PUTTING THE SCI IN SCI-FI

By Nicholas Saunders

By definition, sci-fi does not have to be believable – it’s fiction! Still, directors and screenwriters have often attempted to explain their fiction with real science to keep audiences immersed long enough to tell a story. Sometimes they’re successful, sometimes it’s a laughing-so-hard-in-the-movie-theater-that-popcorn-comes-out-your-nose science disaster.

Fortunately, many of the science fiction films that have been released in the last few years have been increasingly scientifically accurate. Let’s take a look at the most popular sci-fi films from recent years and see how they stack up against reality.

Interstellar (2014)
Directed by Christopher Nolan

By combining astonishing science with equally astonishing visuals, Interstellar paved the way for a new era of sci-fi films. The math behind the black hole and wormhole was provided by physicist Kip Thorne and transferred to the big screen by special effects artists. But how accurate were the representations of physics in the movie?

The supermassive black hole in the film (pictured above) was, as the name implies, massive. The distance from its edge to its center is the same as the distance from the Earth to the Sun. The bright ring around the black hole is an accretion disk containing hot gas and dust that orbits in a plane, much like the plane of planets in our solar system or the rings of Saturn. Because the black hole is so massive, the light from the section of the ring behind the black hole is warped around by gravitational lensing creating two images: one above and one below. I’d hate to contradict Kip Thorne, so I’ll say the presentation of the supermassive black hole in this movie was sufficiently scientifically accurate.

The mass of the black hole doesn’t just affect the path of light, it also affects the passage of time. When Matthew McConaughey’s character, Cooper, takes the spaceship closer to the black hole to a region with higher gravitational field, time passes more slowly due to the curvature of spacetime in the presence of the massive black hole. Confused? Take it up with Einstein. By the time they return to the spaceship, over a decade had passed even if it only felt like hours in their reference frame. This effect is called time dilation, and is well documented and mathematically explained. Not only is it used to deliver a strong emotional impact, but it is also scientifically accurate.

Unsurprisingly, not everything in Interstellar lines up with real science. Here is a rapid-fire list of glaring issues:

— Cooper jumps into a black hole. In reality, entering the event horizon of a black hole would be, at the very least, very uncomfortable. Due to the gradient in strength of the gravitational field, an object entering the black hole would be stretched or spaghettified (yes, that’s a real scientific term).

— They collect “quantum data” from the black hole. When an object enters the event horizon of a black hole, all information about it is lost. The only instance of anything leaving a black hole is through “Hawking Radiation.”

— The Fifth Dimension. This convenient piece of (science) fiction allowed characters to travel through a dimension disconnected from our familiar three (plus time) to communicate with the past.

These three hypotheses were definitely not scientifically accurate.
Let’s start with getting to Mars. Although humans have never walked on the Red Planet, sending spaceships to Mars is well within our technological capabilities. Since 1960, we’ve sent over forty orbiters and landers to study the planet. Landing on the surface is incredibly difficult. The Martian atmosphere is thin and a parachute must be very large to create enough drag to slow down a spacecraft significantly, and also must be very strong to withstand high speeds. Although it would be difficult and dangerous, getting humans to Mars is scientifically possible.

The inciting incident at the beginning of The Martian is a massive windstorm. Mars is prone to strong winds and dust devils, which have actually been helpful in dusting off the solar panels of rovers that get buried in light sand. However, because of its thin atmosphere, Martian wind cannot gain comparable momentum to wind on Earth. In order for the same force as a 50 mph wind on Earth to be applied on Mars, the wind would need to be traveling ~500 mph! Although it makes a convenient plot device to get the action started, the dramatic wind storm that lifts Mark Watney into the air is not scientifically accurate.

What about growing potatoes in the Red Planet’s soil? Is this possible? Our understanding of the planet’s past is constantly changing and growing. NASA currently believes that at some point in the recent past (within the last 500 million years), Mars was able to support liquid water on its surface. There were likely lakes with chemical compositions not entirely different from Earth, and the soil samples taken by rovers indicate that when liquid water was flowing, the soil had a composition that could support life. The atmosphere on Mars today would not allow plants to grow, but inside a shelter with a similar atmospheric composition to Earth, it’s not entirely impossible. These findings make growing potatoes on Mars scientifically plausible.

Arrival is one answer to the question that all sci-fi fans have had at one point, “what would we do if aliens landed on Earth?” First contact is usually imagined as the reception of a cryptic signal from a distant region of space – and for good reason. It is much easier to send signals that travel at the speed of light through space than physical objects, so aliens showing up at our front door unannounced is scientifically implausible.

Barring that detail, let’s talk about how the scientists in the film handled deciphering the alien language. The aliens’ form of communication is entirely incompatible with that of humans, and must be picked apart meticulously piece by piece. One trope that appears constantly in all genres is the nebulous “hacking” on a computer screen, that is almost always unrelated to what the characters are trying to accomplish. Arrival breaks this trend by showing on the computer screens what a scientist would actually be doing. Using the programming language python, which is ubiquitous in scientific data analysis, the characters are working with real code. A subtle detail, but an important way to keep scientists from putting their heads in their hands halfway through the film.
The way they deciphered the language was *scientifically accurate*.

Now onto the main attraction – *aliens*. It’s common for extraterrestrials in science fiction to have strikingly human characteristics. If you don’t believe me, check out any Federation Spacedock or the Cantina on Tatooine. This human resemblance seems unlikely given the diversity of life even on our own planet, but sometimes convenience takes priority in filmmaking. *Arrival* takes their depiction in a new direction, presenting their version of E.T. as a seven-legged cephalopod resembling an ominous giant squid. Obviously, it’s impossible to say for sure if they got it right, but due to their ingenuity, the aliens in *Arrival* are *scientifically plausible*.

The trend towards adhering to scientific accuracy in sci-fi paints an optimistic future for the genre. Showing real science on screen is important not just because it keeps the nerds happy, but also because it can educate an audience about astronomy and physics while telling a story. As our understanding of astrophysics grows, along with our ability to create stunning special effects, we’re in for a spacey future of film.

**SOURCES CITED**

1. Jacob Aaron (2015), Classical and Quantum Gravity, newsscientist.com, retrieved May 2017