

# auro<sup>ra</sup>

The official magazine of The University of St Andrews  
Astronomical Society

astro<sup>soc</sup>



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## **President's Pen**

Hello everyone!

I hope the new academic year is going well for you all, and that you're managing to make the most of being at St Andrews! This semester we've already had a few good events in the Astrosoc vs Quantum Soc pub quiz (we won again of course, hurrah!) and the film night (Independence Day), and we still have our excursions coming up, and maybe one or two other little things too.

I wanted to thank everyone who's been contributing to our bake sales, either by bringing or buying cakes. We really appreciate it! All the money is going towards our Astrofest conference trip in February, and I know everyone going is really excited about it, so please keep up the good work and keep donating money to us! Paying your membership helps too, hint hint...

Enjoy the rest of the semester, and good luck in your exams!

**Emily Ramsden**

**(El Prez)**

## Simulating the Gamma-Ray Sky

### **Andrew McLeod explains some more about gamma-ray telescopes**

The Fermi Gamma-Ray Space Telescope (FGST), launched into orbit in June of 2008, represents an exciting endeavor in high-energy astrophysics due to the unprecedented sensitivity and precision with which it is measuring the gamma-ray sky. Able to detect photons of energies up to 300 GeV (a full order of magnitude higher than its predecessor), the telescope's angular resolution exceeds that of previous gamma-ray telescopes by a factor of 2 and surpasses their field of view by a factor of 4, enabling the telescope to survey the entire sky every 2 orbits. Due to these exceptional advances, Fermi's first year of data is already more precise and comprehensive than any previous survey.

One compelling aspect of this new data is that it imposes new constraints on the parameters that govern gamma-ray producing processes within our galaxy. These processes include Bremsstrahlung, Inverse-Compton Scattering, and neutral pion decay, which depend on the galaxy-wide spectrum and distribution of cosmic-rays as well as the interstellar gas and radiation fields. Because of the resolution with which Fermi can measure the spatial and spectral features of the gamma-ray sky, the contribution from each of these processes can be isolated and studied individually, yielding detailed information about the production and propagation of cosmic-rays in the Milky Way.

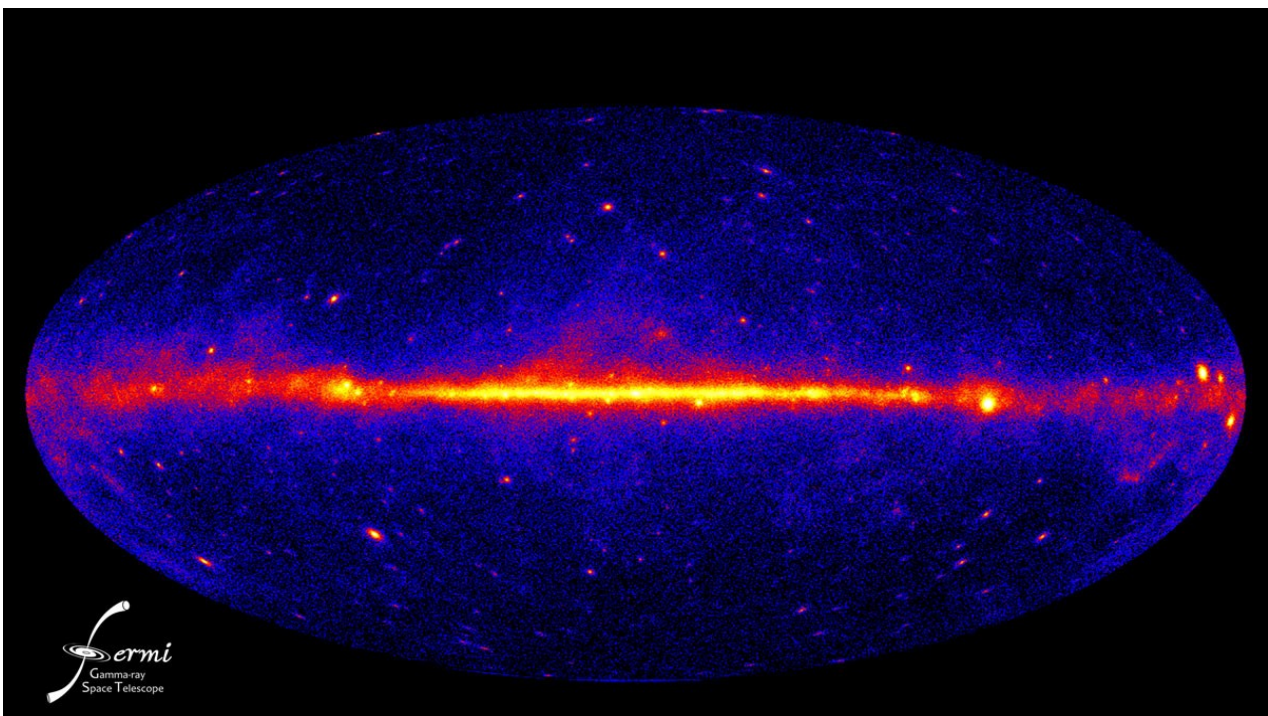
This analysis is carried out by modeling our galaxy with differing physical parameters and comparing the simulated predictions to Fermi's observations. The effects of individual model parameters can be determined by varying each separately; however, current simulations involve over 40 parameters, most of which are only weakly constrained by the local cosmic-ray spectrum. Moreover, many of these parameters depend on each in nonlinear and not well understood ways, necessitating the use of high-dimensional parameter spaces in optimization. Despite this difficulty, significant improvements have been made to galactic models through an in-depth study of eleven parameters including those relating to interstellar gas density, the distribution of cosmic-ray sources throughout the galaxy, and the diffusion equation governing cosmic-ray propagation within our galaxy.

