, Lincoln
David Swaby. Tel: 01522-531591

LIVERPOOL AS www.liverpoolas.org
3rd Fri at The Quaker Meeting House, 22 School Lane, Liverpool L1 3BT
email: clarklunar@aol.com

Jan 15:	Probing Andromeda	Dr Andy Newman
Feb 19:	Newton & Surrey Pumas	Mike Frost
Mar 19:	Visual Amateur Astronomy	Paul Abel
Apr 16:	2008 Eclipse	Paul Money

LOUGHTON AS www.las-astro.org.uk
Every Thurs in the Scout Hall, Loughton Lane, Theydon Bois, Essex.
Jerry Workman (0208-507-7568)

LOWESTOFT & GT YARMOUTH RA (LYRA)
2nd Tues at Waveney Gymnastics Centre (access Notley Rd).
Richard Chilvers: 01502 57401
email: good.goat@tiscali.co.uk

LUTON AS www.lutonastrosoc.org.uk
Last Thurs at Putteridge Bury Campus, University of Bedfordshire
Geoff Mitchell. Email: user998491@aol.com

MACCLESFIELD AS www.maccastro.com
1st Tues (exc Jan) at Jodrell Bank Observatory &3rd Tues at Goostrey Village Hall.
email: secretary@maccastro.com

9 Jan:	James Glaisher 1809-1903	Dr A Chapman
16 Feb:	Effects of Space on Humans	Prof M Narici
16 Mar:	Planetary Nebulae	Myfabwy Lloyd
20 Apr:	Sundials	Mike Shaw
15 Jun:	Exoplanets	Dr Frazer Pearce

MAIDENHEAD AS www.maidenhead-astro.net
1st Fri (exc July & Aug) at Stubbings Church hall, Maidenhead SL6 6QZ
Tim Haymes 07796-164010

MANCHESTER AS www.manastro.co.uk/
3rd Thurs Godlee Observatory, Sackville Building, University of Manchester,
Email: massecretary@manastro.co.uk

MANSFIELD & SUTTON AS www.sherwood-observatory.org.uk/
Sherwood Observatory, Coxmoor Rd, Sutton-in-Ashfield. NG17 5LF
Cathy Beaumont 01623 552276
Email: secretary@sherwood-observatory.org.uk/

MARCHES A G www.spaceguarduk.com/mag
2nd Fri at Spaceguard Centre, Knighton, Powys. LD7 1LW.
Michael Birch 01597 850010 zakdorn@hotmail.com

MEBOROUGH & SWINTON AS
www.msas.org.uk
Every Thurs at Swinton Working Mens Club, 4 Station Rd, Swinton. S64 8AU
Shaun O'dell (Secretary) 01709-579529

MID KENT AS www.mkas-site.co.uk/
2nd and last Fri at The Bredhurst Village Hall, Hurstwood Road, Bredhurst, Kent
email pwparish54@yahoo.co.uk

MIDLANDS SPACEFLIGHT SOC
www.midspace.org.uk

MILTON KEYNES AS www.mkas.org.uk
Alt Fri at Rectory Cottages, Church Green Road, Bletchley, Milton Keynes
Mike Leggett Tel: 01908 503692
Email: publicity@mkas.org.uk

22 Jan:	The Astronomers Roayl	Dr Ann Bonell
5 Mar:	What's wrong with the sun	Dr S Clark
12 Mar:	Exploration of Jupiter	Dr M Leggett
14 May:	Viking Astronomy	Martin Lunn
11 Jun:	Charles Messier	Pierre Girard
9 Jul:	Astronomers in Obscurity	Mark Hurn

MORAY AC, SIGMA www.sigma-astro.co.uk
1st Fri at Birnie Village Hall, Thomshill, Elgin, Moray.
Ian Brantingham 01466 771371
Email: ian@branters.freeserve.co.uk

NENE VALLEY AS
www.eastnothantsastronomy.org.uk
1st & 3rd Mon at Chelveston Village Hall at 7.45pm.
email: stevemwilliams@fsmail.net Tel: 01933-650331

NEWBURY AS www.newburyas.org.uk
1st Fri (Sept-June) United Reformed Church Hall, Cromwell Place, Newbury.
email: rfleet@clara.co.uk

NORMAN LOCKYER OBS SOC http://www.ex.ac.uk/nlo/welcome.htm
Fris & 2nd Mon at Norman Lockyer Obs, Sidmouth Devon. EX10 0YQ
e-mail: enquiries@normanlockyer.org
Tel: 01395 512096

NORTH ESSEX AS http://www.neas.me.uk
3rd Thurs (exc Aug & Dec) at Henry Dixon Hall, Rivenhall End, Witham.
Neil Short e-mail: njs.int@btinternet.com

