**Herança – History, Heritage and Culture Journal**
2026, 9(2), 46-58
ISSN: 2184-3090
https://revistaheranca.com

**Research Article**

# The Universe in Culture: The Physics of the Stars as Artistic Inspiration

Gastón Sanglier Contreras [1*], Roberto A. González Lezcano [2], Eduardo J. López Fernández [3], Carlos M. Iglesias Sanz [4]

[1] Ph.D in Physics, Department of Architecture and Design, Higher Polytechnic School, CEU San Pablo University, Madrid, Spain
[2] Ph.D in Engineering, Department of Architecture and Design, Higher Polytechnic School, CEU San Pablo University, Madrid, Spain
[3] Ph.D in Engineering, Department of Architecture and Design, Higher Polytechnic School, CEU San Pablo University, Madrid, Spain
[4] Ph.D in Architecture, Department of Architecture and Design, Higher Polytechnic School, CEU San Pablo University, Madrid, Spain
* **Corresponding Author:** sanglier.eps@ceu.es

**Citation:** Sanglier Contreras, G., González Lezcano, R. A., López Fernández, E. J., & Iglesias Sanz, C. M. (2026). The universe in culture: The physics of the stars as artistic inspiration. *Herança*, *9*(2), 46-58. https://doi.org/10.52152/heranca.v9i2/1233

**ARTICLE INFO**

Received: 25 Jan 2026
Accepted: 27 May 2026

**ABSTRACT**

From the earliest observations of the starry sky to contemporary cosmology, astronomical discoveries have transformed not only our scientific understanding of the Universe but also the ways in which societies have represented and experienced the cosmos through art, literature, and music. This article argues that major paradigm shifts in the physics of celestial bodies function as catalysts for cultural reconfigurations, generating new representational repertoires across artistic and aesthetic domains – a process conceptualized here as scientific-aesthetic translation. Drawing on Kuhnian philosophy of science, the Science and Technology Studies (STS) concept of co-production, and the UNESCO 2003 Convention on Intangible Cultural Heritage, we develop an analytical framework that moves beyond the descriptive cataloguing of art-science connections to examine the mechanisms through which cosmological knowledge is culturally appropriated and reimagined. The scope is deliberately cross-cultural: paradigm shifts – from the geocentric model to Newtonian mechanics, Einsteinian relativity, and the cosmology of accelerated expansion – are analyzed alongside artistic responses from both Western and non-Western traditions, including Islamic astronomical aesthetics, Mesoamerican cosmological architecture, Buddhist stupa symbolism, and the music-cosmology theory of Al-Kindi and the Ikhwan al-Safa. Contemporary examples – particularly artistic responses to imagery from the James Webb Space Telescope and the Event Horizon Telescope, and the emerging practice of astronomical data sonification – are examined as new frontiers of scientific-aesthetic translation that challenge established disciplinary boundaries. The article contributes to heritage studies by demonstrating that the cultural history of the cosmos constitutes a layered and globally distributed intangible heritage deserving systematic interdisciplinary attention.

**Keywords:** Universe; Astronomy; Art; Cultural Heritage; Sonification; Science-art Translation; Paradigm shift.

## INTRODUCTION

### The Sky as Shared Heritage

Looking at the sky has been one of the foundational experiences of humankind, both from the practical need to orient oneself and measure time and from the symbolic search for meaning. Long before a formal physics of celestial bodies existed, there was already a dense network of narratives, myths, and visual representations that culturally shaped what we now call the cosmos (Aveni, 2002). Across every known civilization – from the Mesopotamians to the Maya, from ancient China to Indigenous Australian cultures – the celestial vault has served as a screen onto which communities have projected their deepest beliefs, fears, and aspirations, as illustrated by early astronomical artifacts such as the Mesopotamian star chart reproduced in Figure 1b, as well as earlier evidence from Minoan Crete, including the Palaikastro moulds (Figure 1a) (c. 1850–1700 BCE), which some

researchers interpret as proto-astronomical devices associated with calendrical and eclipse prediction functions (Tsikritsis et al., 2013; Henriksson & Blomberg, 1996). The later emergence of scientific astronomy did not completely replace these visions; rather, it opened a complex and enduring dialogue between quantitative descriptions of the Universe and qualitative ways of imagining it (Verschuur, 2007; Bardi, 2008).


Figure 1. Early Astronomical Artifacts as Examples of Proto-astronomical Cultural Heritage Minoan Moulds from Palaikastro (c. 1850–1700 BCE), interpreted by some researchers as proto-astronomical devices associated with calendrical and eclipse prediction functions (a). Source: Wikimedia Commons, "Minoan Moulds of Palaikastro". Mesopotamian Star Chart (c. 700 BCE), a well-preserved example of proto-astronomy as a cultural artifact (b). Source: https://sobrehistoria.com/la-ciencia-en-mesopotamia/

The central argument of this study is that major paradigm shifts in physics and astronomy do not merely produce new scientific knowledge: they function as catalysts for cultural reconfigurations, systematically generating new representational repertoires in the visual arts, literature, music, and architecture (Fraknoi, 2015). We term this process scientific-aesthetic translation – the set of mechanisms through which cosmological models and their associated imagery are appropriated, reimagined, and redeployed across artistic and cultural domains, both in the societies in which those paradigm shifts originate and, through processes of cultural diffusion, in other traditions. This concept allows us to move beyond the descriptive observation that science and art have historically influenced one another, toward an analytical account of how and why specific cosmological shifts produce specific cultural responses.

The research gap this article addresses is significant. Although numerous studies have examined individual moments of art-science interaction – the relationship between Copernican heliocentrism and Renaissance painting, or between Einsteinian relativity and the artistic avant-gardes – a systematic comparative analysis of the mechanisms linking successive cosmological paradigm shifts to cultural production, one that (a) applies a consistent theoretical framework, (b) incorporates non-Western traditions as analytically central rather than marginal, and (c) extends from antiquity to the most recent developments in twenty-first-century cosmology, remains largely absent from the existing literature. This article aims to fill that gap, contributing to heritage studies, the history of science and culture, and current debates in science communication.