Such an optimized model provides the best estimate of the parameters governing the Milky Way, which is especially useful in the case of parameters that cannot be measured directly such as the diffusion coefficient governing cosmic-ray propagation. Yet optimization has further applications; for instance, the study of extragalactic gamma-rays is

limited by the precision with which the galactic component can be modeled and subtracted from the overall gamma-ray sky. Galactic models also serve as a gamma-ray background from which astrophysical gamma-ray sources can be identified. This is important because the angular resolution of the FGST is not precise enough to confidently exclude gamma-ray point sources, making background measurements unreliable. The anisotropy of the gamma-ray sky also complicates this problem, since a measurement at high galactic latitudes cannot be used to study sources near the galactic center. Thus, our ability to detect sources such as supernova remnants, spinning neutron stars, and supermassive black holes in the center of distant galaxies depends on the sophistication with which we can simulate the diffuse gamma-ray sky.

The FGST has already improved our knowledge of high-energy processes within the galaxy and it will continue to do so as more data accumulates and is studied. These advances will surely benefit other facets of astrophysics as our models become more sophisticated and incorporate an increasing amount of specialized knowledge. In the meantime, it's never too early to start designing the next-generation gamma-ray telescope.

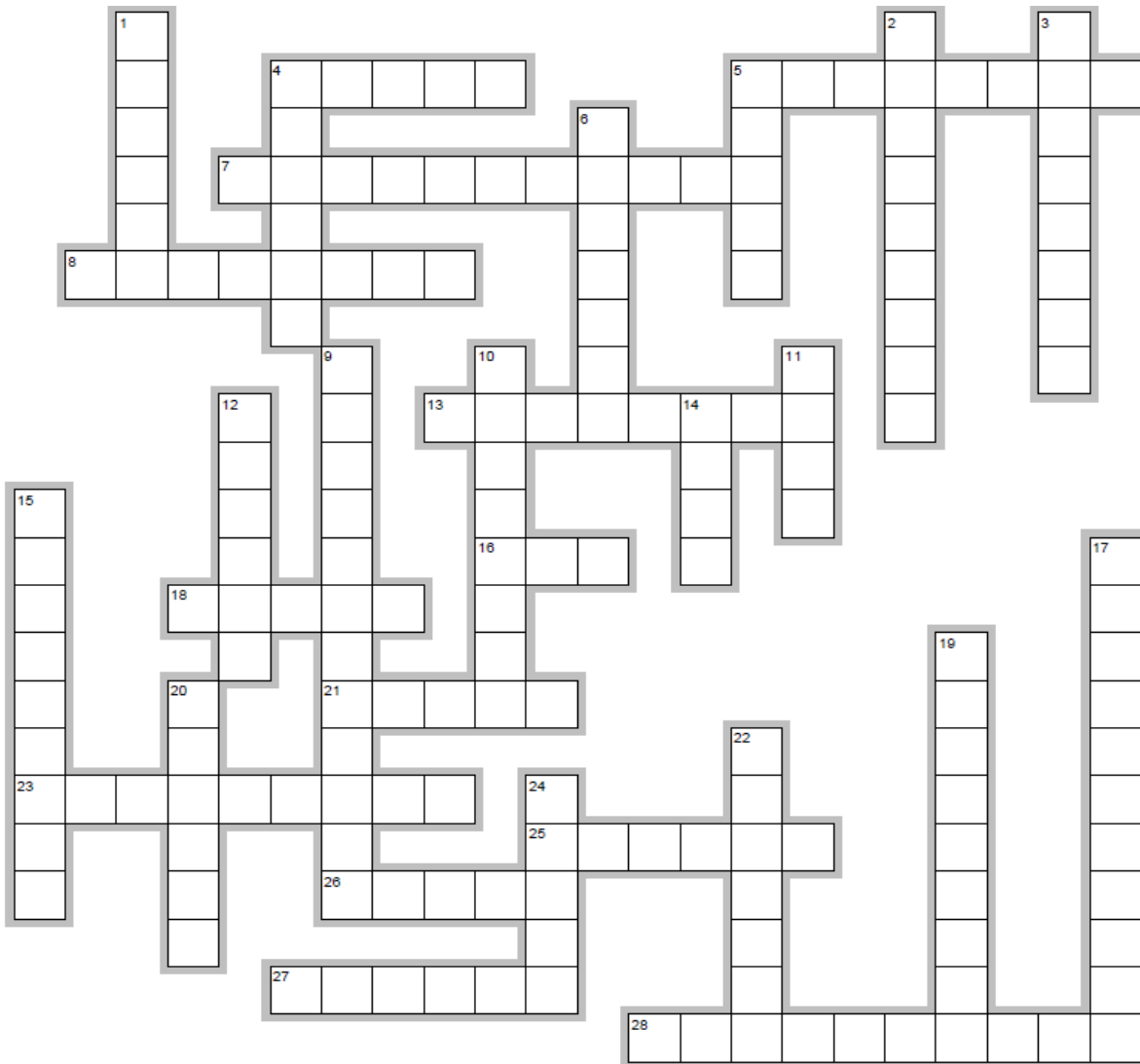
**The gamma-ray sky as measured by the FGST during its first year.**  
**(Credit: NASA/DOE/Fermi LAT Collaboration)**



Picture: <http://today.slac.stanford.edu/images/2009/fgst-1year-map.jpg>

References Atwood, W. B. et al., *Astrophys. J.* 697, 1071 (2009).  
Gehrels, N. and P. Michelson, *Astropart. Phys.* 11, 277 (1999).

**See if you can work out the answers to all the questions in Jamie Jones' astronomy related crossword!**



**Across**

- 4. A type of force arising in a system as a result of differential gravitation. (5)
- 5. The inactive volcano in Hawaii on which the Keck Observatory stands. (5,3)
- 7. A name given to a star which, when viewed from a given latitude, never sets and so can be seen on every night of the year. (11)
