

Bridging Science and Survival: A Cinematic Exploration of Physics in *Interstellar*

Dr. M. John Suganya, Jeevitha. S^{*}, Kiruthick. V.A, Priyanga. B

Department of English, PSG College of Arts & Science, Coimbatore, India.

*jeevithaCY97@gmail.com

How to cite this article: M. John Suganya, Jeevitha. S, Kiruthick. V.A , Priyanga. B (2024) Bridging Science and Survival: A Cinematic Exploration of Physics in *Interstellar*. *Library Progress International*, 44(3), 5828-5831.

Abstract

Science stands as the beacon of human ingenuity, illuminating pathways through the vast uncertainties of existence and exploring the frontiers of the universe. It challenges our understanding, propels our ambitions, and provides the essential frameworks for survival. This article explores the interplay between science, specifically physics, and the human quest for survival as depicted in Christopher Nolan's *Interstellar*. The film portrays a dystopian future where Earth's habitability is rapidly deteriorating, forcing humanity to look beyond the planet for survival. Central to this narrative is the application of advanced physics concepts like wormholes, black holes, and time dilation, since they serve as the critical mechanisms driving the plot and enabling humankind's hope for survival. By delving into these scientific principles, this article highlights how *Interstellar* reflects the fundamental role of physics in extending the boundaries of human existence and adaptability. It also examines the film's deeper philosophical questions about humanity's resilience, the nature of space-time, and the ethical repercussions of survival, eventually underscoring the extensive significance of science in shaping the future of human life.

Keywords: Black holes, Human survival, Resilience, Space exploration, Space-time, Time dilation, Wormholes.

Introduction

Physics plays a powerful role in defining the world and influences everyday life in profound ways, often unnoticed. From waking up to the sound of an alarm clock to using modern technology, physics governs natural laws and technological systems. The fundamental forces of physics are embedded in daily activities such as walking, driving, and cooking. For instance, friction between the feet and the ground allows stable movement, while gravity maintains balance and direction. In transportation, internal combustion engines operate on thermodynamic principles, converting heat into mechanical energy, while cooking involves heat transfer through conduction, convection, or radiation. Technological advances and modern

conveniences are deeply rooted in the principles of physics. Ultimately, physics is integral to modern life, shaping technology, healthcare, and energy solutions. Its principles form the foundation of scientific understanding and technological innovation, providing essential solutions to both current and future challenges faced by humanity.

Interstellar is a science fiction film, directed by Christopher Nolan. The film artfully blends the significance of physics into its narrative, portraying the crucial role of scientific principles in shaping human destiny. Positioned in a future timeline, where Earth nears the ecological catastrophe, a crew of astronaut plunge into an operation to discover a habitable planet for humanity. By delving into the complex science theories, *Interstellar* highlights how physics is not just theoretical but deeply connected to human survival. The film underscores the importance of scientific innovation in overcoming existential threats, reflecting how physics and technological advancements are essential for extending the boundaries of human life beyond Earth.

This science fiction film examines humanity's quest for survival in the face of an ecological apocalypse. Set against a cactopia future shattered by environmental collapse and food scarcity, the film traces the journey of Joseph Cooper, an ex-NASA pilot and a farmer, who is assigned to discover an endurable planet for the humankind. Cooper, together with his son Tom, daughter Murph, and father-in-law Donald, discovers anomalous patterns during a dust storm, leading them to a covert NASA facility led by Dr. John Brand.

Cooper is chosen to pilot the spacecraft Endurance as it navigates a wormhole near Saturn, which transports them into a distant galaxy. There, the crew explores three potential planets, each presenting formidable challenges. On their first destination, an oceanic world subjected to intense time dilation, they encounter perilous conditions that result in the death of their crew member Doyle and a significant time lapse on Earth. The subsequent visit to an ice planet reveals that Mann, a surviving astronaut, has deceitfully presented the planet as habitable. Mann's treachery leads to further casualties and the severe damage of the Endurance.

In a desperate bid to conserve fuel, Cooper and TARS execute a gravity assist manoeuvre around the supermassive black hole Gargantua, sacrificing themselves to ensure the Endurance reaches the final candidate planet. Cooper's fall into Gargantua exposes him to a four-dimensional tesseract, where he experiences time as a physical dimension. Within this tesseract, Cooper manipulates events to send vital information to his past self, thus enabling Murph to decipher the gravity formulae and enable humanity's migration from Earth.

Rescued and brought through an orbital colony in the year 2156, Cooper reunites with the now-elderly Murph, who implores him to seek out Brand, who has settled on a new world. Cooper embarks on another journey with TARS to find Brand, while Brand herself acclimates to the new habitable planet. The film concludes by reflecting on humanity's resilience and the transformative power of scientific discovery in securing a sustainable future.

The film's consultant, theoretical physicist Kip Thorne, ensured that the portrayal of wormholes, black holes, and time dilation adhered to the cutting-edge physics of our time. One of the most iconic scientific elements of *Interstellar* is the use of a wormhole as a gateway to distant galaxies. In the movie, humanity's hope for survival lies in the ability to traverse vast cosmic distances, and the only feasible way to achieve this is through a wormhole, a hypothetical structure that acts as a tunnel through space-time, connecting two distant points. The wormhole which is conveniently located near Saturn, allows Cooper and his team to travel

to another galaxy in search of habitable planets. This concept is based on general relativity, propounded by Albert Einstein. It suggests the theoretical possibility of wormholes. The film presents the wormhole as a perfectly spherical object (as opposed to a two-dimensional circle, which is often seen in visualizations) to reflect how it bends space-time in every direction. When the Endurance spacecraft approaches the wormhole, Romilly (David Gyasi), one of the scientists, explains its mechanics by using a piece of paper and a pen to demonstrate how a wormhole folds space-time, allowing for faster-than-light travel.

