



Gnomon

Newsletter of the Association of Astronomy Education

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SUMMER 2008

International Baccalaureate Astronomy

The International Baccalaureate will offer Astronomy at Standard Level in their examination system. The multi-disciplinary course has been specifically written to appeal to all students who have an inquisitive mind and it does not require a high level of Mathematics. It will give an exciting opportunity for those students who do not wish to take a pure science or who wish to study a subject which links all the sciences together at Standard level.

There are three types of student who will greatly benefit from studying Standard Level Astronomy:

(i) Someone who is interested in Astronomy (possibly as a hobby) but would like the opportunity to learn a lot more about this fascinating subject.

(ii) Students who have an interest in Science but feel that their major areas lie away from Group 4 (the experimental sciences). Nonetheless they do not want to 'forget' their GCSE work but rather, would like to apply it to a subject which has real public-appeal.

(iii) Students who have a strong interest in Physics but feel that studying it as a single subject may be more than they can afford to do.

Unfortunately it will not be possible to take it with Standard or Higher Level Physics – in light of the large material overlap.

This course has four major areas:

(i) The Stars. This section starts

by looking at the Sun - our star - and then explores the properties of other stars. Students will see that there is an astonishing range of stellar types, and that our sun, though essential for our existence, is unremarkable in a collection of different types of stars including massive blue stars, brown dwarfs, red giants, supergiants and white dwarfs. Students will learn how the various types of star are born, how they live, and how they die, including the spectacular death of supergiants to create a black hole. They will even find out why the atoms you are made from were once at the centre of a giant star which exploded billions of years ago!

(ii) The Planets. The second section of the course looks at the creation of the solar system alongside the Sun. Students will see that there are a number of crucial moments in the early history of the solar system which largely determine whether life itself will be possible! The section moves on to consider how life formed on the Earth and the role it has played in modifying the Earth's atmosphere. Finally the course considers how we can find other planets in the universe and how we might look for the presence of life on them.

(iii) The Galaxies. Students will learn that the Sun is one of a hundred thousand million stars that inhabit our galaxy - the Milky Way. The structure of our galaxy along with its properties

is described before moving on to consider all the other types of galaxies that exist in the universe. Finally, active galaxies are discussed – these have huge energy sources, probably based on black holes at their centres. The current ideas about the formation and evolution of galaxies are considered before looking at the larger-scale structure in the universe.

(iv) Cosmology. The final section of the course is a study of the evolution of the universe as a whole. We review the evidence that supports the idea that the universe began in a 'big bang', and we will see how ideas about the early universe are at the forefront of research in physics and cosmology.

The course will include practical project work both in the lab and based on observations of celestial objects. Extensive use will be made of ICT where students can retrieve and analyse astronomical data from sources on the World Wide Web. The World Wide Web is also used as a source of up-to-date information about astronomical observatories, space missions and experiments.

The examiners hope that the course will pull together many subject areas as students try to understand where we have come from in the universe and where we are going.

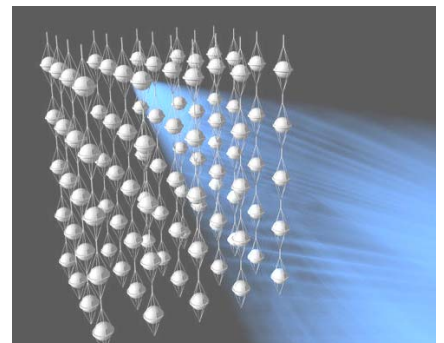
Alan C Pickwick
from a recent
IB Press Release

High Energy Neutrinos

Two projects to detect evidence of extreme astrophysical events are now operational. Antares on the sea bed of the Mediterranean and IceCube in the ice at the South Pole will look for neutrinos emitted by supernovae and by matter falling into Black Holes.

Neutrinos are undetectable but as they pass through matter they collide and transfer their energy to particles with mass and charge. The resulting particle, perhaps a muon, will initially travel at close to the speed of light in a vacuum. However, the speed of light in water or ice is about three quarters of the speed in a vacuum. This causes a shock wave of light to be created by the particle and the resulting cone of light is what is detected.

