

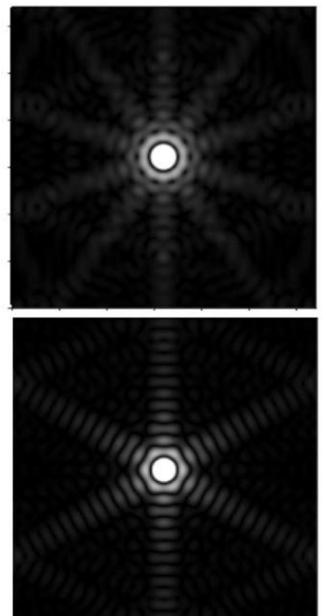
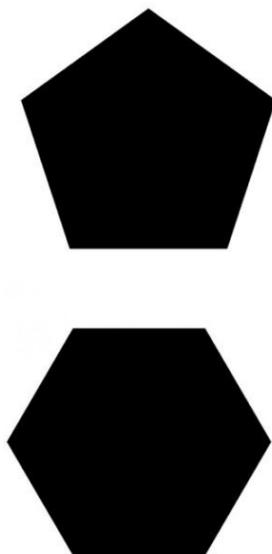
Why are stars depicted as having pointy shapes?



Christmas is the time of coming together with friends and family and also the time of giving (and receiving) gifts. Gifts that come wrapped in festive paper, often with a matching card to spread the holiday cheer. The perfect ingredients for a scientific discussion.

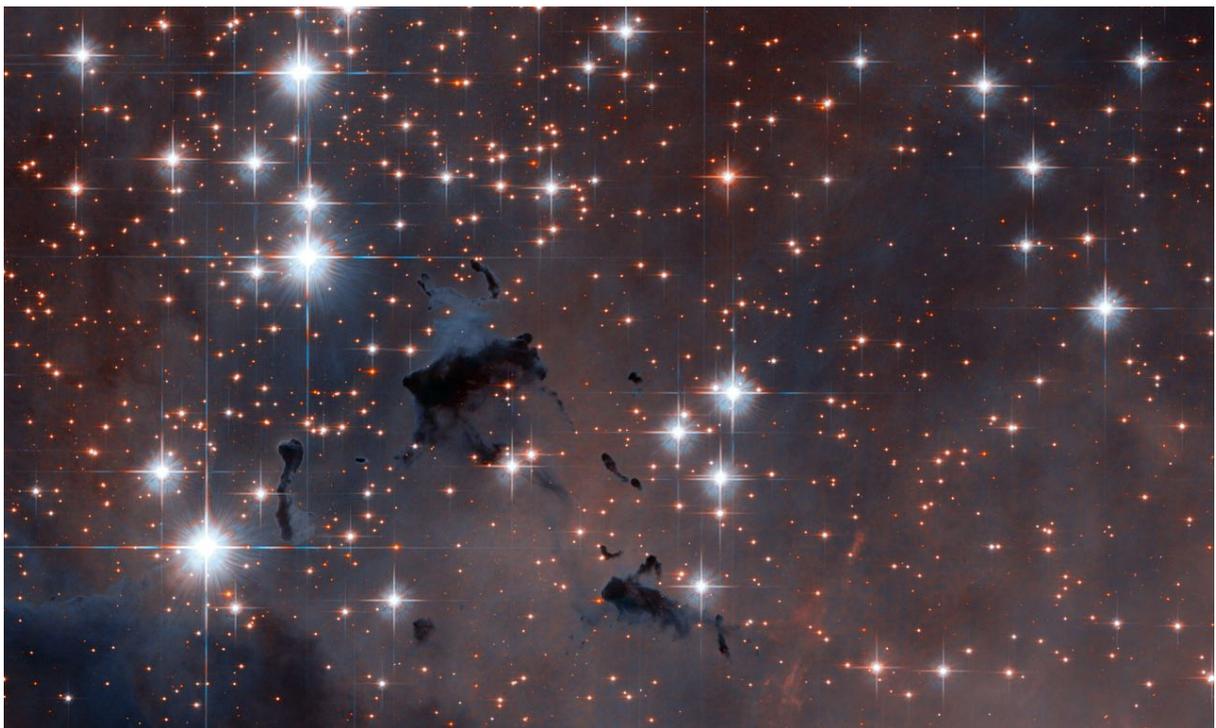
These gifts and cards often depict many beautiful stars which are usually drawn with 4 or more points. Even though most people know that stars are big balls of gas just like our Sun. So one might wonder where this depiction comes from and how scientifically correct it really is. We can answer this question quite accurately by looking at the imperfections in our eyes and the shape of our pupil.

This has to do with the fact that we do not look at all the light that the star gives, but instead only at what falls onto the pupil of our eye. One could compare it with a cookie cutter, where only the light that falls onto the pupil gets used while the rest is thrown away. This process theoretically creates a perfect pinpoint star on our retina, assuming that our pupils are perfectly round. Of course our pupil is not perfectly round and all the small imperfections in our eyes will cause the dot to become irregular and even become pointy.



This is what causes us to perceive the irregular shapes of stars. The interesting part is that everyone has different and unique irregularities in their eyes and will see a star in their own unique way. However, this pattern will be the same for all stars that you see in both shape and orientation. This means that it is impossible to see different shapes at the same time. Which immediately shows the problem with our example card, that depicts differently shaped stars at different orientations.

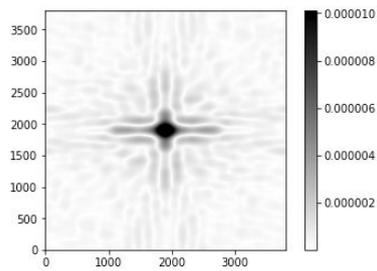
This process works exactly the same for mechanical eyes like cameras and telescopes, which gives us the opportunity to photograph these patterns for ourselves. A great example is the Hubble space Telescope, where the opening of the telescope is obscured with a small mirror and 4 arms to hold it up, giving a very characteristic four pointed star as a result. We can see this structure in all pictures made by the hubble space telescope, making them easy to recognise with some practice.



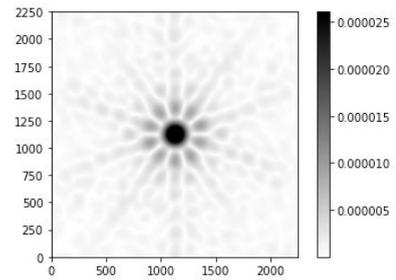
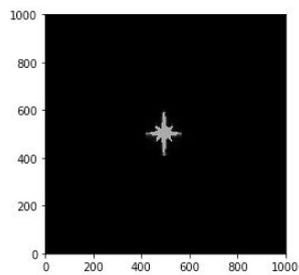
You could play with this effect yourself by making pictures of your christmas tree lights by holding a thin piece of cloth very close to your eyes. The small holes between the fibers will create an oddly shaped pupil, which results in beautiful pointy lights!



Finally, I wanted to know how an eye that sees stars like we draw them would look like. With some calculations we find the following, slightly scary, images.



Out[30]: <matplotlib.colorbar.Colorbar at 0x121b85d90>



Out[16]: <matplotlib.colorbar.Colorbar at 0x117ad0650>