The study draws on contributions from the history of science, art history, musicology, and cultural studies, and applies a historical-analytical approach organized around key paradigm shifts in cosmological thought. Section 2 develops the theoretical framework and clarifies the methodology. Sections 3 through 5 analyze successive paradigm shifts from premodern cosmology to twentieth-century cosmology and their artistic repercussions. Section 6 examines the art-science convergences of the contemporary era, and Section 7 develops the implications for heritage studies. Special attention is paid to non-Western traditions throughout, and to recent astronomical developments – particularly the James Webb Space Telescope (JWST) and the Event Horizon Telescope (EHT) – as catalysts for new forms of artistic creation in the twenty-first century.

## LITERATURE REVIEW

### From Mythic Cosmos to Geometric Cosmos

Mapping the Sky: Premodern and Non-Western Cultures

In many ancient cultures, the firmament was conceived as a web of stories linking stellar movements with divine genealogies, agricultural cycles, and social organization. Greco-Roman constellations, Mesopotamian

zodiacs, and Chinese star charts functioned both as proto-scientific instruments and as visual and narrative artifacts. The celestial vault was represented in temples, manuscripts, and ritual objects, creating an iconography in which astronomical observation and religious symbolism are inseparable. Among the most striking examples is the Mesopotamian Planisphere (c. 700 BCE), which not only records the positions of stars and planets but constitutes a cultural document of the relationship between human society and the cosmos – a paradigmatic instance of scientific-aesthetic translation in which observational data and cosmological narrative are fused into a single artifact.

Beyond the classical Western tradition, the contribution of Islamic scholars during the medieval period was decisive in preserving, extending, and systematizing ancient astronomical knowledge. Islamic astronomers developed trigonometry as a tool for celestial computation, refined the astrolabe, and constructed elaborate observatories; their technical achievements were simultaneously embedded in a rich iconographic tradition of celestial globes and astronomical manuscripts of great aesthetic refinement (King, 2005). Equally significant is the Islamic tradition of cosmological architecture, in which the symbolic relationship between building and cosmos was elaborated with extraordinary sophistication. The great domes of mosques – from the Dome of the Rock in Jerusalem (691 CE) to the Ottoman imperial mosques of Istanbul – were designed to evoke the celestial vault, their interior surfaces decorated with geometric patterns that embodied Islamic mathematical cosmology. Most strikingly, the muqarnas – the honeycomb or stalactite vaulting characteristic of Islamic architecture – has been interpreted by architectural historians as a visual representation of the celestial spheres, translating the Ptolemaic model of nested astronomical shells into architectural form (Nasr, 1964). The Alhambra's Hall of the Two Sisters, with its intricate muqarnas dome, constitutes one of the most sophisticated examples of cosmological architecture in any tradition.

Buddhist cosmological tradition provides another major instance of cross-cultural scientific-aesthetic translation. The stupa, the defining architectural form of Buddhism, embodies a comprehensive cosmological symbolism: the hemispherical dome (anda) represents the sky or cosmic egg; the axial spire (harmika and yasti) represents the axis of the world (Mount Meru) around which the heavens revolve; and the tiered rings of the spire represent the successive celestial realms of Buddhist cosmology (Snodgrass, 1985). The great stupas of Sanchi, Borobudur, and Boudhanath thus function simultaneously as architectural monuments and as three-dimensional representations of the cosmos – demonstrating that the translation of cosmological worldviews into architectural space is a universal rather than exclusively Western phenomenon.

In parallel, Mayan astronomers developed extraordinarily precise calendrical systems based on observations of Venus, the Sun, and eclipses, integrating astronomical knowledge into monumental architecture, painted ceramics, and codices that must be understood as both scientific and artistic achievements (Aveni, 2002). Recent scholarship has drawn renewed attention to the astronomical traditions of Indigenous cultures, documenting how Aboriginal Australian peoples have maintained sophisticated knowledge of the night sky over tens of thousands of years, encoding this knowledge in oral narratives, ceremonial practices, and visual art (Hamacher, 2022). This research challenges the conventional narrative that places the origin of systematic astronomy in ancient Greece or Mesopotamia and enriches the concept of astronomical heritage by including forms of knowledge that have traditionally been marginalized by Western scholarship.

The regularity of lunar and solar cycles was translated across cultures into calendars and architectures aligned with solstices and equinoxes, where the building itself functions as an observational instrument at a territorial scale. Stonehenge in Britain, the Caracol at Chichén Itzá, and the Inca site of Machu Picchu are paradigmatic examples of how architectural form, astronomical observation, and cosmological belief were synthesized into a single cultural expression – illustrating that what we term scientific-aesthetic translation is not a modern or exclusively Western phenomenon but a constitutive dimension of human culture across civilizations.

From Geocentrism to Heliocentrism: An Aesthetic Revolution as Well

The formulation of the heliocentric model by Copernicus and its consolidation by Kepler and Galileo radically altered the "stage design" of the Universe. It is important to note, however, that the heliocentric hypothesis had already been proposed in antiquity by Aristarchus of Samos (c. 310–230 BCE), although his ideas did not achieve lasting influence within the dominant geocentric frameworks of classical (because of priestly views, the heliocentric model was an impiety) and medieval astronomy. Historiographical studies have also pointed out that Copernicus was aware of earlier heliocentric proposals, as suggested by references to Aristarchus in early drafts of De revolutionibus orbium coelestium, later omitted in the published version. Regardless of issues of priority, the Copernican model marked the decisive moment in which heliocentrism became a structurally transformative paradigm within scientific and cultural history.

This shift had profound effects on European visual and literary culture, as it compelled a rethinking of humanity's place in the cosmos (Filippenko, 2011). Copernicus's heliocentric diagram (shown in Figure 2) is itself

a remarkable cultural artifact: a geometric scheme that radically reoriented the entire symbolic and aesthetic space of European culture. The mechanism of translation at work here is particularly revealing: the heliocentric model did not immediately generate new artistic styles, but it fundamentally destabilized the cosmological assumptions underwriting medieval artistic iconography, making the human figure no longer the center of a divinely ordered universe and opening a space of existential uncertainty that artists and writers struggled to inhabit.