When supernova 1987a exploded we detected only 24 neutrinos. However the detectors then were of small volume and it is expected that these very large detectors will give much more information. Extensive educational resources can be found on the web sites:



 <http://icecube.wisc.edu>

 <http://antares.in2p3.fr>

Update from the Annual Business Meeting 2008

We met on a gloriously hot Saturday in June at the newly refurbished apartments of the Royal Astronomical Society. The programme began with the business meeting which was very short and to the point. The elections were held for Council posts for the coming year. The results of these were:

President: Sotira Trifourki
 Vice Presidents: Robert Massey
 Dave Buttery
 Francisco Diego
 Treasurer: Alan Pickwick
 Secretary: Teresa Grafton
 Assistant Secretary: James O'Neill
 Officers: Sandra Voss
 Simon Ould
 Eva Hans

Anne Urquhart-Potts has resigned the secretaryship in order to help Richard Knox in his editorial role and to round up news items for *Gnomon*.

The first key lecture was given by Francisco Diego of UCL and was part of a lecture series he has prepared for schools on the Origin and History of the Universe. The story unfolded along a washing 'time' line hung across the Council Room with illustrative items pegged to it at the correct intervals. This was very well received and question time was lively.

The meeting ended in a flurry of preparations for the rest of the day as members and teachers were already arriving.

Peter Hingley gave a tour of the Library at Burlington House, revealing treasures such as first editions of Newton's *Principia* and John Flamsteed's *Star Atlas*. One teacher said on her blog that "It was kind of mind-blowing to see (and be able to handle!) these old books that did so much to change the way we think about the world".

After a short break for lunch, there were several presentations about classroom activities and web resources. Anne Urquhart-Potts appeared in a duffle coat and bobble-hat to talk about evening observing sessions with school groups. Robert Massey introduced the RAS's list of approved web resources.

The final keynote lecture was given by Roberto Trotta of Oxford University who talked about dark matter in the Universe and exotic particles. This thought-provoking topic rounded off the day and participants left for their trains home armed with photocopyable worksheets.

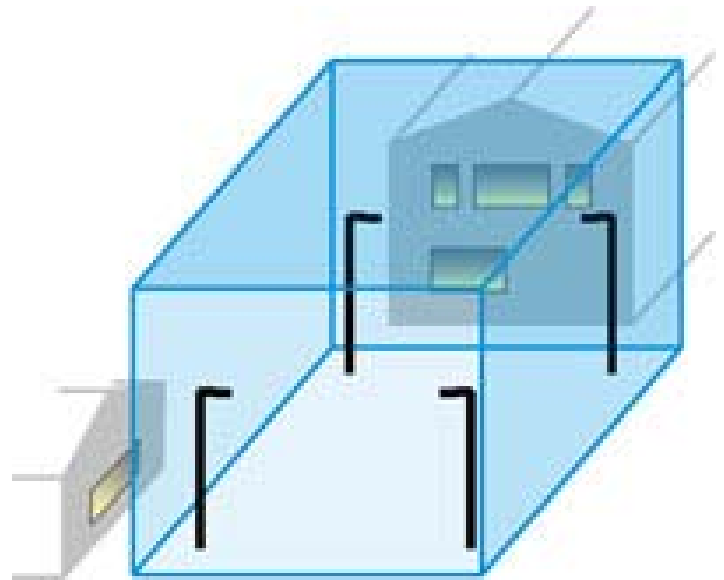
The AAE would like to thank both the main speakers for giving so freely of their time on a Saturday and for making the meeting such a special occasion. All the participants had their minds thoroughly stretched!

Anne Urquhart-Potts

Light Pollution - American Style

For those readers who would like a slightly more technical perspective on lighting and control I can recommend the web pages of the Lighting Research Center at the Rensselaer Polytechnic Institute, Troy, New York.

They have detailed information about new sources of light, particularly light emitting diodes, and how to control the emissions. You can subscribe to their electronic newsletter which always makes interesting reading.



A recent article introduced the idea of an imaginary 'shoe box' that is erected around a location to explore the light entering and leaving the box.

Alan C Pickwick
www.lrc.rpi.edu

More Help for SETI@Home



Following an upgrade of its receiver system at the Arecibo Radio Telescope in Puerto Rico, the SETI@Home project is looking for

more volunteers. You can allow your home computer to search the data whilst it not working for you.