The black hole Gargantua, located near one of the potentially habitable planets, is another major scientific concept in *Interstellar*. Black holes are the specific areas in space with a gravitational force so intense that nothing, including light, can escape. The gravitational field of Gargantua is so powerful that it dramatically alters the passage of time for those near it, a concept referred to as gravitational time dilation, as presumed by Einstein's principle of relativity. Time dilation refers to the principle that time passes more slowly in stronger gravitational fields. Near Gargantua, time for those close to the black hole moves at a much slower pace compared to those farther away from it. This effect plays a crucial role, when the crew members like Cooper, Brand, and Doyle land on the water-covered planet Miller, which orbits close to Gargantua. Due to the proximity of the planet to Gargantua, every hour they spend on the surface equals seven years back on Earth. After a brief but disastrous stay on the planet (where they barely escape a massive tidal wave), they return to the Endurance spacecraft, where Romilly has aged 23 years, while Cooper and Brand have only experienced a few hours. This concept is based on the Schwarzschild radius and the mathematics of general relativity, showing how black holes stretch and distort space-time. Time dilation introduces an emotional weight to the film, as Cooper realizes that while he is trying to save humanity, he's losing precious years with his daughter, Murph.

Another most speculative yet central elements of *Interstellar* is the idea of higher dimensions, particularly the fifth dimension. Toward the climax of the film, Cooper sacrifices himself by detaching from the Endurance and plunging into Gargantua's black hole. Instead of being crushed by the singularity, Cooper ends up inside a 'tesseract' which is a four-dimensional space created by beings who exist in five dimensions. A tesseract is the four-dimensional analogue of a cube, and it allows Cooper to perceive time as a physical dimension. Inside the tesseract, Cooper experiences the nonlinear nature of time. He sees infinite versions of Murph's room stacked around him, representing different moments in time. He is able to interact with the past by manipulating gravity and sending Morse code messages via the ticking of a watch, which eventually helps Murph solve the gravitational equation needed to save humanity.

When the Endurance spacecraft needs to dock with the spinning space station after Dr. Mann's failed mission, Cooper manually pilots the ship in a heart-pounding sequence. To stabilize the ship and match the spin of the station, Cooper uses Newton's Third Law, applying thrust in the opposite direction to achieve the necessary rotation. This scene highlights the precision and complexity of space travel physics, demonstrating how classical physics principles govern even the most advanced space missions.

The emotional and philosophical dimensions of *Interstellar* further amplify its exploration of survival. The film delves into the personal sacrifices and ethical dilemmas faced by the characters, particularly Cooper, who grapples with the tension between his familial

obligations and the greater good. The narrative explores themes like affection, selflessness and the unyielding nature of humanity, portraying them as fundamental to the struggle for endurance. Cooper's eventual fall into the black hole and his subsequent experience within a tesseract, where time is experienced as a physical dimension, serves as a poignant metaphor for the convergence of human aspiration and scientific inquiry.

Interstellar is a cinematic meditation on humanity's twin pursuit of survival as well as knowledge. It emphasizes the critical role of scientific progress, alongside human tenacity, in confronting existential dangers. The film's depiction of complex scientific ideas, paired with its examination of human emotions and moral dilemmas, provides a layered view of the connection between science and survival. By bridging the gap between theoretical physics and human experience, *Interstellar* provides a compelling commentary on the significance of scientific progress and its role in ensuring the continuity and evolution of human life.

References:

1. Hooft, Gerard, et al. INTRODUCTION TO THE THEORY OF BLACK HOLES. 2009, web.space.science.uu.nl/~hooft101/lectures/blackholes/BH_lecturenotes.pdf.
2. Nolan, Christopher. *Interstellar*. Paramount Pictures, 2014. Netflix, www.netflix.com.
3. Stein, Vicky. "Einstein's Theory of Special Relativity." Space.com, 1 Feb. 2022, www.space.com/36273-theory-special-relativity.html.
4. Stewart-Ahn, Aaron. "On Interstellar, Love, Time; and the Limitless Prison of Our Cosmos." *Medium*, 14 May 2018, medium.com/@somebadideas/on-interstellar-love-time-and-the-limitless-prison-of-our-cosmos-ef59ee28fd8e.
5. Suganya, M. John, et al. *A Systematic and Literary Review on the Learning Outcome and Competency-Based Test*. Jan. 2024, <https://doi.org/10.53555/kuey.v30i5.2599>.
6. Suganya, M. John et al. *Embracing Asexual and Aromanticism in Elsa and Merida: A Critical Analysis of Disney's Frozen and Brave*. Jan. 2024, <https://doi.org/10.53555/kuey.v30i5.2601>.
7. Suganya, M. John, et al. *Mood Fluctuations and Familial Ambience of Army Brats in My Super Papa by Bella Meraki and The Lords of Discipline by Pat Conroy*. 25 Nov. 2023, www.onomazein.com/index.php/onom/article/view/305.
8. Wormholes in Spacetime and Their Use for Interstellar Travel, www.pas.rochester.edu/~tim/introframe/AmJPhysBlackHoles.pdf. Accessed 4 Sept. 2024.