NORTH NORFOLK AS http://www.nnas.org
At General Townend Club (Royal British Legion), Cattle Market St, Fakenham.
Email: japrockter@aol.com

Jan 16:	James Naysmyth	Kevin Kilburn

NORTH WALES & LLANDRILLO COLLEGE AS
www.manastro.co.uk/nwgas/llandrillo
2nd Tues at Lecture Hall, Llandrillo College
Jean Smith e.mail: jsmith2859@aol.com

NORTHANTS AA www.naastronomy.com
1st Tues at Church House, St Bodolphs Rd, Barton, Seagrave, Kettering and on 3rd Tues at Newton Field Centre nr Geddington.
Steve Williams 01933 650331.

NORWICH AA
www.norwich.astronomicalsociety.org.uk/
3rd Fri at The Seething Observatory, Toad Lane, Thwaite St Mary
David Balcombe 01953 602624.
email: nassec@tiscali.co.uk

NOTTINGHAM AS http://beehive.thisisnottingham.co.uk/nottinghamastro
1st Thurs British Geological Survey, Nicker Hill, Keyworth, Notts. NG12 5GG.
Rob Bush. email: nottinghamastro@yahoo.co.uk

OBSERVATORY FOR CORNWALL
www.observatoryforcornwall.co.uk
email incoming@observatoryforcornwall.co.uk

ORPINGTON AS www.orpington-astronomy.org.uk/
4th Thurs at High Elms Nature Centre.
email membership@orpington-astronomy.org.uk

ORWELL AS www.oasi.org.uk/
Weds at Orwell Park Observatory, Nacton, Ipswich IP10 0ER
Roy Gooding (Secretary) 01473-462977
email ipswich@ast.cam.ac.uk

PAPWORTH ASTRONOMY CLUB
1st Wed at Vinter Room, Vinter Close (off Elm Way), Papworth Everard
Peter Sandford 01480 830729
email peter@cheere.demon.co.uk

13 Jan:	Extrasolar Planets	Keith Tritton
3 Feb:	Thermal Imaging Cameras	Dr R Salisbury

PETERBOROUGH AS www.pas-stargazer.co.uk
1st Tues at St Kingburgh Church Hall, Castor, Peterborough.
Gerry Holland 01733 769639
Email: gerry_comrep@yahoo.com

PLYMOUTH AS
2nf Friday at GK Centre, Alfred Street (off Lockyer St), Plymouth
Alan Penman (Chair) 01752-338491
email: oakmount12@aol.com -

PORT TALBOT AS
1st Tues–7.45pm at Mozart Drive Community Centre, Sandfields, Port Talbot.
John Minopoli (secretary) - phone 01792 850919.
email: john@jminopoli.freeserve.co uk

READING AS www.readingastro.org.uk
Meets third Sat 7.00pm at St Peters Church Hall, Church Road, Earley.
Chris Menmuir email: info@readingastro.org.uk

REDDITCH AS www.redditch-astro.org.uk
1st Mon (exc Aug) at St Augustine's Catholic High School, Stonepits Lane, Hunt End, Redditch B97 5LX.
email: membership@redditch-astro.org.uk

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RENFREWSHIRE AS
www.renfrewshireastro.co.uk
Meets every Fri 7.30pm at The Coats Observatory
Ian Anderson Tel: 0141 580 9852
email: ianander2000@yahoo.co.uk

SALFORD AS www.salfordastro.org.uk
1st Wed at The Observatory, Chaseley Road, Salford: John Pond

SALISBURY AS
1st Thurs of month at Glebe Hall, Winterbourne Earls, Salisbury—3rd Thurs Viewing night (if clear)
Rita Collins: 01722-332892
Email: astrocat1@talktalk.net

SAWTRY & DISTRICY AS
Last Fri (exc Jul/Aug) at the Football Pavillion, Greenfields, Sawtry.
Contact: Pan Dow 01733-242227
Email: pameladow@btinternet.com

SCARBOROUGH & RYDALE AS
www.scarborough-as.org.uk
3rd Fri (exc Aug & Dec) at East Ayton Village Hall, Willson Lane, East Ayton
01723 500389
email: gwenfrangwernan@btinternet.com

SEKAS (SOUTH EAST KENT) www.sekas.co.uk
Tony Bennet 01843-831079
email: Secretary@sekas.co.uk

SHETLAND AS
Monthly, South Mainland, Shetland
Peter Kelly Tel: 01957 733242
Email: theglebe@zetnet.co.uk

SHROPSHIRE AS www.shropshire-astro.com
1st Sat at Rodington Village Hall
Contact: Mark Wiggin.
e-mail: mark.wiggin@blueyonder.co.uk