Joining the project is simple. Go to the web site and follow the instructions. You will then be a member of the largest computing project on the planet if not in the Universe! Please try to get some young people involved.

<http://setiathome.berkeley.edu>

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There will generally be a 10% discount to AAE members on all publications and advertising rates.
 Practising teachers may claim their subscriptions as an allowance against income tax, effectively reducing their contributions.

All communications (except those to the Editor) should be addressed to:

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 A 25% reduction is made for advertising in all four issues.

Publication Dates:

These are at the equinoxes and the solstices, that is four times a year. Copy deadlines are six weeks before these dates.

International Year of Astronomy

International Year of Astronomy at The Observatory Science Centre, Herstmonceux

As the former home of the Royal Greenwich Observatory IYA 2009 is an important year for The Observatory Science Centre in Herstmonceux, East Sussex. With four of the refurbished historic telescopes now back to working order it is time for a year of celebrations.

The centre has been fortunate enough to secure a contri-



bution from STFC to partly fund our celebrations and we are delighted that we will be collaborating with the Southern Area Group of Astronomical Societies (SAGAS) on this project. The main focus of the activities will be the telescopes and it is our intention to develop workshops both at the centre and as outreach where students will make their own simple refracting telescope and learn about how telescopes work. Looking through the historic telescopes will of course be a highlight of any evening visit.

To celebrate the 40th anniversary of the first lunar landing and the achievements of both Thomas Harriot and Galileo, we are hoping to encourage everyone to appreciate the Moon by having as many telescopes available as possible, old and new, so that students, families and the general public can sketch their own pictures of the Moon. Senior school activity week falls the week before the anniversary of the lunar landings giving us a great opportunity to have a week full of activities related to the Moon. We will also be focusing on the weeks identified by IYA during March and October (www.astronomy2009.co.uk), bringing in speakers and holding activity weekends.

All in all there will be an endless round of activities with much to celebrate and it is hoped that IYA2009 will help to inspire more and more people in the field of astronomy.

Sandra Voss

www.the-observatory.org

www.astronomy2009.co.uk

The Galileoscope Cornerstone Project

Who does not remember the first time they looked at the Moon through a telescope and were amazed by the details of the mountains and craters? The same is true for Jupiter's cloud belts and its Galilean moons, Saturn's rings and remote sparkling star clusters. Observing through a telescope for the first time is an experience that shapes our view of the sky and the Universe.

The IYA2009 programme wants to share this observational and personal experience with as many people as possible across the world and is collaborating with the US IYA2009 National Node to develop a simple, accessible, easy-to-assemble and easy-to-use telescope that can be distributed by the millions. Ideally, every participant in an IYA2009 event should be able to take home one of these little telescopes.

This simple telescope will enable people to build and observe with a telescope that is similar to Galileo's. Sharing these observations and making people think about their importance is one of the main goals of IYA2009: Promote widespread access to new knowledge and observing experiences. A do-it-yourself Galileoscope could be the key to pursuing an interest in astronomy beyond IYA2009, especially for people who cannot afford to buy a commercial telescope.

The project aims to give 10 million people their first look through an astronomical telescope in 2009. This is achievable if, for example, 100,000 amateur observers each show the sky to 100 people. Millions of small telescopes



are sold every year, but anecdotal evidence suggests that most are rarely used for astronomy.

A worldwide Telescope Amnesty programme will invite people to bring their little-used telescopes to IYA2009 events, where astronomers will teach people how to use them and offer advice on repairs, improvements and/or replacements, encouraging more people to stay involved in the hobby.

Organisers of IYA2009 celebrations in all countries are encouraged to promote similar activities, with a common goal of giving 10 million people worldwide their first look through an astronomical telescope.

The taskforce leader in the UK is Prof. Ian Robson (eir@roe.ac.uk) at the Royal Observatory, Edinburgh.

Alan C Pickwick

adapted from the IYA2009 web site

www.astronomy2009.org/cornerstones



Possible design as seen on the web site

Starlight News



A new 8-page publication called Starlight News has appeared. It is aimed at young people but would be helpful to any beginner. It is presently distributed in the centre of Astronomy Now magazine, the first issue went out with the April 2008 issue. It is attractively produced and easy to read. Starlight is funded by the Royal Astronomical Society and the Faulkes Telescope Project.

www.starlight-news.co.uk

The Worldwide Telescope

The Worldwide Telescope (WWT) was launched on the 13th May 2008 and promises to be a major educational resource.