- 8. The most abundant element in the universe. (8)
- 13. Point where a small object affected only by gravity can be stationary relative to two larger objects. (8)
- 16. Soviet space station in operation for fifteen years before being deliberately deorbited in 2001. (3)
- 18. Elementary particle whose name is taken from the sound of a duck in the book 'Finnegan's Wake'. (5)
- 21. The closest dwarf planet to the Sun. (5)
- 23. The name for the theorized exponential expansion of the universe less than a second after the big bang. (9)
- 25. Also known as a shooting star. (6)
- 26. Frank \_\_\_\_\_, American astronomer famous for founding SETI, creating the Arecibo Message and the equation which bears his name. (6)
- 27. An interstellar cloud of dust gas and plasma. (6)
- 28. The smallest unit of time that Physics can reason about in a meaningful way. (6,4)

**Down**

- 1. Mechanical device used to illustrate the relative positions of planets and moons in a heliocentric model. (6)
- 2. The sixth-largest moon of Saturn, discovered by William Herschel and known for its cryovolcanism. (9)
- 3. Most common type of star. (3,5)
- 4. Neptune's most massive moon, known to have a unique orbit. (6)
- 5. Name for the large, dark, basaltic plains of the Moon. (5)
- 6. NASA program which launched two probes in 1977 to study Jupiter and Saturn. (7)
- 9. Characteristic radius associated with every quantity of mass. (13)
- 10. The largest moon of Jupiter and in the whole solar system, discovered by Galileo in 1610. (8)
- 11. The brightest star in Lyra, use as the standard for the magnitude scale, having an apparent magnitude of zero. (4)
- 12. Brightest star in the night sky found in Canis Major. (6)
- 14. The time of day when the Sun crosses the local meridian. (4)
- 15. \_\_\_\_\_ Tereshkova, the first woman in space. (9)
- 17. Many of the moons of Uranus take their names from the characters of this famous playwright. (11)
- 19. Name given to a planet beyond our solar system. (9)
- 20. Calendar established in 46BC and used until 1582 when it was replaced with the Gregorian Calendar. (6)
- 22. \_\_\_\_\_ Centauri, closest star to the Sun. (7)
- 24. Greek letter used to represent the argument of the perihelion and angular velocity. (5)