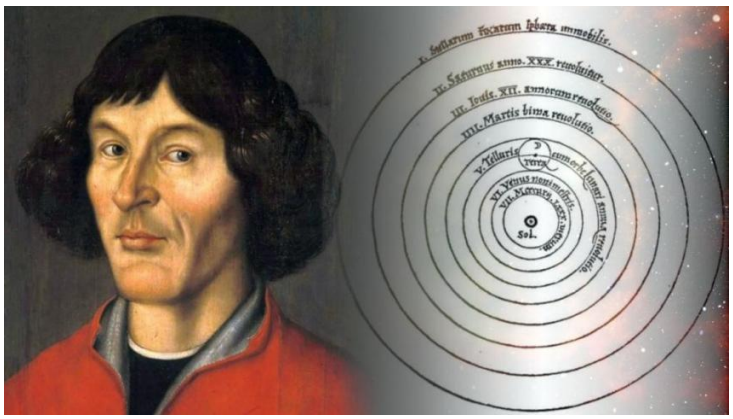


Figure 2. Copernicus's Heliocentric Diagram (1543), a Disruption that Transformed the Cultural Staging of the Cosmos. Source: https://urgente24.com/foco/nicolas-copernico-el-polimata-que-cambio-siempre-la-astronomia-n571465

A necessary antecedent to the Copernican revolution, however, is Aristarchus of Samos (c. 310–c. 230 BCE), whose heliocentric hypothesis is known primarily through later testimony, especially Archimedes' Sand-Reckoner. Aristarchus proposed that Earth rotates daily and revolves annually around a stationary Sun, making him the first known theorist of a heliocentric system (Heath, 1913).

Perhaps no figure better illustrates this confluence of science and aesthetics than Johannes Kepler, whose Harmonices Mundi (1619) proposed that the orbital motions of the planets embodied mathematical ratios analogous to musical harmonies – an idea that not only influenced contemporary music theory but has been repeatedly revisited by composers and artists in subsequent centuries. In Renaissance and Baroque painting, a gradual transition can be observed from a sky conceived as a symbolic backdrop to a more naturalistic representation, where light, atmosphere, and lunar phases are treated with almost scientific attention (Caballero et al., 2010). The English poet John Donne famously lamented the dissolution of the old cosmological order, perceiving in the new astronomy a loss of coherence that he translated into a poetics of fragmentation and doubt. This cosmological decentering prepared modern sensibility toward uncertainty, the infinite, and the plurality of worlds – demonstrating how a single paradigm shift can generate an entire new cultural vocabulary.

## The Scientific Revolution and New Images of the Infinite

### Newton, Celestial Mechanics, and Invisible Order

Newton's synthesis of universal gravitation offered an image of the cosmos as a system governed by a few simple mathematical laws, applicable both to the fall of an apple and to the motion of the planets. The Newtonian paradigm shift generated a specific and analyzable form of scientific-aesthetic translation: the idea of an invisible yet perfectly quantifiable order inspiring a new confidence in reason as the master instrument of human culture (Bennett et al., 2019). To understand the aesthetic responses to this paradigm, however, it is necessary first to trace the longer tradition of cosmic musical speculation from which Newtonian-era musical culture emerged.

The idea that the cosmos is fundamentally musical – that the regularities of planetary motion are expressible as harmonic ratios perceptible by reason if not by the ear – originates with Pythagoras (sixth century BCE), whose mathematical discovery that musical consonances correspond to simple integer ratios provided the conceptual bridge between astronomical regularity and aesthetic experience. This tradition was not exclusively Western. Al-Kindi (c. 801–873 CE), the first systematic Arab philosopher and a preeminent figure of the Islamic Golden Age, wrote the earliest surviving Arabic treatise on music theory (Risāla fī Khubr Taʾlīf al-Alḥān), in which he integrated Pythagorean cosmological musical theory with Aristotelian natural philosophy, explicitly connecting the intervals of the musical scale to the distances of the celestial spheres (Farmer, 1929). A century later, the encyclopedic Rasail of the Ikhwan al-Safa (Brethren of Purity, c. 983 CE) devoted an entire epistle to the

relationship between music, mathematics, and cosmology, arguing that musical harmony is a reflection of the mathematical order of the cosmos and that the study of music is therefore a form of cosmological knowledge (Nasr, 1964). These Islamic elaborations demonstrate that the translation of astronomical order into musical form was a cross-cultural, cross-civilizational phenomenon, developing in parallel and sometimes in dialogue across Greek, Islamic, and Latin Christian intellectual traditions – an early and powerful instance of the universality of scientific-aesthetic translation.

It is against this long-standing tradition that the musical aesthetics of the Newtonian era must be understood. Baroque composers developed increasingly complex contrapuntal forms in which the interweaving of independent melodic lines was understood as a kind of audible geometry, echoing the regularity and lawfulness of planetary orbits (Schwartzman Miles, 2025). Architecture of this period reflected the same Newtonian ideal: the great domed buildings of the eighteenth century – from the Panthéon in Paris to Saint Paul's Cathedral in London – evoke a cosmos ordered by geometry and governed by measurable proportions, where mathematical form becomes the architectural embodiment of cosmic law.

In the visual arts, the Enlightenment produced a body of scientific illustration – astronomical atlases, celestial maps, and engravings of telescopic observations – that occupies a genuinely ambiguous position between scientific documentation and aesthetic creation. The star atlases of Johann Bode and Johann Hevelius, for example, combined precise positional data with elaborate artistic renderings of the mythological figures associated with constellations, producing works that were simultaneously instruments of science and objects of aesthetic contemplation. This dual character of the astronomical image – at once data carrier and aesthetic artifact – would become a defining feature of the relationship between astronomy and visual culture in subsequent centuries. The botanical and geological illustrations of the same era shared this dual status, yet astronomical images carried an additional metaphysical charge: they depicted a cosmos that science was simultaneously rendering more legible and more vertiginously vast.