The project seeks to integrate stories, exploration and source information into one smooth learning environment. This process is described as “contextual narrative”. The telescope is a Web 2.0 visualisation software system and much effort is being put into similar web developments.

The installation routine is well designed and runs smoothly. You do have to have Windows XP or Vista installed - WWT is a Microsoft initiative after all. Unfortunately I came to a halt then I tried to run WWT with: “You need 3D graphics and DirectX installed to run this application”. I am sure that this is fixable and I will report back in a future issue!

Here are the key features as described on the WWT's web site:

* **Exploring the Sky.** Within WorldWide Telescope, you can explore deeply into the sky discovering stars, planets, constellations and rich panoramas. You navigate the same way for each — select a view, select the imagery and **4** explore the images in the field of view.

* **Zoom and Pan.** WorldWide Telescope supports zooming and panning on objects in the sky. As you move through the sky, thumbnails of celestial objects in that constellation display in the navigation pane below the field of view.

* **Orientation in the Sky.** WorldWide Telescope provides two mechanisms to orient you in the sky. The first is the Sky Ball which represents the field of view with a flat yellow plane. The plane expands and contracts as you zoom into and out of the sky. The other mechanism is the Constellation Overview which represents the size of the field of view in relation to the constellation boundary. You also can orient yourself by selecting your city as the default sky view.

* **Collections.** WorldWide Telescope includes a rich set of collections of the deep sky objects including constellations, the solar system, images from the Hubble Space Telescope, the Chandra X-Ray Observatory Center, the Spitzer Space Telescope, Sky Surveys, the Messier Catalogue, named stars and more.

* **Guided tours.** A number of expert-created guided tours of the sky, objects in space and collections of celestial objects are built into WorldWide Telescope. Users can create their own tours and share them with others. Slide-based tours are similar to a PowerPoint slideshow. Creating tours can be as simple as showing images of deep sky objects or places on the Earth that you have visited. Or it can be as immersive as combining images with art and music to illustrate and enhance your tour. You also can add common license art and music to complement your tour.

* **Research the Sky.** Using the Finder Scope, it is easy to identify and research objects in the deep sky. The Finder Scope opens a wealth of data and image resources to use when researching the deep sky objects in Set of Identifications, Measurements, and Bibliography for Astronomical Data (SIMBAD), Students for the Exploration and Development of Space (SEDS), Wikipedia, NASA and the Internet.

* **Join a community of users.** Communities are great places to meet and share information with people who share your interests. Often communities are associated with product manufacturers, such as Meade Instruments Corp., Astronomy magazine, or Sky & Telescope magazine, or scientific communities, such as the Harvard-Smithsonian Center for Astrophysics or NASA. Many communities let you join even if you don't purchase their products or belong to their institution. Joining requirements vary depending on the community.

Alan C Pickwick

www.worldwidetelescope.org

Hubble is 18

The Hubble Space Telescope is 18 years old and to mark this, the team has published a poster of interacting galaxies. It shows the wide range of galaxies that exist and how they progress from spiral to elliptical form as they merge.

Watch out this autumn for the last ever servicing mission to Hubble. A camera, a spectroscope and six gyroscopes will be replaced. If you have some free time you can watch the work as it happens via the web on NASA TV. I watched the last International Space Station mission and it was just like being in orbit! Perhaps you could have a PC in your school running the images continuously.

Alan C Pickwick

www.spacetelescope.org

Curriculum Corner

AstroProjects — Projects for Gifted and Talented Pupils



Screen shot of the Galaxy Challenge page.
Moodle allows individuals or groups to co-operate in projects.

The first three projects to be made available are:

- * Galaxy Challenge – exploring the different types and making a ‘galaxy calendar’.
- * Galaxies Before the Dinosaurs – exploring clusters of galaxies.
- * Celestial Treasure Hunt – a sky survey.

These projects are open-ended with a range of sophistication and difficulty. They are investigative in nature and make use of real scientific data. If you use the projects, Dr. Beare would be delighted to know.

Please email him at richard.beare@warwick.ac.uk

AstroProjects is a new resource for mainstream school children and for the gifted and talented. The aim is to get pupils thinking for themselves and experiencing scientific discovery. There is the possibility for getting pupils to collaborate with groups in their own and other countries using the internet and Moodle for forums and chat rooms.