**Ever wanted to know where your life is headed? That's really what it's all about, right? Well, here's a quick rundown of your stars for the rest of the semester with Rachel Parker..**

### Scorpio

Scorpios are feeling particularly confident at the moment, so take the opportunity to say what you really think. Beware of Mercury though, who might drive you to confrontation with a close friend. Remember – be honest, not hurtful.

### Sagittarius

Get yourself out there! Venus is in the mood for making new friends, so put your glad-rags on and hit the Bop, asap. You never know who you might meet at the shooters bar. For those of you who are already involved, take the chance to arrange a date night. A romantic picnic under the stars perhaps?

### Capricorn

Get those lab reports in as early as possible this week, just in case an invitation comes your way. The recent full moon has made you open to a new relationship, but remember, if you do decide to take the plunge, don't forget about your mates!

### Aquarius

It's drama, drama, drama for you this week, Aquarius. You're feeling extra-vulnerable and even the slightest remark could make you blow your lid. Feeling lonely? Your friends have a proposition for you which you won't be able to resist?

### Pisces

Work has been getting to you recently, so how about taking a break? Maybe a weekend visit to friends at another university? Or how about a night in with a bottle (or three) of Vino and a call to Empire? Treat yourself to some me-time. You deserve it, Pisces.

### Aries

If you're coupled up, take care to listen to your partner this week. There's something on their mind that they want to share. Single? Don't worry, you're going to be in demand sooner than you think.

### Taurus

Oh Taurus. You're a moody one, aren't you? Don't eat that full tube of Pringles. You'll only feel worse. Instead, make that decision you've been mulling over, and you're sure to choose right. Neptune's got your back.

### Gemini

Nothing can hold you back at the moment. So when that enigmatic Scorpio pokes you on Facebook, don't hesitate in poking back. It could be the start of a beautiful relationship...

### Cancer

Mercury tells you the truth about something you've been wondering about for a while on Thursday. It's maybe not the news you wanted to hear, but it's definitely going to work out for the best.

### Leo

Why the pout, Leo? You like them, they like you. What's stopping you? Maybe it's that encounter you had in the physics common room that's still weighing on your mind. Move on, and you'll soon forget what you were so upset about.

### Virgo

You're still recovering from a bout of foot-in-mouth disease, aren't you Virgo? Well, a heartfelt apology is probably the best way to cure it completely – and once you've patched things up, an exciting development involving a spontaneous night out is on the cards.

### Libra

You need to strike that balance between work and play this week. All work and no play - makes for missing out on the best night of the semester so far. So don't turn down that invitation in favour of a night in with the books. After all, you're looking your best at the moment and if you've got it, flaunt it!

Not what you wanted to hear? Look out for your next horoscopes in next semester's Aurora....

## **DISCOVER BULGARIA**

**Last summer, Inna Bozhinova and Maya Petkova took part in an annual observing training course in Bulgaria. Here are some details for any of you budding astronomers, wanting to do some observing abroad.**

*The course is held at the Public astronomical observatory and planetarium, Varna, Bulgaria.*

The Institute of Astronomy with the ational Astronomical Observatory - Rozhen, Bulgaria, and the Society of Innovative Teachers in Bulgaria organize an International Youth Astronomical Summer School. Students in their final years in high school and university students, who are interested in astronomy, have the opportunity to participate in observations of astronomical objects, listen to interesting lectures and participate in discussions at the ational Astronomical Observatory- Rozhen.

In previous years, over 220 students and 30 teachers have participated in the summer school, many of whom have gone on to study astrophysics. Part of your learning incldes telescope operation, and learning how to work the software associated with telescopes. The intensive training during the international astronomical summer schools contributes to the enrichment of the astronomical knowledge of the participants and the development of their skills in working with observing equipment and analytical software. A significant success of the schools is the large percentage of student participants who continue their careers in the field of astronomy. Topicscovered by the programme include astrophysics, CCD observations, Star evolution, Galaxies, Life in the Universe, Sky orientation, Moon and Planet observations, Deep sky observations, Comet and asteroid observations.