Romanticism: The Sky as Sublime Experience

Romanticism reacted to the "disenchanted" celestial mechanics of the Enlightenment by emphasizing the subjective experience of infinity, vertigo before nocturnal immensity, and human smallness before an overwhelming nature. Painters such as Caspar David Friedrich or J. M. W. Turner made the sky and light protagonists, generating landscapes in which the human figure is dwarfed by the sublimity of the firmament. Friedrich's Wanderer above the Sea of Fog (1818) (depicted in Figure 3) is emblematic: the anonymous figure contemplates a limitless horizon, evoking both the aspiration toward knowledge and the recognition of its limits, a visual embodiment of the Kantian sublime that resonated deeply with the new cosmology of vast and inhospitable distances. The mechanism of translation operating here is not direct illustration of astronomical data but an aesthetic response to the affective implications of scale: the observations of William and Caroline Herschel, who catalogued thousands of nebulae and proposed that the Milky Way itself was one island universe among many, provided Romantic artists and poets with a new scale of the infinite that traditional religious iconography could not accommodate.

Figure 3. Caspar David Friedrich, Wanderer above the Sea of Fog (1818), the Romantic Sky as a Sublime Experience. Source: https://www.artheroes.com/en/artwork/Wanderer-above-the-Sea-of-Fog-Caspar-David-Friedrich-wide-version/1203778

In literature, descriptions of the sky became charged with existential and metaphysical connotations, while in music dynamic and chromatic contrasts were explored to evoke cosmic storms or stellar silences. The Romantic

investment in the sublime night sky also gave rise to a tradition of popular astronomical writing that sought to communicate scientific knowledge through emotional and aesthetic means – a tradition continued in the twentieth century by Carl Sagan (1980) and Neil deGrasse Tyson (Tyson & Goldsmith, 2004), who combined rigorous scientific content with rhetorical strategies designed to provoke a sense of cosmic wonder, and who thus function as intermediaries in the chain of scientific-aesthetic translation between the scientific community and the broader public.

## From Spacetime to Cosmic Expansion: Art in the Age of Relativity and Cosmology

### Relativity, Spacetime, and the Artistic Avant-Gardes

The theory of special and general relativity introduced a conception of space and time as a unified, flexible, and dynamic entity, profoundly different from the rigid Newtonian framework. Although early twentieth-century artistic avant-gardes did not literally "illustrate" these theories, they shared an intellectual atmosphere of rupture with classical intuitions of space and simultaneity (Aczel & Bernstein, 2000). The relationship between the relativistic paradigm shift and the artistic revolutions of the early twentieth century exemplifies the co-production dynamic identified in the theoretical framework: contemporaneous scientific and artistic revolutions were parallel responses to a common crisis of representation, each reinforcing the cultural plausibility of the other's central claim – that reality cannot be rendered through classical conventions, whether of linear perspective, tonal harmony, or Newtonian mechanics.

Movements such as Cubism, Futurism, or certain strands of abstraction may be interpreted as visual explorations of multiple spaces, fragmented viewpoints, and overlapping temporalities (Marché, 2005). Picasso's analytical Cubism, which simultaneously presents multiple perspectives of the same object, offers a visual analogy to the relativistic idea that there is no privileged observer position. Marcel Duchamp's interest in fourth-dimensional geometry, documented in his preparatory notes for The Large Glass, shows how directly some avant-garde artists engaged with the non-Euclidean geometry associated with the new physics. In parallel, composers such as Arnold Schoenberg experimented with non-linear temporal structures and sonic textures that dissolved the traditional hierarchies of Western tonality, resonating – albeit indirectly – with new physical paradigms. These correspondences must be interpreted with care: they are not direct applications of scientific theory to artistic practice but rather parallel expressions of a shared intellectual climate in which foundational certainties about space, time, representation, and causality were being simultaneously questioned.

### Twentieth-Century Cosmology: Big Bang, Galaxies, and New Metaphors

The consolidation of the Big Bang model, the observation of distant galaxies, and evidence for the accelerating expansion of the Universe provided a repertoire of images – initial explosions, cosmic microwave background radiation, large-scale web-like structures – that were quickly incorporated into the cultural imagination (Perlmutter et al., 1999). The discovery by Hubble in the 1920s that the "spiral nebulae" were in fact independent galaxies, each containing billions of stars, fundamentally altered the perceived scale of the Universe and opened up a space of unimaginable vastness for artistic exploration. The Hubble Deep Field images (Figure 4), first released in 1995, simultaneously constitute some of the most scientifically important data in observational cosmology and some of the most aesthetically powerful images of the late twentieth century – a decisive instance of scientific-aesthetic translation in which the instrumental output of cosmological measurement became a globally circulated aesthetic object.

Figure 4. Hubble Deep Field (1995), Images that Have Nourished the Contemporary Artistic Imagination. Source: NASA/STScI, Hubble Deep Field. https://science.nasa.gov/image-detail/stsci-01evvfya7x23asyxfwh5ejgmt9/

In science fiction literature, these ideas became narrative settings for exploring interstellar travel, distant civilizations, and temporal paradoxes, expanding the horizon of collective imagination. In music, works such as Gustav Holst's The Planets (1916), although predating current cosmology, anticipated the tendency to associate cosmic phenomena with specific sonic atmospheres – a tradition continued in film soundtracks by composers such as Hans Zimmer for Interstellar (2014), whose music drew explicitly on the physics of black holes and gravitational time dilation. The later discovery of dark matter (Rubin & Ford, 1970) and dark energy introduced into cultural discourse a new category of the invisible: the notion that the visible cosmos is merely a thin veil over a much vaster invisible reality has resonated powerfully with literary, visual, and musical artists (Impey, 2011). Dark matter has become a pervasive metaphor for what lies beyond the perceptible – a contemporary rearticulation of ancient themes of the hidden and the ineffable.

Contemporary artists such as Josiah McElheny, whose installation works explore the history of cosmological models and their aesthetic implications, have drawn explicitly on the physics of dark matter and dark energy to problematize the relationship between visibility and reality. His project An End to Modernity (2005) reconstructed the imaginary space of the Big Bang using hanging glass orbs that evoked both the expanding Universe and the modernist dream of transparent, luminous knowledge – demonstrating how artistic practice can engage with the epistemological dimensions of cosmological discovery, not merely its imagery.