Much use will be made of data from the Sloan Digital Sky Survey. This is a very recent catalogue of the sky observed from New Mexico using a dedicated 2.5 metre aperture telescope. The images have been recorded in five wavebands from the ultra-violet through to the infrared. The survey also has spectra for many interesting objects.

The activities will include observations from robotic telescopes to allow the collection of “light curves” from variable stars and spinning asteroids.

A set of visual tools have been created to make processing the data straight forward.

The funding is provided by the Science and Technology Facilities Council (I hope this funding continues! ACP.) and is driven by Dr Richard Beare of the Astronomy Education Institute at Warwick University.

<http://astroprojects.net>

Stardust Comet Dust Resembles Asteroid Materials

When teaching about comets and meteorites the conventional wisdom has been that comets formed early on in the cold outer parts of the solar system and that meteorites are the remains of the formation of the inner, rocky planets.

However, this view is contradicted by the dust of comet Wild 2 returned by NASA’s Stardust mission. Much of it formed very close to the young sun.

New research by scientists at Lawrence Livermore National Laboratory and collaborators reveals that, in addition to containing material that formed very close to the young Sun, the dust from Wild 2 also is missing ingredients that would be expected in comet dust. Surprisingly, the Wild 2 comet dust samples better resemble a meteorite from the

asteroid belt rather than an ancient, unaltered comet.

The team, using Livermore’s SuperSTEM (scanning transmission electron microscope), specifically searched for two silicate materials in Stardust that are believed to be unique to cometary interplanetary dust particles: amorphous silicates known as Gems (glass with embedded metal and sulfides); and sliver-like whiskers of the crystalline silicate enstatite (a rock-forming mineral).

The Stardust spacecraft is continuing on a low-cost mission that will expand the investigation of comet Tempel 1 initiated by NASA’s Deep Impact spacecraft.

Alan C Pickwick
adapted from the Stardust web site

www.nasa.gov then choose Missions from the top menu bar and then Stardust from the list.

For your Library

Cambridge Illustrated Dictionary of Astronomy by Jacqueline Mitton. £18.90. Hardcover: 416 pages. Publisher: Cambridge University Press (20 Dec 2007) ISBN-13: 978-0521823647. Dimensions: 23.2 x 15.4 x 1.8 cm.

This new dictionary is up-to-date and well presented. The layout is open and welcoming with an image or graphic on nearly every page. The entries are wide-ranging and text concise. It ranges from meteorites and the solar system to stars, galaxies and the big bang.

The level of the text is suitable for secondary school use in the library or staff room – where it would be likely to give the answer to those awkward questions that children delight in asking! It is the first edition and I did spot an error relating to the periods of Cepheid Variable stars – the brighter ones have longer periods not shorter. However it is unlikely that there will be many more given the excellent reputation of the author.

Alan C Pickwick

Illustrated Guide to Astronomical Wonders: From Novice to Master Observer (DIY Science by Robert Thompson and Barbara Fritchman Thompson. £18.50. Paperback: 519 pages. Publisher: O'Reilly Media, Inc.; 1st edition (31 Oct 2007). ISBN-13: 978-0596526856. Dimensions: 24.4 x 20.3 x 3.6 cm.

This book offers an easy way into observing with binoculars or a telescope. The introduction covers the fundamental concepts and terminology of observational astronomy and there is guidance on what equipment to buy and how to use it effectively.

The bulk of the book, over 400 pages, is used to describe each constellation in turn. To start with there is a well-designed summary box covering pronunciation, time of year to observe and lists of binocular and 'urban' objects. This is followed by several paragraphs of text which places the constellation in its historical context and highlights the most interesting objects. There are then over a dozen pages of finding charts and photographs.

The text is written in a simple conversational style and it draws the reader into the subject. Recommended.

Alan C Pickwick

Children Love Disaster Stories

There is an excellent list of asteroid and comet impacts and near-misses at the NEO (Near Earth Objects) Information Centre. The centre is part of the UK Government's response to the Report of the Task Force on Potentially Hazardous Near Earth Objects and it provides services to the public, educators, media and scientists to encourage understanding and advancement of NEO science.