**For more information on the summer school, contact Inna and Maya on map32 or inb.**

**Reach for the stars**

**In this article, Elizabeth Cooke ponders where to go for her Mid-Semester Break.**

Most people from England and Europe seem to think that Scotland is far enough, let alone those students among us from outside the EU. But soon people could be travelling from far and wide to Scotland, and beyond.

Virgin Galactic, a company established by Richard Branson and his Virgin group, is aiming to make space travel accessible to everyone: not just the elite few. They are currently looking into building a spaceport in Moray, NE Scotland, where flights would take customers on a 100km journey to the edge of space, making every passenger an official astronaut in the process.

RAF Lossiemouth is one of a few sites in the UK being considered for a spaceport, due to the station's runway and expertise in supersonic flights. The dark skies of Scotland already offer beautiful views for stargazers; this initiative could make the night sky as important for tourism as the highland landscapes.

The downside to this is, however, that UK law cannot allow it to proceed at the moment. The Outer Space Act 1986 limits the UK's activities in space by requiring any individual or organisation to apply for a license six months in advance each time they want to launch or operate any space object.

When this act was passed Britain never really predicted a time when civilians would be able to fly into outer space. As such, the British National Space Centre, BNSC, controls how many launches can be performed and when they can happen; restricting Virgin Galactic and anybody who would wish to follow in their footsteps. There is also no regulator and no insurance; Britain has no structure for the industry to build upon but also cannot ensure the necessary safety standards at the moment. If anybody here wished to launch a 'space object' there is no system through which to do it.

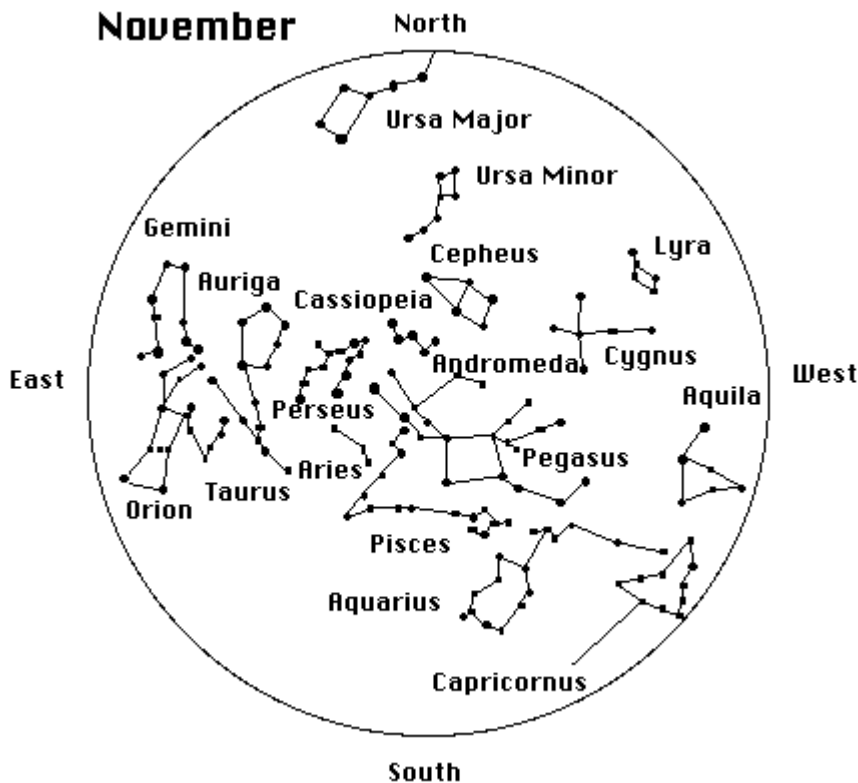
Thankfully the BNSC are now in the process of reviewing their Licensing Regime which controls the UK's space activity. They are looking to analyse how the Outer Space Act is implemented, taking into consideration the changes in today's accessibility to outer space. Hopefully then changes will be made to allow for better safety regulations and monitoring processes allowing Britain to once again join the space race. For now Richard Branson

and his team will be launching from the Mojave spaceport in California, hoping to eventually expand to sites all over the world. Currently Scotland and Sweden are the top choice locations.