## METHODOLOGY

### Paradigm Shifts, Co-Production, and Scientific-Aesthetic Translation

The analytical framework of this article draws on three complementary theoretical traditions. First, Thomas Kuhn's concept of scientific paradigm shifts provides the structuring logic: Kuhn argued that scientific revolutions are not merely accumulations of new data but fundamental reorganizations of the conceptual framework through which a community understands a domain of nature (Kuhn, 1962). We extend this concept to the cultural domain, arguing that cosmological paradigm shifts generate analogous reorganizations in the representational resources available to artists, writers, and musicians – not because artists literally apply scientific theories, but because paradigm shifts alter the available conceptual vocabulary, the set of productive metaphors, and the affective relationship between human observers and the cosmos.

Second, the Science and Technology Studies (STS) concept of co-production (Jasanoff, 2004) provides an account of the bidirectionality of this process: scientific knowledge and social or cultural orders are produced simultaneously and mutually shape one another. Rather than treating artistic responses as merely derivative of scientific discoveries, the co-production framework recognizes that cultural and aesthetic practices actively participate in the construction of what "the cosmos" means in any given historical context. Artistic representations of the Universe are not passive reflections of scientific knowledge; they are active interventions in the cultural negotiation of that knowledge, influencing which aspects of cosmological discovery gain cultural salience, which metaphors become dominant, and even which directions future scientific imagination takes.

Third, the UNESCO 2003 Convention for the Safeguarding of the Intangible Cultural Heritage provides the normative and institutional framework for the heritage-studies dimension of the argument. The Convention defines intangible cultural heritage as including "practices, representations, expressions, knowledge, skills – as well as the instruments, objects, artefacts and cultural spaces associated therewith" that communities, groups, and individuals recognize as part of their cultural heritage. The cultural history of the cosmos – its narratives, iconographies, sonic imaginations, and architectural expressions – meets this definition comprehensively, and the article argues for its systematic recognition under this framework (Deacon, 2003).

These three frameworks converge in the concept of scientific-aesthetic translation, which we define as the set of processes through which cosmological models, images, data, and discoveries are transposed from the scientific register into representational, narrative, sonic, and spatial registers across cultures and historical periods. This concept has several analytical advantages: it implies that translation always involves a transformation (not a simple transfer) of meaning; it acknowledges the agency of the "translators" – artists, writers, architects, musicians – who are not merely receptive but creatively interpretive; and it allows for cross-cultural comparison by treating both Western and non-Western aesthetic responses to astronomical phenomena as instances of the same class of process.

### Methodology and Selection Criteria

The article follows a historical-analytical methodology organized around five major cosmological paradigm shifts: (1) the transition from mythic to geometric cosmology in ancient and premodern cultures; (2) the Copernican revolution and its aftermath; (3) the Newtonian synthesis and Enlightenment cosmological aesthetics;

(4) the relativistic and Big Bang cosmological revolution of the twentieth century; and (5) the contemporary expansion of observational and computational astronomy enabled by space telescopes and radio interferometry.

For each paradigm shift, examples of scientific-aesthetic translation are analyzed across three registers: the visual (painting, sculpture, astronomical illustration, digital art), the sonic (music theory, composition, data sonification), and the spatial (architecture, urban planning, landscape design). Examples have been selected on the basis of two criteria: (a) the directness and demonstrability of the connection between the cosmological development and the artistic response, and (b) the cultural diversity of the instances, with deliberate effort to include non-Western traditions alongside the better-documented European cases. The scope is explicitly global and comparative rather than Western-centric, in recognition of the fact that astronomical observation and its cultural consequences are universal human phenomena. At the same time, the article does not claim exhaustiveness: within any single paradigm shift, the instances analyzed are illustrative rather than comprehensive, intended to support the analytical argument rather than to constitute an encyclopedic catalogue.

## RESULTS

### The Universe in Contemporary Visual Culture

Scientific Images and Digital Art

Space telescopes and planetary missions have generated an unprecedented archive of images of nebulae, galaxies, and planetary surfaces, widely circulated through digital media. This material, produced from physical data and processed through algorithms, occupies a blurred frontier between scientific document and aesthetic object – and it is precisely this ambiguity that makes it a particularly generative site of scientific-aesthetic translation. The James Webb Space Telescope (JWST), launched in December 2021 and fully operational from 2022, has opened a new chapter in this relationship. Its first publicly released full-color images, disseminated globally in July 2022, provoked an immediate and intense artistic response: NASA documented hundreds of artistic submissions inspired by the JWST through its public art program, spanning media from painting and sculpture to poetry, song, and immersive digital installation (NASA, 2024). The immersive experience Beyond the Light, created in collaboration between ARTECHOUSE Studio and NASA's Goddard Space Flight Center, translated JWST scientific data into a cinematic installation experienced by hundreds of thousands of visitors in New York and Washington, D.C. (Artechouse, 2023).

Many contemporary artists work directly with astronomical data, translating them into light installations, abstract cartographies, and animations that thematize the scale and complexity of the cosmos (Dick & Lupisella, 2009). Astrophysicist and painter Nia Imara, in her book Painting the Cosmos (2025), demonstrates how the relationship between art and astronomy can be explored simultaneously from a scientific and a creative perspective, tracing correspondences between cosmic processes and artistic traditions across diverse cultural contexts (Imara, 2025). The resulting works do not merely "represent" the Universe but problematize our perceptual relationship with magnitudes and processes that exceed everyday experience – enacting the epistemological reflexivity that, we have argued, is characteristic of the most productive forms of scientific-aesthetic translation.

Sonification: Translating the Cosmos into Sound

Beyond visual representation, a growing practice known as astronomical data sonification has emerged as a significant new form of scientific-aesthetic translation. Sonification converts numerical data from astronomical observations into sound, allowing the structure of a galaxy, the pulsation of a neutron star, or the cosmic microwave background spectrum to be perceived auditorily (Shapere, 1964). Institutions such as NASA and the European Space Agency have developed systematic sonification programs that have both scientific and communicative dimensions: they make astronomical data accessible to visually impaired audiences while simultaneously creating genuinely new aesthetic experiences that translate cosmological structure directly into sensory form.