The web site explains the nature of NEOs, the hazard they pose and what efforts are being made to detect them and what could be done to avert a collision.

The centre is co-ordinated by the British National Space Centre and is supported by the Minor Planet Centre. The latter catalogues new observations of asteroids and comets and ensures that astronomers can obtain the information they need to follow up new observations.

 www.nearearthobjects.co.uk/report/annexB.htm

Duane Hilton's rendition of a brilliant fireball streaking above a snowy Canadian landscape. On January 18, 2000, residents of Western Canada were surprised when a fireball as bright as the Sun streaked across the morning sky. Exploding with an estimated yield of 5-10 thousand tons of TNT, the brilliant meteor attracted the attention of defence satellites, seismic monitoring stations, and just about anyone who happened to be standing outdoors within 700-800 km of the dazzling meteor's path.

"People described it as coming over the mountains, over their heads, and then disappearing over the horizon," says Dr. Peter Brown of the University of Western Ontario. "It was very long-lasting and unusual. We estimate that this object was about 7 meters across and 200 to 250 metric tons. This wasn't your average meteoroid -- it was basically a C-class asteroid detonating in the atmosphere over the Arctic!" NASA.



 <http://science.nasa.gov>

SuperWASP - A British Success

SuperWASP is the UK's leading extra-solar planet detection program comprising of a consortium of eight academic institutions which include Cambridge University, the Instituto de Astrofisica de Canarias, the Isaac Newton Group of telescopes, Keele University, Leicester University, the Open University, Queen's University Belfast and St. Andrew's University.

SuperWASP consists of two robotic observatories that operate continuously all year around, allowing coverage of both hemispheres of the sky. The first, SuperWASP-North is located on the island of La Palma amongst the Isaac Newton Group of telescopes (ING). The second, SuperWASP-South is located at the site of the South African Astronomical Observatory (SAAO), just outside Sutherland, South Africa

The observatories each consist of eight wide-angle cameras that simultaneously monitor the sky for planetary transit events. A transit occurs when a planet passes in front of its parent star temporarily blocking some of the light from it. The eight wide-angle cameras allow us to monitor millions of stars simultaneously enabling us to detect the rare transit events.

SuperWASP detects planets by looking for 'transits'. These occur when a planet passes in front of its parent star, temporarily obscuring some of its light. This can be detected from the Earth as a slight dimming of the star's luminosity. The dimming can be as little as 1% so extremely accurate measurements are needed. As the planet passes in front of the star it produces a characteristic 'light-curve' whose shape is affected by the size and orbital distance (and hence orbital period) of the planet. SuperWASP constantly monitors the brightness of the stars in its field of view and alerts us of any variations that may be due to the presence of a planet.

The easiest planets to detect are close orbiting gas giants known as 'Hot Jupiters'. These are very large planets (about 10 times the size of the Earth) which orbit extremely closely to their parent star (far closer than Mercury orbits our Sun). Their size and proximity creates a large decrease in brightness which is easy to detect. Their close proximity to their star produces very short orbital peri-

ods, sometimes as short as a few days, which enables the whole transit to be observed from only a few observations. Venus transits our Sun but is such a small planet that its transit hardly blocks any light and so would be very difficult to detect if it were orbiting around another nearby star.

The SuperWASP observatories each consist of an array of 8 cameras, backed with a high-quality CCD. These cameras are extremely wide field – up to 2000 times greater than a conventional astronomical telescope. The cameras continuously image the night sky, each camera capturing up to 100,000 stars per image (this many are needed to stand any chance of detecting transiting planets). This amounts to over 50 gigabytes of observational data per night, per observatory, which is automatically processed by our custom built computer 'Pipeline'.

The 'Pipeline' first reduces the images by removing errors such as variations in pixel sensitivity, dirt/scratches on the lenses, noise etc. This is done by comparing the images to special calibration images. The 'pipeline' then examines the images and matches each star with

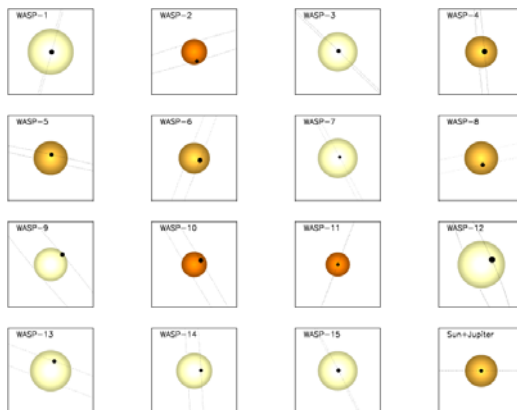
an astronomical catalogue of stars to identify them. Finally a complex photometric analysis is performed to measure the brightness of every star, the results of which are stored in the project database hosted by the University of Leicester.

