

Hi this is Steve Nerlich from Cheap Astronomy www.cheapastro.com and this is *The stay-at-home's guide to 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 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 an awful long time to build a spacecraft than can match that.

But going back to what you can see from your backyard. Since the Milky Way is about 100,000 light years in diameter – and hence has a radius of 50,000 light years – 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 generally nowhere near the Milky Way. 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. Galactic north is up towards the ceiling and when you are looking down at the plate, it's like you are looking down at the solar system from its north.

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 are moving around the table to your left.

To make some kind of sense of this imagine your 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 that's how the solar system ended up moving the way that it does.

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. 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 galactic tilt of 63 degrees, giving you a total of 86.5 degrees – or to put it another way, from the galaxy's point of view, the Earth is spinning on its side.

But from your particular backyard, this is all a case of more or less. Since the rotational plane of the solar system isn't exactly face on to the centre of the galaxy – you won't always see the Milky Way cutting across the middle of the sky. At different times of the night and from different observation points on the Earth's surface, the Milky Way may sometimes seem to be down near the horizon – making it difficult to judge exactly which way it is apparently orientated in the sky.

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 millimetres. 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.

In this context, the parallax change between what you see from one position in our solar orbit – and what you see 6 months later is negligible. Nonetheless what side of the Sun you are on is an absolute determinant of what you can see in the night sky – since what you can see at midnight on one side of the solar orbit – will be what you can see at midday on the other side of the orbit – which to say you won't see anything, because it will be midday.

Since we are embedded within the Milky Way, you can always see some part of it at night. But exactly what part you see is very dependent on the time of year – and 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 the south pole of the Earth is always roughly orientated that way.

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.

So, 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 – 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 through the galactic disk to the centre of galaxy, with Arcturus behind you down near the 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 systems path around the galaxy 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. Awesome.

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 been estimated that we are currently approaching a galactic plane crossing. But when we say we are approaching the midplane of a disk that is around 1,000 light years thick, we could be anything up to 100 light years from that midplane. Indeed, determining exactly where the midplane is, remains a major technical challenge for astronomers.

One thing we can be confident of is that there is a vanishingly small chance that we'll be crossing this midplane on December 21 2012. And even if this is some kind of cosmic trigger event, 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.

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

So yes we are all going to die, but probably from old age.

Thanks for listening. This is Steve Nerlich from Cheap Astronomy, 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.