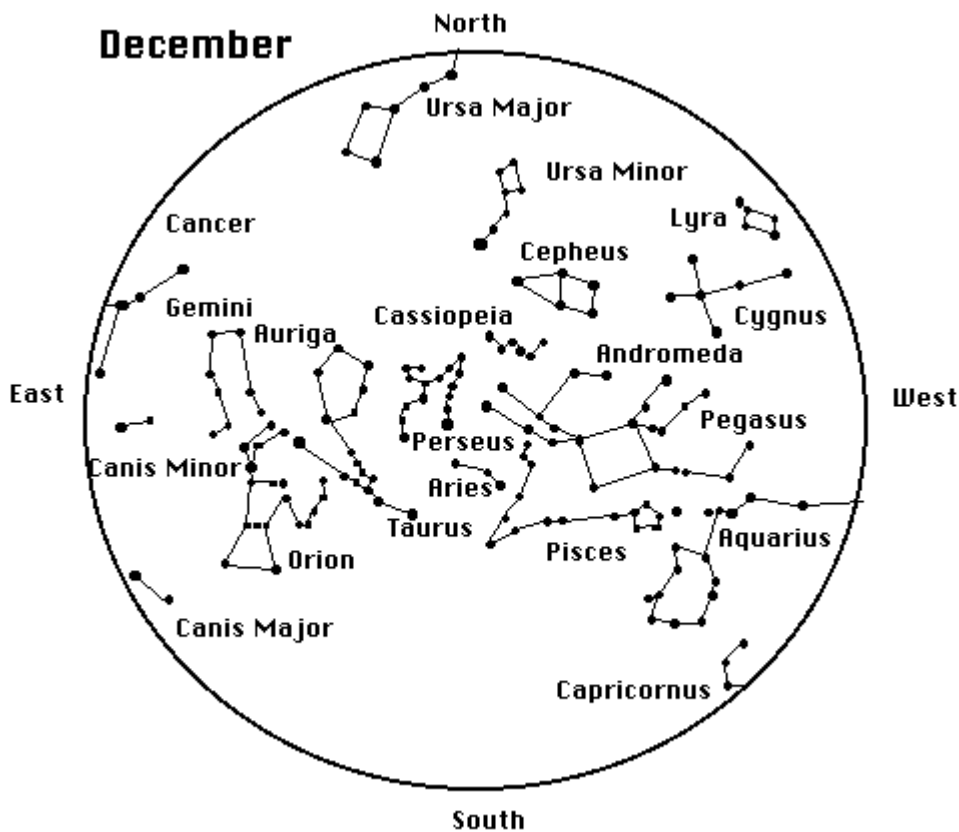
Even so, if RAF Lossiemouth becomes a hotspot for space tourists it's still a long way from being an annual Astrosoc fieldtrip. Tickets are currently £100,000 per person per trip and, as yet, the university is unwilling to subsidise us.

### WHAT TO SEE THIS WINTER

El Prez, Emily Ramsden tells us a little about what to expect from the night skies over the coming months.



Often I'll go up to the observatory on an evening all set to look at some lovely stars, and then realise I have no idea which constellation is which or what there is to look at even if I could locate anything! So (possibly more for my benefit than anyone else's) here are the star maps for this winter and a few things worth looking for.



**Orion:**

M42 is otherwise known as the Orion nebula, and is a gigantic luminescent gas cloud located at the tip of Orion's dagger (hanging from his belt). Should be visible with binoculars or even the naked eye if you're somewhere dark enough. This might be a good point to ask the sports centre to shut off their lights...

**Cassiopeia:**

NGC457 is located below the bottom of the W in this constellation. It's an 'elongated' open cluster that should be visible through binoculars and, if you take the two brightest stars to be eyes is supposed to look a bit like an owl?

**Pegasus:**

If you follow the end of the western-most leg of this flying horse you should find M15, a globular cluster that's 30,000 light years away. Visible with binoculars!

**Pisces:**

The head of Pisces is also known as 'The Circlet' and is a ring of seven stars that are all 4<sup>th</sup> or 5<sup>th</sup> magnitude. Supposedly visible with the naked eye, but possibly not that easy to spot.

**Gemini:**

The two northern-most stars of this constellation are Castor (right on the map, up in the sky) and Pollux (left on the map, down in the sky). If you follow Castor down (on the map) to the bottom of the constellation and then go up and right a bit (on the sky), you should find M35, another open cluster that can be seen with binoculars. Confused yet?

**Cygnus:**

If you use binoculars, go up and a little to the left of the eastern-most star and you should spot NGC 7000. Also called 'The North American Nebula' it is supposedly shaped like the USA. It might be easier to see it on a long exposure photo though, so ask your observing directors at the next observing session.

All the directions I've given are supposing you're actually looking at the object in the sky, not necessarily the sky, since the sky is all the way around you and the maps are a circle...well, good luck!