When sufficient observations have been made (over several months), searches are performed for dips in brightness that might indicate the presence of a planet passing in front of a star. Unfortunately there are a large number of phenomenon, other than planets, that can cause changes in stellar brightness. Very careful analysis is needed to verify the presence of a planet which is performed with the help of our collaborators from the Geneva Planet Search group. To confirm the presence of the planet they use sensitive spectrographs to measure the minute shift in position of the star as the planet orbits around it.

Alan C Pickwick

adapted from the SuperWasp web site

 www.superwasp.org



Sky Diary Summer 2008

Welcome to this quarter's Sky Notes. All times mentioned are in BST.

July: The New Moon is on the 3rd and the Full Moon on the 18th.

August: The New Moon is on the 1st & 30th and the Full Moon on the 16th.

September: The New Moon is on the 29th and the Full Moon on the 15th.

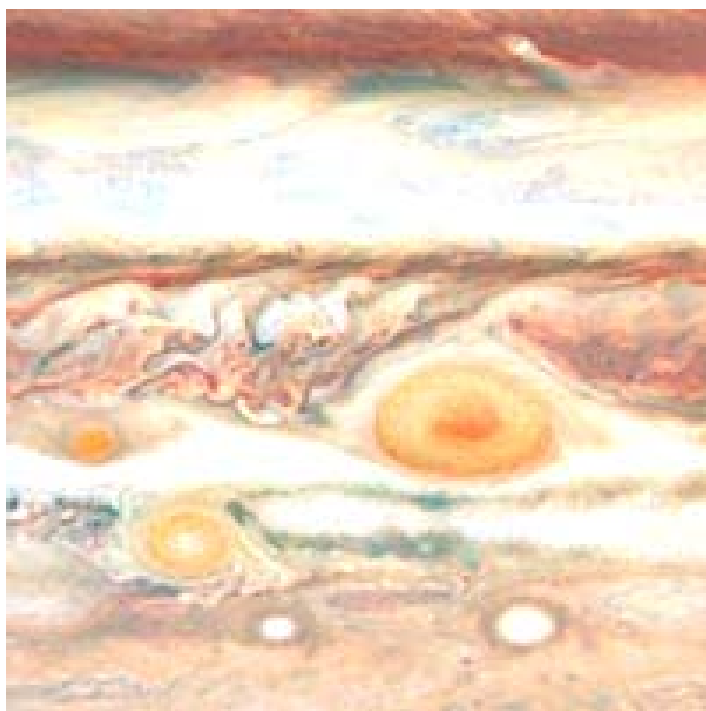
In July we see little of the inner planets. Mercury sits in Gemini and only just pokes its head over our horizon near the middle of the month just before sunrise. If you still fancy a go then observe towards the north-east and always be careful not to accidentally point your telescope at the Sun, for obvious reasons. Venus is even more unfavourable as at its apparent angle to the Sun it will almost set at the same time.

This month we have to talk about Mars at Saturn at the same time. They are both unfavourably placed in the

☞ sky, setting 45 minutes or so after sunset. It is worth trying to observe them on the 10th though. They will be very close to each other and a great view through a pair of binoculars.

Moon phases for the third quarter of 2008				
	New Moon	First Quarter	Full Moon	Last Quarter
July	3	10	18	25
August	1/30	8	16	23
September	29	7	15	22

Jupiter is the planet to get a glimpse of this month. It is at opposition on the 9th. Although fairly low at around 14° altitude you will be able to see it at its largest apparent diameter (47.5") due south at midnight. This is a perfect opportunity to observe or even image the fast rotation of this mighty planet. With a rotation of just 10 hours you can easily see changes in one night. Hopefully the 13th will be a clear night as at midnight the Great Red Spot will be in a prime observing position. If you have access to a larger telescope a look for the new Red Spot Jr. as recently seen



Hubble close-up of the three red ovals. (Image: Imke de Pater and Michael Wong, UC Berkeley)

by the Keck and Hubble telescopes.

