

Hi this is Steve Nerlich from Cheap Astronomy [www.cheapastro.com](http://www.cheapastro.com) and this is *The stay-at-home's guide to the galaxy*.

### 1. Getting to grips with the galaxy.

You can get your galactic bearings from the comfort of your backyard – which is in many ways the best place to do it from. Spaceship Earth has been doing a complete circuit of the Milky Way Galaxy every 225 million years since its birth – meaning it's done this remarkable feat over 18 times now. At the moment we are whizzing around the galactic core at a speed, relative to it, of 220 kilometres a second. It is going to take us a while yet to build a spacecraft than can match that.

But going back to what you can see from your backyard. The Milky Way is about 100,000 light years in diameter and we are just over halfway out from the centre. You may have noticed that the ecliptic, a line traced by the Sun's apparent movement across the sky and representing the rotational plane of the Solar System, is never really parallel to the starry ribbon of the Milky Way across the sky. From this, you might have gathered that the Solar System's alignment is a bit askew to the main disk of the Milky Way.

To visualise what's going on – imagine you are sitting at a round table with a dinner plate. The table is the galactic disk of the Milky Way and the dinner plate is the rotational plane of the Solar System. If you hold the plate at a 63 degree angle to the table and imagine the Earth is moving around the rim of the plate – you've got the general idea.

Around September, the Earth will be near the top of the plate – and going forward, the Earth will orbit anti-clockwise so December is to the left of the plate, March is at the bottom and so on. And just to keep it interesting, the galaxy (remembering that's the table) is rotating clockwise – so the Solar System along with the rest of the contents of the galactic disk is moving around the table to your left.

To make some kind of sense of this imagine the dinner plate is a wheel that rotates anti-clockwise. That means if you let it go, it would roll along its edge in the same clockwise direction that everything else is moving in the galactic disk. So maybe the general momentum of how everything moves in our galaxy is what's made our Solar System rotate in the direction that it does.

Anyhow, around the equinoxes (in March and September) and at the right time of night you can see the Milky Way at an angle in the sky approximating 63 degrees – since this is the tilt of the plane of rotation of the Solar System to the galactic disk.

Around the solstices (in December and June), you might see the Milky Way running almost north to south across the sky – which is almost perpendicular to the ecliptic. This is because the Earth's axis of rotation is tilted 23.5 degrees, relative to the rotational plane of the Solar System – and around the solstices this angle adds to the Solar System's relative galactic tilt of 63 degrees, giving you a total of pretty much 90 degrees – or to put it another way, from the galaxy's point of view, the Earth is spinning on its side.

## *2. So just how much of the galaxy can we see?*

To get a sense of scale of the galaxy – imagine its circular diameter is 10 metres, then the diameter of Earth's orbit is about 0.1 of a millimetre. Or we can speak in real terms and say the galaxy's diameter is 6 billion Astronomical Units (AU) – where one Astronomical Unit is the average distance from the Earth to the Sun.

Since the Milky Way galaxy is so big and we are embedded within it, you can always see some part of it at night. But exactly what part you see is very dependent on the time of year – since what you can see at midnight on one side of the solar orbit – will be practically 180 degrees different from what you will see on the other side of the solar orbit. And what parts of the galaxy you can see will also be somewhat dependent upon your location on Earth's surface – as it's generally the case that you will get better views of the galactic centre from the southern hemisphere – because, remember that from the galaxy's perspective the Earth spins on its side – and it's the south pole of the Earth is always roughly orientated towards the galactic centre.

So, for the Southern hemisphere, the nights around September – are when the centre of the galaxy (being in Sagittarius) is almost directly overhead. Six months later in March, there's a fainter band of Milky Way overhead between Sirius and Procyon – representing a view almost straight out towards the outer edge of the galaxy. For the northern hemisphere, you generally only see the outer edge of the galaxy – and the centre of the galaxy, Sagittarius, is only visible over the southern horizon between June and September.

## *3. The awesome stuff.*

So, now let's try and pull all this together for a backyard total perspective vortex experience. A line drawn from the galaxy's centre straight up towards its north (not our north) – passes fairly close to the bright star Arcturus, while a line drawn down to its south passes through the constellation Sculptor. So, in September, in the southern hemisphere – it's possible to stare straight up at the centre of galaxy, with Arcturus behind you down near Earth's western horizon. From this orientation, you can know we are progressing in our 220 kilometre a second clockwise galactic orbit, towards your left.

Then, come December, when Earth is at the leading edge of the Solar System's path around the galaxy, it doesn't really matter what hemisphere you are in, you can look towards see the constellations Hercules and Lyra – or just look for the bright star Vega. That is the direction the whole Solar System is heading – and, if you are facing that way, you are looking into our spacetime future. Awesome.

## *4. We are all going to die.*

Although it's difficult to tell from your backyard, the Solar System is currently slightly to the north of the mean centre (and densest part) of the galactic disk. It's speculated that we pass through the dense middle of the galactic disk every 30 million years or so – and that this galactic plane crossing may perturb the outer Solar System sending a rain of comets down to Earth and causing periodic mass extinction events.

It's thought that we are currently approaching another galactic plane crossing. But when we say we are approaching the mid-plane of a disk that is around 1,000 light years thick, determining exactly where the mid-plane is, remains a major technical challenge for astronomers. Doomsday merchants say the pending mid-plane crossing may be the end of the world as we know it. But even if we crossed the galactic mid-plane tomorrow, it will take any perturbed comets from the Oort cloud several thousand years to make their way into the inner Solar System and destroy the Earth.

Indeed, there is another theory that suggests it's actually more dangerous for the Earth to be a long way out from the mid-plane of the disk, as we can then be blasted by cosmic rays we are otherwise protected when we're inside the disk, due to the galaxy's magnetic field.

So the risk of death is always there, as we whizz around the galaxy at 220 kilometres a second. But we have done 18 circuits of the galaxy already, without too much drama. So, while we are all going to die, it will probably be from old age.

Thanks for listening. This is Steve Nerlich from Cheap Astronomy, [www.cheapastro.com](http://www.cheapastro.com). Cheap Astronomy offers an educational website helping you to get from A and B – even if B is in lateral motion perpendicular to the rotational plane of an arbitrarily horizontal coordinate system. No ads, no profit, just good science. Bye.