The sonification of black hole data is a particularly striking example. Following the imaging of the supermassive black hole in M87 by the Event Horizon Telescope (Wardle & Event Horizon Telescope Collaboration, 2019) – the first direct visual evidence of a black hole's event horizon – NASA produced a sonification of the acoustic waves detected propagating through the hot gas of the Perseus galaxy cluster, transposed into the audible frequency range. The cultural impact of this sonification was remarkable: widely shared on social media, it introduced millions of people to concepts of general relativity and plasma physics through direct sensory and aesthetic experience, illustrating the capacity of sonification to function as a channel of public science communication. More recently, the EHT collaboration has developed techniques to produce

sharper multi-frequency images of M87*, opening new prospects for observation (Medeiros et al., 2023). In the domain of contemporary music, composers working directly with radio telescope data as raw material for musical composition reflect a broader shift toward data-driven and generative art forms in which the boundary between scientific measurement and artistic creation is deliberately blurred (Salimpour, Tytler & Fitzgerald, 2025).

Popular Culture: From Cinema to Electronic Music

Science fiction cinema has played a central role in disseminating images and narratives about space, from early silent films to contemporary blockbusters. Representations of space travel, black holes, or contact with other civilizations combine scientific inspiration with creative license, feeding an imaginary that in turn influences scientific vocations and public debates. The film Interstellar (2014) exemplifies particularly close collaboration between filmmakers and scientists: director Christopher Nolan worked with physicist Kip Thorne – a 2017 Nobel laureate for the detection of gravitational waves – to produce the most scientifically accurate cinematic depiction of a black hole to date, using general relativistic raytracing code developed specifically for the film. This example is instructive for the co-production model: the scientific and aesthetic practitioners collaborate in real time, producing simultaneously a scientifically novel visualization and a culturally powerful artistic object.

In popular music, explicit references to the cosmos abound in titles, lyrics, and soundscapes seeking to evoke distance, emptiness, or expansion. From David Bowie's Space Oddity to the ambient cosmic textures of contemporary electronic musicians, space has become one of the most persistent metaphors in popular musical culture. Electronic music has developed a rich tradition of "cosmic" aesthetics, from the German krautrock of the 1970s – Tangerine Dream, Klaus Schulze – to contemporary artists working with synthesizers and spatial audio to evoke the scales and textures of astrophysical phenomena. A distinctive modern case is the cosmic soundworld of Evangelos Odysseas Papathanassiou (Vangelis): electronic timbres in Albedo 0.39 and Heaven and Hell became inseparable from Carl Sagan's Cosmos, while Mythodea was linked to NASA's 2001 Mars Odyssey mission. His music gave the Universe a recognizable sonic signature, translating astronomical scale into ritual, electronic, and symphonic affect (YourClassical, 2016). These creative practices demonstrate how the physics of celestial bodies functions not only as a source of scientific knowledge but as a reservoir of emotional and existential symbols accessible to broad popular audiences, completing the circuit of co-production by which cultural imaginations of the cosmos feed back into the scientific culture that generated them.

## DISCUSSION

### Toward a Heritage-Based Reading of the Universe

The Cosmos as Intangible Cultural Heritage

The UNESCO 2003 Convention for the Safeguarding of the Intangible Cultural Heritage provides the institutional framework within which the argument of this article finds its heritage-studies application. The Convention defines intangible cultural heritage as including "practices, representations, expressions, knowledge, skills – as well as the instruments, objects, artefacts and cultural spaces associated therewith" that communities, groups, and individuals recognize as part of their cultural heritage. The cultural history of the cosmos – its narratives, iconographies, sonic imaginations, and architectural expressions across world civilizations – meets this definition comprehensively (Holbrook et al., 2008). It is not only a matter of material objects (astronomical instruments, observatories, star maps) but of an intangible heritage composed of narratives, iconographies, and music inspired by the sky (Dick, 2015). UNESCO's programme on the heritage of astronomy, which includes both built observatories and the non-material traditions of cultural astronomy, reflects growing institutional recognition of this dimension.

The heritage perspective crucially highlights the stakes of cultural diversity in astronomical heritage. The Islamic, Mayan, Buddhist, Indigenous Australian, and Chinese astronomical traditions documented in this article represent irreplaceable archives of human observation and imagination; their marginalization in the dominant Western narrative of the history of astronomy constitutes a heritage loss as significant as the physical loss of ancient observatories. The heritage perspective enables a productive articulation between the history of science and disciplines such as art history, comparative literature, and museology, supporting conservation, exhibition, and mediation projects that render this intersection of knowledge visible (Bonnet & Woltjer, 2008).

Recent work in science education has further demonstrated the importance of cultural dimensions in teaching astronomy. Salimpour, Tytler, and Fitzgerald (2025) have proposed a framework for integrating art-science dynamics into astronomy education, arguing that approaching the night sky through students' own cultural traditions not only enhances engagement but provides deeper and more durable scientific understanding. This pedagogical research converges with the heritage perspective to suggest that the relationship between

astronomy and culture has immediate practical implications for how science is taught and communicated in diverse contemporary societies (Silva, 2015).

From an institutional perspective, museums of science and natural history have increasingly recognized the cultural dimension of astronomical heritage, developing exhibition formats that place scientific instruments and data alongside artistic interpretations of the cosmos. The Adler Planetarium in Chicago, the Cité des Sciences et de l'Industrie in Paris, and the Natural History Museum in London have all developed permanent collections and temporary exhibitions that explore the relationship between astronomical discovery and cultural imagination. These institutions function as mediators between scientific communities and broader publics, translating technical knowledge into emotionally and aesthetically resonant experiences – embodying in their institutional practice the convergence of science communication, cultural heritage, and artistic interpretation that this article has traced across centuries.

The relationship between cosmic physics and artistic form can be framed through symmetry and symmetry breaking, which Mainzer (2022) discusses as shared principles across science and the arts.

Implications for Architecture and Design

In architecture, the relationship with the sky is manifested in orientations, openings, and devices for controlling light and climate, but also in the symbolic dimension of domes, observatories, and contemplative spaces. The history of astronomical observatories, ancient and modern, shows how architectural form responds to technical requirements of observation while simultaneously constructing an institutional image of scientific knowledge. Yerkes Observatory (visible in Figure 5), built in 1897, exemplifies how architectural form responds to scientific requirements while constructing an institutional monument to knowledge. The great nineteenth-century observatories were designed not only as functional instruments but as cultural landmarks, their domes and towers asserting the prestige of astronomical science in the urban landscape.