In order to find Uranus and Neptune use a star map to identify their position against background stars in Capricornus and Aquarius. Uranus can be seen through binoculars but Neptune is faint enough to require a telescope and some dark skies.

The more favourable meteor showers peaks during July are on the 8th and 26th of the Capricornid streams. The best opportunity of the month will be on the 28th for the delta Aquarids at around 20 per hour. The meteors will appear to radiate from the southern part of the sky.

August is a special month this year as we are treated in the British Isles to two eclipses. The first is on the 1st when a 27% partial solar eclipse will be seen. The maximum will be around 10:15 and the Sun will be high enough at 40 degrees not to be a problem. Make sure you are careful when observing the Sun. Never rely on old solar eclipse glasses as when stored they can be scratched and be-

come useless. The best method of viewing will always be projection using binoculars or a telescope onto a white piece of card at the focal point.

On the 16th we are also treated to a partial eclipse of the Moon. Starting at 20:36 this type of eclipse is perfectly safe to observe the unaided eye. The maximum occurs at 22:10 when 81% of the Moon is immersed in the Earth's umbral shadow low in the south-east.

During August Mercury is not visible. Venus is now moving away from the Sun and will soon appear in the evening sky just after sunset. Mars is unfavourable to observe.

Jupiter again is up all night this month but thankfully is at its highest point earlier on in the evening. So you can definitely get a chance to see it and get some sleep in too. Saturn is unfavourable to see this month.

Uranus is near opposition and Neptune is at opposition on the 15th. So this is a good time to look out for these

Rising and setting times (UT): lat.52°N; long.3°W						
	July 15		August 15		September 15	
	Rise	Set	Rise	Set	Rise	Set
Sun	04h 10m	20h 24m	04h 56m	19h 35m	05h 46m	18h 26m
Mercury	02h 54m	19h 28m	06h 25m	20h 09m	08h 29m	18h 47m
Venus	05h 00m	21h 00m	06h 39m	20h 16m	08h 17m	19h 11m
Mars	08h 25m	22h 09m	08h 15m	20h 37m	08h 08m	19h 06m
Jupiter	19h 52m	03h 47m	17h 39m	01h 28m	15h 35m	23h 17m
Saturn	08h 10m	22h 09m	06h 28m	20h 13m	04h 49m	18h 18m
Uranus	22h 24m	09h 56m	20h 21m	07h 49m	18h 17m	05h 41m
Neptune	21h 30m	07h 12m	19h 26m	05h 05m	17h 23m	02h 59m
Moon*	19h 03m	00h 50m	19h 07m	02h 55m	18h 08m	05h 50m

* Moon rise and set times are for the stated venue only, but other locations in the UK and other dates can be estimated from these and the Moon phase table

planets and work out their positions.

August is a busy time for meteor watchers. On the 2nd the alpha Capricornids are at a favourable maximum but expect poor rates of only 5 per hour. You should see a better rate of 10 per hour on the 6th and 7th for the iota Aquarids and the delta Aquarids respectively. The same rate is seen for the alpha Aurigids on the 28th. Of course the real winner in August is the Perseid shower on the 12th/13th. This shower may show rates of 80 per hour. Unfortunately the 11 day-old Moon is around most of the night which means only the brighter meteors will be seen.

September sees the autumn equinox at 17:00 on the 22nd when the Sun crosses the celestial equator. Day and night are of equal length everywhere in the world on this date.

Mercury is still too close to the Sun to observe properly. Venus on the other hand will start to become visible in the evening sky. This bright object will be seen in the west just after sunset. Mars again is unfavourable to observe.

Jupiter during September will be near its highest point at sunset. It is still favourable to observe but make sure you get your observations done as it will soon end up in the evening twilight.

Saturn is at solar conjunction on the 4th so is unobservable this month.

Uranus and Neptune are still worth hunting down.

Favourable meteor showers from the Piscids on the 9th and 21st. Expect a rate of 5 per hour.

Finally if you are up on the morning of Saturday the 20th from 03:00 to 04:19 the Moon will occult several stars in the Pleiades star cluster. I wish you all clear skies.