## Astronomy and the iPod touch

Nell Wilson examines exactly why she first joined astrosoc, and encourages you to follow suit....

The reason I decided to join Astrosoc is thanks to my iPod Touch. A few months ago I downloaded an application called *Pocket Universe*, a popular program which equips you with a virtual map of the night sky and can pin-point your location using either the iPhone's built in GPS system or over a wifi connection, to aid you with star-gazing. Wow.

I headed straight outside and gave it a whirl, knowing, it must be said, NOTHING about astronomy up until that point. It was amazing. Suddenly I could pick out the whole of the constellation Taurus and check out which were its brightest stars; I could see the weird 'W-shaped' Cassiopeia; the Square of Pegasus; and others such as Cepheus which I had never even tried to recognise before. Over the next few weeks I began to regularly check the application's ephemeris to see at what time certain constellations/planets/meteor showers would be visible and to use a pair of binoculars to look at things a bit more closely - I was particularly awed to see Mars and notice its red glow. There is something pretty impressive about being able to navigate the solar system in the palm of your hand.

Additional features of *Pocket Universe* include a simple Lunar Phase calendar, a very small program for helping you to view Jupiter's Moons, Night Vision, and a 'locator' for helping you find what your looking for. The coolest feature, however, is something called 'Motion Tracking': when you move your device the map moves with you, making it easier to determine what you are looking at. This works to best advantage with the iPhone's GPS tracking system and compass.

Other astronomy apps that i've installed include *Planets*, *Distant Suns Lite* and *Moon Globe*. The first of these is really only a novelty, which gives you basic information and a virtual set of planets which you can touch, rotate and zoom into (rather like Google Earth, just without the rich level of detail, as the zooming feature only makes the planets bigger). However, the graphics are quite impressive, especially the virtual Earth which includes a sunlight map, detailing exactly which part of the world is in darkness/light.

*Distant Suns Lite* is similar to *Pocket Universe*, only the interface is a little different, the map more detailed, and there are more viewing features. Plus it's free.

Moon Globe is a very recent acquisition of mine, which I am massively impressed by. There are two different modes to the program: 'telescope mode' and 'globe mode'. The first shows the moon as it appears from your location on Earth, and the second allows you to view the moon from above it. The graphics are splendid, and you get an entire 3D representation of the moon, which you can rotate and resize with your fingers. It features an incredibly detailed name map of all the different geological locations, such as the 'Ocean of Storms' and the 'Sea of Islands', and provides links to Wikipedia for extra info. There is also a searchable index of these names, and a 'sky compass' for making your moon-gazing a slicker and more accurate experience.

**SOME USEFUL PRICES FOR THE APPS:**

Pocket Universe - £1.79

Distant Suns Lite - Free

Distant Suns (Full Program) - £2.99

Planets - Free

Moon Globe - Free

Mars Globe - £1.79

**I want a green moon – I'm fed up with a blue!**

**Anna Louise Richards explains a bit more about the moon and its various names.**

Most people will have heard the saying 'Once in a Blue Moon' and you may have even heard about the Harvest Moon (outside of an addictive Nintendo farming game that is). However, did you know that in various cultures the full moon of every month had a name?

Originally moon names were assigned due to the seasons and religious events. So in medieval England the Lenten Moon was the last moon before March 21<sup>st</sup>, followed by the Egg Moon which was the first full moon before Easter. Now names are assigned to the months in which they occur for ease of reference but most match up with the older names anyway.<sup>1</sup>

So here are the modern English moon names:

January	Old Moon (or, Ice Moon)
February	Wolf Moon
March	Lenten Moon (or, Chaste Moon)
April	Egg Moon
May	Milk Moon
June	Flower Moon
July	Hay Moon
August	Grain Moon (or, Dog Moon)
September	Corn Moon
October	Harvest Moon
November	Hunters Moon
December	Oak Moon

And the Native American names:

January	Wolf Moon
February	Snow Moon
March	Worm Moon
April	Pink Moon
May	Flower Moon
June	Strawberry Moon
July	Buck Moon
August	Sturgeon Moon
September	Harvest Moon
October	Hunters Moon
November	Beaver Moon
December	Cold Moon

The reasons for these names, as I said above, could come from association with the liturgical calendar (religious events) but as can be seen, they are also concerned with events occurring in the seasons, such as 'Flower moon' in June and 'Hay Moon' in July. The Harvest and Hunters' Moons are so called (apparently) because in the evenings around the full moons the moon rises about 30 minutes later, rather than the usual 50, meaning that there is no long period of darkness between sunset and moonrise, which allowed harvesters and hunters to carry on working after sunset.<sup>ii</sup>

The alternate name for August's moon, the 'Dog Moon', likely refers to the star 'Sirius', the rising of which signalled the hottest days of summer for the Ancient Greeks and Romans.

