Dear Cheap Astronomy - Episode 007

Question 1:

Dear Cheap Astronomy - Astrophotography, is it just a money pit or is it good science?

One of the most frequently asked questions that hard-core astrophotographers have to face is - Come on, all those colours and those sparkly points of light - that's just filters and stuff. What does that galaxy, gas cloud or Messier object you have photographed really look like?

Astrophotography is an area where the line between what's flim-flam versus what's scientific observation can sometimes become a little unclear. But, let's start by saying that most hard core astrophotographers are meticulous in documenting all the technology that underlies the image that they produce. Whether or not you accept that the image that they developed is 'real' - you will know exactly how they got it and you will be able to reproduce that same image. So, this much of astrophotography is definitely good science.

And we have to think about the meaning of the statement... does it really look like that. Perhaps what we are asking is - would that object look just like it does in this photo, if I had a warp drive starship that could fly me to a point where this same galaxy, gas cloud or Messier object would fill my field of view when I looked out through the starship's viewscreen.

To answer that question, we firstly have to consider whether your eyes are going to be fully dark-adapted when you take that first look. If they are not - then no, you probably won't see all the colours and the intricate detail that astrophotographers have worked hard to bring to prominence when you first view their photographs.

Also, we should probably check when you last cleaned your starship's viewscreen. And even then, what something really looks like will vary depending upon whether you are myopic, have macula degeneration, are colour blind or maybe just had a few too many drinks last night. What something really looks like is a very subjective concept.

Generally, astrophotographers aim to give you the most unsullied image that they can achieve with the technology they have at their disposal. So yes this may involve using filters and the stacking of multiple images - so as to enhance the brightness and detail of a particular image.

But, arguably, the photograph that they give you really is a genuine representation of what someone would see after being blindfolded for thirty minutes and then wearing their prescription glasses while looking through a brand-new state-of-the-art viewscreen that had just been fitted on their starship. Something that is only real under a very particular set of circumstances, is still real - and if you document what those very particular set of circumstances are, then you are doing good science.

But one example of where the reality and the scientific relevance of astrophotography starts becoming unstuck is when astrophotographers use the equivalent of what terrestrial photographers call star filters. A star filter slightly diffracts a point source of light to give it artificial rays - usually four of them, extending outwards from the point source.

This looks pretty, I suppose, and it appeals to the collective cultural norm of drawing stars with sticky-out bits, like you see on any national flags that include stars - for example Syria, China or the USA, just to name a few. But no - out in your starship, with your prescription glasses, dark-adapted eyes and a brand-new viewscreen you are not going to see stars with sticky out bits. So perhaps this use of star filters is not altogether good science, it's just photography.

Question 2:

Dear Cheap Astronomy - You were criticising the use of star filters in astrophotography - but are you sure you aren't just looking at diffraction spikes?

Well yes, of course I was just looking at diffraction spikes and really you could have just said: *You got it wrong*. This story starts a while back when we were trying to answer a question on astrophotography and Julia narrated something that I wrote, which was: *A star filter slightly diffracts a point source of light to give it artificial rays - usually four of them, extending outwards from the point source.*

Well, no they probably aren't star filters – I mean there are a few artistically-minded astrophotographers who actually do use filters to give stars an artificially-spiky appearance, but for the most part what you are seeing are diffraction spikes – a common artifact of reflecting telescopes.

Many people purchasing their first reflector telescope, probably wonder why the secondary mirror and the struts that hold it in place in the middle of the telescope tube don't disrupt the path of light collected by the telescope tube. Well in fact they do disrupt that light, but just by a tiny, tiny bit.

In a standard Newtonian reflecting telescope there's an open telescope tube into which the light falls. This light is then reflected off the primary mirror at the far end of the tube, as well as being concentrated by the parabolic shape of the primary mirror. This concentrated light is reflected back up towards the primary mirror's focal point, which is where the secondary mirror is traditionally positioned.

The secondary mirror's role is to reflect the concentrated and focused light beam off to its collection point - which on an expensive telescope might be a CCD, or even a spectroscope - but on a cheap telescope, might just be your eyeball.

But, in any case, the secondary mirror sits smack in the middle of the telescope tube and you need to support it with struts. So this whole structure, the secondary mirror and the struts, sits smack in the middle of the path of the light that enters your telescope.

But remember that the light entering a telescope originates from point sources – like stars. So the light that enters your telescope is much like the spherical ripples from a pebble dropped into a pond. If you put an obstruction in the way of such an expanding spherical ripple, it may be momentarily disrupted, but usually the expanding sphere reforms into a new sphere beyond that point of obstruction – thus rendering that obstruction almost invisible to a distant observer. Hence, the secondary mirror and the supporting struts, of which there are generally four, do become largely invisible in a reflecting telescope – except at extreme magnifications.

It is at those extreme magnifications that very bright light sources will take on diffraction spikes – generally four, because there are generally four supporting struts holding the secondary mirror. The effect is most commonly seen in bright foreground stars, which are stars in our galaxy, when a powerful reflecting telescope is working to observe other distant galaxies. The light from those foreground point-source stars suffer from a degree of spherical aberration at very high magnification – meaning they develop a circular haze about them. And that circular haze is channelled into four spikes by the distorting effect of the four struts that hold your secondary mirror in place. And so real stars do take on the appearance of the spiky pretend-stars that we put on national flags and on Xmas trees.

Ironically, people have become so used to this effect that some refracting telescope owners actually do use filters to introduce artificial diffraction spikes into their astrophotographs – so Cheap Astronomy's first answer was still correct to that extent.