Figure 5. Yerkes Observatory (USA, 1897), Architecture in the Service of the Physics of Celestial Bodies. Source: https://www.pierceengineers.com/adaptive-reuse-and-historic/yerkes-observatory

Contemporary observatory architecture continues this tradition with greater self-consciousness about the relationship between scientific function and cultural symbolism. The European Southern Observatory's facilities in the Atacama Desert, or the Extremely Large Telescope currently under construction in Chile, are conceived as much as landmarks – markers of human aspiration to understand the cosmos – as scientific instruments. In contemporary design, "cosmic" aesthetics appear in graphics, lighting, interfaces, and immersive experiences that translate astronomical data into visual and spatial languages communicable to the general public. The dark sky movement (which advocates for the protection of naturally dark night skies from light pollution) represents a convergence of astronomical, ecological, and cultural concerns, arguing that the ability to see the Milky Way constitutes a fundamental heritage right that modern urbanization has progressively eroded.

Dark Matter, Dark Energy, and the Limits of Representation

The discovery and theoretical elaboration of dark matter and dark energy has introduced into contemporary culture a new category of the invisible that is both scientifically rigorous and culturally productive. Dark matter, first inferred from the anomalous rotation curves of galaxies by Vera Rubin and collaborators (Rubin & Ford, 1970), accounts for approximately 27% of the total energy content of the Universe but has never been directly observed; its existence is inferred entirely from its gravitational effects on visible matter. Dark energy, responsible

for the observed acceleration of cosmic expansion (Perlmutter et al., 1999), accounts for roughly 68% of the Universe's total energy density. These invisible components – together constituting more than 95% of the cosmos – present a particularly revealing case for the concept of scientific-aesthetic translation: what is translated is not an image but an absence, the aesthetic and cultural challenge of representing that which science has demonstrated to exist but cannot observe. The notion of a universe in which the visible is a tiny and perhaps atypical fraction of total reality speaks to deep cultural anxieties about the nature of knowledge, the limits of perception, and the possibility of hidden dimensions of existence – a contemporary rearticulation of ancient themes of the hidden and the ineffable (Impey, 2011).

## CONCLUSION

Throughout history, advances in the physical understanding of celestial bodies have not remained confined to the scientific community but have significantly transformed artistic ways of imagining the cosmos. This article has argued that this relationship is best understood through the concept of scientific-aesthetic translation – the mechanisms by which cosmological paradigm shifts generate new representational repertoires across the visual arts, literature, music, and architecture. This framework, grounded in Kuhnian philosophy of science, STS co-production theory, and the UNESCO Intangible Cultural Heritage framework, provides a more analytically rigorous account of the art-science relationship than previous descriptive surveys have offered.

Three key analytical findings emerge. First, scientific-aesthetic translation is universal rather than distinctively Western: the analysis of Islamic muqarnas cosmological architecture, Buddhist stupa symbolism, Mayan astronomical iconography, and the music-cosmology tradition of Al-Kindi and the Ikhwan al-Safa demonstrates that the mechanisms linking cosmological knowledge to cultural and aesthetic production operate across civilizations. Future scholarship must therefore be explicitly comparative and cross-cultural in its approach to this relationship. Second, the mechanisms of translation vary systematically across registers: visual arts tend toward direct iconographic response to new astronomical images; music toward a more mediated response to the mathematical structure of cosmological models; architecture toward the embodiment of cosmological order in spatial form; and literary and popular culture toward metaphorical and narrative appropriation. Identifying these different mechanisms is essential for a deeper account of how science shapes culture. Third, the contemporary era represents a qualitative intensification of scientific-aesthetic translation: the global circulation of JWST and EHT images, the practice of astronomical data sonification, and the emergence of artist-scientist collaborations represent unprecedented forms of integration between scientific production and aesthetic creation, challenging disciplinary boundaries in ways that have profound implications for education, heritage practice, and public science communication.

For heritage studies, the cultural history of the cosmos opens a fertile field where physics, art history, literature, and music converge in the task of preserving and reinterpreting what we might call our collective "celestial heritage." This heritage is not only material – in the form of observatories, instruments, and celestial maps – but deeply intangible, embedded in the narratives, images, and sounds through which humanity has made sense of its place in the Universe across millennia. Recognizing, studying, and transmitting this heritage is itself a form of cultural practice, one that affirms the unity of scientific curiosity and aesthetic imagination as constitutive dimensions of what it means to be human in a cosmos that exceeds our grasp but not our capacity for wonder.

Future research should explore more systematically the specific intermediary channels – popular scientific writing, museum exhibitions, digital media, and educational curricula – through which astronomical discoveries reach aesthetic and cultural practitioners. Comparative studies focusing on specific non-Western astronomical traditions (Islamic, East Asian, Mesoamerican, South Asian) as primary rather than supplementary subjects of analysis would substantially contribute to a genuinely global cultural history of the cosmos.

## REFERENCES


Aczel, A. D., & Bernstein, J. (2000). God's Equation: Einstein, relativity, and the expanding universe. *American Journal of Physics*, *68*(7), 676-682. https://doi.org/10.1119/1.19514

Artechouse. (2023). *Beyond the light: A cinematic experience inspired by NASA's James Webb Space Telescope*. ARTECHOUSE Studios. https://www.artechouse.com/beyond-the-light-webbys/

Aveni, A. F. (2002). *Conversing with the planets: How science and myth invented the cosmos* (Rev. ed.). University Press of Colorado.

Bardi, A. (2008). *La Astronomía. Una ciencia para soñar* [Astronomy. A science for dreaming]. Endias.

Bennett, J. O., Donahue, M., Schneider, N., & Voit, M. (2019). *The cosmic perspective* (9th ed.). Pearson.

Bonnet, R.-M., & Woltjer, L. (2008). *Surviving 1,000 centuries: Can we do it*? Springer.

Caballero, J.A., Sánchez, S.G., Caballero, I. (2010). The Music and the astronomy. In: Diego, J., Goicoechea, L.,

Deacon, H. (2003). *Convention for the safeguarding of the intangible cultural heritage*. Paris, France: Unesco.