SOLENT AMATEUR ASTRONOMERS
www.delscope.demon.co.uk
3rd Tues. Room 8, Oaklands Centre, Fairisle Road, Lordshill, Southampton
Ken Medway. 02380-582204
email: ken@medway1875.freeserve.co.uk

SOUTHAMPTON AS www.southampton-astronomical-society.org.uk
2nd Thurs at Edmund Kell Unitarian Church Hall, Bellevue Road
Email: secretary@southampton-astronomical-society.org.uk

SOUTH CHESHIRE AS www.scastro.org/
scastro.stewart@googlemail.com
Meets alternate Thurs

SOUTH LINCS A & G S www.solags.co.uk
3rd Frid (exc Jul/Aug) at St Mary's Church Hall, Pinchbeck, Spalding.
Martin Anderson 01406-380003
email: secretary@solags.co.uk

Jan 15:	Eclipses	K Malin-Smith
Feb 19:	What space junk tells us	M Czajkowski
Mar 19:	Cosmic Recycling	N Hewitt
Apr 16:	Astroimging—beginners	P Pocklington
Jun 18:	Hometown	Jeff Powell

LIST OF OFFICERS 2008/2009

President, Secretary, Treasurer & Newsletter Editor - See Page 1

Vice President:
Callum Potter: vicepresident@fedastro.org.uk

PLI & Distribution:
Steve Williams: plisecretary@fedastro.org.uk

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John Axtell: membership@fedastro.org.uk

Meetings Sec:
Shaun O'Dell (see details on Page 1)

Webmaster:
Gary Gawthrope webmaster@fedastro.org.uk

Chilterns Group :	Steve Williams
North West Group :	vacant
West Midlands :	Dave Evetts
SAGAS:	Keith Brackenborough
Yorkshire Group :	Paul Harper

SOUTH WEST HERTS AS www.swhas.org.uk
Shirley@atwhitelands.freeserve.co.uk

STAFFORD & DISTRICT AS www.freewebs.com/philiphall/
3rd Thurs at Weston Road High School, Stafford. ST18 0YG
Joe Jaworski, 0543 686043

ST NEOTS AS
Meets 1st Mon 19.00hrs at Paxton Pits Nature Reserve, High St., Little Paxton, St Neots.
David Roberts 01480-212960
email: davidr.astro@btinternet.com

STOUR AS www.stourastro.org.uk/
Meets 1st Tues 19.30hrs in the Jubilee Room, Cavendish Memorial Hall,
Tony Dagnall email: members@stourastro.org.uk

STRATFORD UPON AVON AS www.astro.org.uk
Home Guard Club, Tiddington, Stratford upon Avon.
Mike Whitecross 01789 731784

SUNDERLAND AS www.sunderlandastro.com
2nd & 3rd Sunday Wildfowl & Wetlands Trust, Washington
Graham Darke 0191 415 2625 darke@bun.com

Jan 17:	First Stars	Dr Tom Theuns
Feb 21:	The H-R Diagram	Dr Paul Lewis
Mar 21:	PanSTARRS	Prof Shaun Cole

SWANSEA AS www.swanastro.co.uk
2nd & 4th Thur at Lecture Theatre C, Science Block, Uni of Wales, Swansea 01792-299311

TAVISTOCK AS
http://tavistockastronomicalsociety.googlepages.com/home
Kelly College. Exeter Road, Tavistock
Email: jewelsv137@aol.com Tel: 07877-448117 or robin@sigmanova.com

THE LEWES ASTRONOMERS
www.lewesastro.org.uk
1st Wed at Southover Grange, Southover High St. Lewes. BN7 1TP.
Alice Smol 01273-477441 email: alice.smol@tesco.net

THURROCK AS www.thurrockastronomy.com
First Wed (exc Aug) at Methodist Hall, High Street, Horndon -on-the-Hill SS17 8LN
Roy Hookway Tele;01375 676602
email: roy.hookway1@btinternet.com

TIVERTON AS ww.tivas.org.uk
Fri at St Aubyn's School, Blundells Road, Tiverton.
Neil Purves 01884-277425

TORBAY AS www.torbayastro.org
1st & 3rd Thurs - Sep to Apr at Torquay Boys Grammar School.
Dennis Humphreys on 01626 367280

UNIVERSITY OF BIRMINGHAM AS
www.astrosoc.org.uk
We are a University society but all are welcome.
Kym Goss, email: kjg494@googlemail.com

USK AS www.uskastronomicalsociety.org.uk
Email: jbprince9@yahoo.co.uk

VECTIS AS (IoW) www.vectis-astro.org.uk
4th Fri of month (exc Dec) at Parish Hall, Town Lane, Newport.
Sue Curd email: secretary@vectis-astro.org

