Question 1:

Dear Cheap Astronomy – have we got any spacecraft on the other side of the Sun.

Well, yes and no. Nearly all our spacecraft orbit the Sun – since they are either orbiting Earth or another planet or are touring the asteroid belt – and hence they've all been around the back of the Sun at one time another. The only spacecraft we don't have orbiting the Sun are the ones on their way out of the Solar System – the Pioneers, the Voyagers and New Horizons, which have sufficient escape velocities to leave solar orbit.

And while we're on the subject, remember Elon Musk's car launched in 2018 – people often ask if it's got to Mars yet, to which the answer is no, but it has overtaken Mars more than once. Again, like pretty much everything else in the solar system, the Tesla roadster orbits the Sun – and since it left Earth several years ago and left already possessing Earth's solar orbital velocity, it has been round the Sun several times now. When you live in the solar system going around the Sun isn't that big a deal.

And as for getting excited about observing the other side of Sun, since it rotates every 27 days, we get to see its 'other side' on a regular basis. But OK, with all that nitpicking done, there is some genuine scientific value in being able monitor the far side of the Sun before it revolves around into view from Earth as this will enhance our space weather forecasting. To explain, when people talk about space weather they mostly just mean how space may be influencing our planet and most of that is about solar wind, solar flares and coronal mass ejections from the Sun, which can send high energy charged particles our way. Those particles have the potential to cause anything from radio blackouts to power grid blackouts. They could use also burn out electronics onboard spacecraft and satellites. Since sunspot activity correlates with increased flares and mass ejections, if we could see active sunspots in advance of them turning to face Earth, we'd have some extra warning about potentially-disruptive space weather coming our way.

And while we're on the subject, when we say the Sun rotates every 27 days, that's an average measure. Much like the gas giant planets, different parts rotate at different rates. So material around the equator rotates every 25 days, while up near the poles, material rotates every 35 days and there are various gradations in between. Also, the Earth's orbital plane is tilted by about 7% relative to the Sun's equator such that we see a bit more of its north pole around September and more of its south pole around March.

But anyway, there are some issues to think through in trying to observe the Sun from the other side of Earth's orbit. If you are trying to do station keeping, that is to keep a spacecraft in the same relative position relative to Earth then you have keep burning fuel to counter various perturbations, such as when Venus passes by. To minimize fuel consumption, you could position a Sun-observing spacecraft at Lagrange point 3 – which is on the opposite side of the Sun relative to the Earth. A spacecraft at Lagrange point 3 could complement the Sun-observing spacecraft we currently have at Lagrange point 1, which is on the Earth's side of the Sun. From L3 you can't readily communicate back to Earth because the Sun is in the way. But you could put relay spacecraft at L4 or L5, which have line of sight of both Earth and L3. We got close to something like this with NASA's STEREO spacecraft, which were two virtually identical spacecraft which launched from Earth in 2006, left Earth's orbit around the Sun and then looped back such that one was ahead of Earth in its orbit and the other behind. Due the various perturbations we discussed earlier they both drifted further apart, at one time they were about 90 degrees apart and in early 2011 they were both 180 degrees apart and were then able to jointly provide a complete 360 degree view of the Sun, even though they then began drifting again. But a few years later the STEREO B spacecraft became non-operational and that was that. So, can we observe the far side of the Sun? Sure, arguably we do it all the time. But putting the pedantics to one side, it's possible we could position a spacecraft at L3 and then have a relay station at L4 or L5 to send its data back to Earth.

Question 2:

Dear Cheap Astronomy – Hubble crisis

So there's a crisis in cosmology apparently. Although, in most respects it's just business as usual really. There aren't many scientists who are overwhelmed by existential angst when they suddenly realise they don't know everything.

The crisis first started being talked around 2014 as it became apparent there consistent discrepancies in measurements of the Hubble constant, which is a measurement of how fast the Universe is expanding. What's sometimes called the late-time method involves measuring relative distance markers, for example standard candles like Type 1a supernovae which explode with the same intrinsic brightness – so a bright one must be closer than a dim one. Using such a standard candle as a distance measure and using its red-shift to tell you how fast it's expanding away from you, you can calculate the Universe's current expansion rate, which works out to around 73 kilometres per second per megaparsec – where a megaparsec is about 3.3 million light years.

But you can also do what's called the early-time method, where you consider the cosmic microwave background as reflecting the temperature of the early universe and its tiny fluctuations as reflecting the initial conditions of the Universe – how much radiation versus how much mass for example, and on that basis calculate how things would have unfolded over the next 13.8 billion years, including how fast it should be expanding now. If you calculate the Hubble constant this way you get 67 kilometres per second per Megaparsec.

The late standard candle measure of 73 and the early CMB measure of 67 have errors bars defined – but even with those the two measures just don't overlap. So, that's the Hubble crisis or the Hubble tension as many refer to it these days. Essentially, the early CMB estimate is what you should expect to get if our standard model of the Universe is right and the late standard candle measure is what you actually get.

So, one explanation for the discrepancy is that the standard model is wrong, or at least a bit wrong. The idea that this sent shudders through the astronomical community is journalistic fabrication. It's unlikely anyone in the astronomical community has thought the standard model to be anything more than a bit right. The whole idea of a working model is that you expect to keep making tweaks and adjustments to it as you go.

But another possible explanation for the Hubble discrepancy is that the methodologies by which we calculate the early late measures may not be quite right. It's more than likely that another hundred years of technology development will result in more accurate figures and we're likely to also refine some of the assumptions that underlie our calculations. There's a string of assumptions that underlie the 'distance ladder' by which we determine how far away distant things really are and another string of assumptions whereby we construct how the modern Universe has unfolded since the CMB was first released. So couldn't that be it, we just need to tighten up both measures until they come together? After all, 67 – 73, they're only out by five units, I mean it's not bad.

Most of the astronomical community aren't keen on this view, since there's been a lot of work by a lot of independent observatories and by a lot independent theoreticians, trialing new assumptions and trialing new technologies and with everyone checking each other's work as they go. But despite all that everyone keeps landing at around same results, early 67, late 73. Presumably, there be some resolution to the current tension at some point and probably at about that same point a new contention will arise. This is the nature of science and also the science of nature.