Then there is the ever popular 'Blue Moon'. For the second half of the 20<sup>th</sup> century it was

believed that this referred to the second full moon in a month due to a miss interpretation of the Maine Farmer's Almanac but it actually refers to the fourth full moon of a season (if a season is basically taken as comprising of three months, though they are actually compiled around solstices and equinoxes). For the curious, the next 'Blue Moon' to occur according to the first former definition is December this year, and the next according to the Farmer's Almanac is November 2010.<sup>iii</sup>



Picture taken from APOD, taken this Halloween!

#### *References*

<http://www.skyandtelescope.com/observing/objects/moon/3304131.html>

[http://en.wikipedia.org/wiki/Harvest\\_moon](http://en.wikipedia.org/wiki/Harvest_moon)

[http://en.wikipedia.org/wiki/Full\\_moon#Full\\_moon\\_names](http://en.wikipedia.org/wiki/Full_moon#Full_moon_names)

[http://en.wikipedia.org/wiki/Hunter%27s\\_moon](http://en.wikipedia.org/wiki/Hunter%27s_moon)

## **STAR PHOTOGRAPHING COMPETITION**

The first annual St Andrews' Observatory best astronomical image competition has been announced by Simon Driver. Here are the details for all of you budding astronomers...

Rules:

1. Observations must be taken with one of the Observatory's telescopes (10", 16", JGT\*\*\*).
2. Eligibility: all staff, postgraduates, and students who have completed their observer training course and are not on the judging panel.
3. Photos can be of any astronomical object (moon, planets, star clusters, nebulae, galaxies etc).
4. Deadline for submissions 1st March 2010, decision by mid-March.
5. Prize: 1st 30 pound amazon.com voucher, 2nd prize 20 pound amazon.com voucher, 10 pound amazon.com voucher.
6. Decisions will be made by a committee consisting of one staff member (me), one PhD student, and one undergraduate student.
7. Submission of a .gif image with date and time of obs via email to spd3 anytime before the 1st March 2010.

Prize winners will have their pictures framed, mounted and exhibited in the main School concourse and thereafter at the Observatory.

\*\*\*Any students who would like to use the JGT for this purpose must submit an email request containing:

1. your objects name.
2. your objects RA, Dec, size and flux.
3. optimal date/time for observation.
4. your mobile number.

## COMING UP THIS YEAR....

**Astrofest** –February 2010. We'll report on this fantastic event in the next issue. About 20 astrosoc members are going to this conference in London in the break between the 2 semesters

### **Glasgow Planetarium trip**

**Quantum Soc vs Astrosoc pub quiz!** We (Quite convincingly) won the last round of this popular quiz held in the Whey Pat. Fingers crossed the trophy can stay on Emily's shelf for the rest of the year

**Observing nights** – keep an eye on your emails and on the website on Mondays and Wednesdays – our lovely observing directors will let you know when observing is on.

## **ASTROSOC COMMITTEE CONTACT DETAILS**

President: Emily Ramsden

Vice President: Adam

Treasurer: Gordon Gibb

Secretary: Leah Wynne Jones

Observing Directors: James Sinclair, Daniel Lodge

Social Convenor: Nicky Agius

Webmaster: Joe Llama

Magazine Editor: Kit Millar

Ordinary Members: Jo Barnes, John Rostron, Ross McWhirter

## Editor's Note:

So this is my first edition of Aurora, and I hope its not been too much of a let-down! After making the freshers edition (Which you hopefully got a copy of at the freshers fayre) I was terrified – my English skills stopped when I finished higher english, and my friends have to correct my english more often then should be necessary for an 18 year old.

I just want to say a wee thank you to everyone who contributed to the magazine, and sorry for bombarding your inboxes for weeks asking for articles! Luckily some of you found time to write me something, and i'm so grateful to you – you're off the hook for next edition!

See you all soon around the physics building, and good luck with any exams and assignments due in over the next few months!

Kit x

## **CONTRIBUTORS**

Emily Ramsden

Andrew McLeod

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Inna Bozhinova

Maya Petkova

Images: The images not part of the articles were taken from [spacetoday.org](http://spacetoday.org)

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