Hi this is Steve Nerlich from Cheap Astronomy www.cheapastro.com and this is *The transit of Venus.*

The 2012 transit of Venus will proceed for nearly 7 hours over the 5th and 6th of June depending on where you happen to be in relation to the international date line. And if that seven hours happens to coincide with your particular experience of dusk to dawn when the Sun is not visible in the sky, well, you probably want to skip on to the next podcast. This will be the case for most of South America and the west coast of Africa and a bunch of mid Atlantic islands - sorry folks.

Even for those who can see it - it's not likely that anyone is going to squeeze much in the way of ground-breaking science out of this event, which was closely monitored by 21st century technology the last time that it happened in 2004. But, this 2012 transit will be only the seventh ever scientifically recorded transit and it will only be the eighth time that humanity has even been aware that this event takes place - so there is still room to get a little bit excited about it.

So, just what is a transit of Venus? Well, the Earth orbits the Sun - and Venus orbits the Sun - but Venus is closer in to the Sun, so its orbital period has to be quicker - because of Kepler's third law. It works out that the Earth orbits the Sun at a speed of 29.78 kilometres a second - a speed that is almost exactly 8/13ths of the speed that Venus orbits the Sun at 35.02 kilometres a second. So for every thirteen solar orbits that Venus does, Earth does almost exactly eight orbits.

So it works out that, since we are living on Earth, transits of Venus generally happen in pairs separated by 8 years (that is 8 Earth solar orbits), with either 105.5 or 121.5 years separating the last of the 8 year pair and the first of the next pair.

Part of the reason that 8 year pairs of transits of Venus only happen every hundred years or so is that Venus and Earth don't orbit in the exactly the same plane, even though they almost do. So firstly, since they *almost do* orbit in exactly the same plane, in the unlikely event that a transit of Venus does come off there's a pretty good chance it will happen again eight years later, but after that things get a bit out of alignment and it works out that there won't be another transit for at least another 105.5 years.

We have to say *at least* 105.5 years because there is a slight misalignment built into the whole system - because the Venus-Earth orbital period differentiation is not an exact ratio of 8 and 13. So although the transits do generally come in pairs eight years apart, eight years after you get one pair, the planets just miss each other and in eight more years they miss each other a little more. In fact, they keep on missing each other for at least another 105.5 years. And even then, every second cycle a transit opportunity just misses and it takes another 16 years (that is, two more 8 year cycles) until you get another alignment 121.5 years later. So between the 8 year pairs -first there's a gap of 105.5 years, then there's a gap of 121.5 years - and then it's back to a gap of 105.5 years again - and so on.

But look, rather than getting too caught up in the numbers, let's try a history lesson. Johannes Kepler, one of the great astronomers of his day and of most days since, became the first person to predict a transit of Venus in 1631 – although, as it happened, that transit was not visible from Europe because it happened over the seven hours between Europe's dusk and Europe's dawn. So it fell to Jeremiah Horrocks and William Crabtree to make the first ever scientific observation of a transit of Venus, 8 years later in December 1639.

After that, indeed 121.5 years after that, the next two transits of Venus were in June 1761 and June 1769 - the latter famously observed from Tahiti by Lieutenant James T Cook (and

OK, I am kidding about the T). Then 105.5 years passed until there were two more transits observed in December 1874 and December 1882.

And then another 121.5 years passed until the June 2004 transit – which is now to be followed eight years later by the June 2012 transit. Hence, this year's transit is only the seventh transit of Venus since Kepler first figured out that transits of Venus even happen. You are allowed to get a little bit excited.

But even though I hope we've given some explanation of the 8 year pairing and 121.5 and the 105.5 intervening breaks - you might now be wondering about those point fives? When we say point five, we mean point five of a year, which is six months or half an Earth solar orbit.

The six month thing is yet another consequence of the fact the Earth's and Venus' orbits are almost, but not quite exactly, lying the in same parallel orbital plane. So if you imagine two rings that are almost but not quite exactly in parallel with each other - there will only be two points at which those two rings intersect and those two intersection points will be at directly opposite points of each orbit. So, if you imagine one of those rings is the Earth's orbit, those two intersection points will be six months apart.

So when the planets line up and you get a transit of Venus in June 2004, it works out that the next one is also in June, in 2012. But from there, potential line-ups for transits keep just missing and this mismatching progresses around the two orbits until the next line up happens in December when Earth is on the opposite side of the Sun.

Given this pattern, we know that the next predicted paired transits of Venus will be in December 2117 and December 2125. But, because we are dealing with almost but not exactly alignments, we find that even the June-December thing is only a temporary phenomenon. Before the 1631 transit, the 8 year pairings occurred in May and November. And even the 8 year pairings only happens most of the time. Apparently the transit of 1396 did not have an 8 year pair and there will be another of these rare solo transit events in 3089.

And if all these numbers are becoming a bit tedious, let's go back to the history again. The transits in 1761 and 1769 were a huge deal. Edmund Halley, even though he died in 1742, had suggested that if the 1761 or 1769 transits of Venus could be observed from different points on the globe - ideally from widely spread locations in the Northern and Southern hemispheres - then you would be able to calculate the astronomical unit, the distance from the Earth's orbit to the Sun. This would be achieved by considering the two distant points on Earth to be two points of a triangle - and then the parallax and a bit of trigonometry would give you length of the side of the triangle which represented the distance between the Earth and the Sun.

Preliminary observations were taken at the the 1761 transit, which were inconclusive due to bad weather. So, King George the 3rd of England approved a project to finally nail the astronomical unit through observations of the 1769 transit - a project which included sending Lieutenant James Cook across the globe in the good ship Endeavour.

James Cook was a passable astronomer who had made observations of the 1761 transit from Canada. He was also a kick ass navigator and as far as captaining a vessel goes James Cook made James Kirk look like a fictional character.

Cook was assigned to sail to the south Pacific island of Tahiti to do the 1769 transit of Venus observation - and if he just happened to stumble upon Australia afterwards - well, no-one

would be complaining. And that is pretty much how it worked out. Of course Australia had actually been discovered by its indigenous people about 40,000 years earlier, but that is a another story.

Anyhow, to finish up, since we are talking about transits you might want to know that a solar eclipse and a transit of Venus can happen at the same time - even though it's a pretty rare event. The last time this happened was in the year 15,607 BC. And the next time a simultaneous solar eclipse plus a Venus transit will occur is on the 5th of April, 15,232 AD - so it's a roughly once every 30,000 years.

It is also possible, although exceedingly rare, for Mercury and Venus to transit the Sun at the same time. The last time this happened was in 373,173 BC and the next time it will happen will be on the 26th of July, 69,163 AD - so it's roughly a once every 440,000 year event.

And finally, to really finish up, guess what the humble publisher of this humble podcast be doing on the day of this historic and transitory event on the 5th or 6th of June 2012. Although Australia will be a pretty good vantage point from which to view the 2012 transit, it's been a while since the last Cheap Astronomy field trip, so I'm thinking we might go somewhere a little special... Hawaii! I know I'm a little excited too.

Thanks for listening. This is Steve Nerlich from Cheap Astronomy www.cheapastro.com. Cheap Astronomy offers an educational website for all those times when the planets really are in alignment. No ads, no profit, just good science. Bye.