Dick, S. J. (Ed.). (2015). *Historical studies in the societal impact of spaceflight* (Vol. 4803). National Aeronautics and Space Administration, Office of Communications, NASA History Program Office.

Dick, S. J., & Lupisella, M. (Eds.). (2009). *Cosmos & culture: Cultural evolution in a cosmic context*. National Aeronautics and Space Administration, Office of External Relations, History Division.

Farmer, H. G. (1929). *A history of Arabian music to the XIIIth century*. Luzac & Co.

Filippenko, A. V. (2011). The cosmos and culture: How astronomy has shaped civilization. In D. Valls-Gabaud & A. Boksenberg (Eds.), *The role of astronomy in society and culture* (Proceedings of the International Astronomical Union, Vol. 5, Symposium S260, pp. 15–26). Cambridge University Press.

Fraknoi, A. (2015). Interdisciplinary approaches to astronomy: Cosmic fiction, drama and poetry.

Hamacher, D. (2022). The first astronomers: How indigenous elders read the stars. *The First Astronomers: How Indigenous Elders read the stars*.

Heath, T. L. (1913). Aristarchus of Samos: *The ancient Copernicus. A history of Greek astronomy to Aristarchus, together with Aristarchus's treatise on the sizes and distances of the Sun and Moon*. Oxford: Clarendon Press.

Henriksson, G., & Blomberg, M. (1996). *Evidence for Minoan astronomical observations from the peak sanctuaries on Petsophas and Traostalos*. Opuscula Atheniensia, 21, 99-114.

Holbrook, J., Medupe, R. T., & Urama, J. O. (Eds.). (2008). *African cultural astronomy: Current archaeoastronomy and ethnoastronomy research in Africa*. Springer Science & Business Media.

Imara, N. (2025). *Painting the cosmos: How art and science intersect to reveal the secrets of the universe*. BenBella Books.

Impey, C. (2011). *The living cosmos: our search for life in the universe*. Cambridge University Press.

Jasanoff, S. (Ed.). (2004). *States of knowledge* (pp. 1-317). Abingdon, UK: Taylor & Francis.

King, D. A. (2005). In synchrony with the heavens: Studies in astronomical timekeeping and instrumentation in medieval Islamic civilization (Vol. 2). Brill.

Kuhn, T. S. (1962). *The structure of scientific revolutions*. University of Chicago Press.

Mainzer, K. (2022). Symmetry and symmetry breaking in science and arts. *Proceedings of the European Academy of Sciences and Arts*, *1*(1). https://doi.org/10.4081/peasa.5

Marché, J. D. (2005). *Theaters of time and space: American planetaria, 1930-1970*. American Association of Physics Teachers.

Medeiros, L., Psaltis, D., Lauer, T. R., & Özel, F. (2023). The image of the M87 black hole reconstructed with PRIMO. *The Astrophysical Journal Letters*, *947*(1), L7. https://doi.org/10.3847/2041-8213/acc32d

NASA. (2024). *James Webb Space Telescope art program*. NASA Science. https://science.nasa.gov/mission/webb/jwstart/

Nasr, S. H. (1964). *An introduction to Islamic cosmological doctrines*. Harvard University Press.

Perlmutter, S., Aldering, G., Goldhaber, G., Knop, R. A., Nugent, P., Castro, P. G., ··· Supernova Cosmology Project.

(1999). Measurements of Ω and Λ from 42 high-redshift supernovae. *The Astrophysical Journal*, *517*(2), 565-586. https://doi.org/10.1086/307221

Rubin, V. C., & Ford, W. K. (1970). Rotation of the Andromeda Nebula from a spectroscopic survey of emission regions. *The Astrophysical Journal*, *159*, 379-403. https://doi.org/10.1086/150317

Sagan, C. (1980). *Cosmos*. Random House.

Salimpour, S., Tytler, R., & Fitzgerald, M. T. (2025). The meeting of old friends: Exploring the art-science dynamic in the context of astronomy and astronomy education. *Science & Education*, *34*(4), 2707-2737. https://doi.org/10.1007/s11191-024-00604-1

Schwartzman Miles, A. (2025). *Exploring astronomy through music and art*. Miscellany News. https://miscellanynews.org/2025/02/12/features/exploring-astronomy-through-music-and-art/

Shapere, D. (1964). The structure of scientific revolutions. *The Philosophical Review*, *73*(3), 383-394. https://doi.org/10.2307/2183664

Silva, L. M. (2015). *Astronomía y cultura: Astronomía en la literatura desde los clásicos hasta el siglo XVII. UNED-La 2* [Video]. YouTube.

Snodgrass, A. (1985). *The symbolism of the stupa*. Cornell University Press.

Tsikritsis, M., Theodossiou, E., Manimanis, V. N., Mantarakis, P., & Tsikritsis, D. (2013). A Minoan eclipse calculator. *Mediterranean Archaeology and Archaeometry*, *13*(1), 265-275.

Tyson, N. D., & Goldsmith, D. (2004). *Origins: Fourteen billion years of cosmic evolution*. WW Norton & Company.

Verschuur, G. L. (2007). *The invisible universe: The story of radio astronomy*. Springer.

Wardle, J. F., & Event Horizon Telescope Collaboration. (2019). First M87 event horizon telescope results. I.: The shadow of the supermassive black hole. *Astrophysical Journal Letters*, *875*(1), 1-17. https://doi.org/10.3847/2041-8213/ab0ec7

YourClassical MPR. (2016, April 20). *Music and creativity in ancient Greece*. Minnesota Public Radio. Retrieved from https://www.yourclassical.org/story/2016/04/20/music-and-creativity-in-ancient-greece

## ETHICAL DECLARATION

**Conflict of interest:** The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. **Financing:** This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors. **Compliance with Ethical Standards:** As a theoretical and historical study based entirely on the critical analysis of published literature, historical artifacts, and secondary cultural data, this research did not involve any experimental studies with human participants or animals. Consequently, institutional review board approval was not required.**Peer review:** Double anonymous peer review. **Generative AI Statement:** The authors declare that no generative AI or AI-assisted technologies were utilized in the conceptualization, data analysis, or manuscript drafting of this study.