WADHURST AS www.wadhurst.org.uk/was/
Third Wed at the Methodist Church Upper Room, High Street, Wadhurst.
G G Rathbone, 13 Brookfield, Kemsing, Sevenoaks, Kent. TN15 6SQ

WALSALL AS www.walsallastro.co.uk
Every Thurs at the Rushall Olympic Football Club, Dales Lane, Walsall.
Alan Ledbury 01922 632624 email:
email: g.ledbury@blueyonder.co.uk

WEBB DEEP-SKY SOCIETY
www.webbdeepsky.com/
Bob Argyle. email: rwa@ast.cam.ac.uk

WESSEX AS www.wessex-astro-society.freeserve.co.uk
First Tues - Allendale Centre, Wimborne, Dorset.
Alan Jefferis, e-mail alan@ajefferis.freeserve.co.uk

WEST DIDSBURY AS
2nd Mon (exc Aug) at William Hulme Grammar School, Springbridge Rd, Whalley Range. M16 8PR
Susie Metcalfe email: susiemetcalfe@yahoo.com

WEST OF LONDON AS www.wolas.org.uk
Second Mon (exc Aug) at: Christ Church Chapel, Redford Way, Uxbridge AND at St John's Ambulance Hall, North Harrow (odd months)
Duncan J Radbourne.
Email: duncan.radbourne@gmail.com

WEST NORFOLK AS
http://westnorfolkas.googlepages.com/wnashomepage
Meets on 2nd Mondays at Tottenhall Village Hall, Nr Kings Lynn
Derek Crawford Email: 163@hotmail.com
23 Beaumont Way, Marlborough Pak, King's Lynn. Norfolk. PE30 4UB

WEST YORKSHIRE AS www.wyas.org.uk
Every Tues (exc Aug/BH's) at 'Rosse Observatory', Carleton Rd, Carleton, Pontefract.
James Boulton 01924-379376.
Email: secretary@wyas.org.uk

WILTSHIRE AS www.wasnet.co.uk/
Andrew Burns Email: anglesburns@hotmail.com

WIGTOWNSHIRE AS www.wigtownshire-astro.org.uk
Second Wed Glenamour, Newton Stewart.
Robin Bellerby 01671-404387 / 07966-413679
Email: robin@glenamour.com

WHITE PEAK ASTRO OBS GROUP
www.wpaog.co.uk/
Hopton Cottage, Hopton, Top Hopton, Derbyshire, DE4 4DF
Robin Spencer. Tel: 01332-881912
Email: robin108@tiscali.co.uk

WOLVERHAMPTON AS www.wolvas.org.uk
Alt Mon, between Sep & Apr at The Environmental Centre, Highfields School, Boundary Way, Penn Wolverhampton. WV4 4NT
Graham Mogford grahammogford@hotmail.com

WORCESTER AS www.worcesteras.freeserve.co.uk
Meetings held 2nd Thurs 8-10pm at University College, Oldbury Rd, Worcester
Michael Morris. Email: michaelmorris@hotmail.com

WORTHING AS
Meet 3rd Mon (exc Aug) 7.30pm at Emmanuel United Reform Church, corner Heene Rd/St Michaels Rd.
Graham Boots
Email: meeting_secretary@was.org.uk 01903 505346
101 Ardingley Drive, Goring, Worthing West Sussex BN12 4TW

WORTHING ASTRONOMERS
www.worthingastronomers.org.uk
Meet 1st Wed at 'North Star', Littlehampton Rd., Worthing
Brian Halls: 01903-521205
Email: info@worthingastronomers.org.uk

WYCOMBE AS www.wycombeastro.org.uk
Third Weds at Woodrow High House, between High Wycombe and Amersham.
Jackie Harris. Email: www.wycombeastro.org.uk

Feb 17:	Ptolemy landing on a comet	Dan Andrews
Mar 17:	Enormous Energies	Martin Hardcastle
Apr 21:	Quantum Universe	Sean Ryan
May 19:	Eclipse 2009	Jerry Worman
Jun 16:	Distance	Prof Stuart Malin

YORK AS www.yorkastro.co.uk
Denham Room, The Priory Street Centre, York,
Martin Whillock on 01347 821849
email: martin@whillock.me.uk

Details of meetings mentioned in the Society Roundup should be confirmed before travelling. All programmes may be subject to change with no notice. The FAS can accept no responsibility for any inaccuracies. However if the details of your society are incorrect, or indeed if you aren't included, please send details to the Editor.

Deadlines for submission for the next newsletter:
Spring 2010 — 26 March 2010
Please remember to send ALL items to the Editor. Material can only be returned if supplied with a SAE.