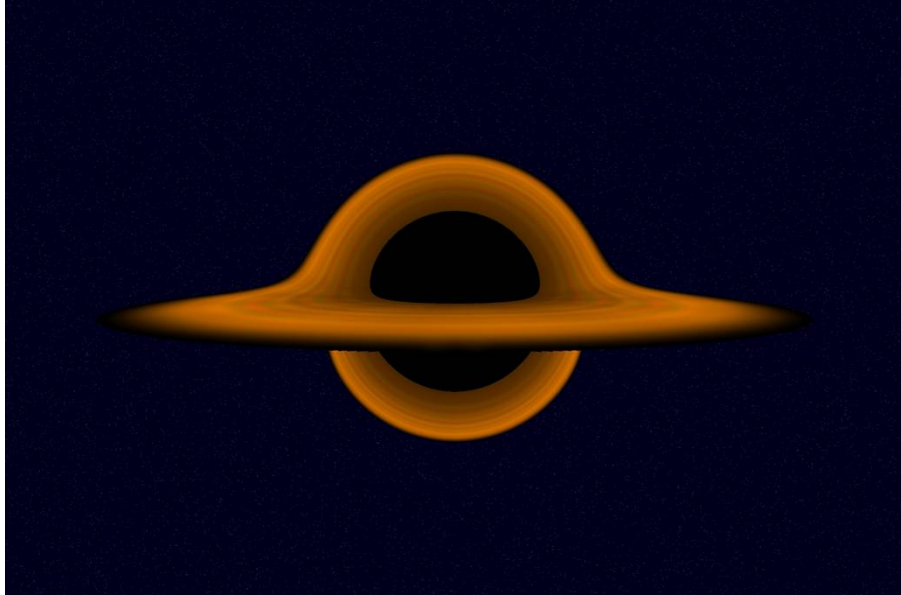


# When Science Fiction Becomes Reality

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Since I was a child, I have been interested in natural science. I sometimes watched experiments at science museums intently, wondering what would happen next. Also, I was a big fan of a drama in which a university physics professor solves cases using physics-based tricks.

I was very excited to see how the world, the universe, the past, present, and future (as a whole, time and space) are governed by the laws of physics, and as a result, various phenomena occur, including things that seem mysterious at first glance.

What led me to see physics as a subject worth devoting my life to studying was watching movies directed by Christopher Nolan. He is a film director who has made films in various genres, especially science fiction. I watched several of his films over a short period, but “INTERSTELLAR” left the strongest impression on me.

Through this movie, I was immediately struck by the solemn and mysterious images he

created. In "INTERSTELLAR", there is a giant black hole that the main characters visit, and I was completely overwhelmed by the breathtaking visuals of the massive black hole. Even now, that beautiful image of the black hole remains vivid in my mind. I was thrilled by the thought that something so beautiful and mysterious might exist somewhere in our universe, and at the same time, it almost felt too incredible to believe.

Although the story of "INTERSTELLAR" is complicated, it is also very logical. The story progresses at the same time in multiple locations where time moves at different speeds, such as on a star near a black hole and on Earth. For example, the movie shows that if you go near a black hole for just one hour and come back, many years will have passed at the place you left. I was so impressed by these scenarios.

I was fascinated by the movie and started reading articles and watching videos of people analyzing the physics behind the film. Through these examinations, I learned about general relativity, developed by Einstein, which states that mass distorts space and time. According to general relativity, the closer you get to a black hole, the more slowly time progresses. I was shocked to discover that time passing differently depending on where you are wasn't just a clever plot device for the movie, but a real scientific fact.

After learning this, I once again realized what I felt when I was young: Time and space as a whole are governed by the laws of physics, and various phenomena occur, including those that seem mysterious. From then on, I wanted to understand physics much more deeply.

That is why I enrolled in the department of physics at the university and studied a lot. I learned so many theories and experiments, and general relativity attracted me the most. As I learned more, I was thrilled to truly understand the exact things that had amazed me in the movie: how mass distorts time and space, and how this causes the flow of time to change depending on your location. I also liked general relativity because its ideas develop in a particularly logical way. Furthermore, different from other theories, such as quantum mechanics and nuclear physics, which deal with extremely small particles, general relativity deals with extremely large scales, such as black holes and

the universe itself. These aspects of general relativity also attracted me.

As I was studying general relativity, I learned about the physical phenomenon called "gravitational waves". In general relativity, distortions of time and space are generated when there is an object with mass. When massive objects such as black holes or neutron stars accelerate, the distortions propagate as waves. These are the gravitational waves. I was amazed to know that these gravitational waves were directly detected by humans for the first time just about ten years ago, in 2015.

Before I learned this, black holes felt like pure science fiction to me. Even though I understood them in theory, it was hard to believe they actually existed in our reality, just like the ones in "INTERSTELLAR". But the moment I learned that humans had detected gravitational waves caused by the movement of real black holes, that magnificent black hole from the movie flashed in my mind again. The realization that such extreme objects exist in our universe, and that we have the physical evidence to prove it, completely blew my mind.

At that time, I felt a strong admiration for the possibility of investigating the universe through gravitational waves, which are an actual physical phenomenon, and I even started thinking that I wanted to pursue this for the rest of my life.

By analyzing gravitational waves from distant astrophysical objects, we can test if our current theories are correct, discover how many black holes are out there, and even measure how fast the universe is expanding.

However, gravitational waves are incredibly weak. For example, imagine your hair standing up due to static electricity. That happens because the electromagnetic force from your hair, a tiny amount of static, is stronger than the gravity of the entire Earth trying to pull your hair down. Since gravity is such a weak force, gravitational waves, which are ripples in space and time, are extremely tiny. They are easily buried in the background noise of detectors, so we cannot find the signals just by looking at the data with our own eyes.

Therefore, we use various algorithms to separate the true signals from the noise. I am

currently researching ways to use machine learning to make this search much faster and to detect even weaker signals that we might otherwise miss.

I enjoy researching every day, driven by the same excitement I felt in front of the TV and at the movie theater when I was 12 years old. I want you to cherish the curiosity and excitement you feel right now and never forget the desire to pursue them. One day, that curiosity may turn the stories that fill you with wonder today into reality.

#### Declaration of Assistive Technologies:

I used Gemini to help check my grammar and improve the clarity of my /writing.

The black hole image is an original simulation I created myself, and I used GitHub Copilot to help me write the code for it.

#### References:

Nolan, C. (Director). (2014). *INTERSTELLAR* [Film]. Warner Bros. Pictures.

#### Acknowledgements:

I would like to thank Mark Vagins and Sungmok Lee for their valuable feedback and helpful suggestions. Their comments greatly improved this essay.